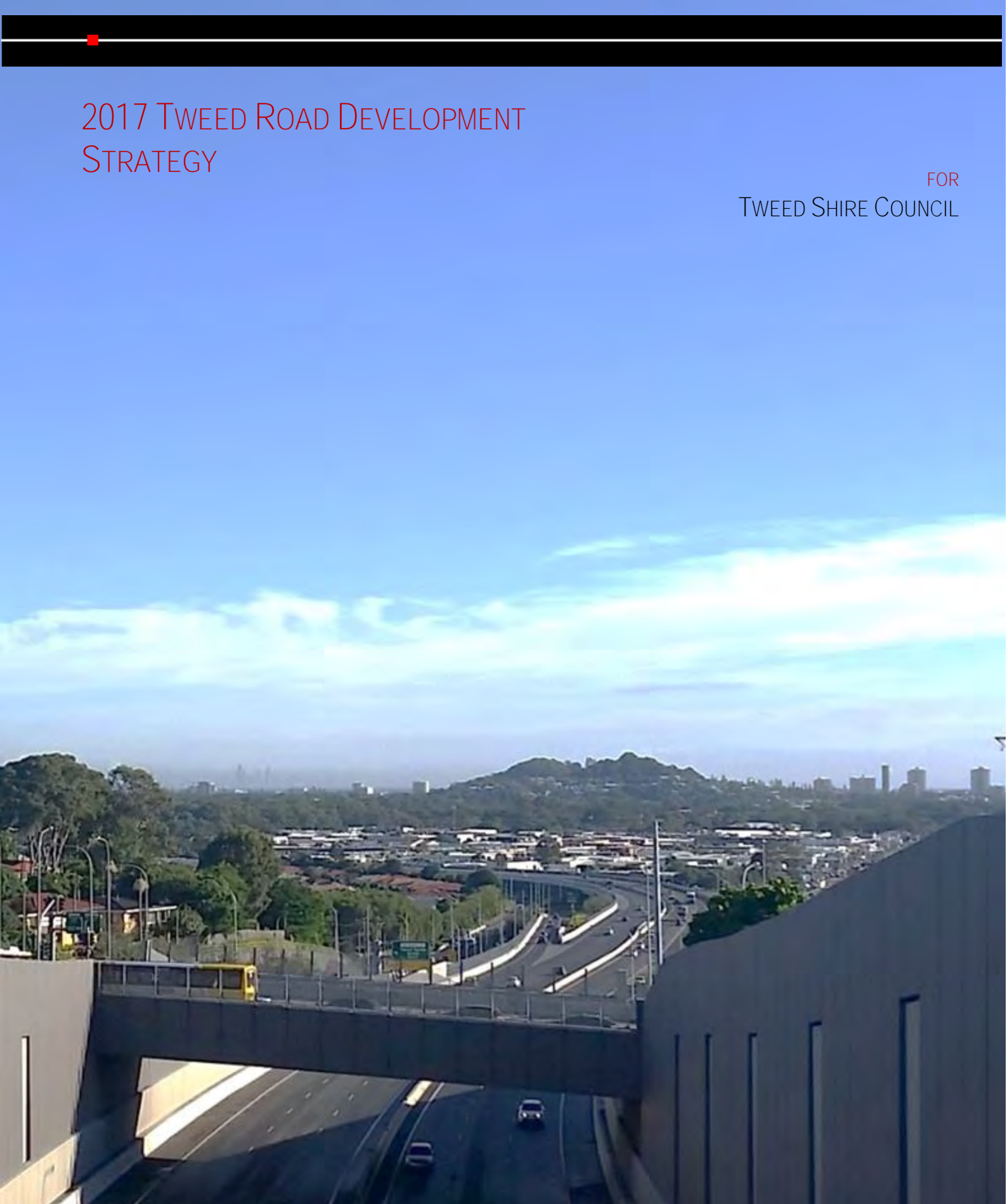


2017 TWEED ROAD DEVELOPMENT STRATEGY

FOR
TWEED SHIRE COUNCIL



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EXECUTIVE SUMMARY

BACKGROUND

The current Tweed Road Development Strategy (TRDS) was developed in 2007 and provides the Tweed Shire's road network requirements to cater for long term growth. These road network requirements also form the basis for Council's Section 94 Roads Contribution Plan.

While predicted traffic levels on Tweed's road network is mainly based on increases in population and land use intensification within the Tweed region, proximity to the high growth area of South East Queensland is expected to have additional impacts on congestion that are outside Council's immediate ability to control. There is a reliance on the Pacific Highway as a 'trunk route' for access in and around Tweed Shire, as such suggested road network improvements within this document may be influenced by changes that occur outside the Tweed Shire (i.e. interstate and inter regional traffic movement on the Pacific Highway). This requires a level of flexibility in potential upgrades. As details regarding actual traffic levels become available in the future further assessment of the proposed upgrades may suggest modification and changes to the upgrades proposed in this document.

The TRDS is based on practical rather than "aspirational" road network infrastructure (i.e. which can be funded, and which can provide practical benefits to the Tweed community within the expected timeframes). Findings rely on projected changes in demographics, economics and land use patterns. These are subject to change and can influence the timing and the form of future network improvements.

It should be noted that the Queensland and New South Wales governments have, in recent times, invested in improvements to the Pacific Highway in the Tweed Shire (e.g. Tugun Bypass and Sextons Hill upgrades). It should also be noted that upgrades such as this, outlined in this document, will be influenced by a number of factors including State and federal government priorities.

The 2017 TRDS review incorporates a more detailed road infrastructure assessment process than previous strategies using an AIMSUN traffic model for the "inner core" region. This model uses outputs from the strategic (EMME) model to allow the review, testing and confirmation of likely intersection requirements across the network in addition to road link upgrades.

The recommendations within this document require further analysis and assessment prior to implementation and do not account in detail for influencing factors including but not limited to environmental, civil, flooding, amenity and land use planning.

TRANSPORT MODEL DEVELOPMENT

The existing 2016 Gold Coast Strategic Transport Model - Multi Model (GCSTM-MM) was used as the basis for developing the TRDS EMME base model. This model was reduced to the road network and zoning system south of Currumbin Creek and then extended into the Tweed. The model development made use of GIS layers provided by Council to assist in creating the major road network and Tweed Shire zones in the model. Key data such as population, employment and enrolments at the ABS - Statistical Area Level 1 (SA1) was added.

The AIMSUN model was coded in a common link and node system to the EMME model to allow ease of integration between models. The use of two models has allowed detailed intersection requirements within the inner core area to be defined as well as road link needs across the wider road network to be determined as per previous strategies.

Population forecasts were based on the number of additional dwellings across Tweed Shire given future development expectations provided by Tweed Shire Council (TSC). This data incorporated approved developments, **urban release areas and expected 'in fill' development** of established areas. Three (3) growth options were tested, namely High, Medium and Low growth projections 2041.

SCENARIO TESTING

The strategic transport model was used to test a series of road network and infrastructure scenarios to optimise a preferred suite of upgrades required by 2041. Key modelling outputs included Vehicle Hours Travelled (VHT) and Vehicle Kilometres Travelled (VKT). In addition, link volume and Degree of Saturation (DOS) plots were compared to determine the performance of each scenario tested.

An additional 187,000 trips per day are expected to use the Tweed road network by 2041 (under the Medium Yield scenario). These additional trips increase average trip times by over four minutes and decrease average speed by 7.5 km/h compared to 2016 conditions. This growth was shown present challenges for major road links such as the Pacific Highway, Tweed Coast Road, Tweed Valley Way and Kennedy Drive in particular.

Scenario 1 maintains the conditions of the base network with the exception of a six-lane upgrade on the Pacific Highway. The six-laning of the Pacific Highway provides the opportunity for more trips to use the highway generating longer average trip distances (VKT) and with less delay. The key function of this Scenario is for interstate and inter regional movements and to improve freight efficiency promoting regional and state **economic growth. However, the Pacific Highway also acts as a key 'trunk route' for access in and around Tweed Shire.**

It is acknowledged that for the TRDS the Pacific Highway provides the dual role of **'local function' within the Tweed Shire road network and 'state/national function' connecting interstate travel and freight movement. Any integration of the 'local functions' should also preserve the higher 'state/national function' of the Highway.**

Scenario 2 incorporates upgrades to the Tweed road network which cater for immediate and short term network deficiencies. Scenario 2 improves the local road network to cater for forecast traffic at the Pacific Highway/Tweed Coast Road interchange. The additional capacity with proximity to interchange coupled with new east-west linkages between Kingscliff and Chinderah improves accessibility to Kingscliff town centre and reduces the dependence on constrained intersections at Cudgen Road/Tweed Coast Road as well as at the Kingscliff north interchange with the Pacific Highway at the Waugh Street/Phillip Street intersection.

The partial construction of the Kirkwood Road (northbound) interchange and connection to Fraser Drive provides a benefit to the Kennedy Drive and the Darlington Drive interchanges. This is a result of providing a more direct route to the western areas of South Tweed (i.e. Banora Point west, Flame Tree Park) that would otherwise use routes such as Leisure Drive or Dry Dock Road.

Scenario 3 incorporates further network improvements to Tweed Coast Road and includes the full construction of the Kirkwood Road Interchange. To maintain the northbound off-ramp to Kennedy Drive, it is proposed that Sugarwood Drive is converted to a two-lane service road (bi-directional), as shown in Figure 7.4. The rationale for this upgrade over the previous TRDS service road bridge plan is to use existing infrastructure (i.e. northern off-ramp and dual lane service road) given its underutilisation, it also provides a more efficient signalised intersection with Kennedy Drive with three approaches instead of four and complimentary turn movement flows during peak periods allowing for efficient signal phasing. Notwithstanding the above, an alternate option to retain the Sugarwood Drive / Kenney Drive intersection configuration remains considered. To achieve this, the northbound ramp locations of the Kirkwood Road interchange require a shift further south in order to achieve adequate separation of the northbound on-ramp from the Terranora Inlet Bridge abutments. This configuration will also require integration of Enterprise Avenue connection to the Kirkwood Road northbound ramps.

The full implementation of the Kirkwood Road interchange increases the permeability of the road network taking pressure of other east-west connectors such as Dry Dock Road, Kennedy Drive and Leisure Drive.

Scenario 4 incorporates all of the road infrastructure upgrades proposed under the previous TRDS. The implementation of the previous TRDS is forecast to significantly improve the performance of the local road network with a 4.5 km/h increase in average travel speeds compared to the Base Case.

Scenario 5 includes sensitivity tests for a series of potential road link options considered by Council in recent years. This included the following:

- Test 1 - Round Mountain Interchange at the Pacific Highway. With the inclusion of a new interchange at Round Mountain Road, Reserve Creek Road experiences an increase of 2,300 trips per day. This volume increase is not considered significant in itself to warrant the need for the interchange; and
- Test 2 – North Kellehers Road Link. The daily volumes on Coronation Drive without the Kellehers Road link demonstrates an increase of around 1,100 vehicle per day through Pottsville Town Centre by 2041. It is important to note that this is for a typical weekday operation only. As such, traffic utilisation of the proposed linkage would primarily occur during peak periods as well as weekends and seasonal periods. Beyond 2041 as Dunloe Park Urban Release Area continues to develop, the Kellehers Road link to Black Rocks will increasingly be utilised as the alternate route around Pottsville Town Centre.

THE PREFERRED SCENARIO

The Preferred Network Scenario (Scenario 6) offers a slight improvement when compared to the previous TRDS with improvements to both average speed and travel time despite the latest modelling showing more trips on the network. When compared to Scenario 4, both VKT and VHT decreases.

Whilst the network-wide performance statistics of Scenario 3 appear better than for Scenario 6, it is important to note that the inclusion of several lower-order roads within Scenario 6 improves accessibility and route choice and reduces trip lengths and hence the reduction in overall VKT.

As opposed to the previous TRDS proposal, the Scenario 6 upgrade does not necessitate the construction of additional **“separate” bridges over Terranora Creek and Kennedy Drive** for the collector-distributor roads and are expected to be less costly compared to the previous TRDS planning.

Potential network improvements and the issues addressed by each are summarised in Table E1.

Scenario 7 was used to test impacts of implementing the preferred upgrades as per Scenario 6, but without the inclusion of the six-laning of the Pacific Highway between Sextons Hill and Stewart Road. The modelling showed that retaining the existing four lane configuration of the Pacific Highway from Stewart Road to Sextons Hill detrimentally affects the performance of the Tweed road network. The overall network VKT reduces, whilst the overall VHT increases which reflects a constraining of the network, more congestion, and slower speeds. This would likely result in a reduction in the attractiveness for trips to/from the Gold Coast, particularly during morning and afternoon peak periods.

The timing of six-laning of the Pacific Highway in Tweed Shire will be dependent on future review and analysis from RMS as well as ongoing works occurring on the Gold Coast south of Reedy Creek. It is likely that there will need to be coordination of timing Pacific Highway works with the works programmed in Queensland.

POTENTIAL NETWORK IMPROVEMENTS

Table E1 details a total of 52 potential road infrastructure upgrades for inclusion within the 2017 TRDS. This table also identifies the relevant road authority, the likely priority or trigger for the upgrade, specific upgrade inclusions and how these address the identified traffic issues identified through the study (refer to Section 5 of the report).

Figures E1 to E4 show the locations of each proposed upgrade with Appendix E providing conceptual intersection layouts.

Table E1: TRDS Road Network Projects

ID#	Recommendation	Road Authority	Priority/ Trigger	Inclusions	Issue/s Addressed	Comments
1	Construct Cobaki Parkway	TSC	Timing of land release area	Boyd St overpass (Pacific Mwy) to Piggabeen Rd connection, passes through Cobaki development area. 2-lane Piggabeen Rd to Town Centre. 4-lane section for Town Centre, north.	Future development, Kennedy Dr capacity and Piggabeen Rd/Inlet Dr intersection (Issues 1 & 4).	Construct as part of Cobaki development, planned to provide new connection to QLD road network.
2	Cobaki Interchange	RMS (with TMR, CoGC)	Long Term	Pacific Motorway interchange at Boyd St, Northbound-on and Southbound-off ramps.	Future development, Kennedy Dr capacity and Piggabeen Rd/Inlet Dr intersection (Issues 1 & 4).	Requires Cross-Border agency collaboration (RMS, TSC, CoGC, TMR). Inclusion in future planning is subject to funding and RMS policy and timing.
3	Piggabeen Road to McAllisters Road extension	TSC	Timing of land release area	McAllisters Rd (Item 5) to Piggabeen Rd connection, two lanes.	Capacity on Scenic Dr and Piggabeen Rd due to future development in area.	
4	McAllisters Road extension to Scenic Drive	TSC	Timing of land release area	Scenic Dr to McAllisters Rd connection, in conjunction with Item 4.	Kennedy Dr capacity and Piggabeen Rd/Inlet Dr intersection (Issues 1 & 4).	Provides improved connection to Bilambil and an alternate route to Kennedy Dr.
5	Upgrade Kennedy Drive/ Piggabeen Road intersection to roundabout	TSC	Medium Term	Single lane roundabout intersection.	Piggabeen Rd/Inlet Dr intersection (Issue 4).	
6	Upgrade Pacific Highway ramp (southbound)/ Gold Coast Highway intersection.	RMS	Medium Term / Kennedy Dr NBD off-ramp removal	Additional westbound through lane on Gold Coast Highway. Realignment of southbound motorway on-ramp as exit lanes.	Kennedy Dr roundabouts capacity (Issue 1). Pacific Mwy interchange capacity.	
7	Upgrade Pacific Highway ramp (northbound)/ Sugarwood Drive intersection	RMS	Medium Term / Kennedy Dr NBD offramp removal	Dual right and left turn lanes and extension for northbound on-ramp northbound off-ramp left turn moved to intersection.	Pacific Mwy interchange capacity.	
8	Six-laning of the Pacific Highway	RMS	Long Term	Motorway upgrade 6-lanes, Tugan to South Tweed Heads/Sextons Hill interchange.	Interstate highway capacity.	
9	Signalise Sugarwood Drive/ Parkes Drive intersection	TSC	Medium Term / Dependent on land release area	Signalise Parkes Dr/Sugarwood Dr intersection. Northbound off-ramp leg moved as part of Item 9.	Future network capacity.	
10	Convert Sugarwood Drive to a two-way service road	RMS/ TSC	Medium Term / Kennedy Dr NBD offramp removal	Upgrade Sugarwood Dr to two-way road, from motorway interchange to Kennedy Dr.	Future network capacity and Kennedy Dr roundabouts capacity (Issue 1).	Caters for westbound traffic upon closure of NB Kennedy Dr motorway off-ramp in coordination with Item 18.
11	Signalise Kennedy Drive/ Sugarwood Drive intersection	RMS/ TSC	Medium Term / Kennedy Dr NBD offramp removal	Signalise Kennedy Dr/ Sugarwood Dr, adds southbound movement from Sugarwood Dr in conjunction with Item 12 and Item 10.	Future network capacity and Kennedy Dr roundabouts capacity (Issue 1)	Signals and interchange upgrades mitigate congestion. Signal coordination modelled with increased turn lane capacity demonstrates improved operation compared to existing roundabout configuration. Improves safety for pedestrians.

ID#	Recommendation	Road Authority	Priority/ Trigger	Inclusions	Issue/s Addressed	Comments
12	Signalise Pacific Highway (southbound)/ Kennedy Drive intersection	RMS/ TSC	Short Term / Kennedy Dr NBD offramp removal	Upgrade existing southbound on-ramp/Kennedy Dr roundabout in coordination with Item 11. Includes additional westbound trap lane for northbound traffic.	Future network capacity and Kennedy Dr roundabouts queuing (Issue 1).	In coordination with Item 11.
13	Upgrade Kennedy Drive/ Ducat Street intersection	TSC	Short Term / Kennedy Dr NBD offramp removal	Ducat St dual right turn and 3 rd lane extension westbound on Kennedy Dr.	Future network capacity and Kennedy Dr /Ducat St intersection queuing (Issue 1)	In coordination with Items 11 and 12.
14	Upgrade Wharf Street / Boyd Street / Kennedy Drive on-ramp intersections	TSC	Short Term	Option tested includes median separation of Kennedy Dr on-ramp and 70m extension of northbound kerbside lane on Wharf St.	Weave, queuing and capacity issues for traffic entering Wharf St/Boyd St intersection from Kennedy Dr on-ramp (Issue 3)	Wharf St /Boyd St upgrade was tested and option proposed. Median dividing left turn lane into Boyd St will reduce weaving.
15	Upgrade Wharf Street/ Florence Street intersection	TSC	Medium Term	Add lane to western leg and new southbound left turn pocket.	Future network capacity.	
16	Remove NBD off/ramp on Pacific Highway at Kennedy Drive	RMS/ TSC	Medium Term	Remove northbound motorway off-ramp. Westbound vehicles to exit at Sugarwood Dr off-ramp. In conjunction with Items 10, 11 and 18.	Future network capacity, Kennedy Dr roundabouts queuing (Issue 1).	Reliant on Kirkwood Rd interchange configuration (Item 18).
17	Kirkwood Road extension to Fraser Drive	TSC	Medium Term	4-lane connection from Fraser Dr to Kirkwood Rd. Includes two-lane overpass.	Machinery Dr and Leisure Dr queuing and intersections capacities (Issues 5, 6 and 8)	
18	Pacific Highway (northbound)/ Kirkwood Road interchange (northbound)	RMS/ TSC	Medium Term	New roundabout interchange with northbound on and off ramps. In conjunction with Item 17.	Future network capacity Leisure Dr/Darlington Dr intersection queuing and Darlington Dr/Sextons Hill Interchange capacity (Issues 8 and 9)	Alignment and configuration of ramps to consider associated upgrade timing including Kennedy Dr (NB) off-ramp closure (Item 16) and Enterprise Ave extension (Item 19).
19	Extend Enterprise Avenue to Kirkwood Road	TSC	Medium Term	North-south 2-lane connection to new Kirkwood Rd interchange (Item 18)	Machinery Dr intersections at capacity and have significant queuing (Issues 5 and 6)	Enterprise Ave to Kirkwood connection and interchange provides alternate route for Banora Point and industrial area traffic. Reduces congestion in coordination with Item 18.
20	Four-laning of Fraser Drive	TSC	Medium Term	Kirkwood Rd/Fraser Dr (Item 17) intersection to Fraser Dr/ Amaroo Dr intersection. Approx 3.4km 4-lane section.	Network capacity, specifically for Terranora and Bilambil developments.	
21	Signalise Greenway Drive/ Traders Way intersection	TSC	Medium Term	New signalised intersection.	Network capacity as well as Machinery Dr and Leisure Dr queuing and intersections capacities (Issues 5, 6 and 8)	In coordination with Enterprise Avenue extension (Item 19).
22	Four-laning of Greenway Drive	TSC	Medium Term	Traders Way to Doyal Dr (St Joseph's College entrance). Approx 850m 4-lane section.	Network capacity as well as Machinery Dr and Leisure Dr queuing and intersections capacities (Issues 5, 6, 8).	In coordination with Items 19 and 21.
23	Signalise Leisure Drive/ Darlington Drive intersection	TSC	Short Term	Replaces existing roundabout.	Darlington Dr/Leisure Dr queuing and intersection capacity. Improve pedestrian safety (Issue 8).	

ID#	Recommendation	Road Authority	Priority/ Trigger	Inclusions	Issue/s Addressed	Comments
24	Construct Fraser Drive/ Broadwater Parkway intersection	TSC	Timing of land release area	Priority controlled intersection in conjunction with Broadwater Parkway connection (Item 25).	Network capacity and Area E access. Reduce reliance on Terranora Road.	
25	Construct Broadwater Parkway	TSC	Timing of land release area	Terranora Rd to Fraser Dr 2-lane connection via Altitude Aspire development.	Network capacity and Area E access. Reduce reliance on Terranora Road.	
26	Upgrade Terranora Road/ Mahers Lane intersection (roundabout)	TSC	Timing of land release area	Roundabout intersection. In conjunction with upgrade Item 25.	Network capacity and queuing issues on Mahers Ln (Issue 11).	
27	Extend Davey Street to Minjungbal Drive	TSC	Long Term	Davey St extension to Minjungbal Dr Interchange/ Underpass. Via Soorley St to the east of Eastlake Dr.	Machinery Dr intersections at capacity and have significant queuing (Issues 5 and 6). Darlington Dr queuing (Issue 9).	Connection to East Banora investigated. Davey St link to consider connection to Elsie St to improve access to East Banora Point).
28	Upgrade Minjungbal Drive/ Machinery Drive intersection	TSC	Medium Term	Upgrade signal cycle times and phasing.	Machinery Dr Intersections at capacity and have significant queuing (Issues 5 and 6).	
29	Upgrade Sexton Hill Drive/ Darlington Drive intersection	TSC	Medium Term	Add left turn slip lane to Darlington Dr from Sexton Hill Dr.	Darlington Dr queuing and capacity on Sextons Hill Interchange (Issue 9).	
30	Upgrade Waugh Street/ Phillip Street intersection (roundabout)	TSC	Short Term	New roundabout intersection.	High right-turn volumes at intersection (Issue 13). Increase intersection capacity for future traffic growth	
31	Upgrade Wommin Bay Road/ Sand Street intersection (roundabout)	TSC	Medium Term / Timing of Land Release Area	New roundabout intersection.	Increase intersection capacity for future traffic growth	
32	Upgrade Pacific Highway/ Tweed Coast Road interchange	RMS/ TSC	Medium Term	Southbound off-ramp (Item 35) access to Morton St and short additional lane on roundabout between northbound motorway on and off ramps.	Removes weave to access Morton St (Issue 13). Increase intersection capacity and improve operations and safety.	
33	Construct direct connection between Pacific Highway offramp and Morton Street. Retain existing Morton Street access as left-in/left-out only.	TSC	Medium Term	Morton St access from southbound off-ramp and restriction of existing Morton St/Tweed Coast Rd intersection to left-in/left-out only. Completed in conjunction with Item 32.	Weave to access Morton St (Issue 14) and future development in area.	Restricting Morton St/Tweed Coast Rd intersection to left-in/left-out reliant on new roundabout on Tweed Coast Rd as part of development access to provide U-turns.
34	East-west link to Tweed Coast Road	TSC	Timing of land release area	New east-west link from north Kingscliff to Tweed Coast Rd. Further investigation required, proposed option includes Ozone St extension to Tweed Coast Rd via new Sand St intersection (Item 37).	Future development and traffic capacity of Tweed Coast Rd / Cudgen Rd intersection (Issue 12).	Configuration and alignment of this link is subject to further detailed assessment. Key outcome of the upgrade is providing a northern east-west link between Kingscliff and Tweed Coast Rd (from Elrond St or Sand St to Tweed Coast Rd).
35	Four-laning of Tweed Coast Road	TSC	Timing of land release area	Pacific Motorway interchange to Tweed Coast Rd/ Casuarina Way intersection. Approx. 6.2km 4-lane section.	Future network capacity.	

ID#	Recommendation	Road Authority	Priority/ Trigger	Inclusions	Issue/s Addressed	Comments
36	Construct Tweed Coast Road/ East-west Link Road intersection (roundabout)	TSC	Medium Term / Timing of land release area	2-lane roundabout intersection in conjunction with Item 34.	Future network capacity and growth in the Kingscliff area. No existing east-west links between North Kingscliff and Tweed Coast Rd forces traffic to utilise Cudgen Rd intersection (Issue 12).	In coordination with Items 32 and 34. Location reliant on development layout.
37	Upgrade Ozone Street/ Sand Street intersection (roundabout)	TSC	Timing of land release area	2-lane roundabout in conjunction with Item 34.	Provides network capacity to cater for growth in the Kingscliff area. New east-west link between North Kingscliff and Tweed Coast Rd to reduce reliance on Cudgen Rd intersection (Issue 12).	
38	Extend Elrond Drive to Ozone Street	TSC	Timing of land release area	Elrond Dr to Ozone St connection, further investigation to be undertaken.	Provides network capacity to cater for growth in the Kingscliff area. New east-west link between North Kingscliff and Tweed Coast Rd to reduce reliance on Cudgen Rd intersection (Issue 12).	These are noted as potential links for further assessment, same traffic function achieved. Key outcomes for links are: 1) northern east-west link (Elrond to TCR). 2) southern east-west link (Turnock to TCR). 3) North-south link (Elrond to Sand).
39	Upgrade Tweed Coast Road/ Crescent Street intersection (roundabout)	TSC	Timing of land release area	2-lane roundabout intersection.	Future network connectivity and capacity. In conjunction with Item 41.	Location reliant on Crescent St and Turnock St extension (Item 40).
40	Extend Turnock Street to Tweed Coast Road	TSC	Timing of land release area	New east-west link between south Kingscliff and Tweed Coast Rd. Completed in conjunction with Item 39.	Future development in area and traffic capacity of Tweed Coast Rd / Cudgen Rd intersection (Issue 12).	Alignment reliant on development layout.
41	Upgrade Tweed Coast Road/ Depot Road intersection (roundabout)	TSC	Timing of land release area	2-lane roundabout intersection.	Future network capacity and access to land release area.	
42	Upgrade Pacific Highway (northbound)/ Cudgera Creek Road intersection (roundabout)	RMS/ TSC	Medium - Long Term / Timing of Land Release Area	Single lane roundabout intersection.	Future network capacity.	
43	Upgrade Pacific Highway (southbound)/ Cudgera Creek Road intersection (roundabout)	RMS/ TSC	Medium – Long Term / Timing of Land Release Area	Single lane roundabout intersection.	Future network capacity.	
44	Upgrade Cudgera Creek Road/ Pottsville Road intersection (roundabout)	TSC	Long Term / Timing of land release areas	Single lane roundabout intersection.	Future network capacity.	
45	Extend Kellehers Road to Pottsville Road	TSC	Timing of Land Release Area	Kellehers Rd extension to Pottsville – Mooball Rd. Completed in conjunction with Item 46.	Future network capacity and new development areas connectivity. Reduce reliance of through traffic via Pottsville Town Centre (Issue 15).	
46	Construct Pottsville Road/ Kellehers Road (extension) intersection	TSC	Timing of Land Release Area	New priority controlled intersection. Completed in conjunction with Item 45.	Future network capacity and new development areas connectivity. Reduce reliance of through traffic via Pottsville Town Centre (Issue 15).	

ID#	Recommendation	Road Authority	Priority/ Trigger	Inclusions	Issue/s Addressed	Comments
47	Extend Cane Road to Rous River Way	TSC	Long Term / Timing of land release area	Cane Rd/Queensland Rd intersection to Rous River Way connection.	Future network capacity and new development area connectivity. Bypass route for Murwillumbah Town Centre	
48	Extend West End Street to Frances Street	TSC	Medium Term	West End St to Frances St connection.	Improve future network capacity and Wollumbin St queuing (Issue 17).	Connection to West End St preferred to provide direct connectivity to primary traffic route through Murwillumbah via Wollumbin St.
49	Four-laning of Tweed Valley Way (River Street to Quarry Road)	TSC	Medium Term / Timing of Land Release Area	Alma St/ Tweed Valley Way roundabout to 150m east of the Quarry Rd /Tweed Valley Way intersection. Approx 1.4km 4-lane section.	Future network capacity.	
50	Upgrade Tweed Valley Way/ Quarry Road intersection	TSC	Medium Term/ Timing of land release area	Signalise intersection.	Future network capacity west of Murwillumbah.	

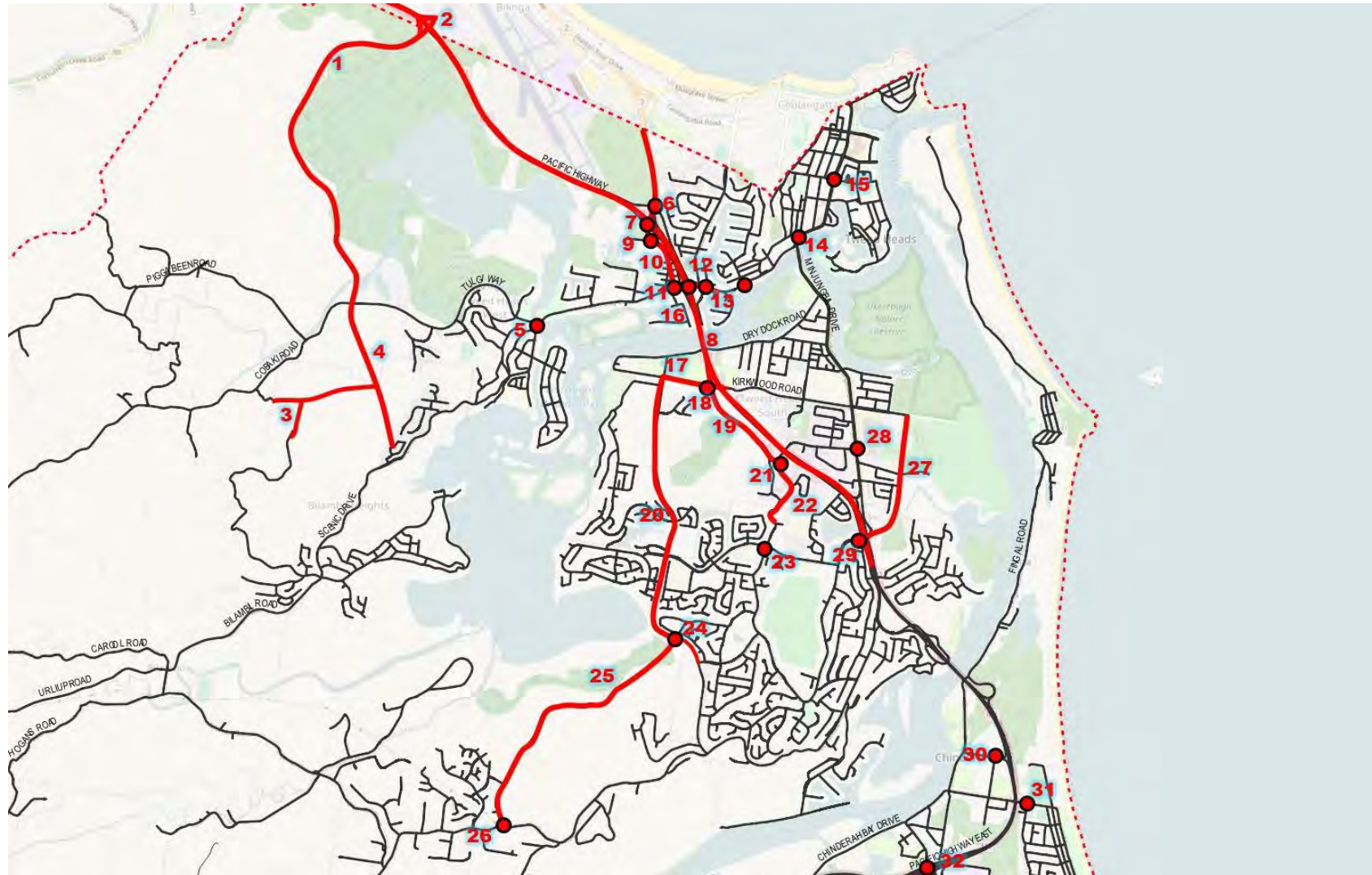


Figure E1: TRDS Inclusions – Tweed Heads, South Tweed Heads, West Tweed Heads and Chinderah

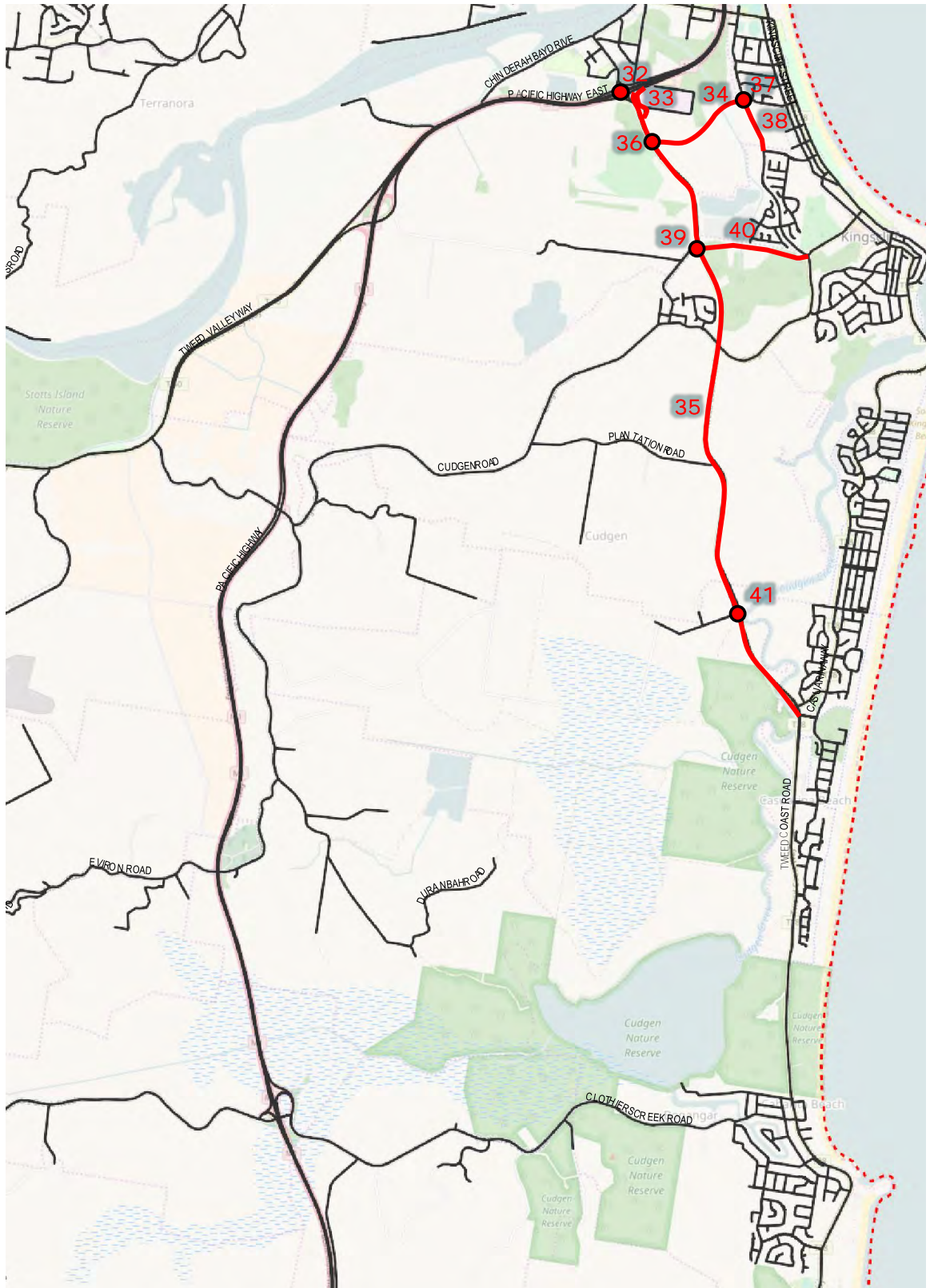


Figure E2: TRDS Inclusions – Kingscliff

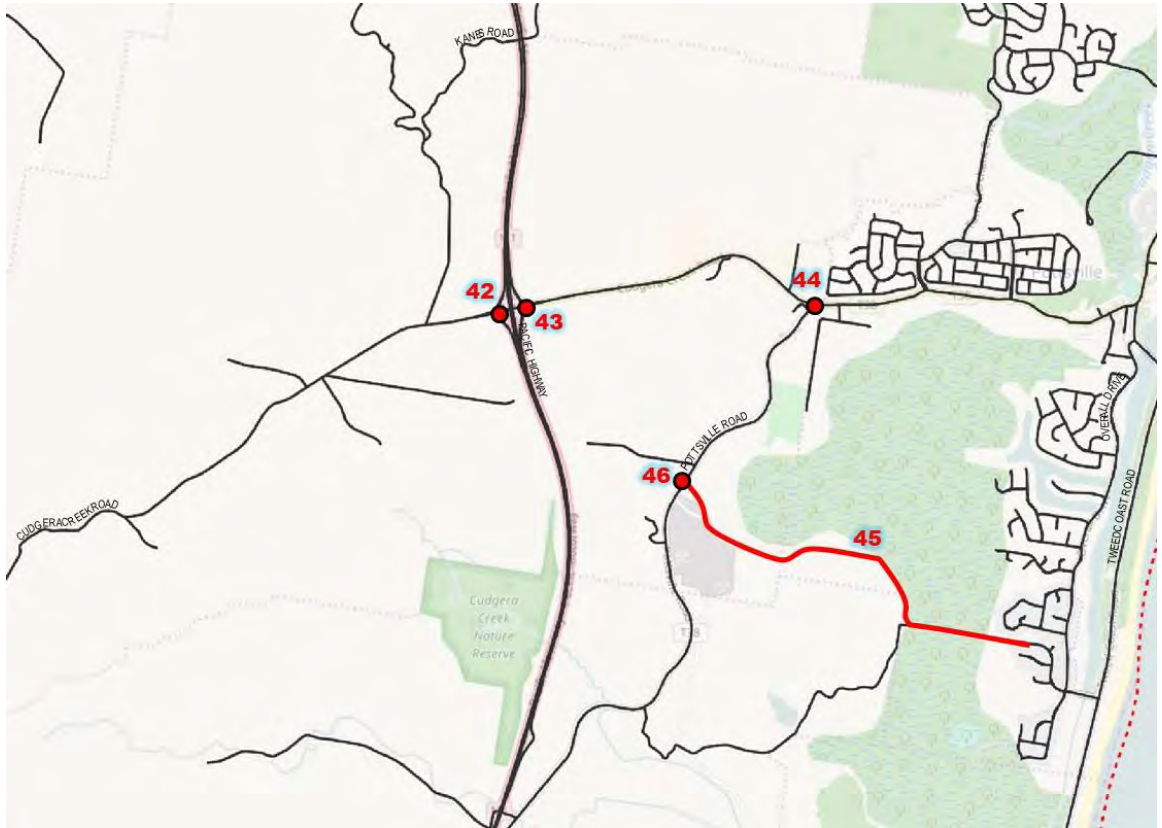


Figure E3: TRDS Inclusions – Pottsville



Figure E4: TRDS Inclusions – Murwillumbah

1. INTRODUCTION

1.1 BACKGROUND

The Tweed Road Development Strategy (TRDS) is the **Tweed Shire's road network** upgrades to cater for long term growth and forms the basis for **Council's** Section 94 Roads Contribution Plan.

Tweed Shire Council (TSC) first undertook the TRDS in 1997. This work assessed the Shire's road network needs and established a philosophy and methodology for calculating development contributions for road network upgrades. The TRDS has since been reviewed in 2004 and in 2007 to update it with new information on development progress and planning and on road infrastructure improvements. Previous TRDS studies have used strategic modelling, relating to link based capacity analysis on major road links without specifically considering intersection needs.

While predicted traffic levels on Tweed's road network is mainly based on increases in population and land use intensification within the Tweed region, proximity to the high growth area of South East Queensland is expected to have additional impacts on congestion that are outside Council's immediate ability to control. There is a **reliance on the Pacific Highway as a 'trunk route' for access in and around Tweed Shire, as such suggested** road network improvements within this document may be influenced by changes that occur outside the Tweed Shire (i.e. interstate and inter regional traffic movement on the Pacific Highway). This requires a level of flexibility in potential upgrades. As details regarding actual traffic levels become available in the future further assessment of the proposed upgrades may suggest modification and changes to the upgrades proposed in this document.

In recent years, TSC has completed a range of road projects on Council-controlled roads. In addition, both the NSW Roads and Maritime Service (RMS) and the QLD Department of Transport and Main Roads (TMR) have completed significant road upgrades such as the Sextons Hill Bypass and the Tugun Bypass.

In 2009, TSC adopted the Tweed Urban and Employment Lands Release Strategy setting out potential housing and employment areas across the Shire for the next 25 years. This included development within the urban-zoned areas of Kings Forest, Cobaki, Area E (Terranora), Bilambil Heights, Pottsville and Murwillumbah.

Previous TRDS's have been based on the VLC Zenith Strategic model which was not a "proprietary" software package. The 2017 TRDS study has created a new strategic transport model in the common EMME package. Also, given that new development and likely traffic infrastructure requirements are predominately located in the "core area" bounded by the state border, Casuarina/Kings Forest and the Terranora Broadwater and that intersections are dominating capacity limitations in developed urban areas, the 2017 TDRS incorporates an additional level of intersection-capacity analysis using an AIMSUN model for the inner core area. This model uses outputs from the strategic (EMME) model to allow the review and option testing of both road link and intersection requirements across the network.

Figure 1.1 shows the study area for the project.



Figure 1.1: Project Study Area

1.2 TWEED ROAD DEVELOPMENT STRATEGY OBJECTIVES

Key objectives of this 2017 TRDS review were to:

- review the previous TRDS considering contemporary road network and intersection capacity planning and updating population and employment growth projections for Tweed Shire, whilst also considering recent traffic studies and planning strategy documents;
- develop a strategic traffic model and a mesoscopic traffic model (for the core-urban area) for the Tweed road network, calibrated to reflect current traffic volumes (base year), and capable of projecting traffic growth for a planning horizon of 25-30 years;
- use the traffic model to input and test road and intersection improvement options to achieve an optimised future distributor road network, including relevant triggers/thresholds for the timing of road network upgrades;
- review Council's adopted levels of service (e.g. percentage utilisation, delays and queuing at intersections) for the distributor road network against best practice benchmarks as an input to optimising project designs to achieve better value for money process;
- **review Council's road hierarchy;** and
- produce works program as the basis for a subsequent review of the Tweed Road Contribution Plan, based on the prevailing contribution scheme philosophy.

1.3 STUDY METHODOLOGY

The 2017 TRDS **development has included the creation of two "levels" of traffic modes as follows:**

- a link-based strategic model for the major road network for the entire LGC using EMME; and
- an **"Inner Core" Mesoscopic-simulation** model using AIMSUN.

For the EMME Model, the latest version of the Gold Coast Strategic Transport Model – Multi Model (GCSTM-MM) was extended to **'build-in'** the Tweed Base Strategic Transport Model (TSTM-MM) for a 2041 design year (25 year design horizon).

The separate (but linked) mesoscopic model was created for the "core" urban area bounded by the state border, Casuarina/Kings Forest and Terranora Broadwater.

The steps used in the development of the 2017 TRDS are summarised as follows:

- Review of Previous Studies - a review of previous studies was undertaken to confirm the appropriateness and currency of the previous road infrastructure planning for the Tweed;
- EMME Model Development - the 2016 Base EMME model was developed using the existing 2016 GCSTM-MM model. GIS layers provided by Council were used to develop Tweed zones with population, employment and enrolment demographics at the ABS - SA1 Level Zoning system;
- AIMSUN Model Development - in parallel with the EMME model, a TRDS Core AIMSUN model was created for the region bounded by the State border, Casuarina/ Kings Forrest and the Terranora Broadwater;
- Calibration and Validation of Models - Calibration and Validation was undertaken on the Base Year 2016 EMME and 2016 AIMSUN models to ensure that models were fit for purpose for assessing network upgrade options. Outputs from each model were also extracted and reported along with the model development process. Base model calibration reports were developed for both models;
- Base Model Validation Reporting and Presentations -
- Ultimate Base Model Development - **TSC's forecast population, employment and enrolment** demographics were incorporated into the ultimate base model at the EMME zone level. Three growth scenarios were developed (Low, Medium, High) for an "Ultimate Design Year" of 2041. Outputs for each scenario were extracted and compared to determine the likely critical road links and locations with poor levels of service.
- Network Testing - for the medium growth scenario, a series of upgrade options were tested in the models, reviewed and workshopped with Council and RMS. These tests included upgrades both within the previous TRDS as well as new road network and intersections upgrade options;
- Preferred Network – the preferred network was developed and optimised in both the EMME and AIMSUN to identify likely intersection pinch points and likely future upgrades. Outputs included:

- new links needed;
- upgrade needs links;
- new intersections and likely configurations;
- network performance such as VHT and VKT;
- traffic volume plots (daily and peak periods); and
- volume to capacity (V/C).

1.4 CONTENTS OF THIS REPORT

This report includes the following:

- Section 1 – Introduction, Background and Study Methodology;
- Section 2 – Existing Road Network;
- Section 3 – Review of Previous Studies including key considerations for the TRDS 2017 Review;
- Section 4 – 2016 Base Year Model Development for the Tweed Strategic Transport Model Version 1.0 (TSTM-MM V1.0) and the Tweed Core Area Mesoscopic AIMSUN Model;
- Section 5 – Existing Conditions Assessment;
- Section 6 – Year 2041 demographics forecasts based on Councils current development planning and expected population growth;
- Section 7 – Future Road Infrastructure Options tested within the TSTM-MM and AIMSUN model and option testing modelling Results including intersection configuration needs; and
- Section 8 – Tweed Road Development Strategy Master Plan based on the preferred network option.

1.5 LIMITATIONS OF ASSESSMENT AND ANALYSIS

The TRDS is based on practical rather than “aspirational” road network infrastructure (i.e. which can be funded, and which can provide practical benefits to the Tweed community within the expected timeframes). Findings rely on projected changes in demographics, economics and land use patterns. These are subject to change and can influence the timing and the form of future network improvements.

The strategic nature of this document is such that potential upgrades are limited to ‘**higher level**’ road network planning recommendations based on strategic traffic volumes and relative impacts/outcomes at various locations across the network.

The recommendations and upgrades within this document will require further analysis and assessment prior to implementation and does not account in detail for other influencing factors including, but not limited to:

- flood levels and restrictions;
- environmental constraints and restrictions;
- acoustics and amenity impacts and restrictions;
- geotechnical constraints;
- existing land uses;
- protection of native wildlife (i.e. koalas);
- public and active transport;
- advancements in technology (i.e. driverless cars); or
- road safety and environment impacts.

The TRDS is a strategic document focused on the capacity of the existing and future networks within the Tweed Shire. Recommended upgrades are considered to be flexible, to a certain extent, to allow for future changes to traffic volumes, state planning and any unforeseen impacts.

2. EXISTING ROAD NETWORK DETAILS

2.1 ROAD INFRASTRUCTURE AND ROAD HIERARCHY

TSC is responsible for a significant length of public roadways within the Tweed Shire LGA. As at 30 June 2015 this includes:

- local roads (full financial responsibility of Council):
 - urban: 458km;
 - non-urban, sealed: 481km;
 - non-urban, unsealed: 158km; and
 - Total: 1,097km;
- regional roads (subject to “block grant” funding from the RMS):
 - urban: 34km;
 - non-urban, sealed: 114km; and
 - non-urban, unsealed: none;
 - Total: 148km.

The Pacific Highway between Yelgun (to the south) and the NSW/QLD border (to the north) run through the Tweed Shire LGA. This road is under the jurisdiction of the RMS.

Figure 2.1 illustrates the existing road network and hierarchy within Tweed Shire.

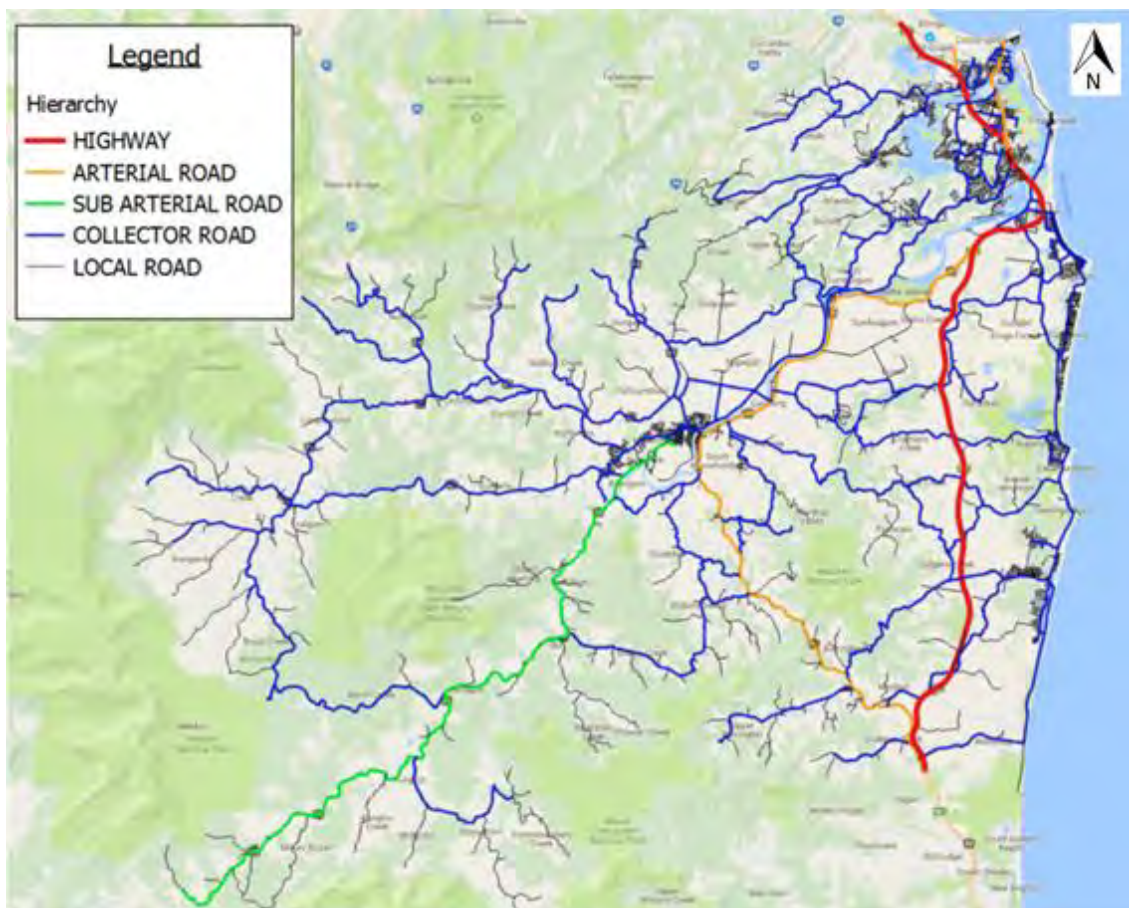
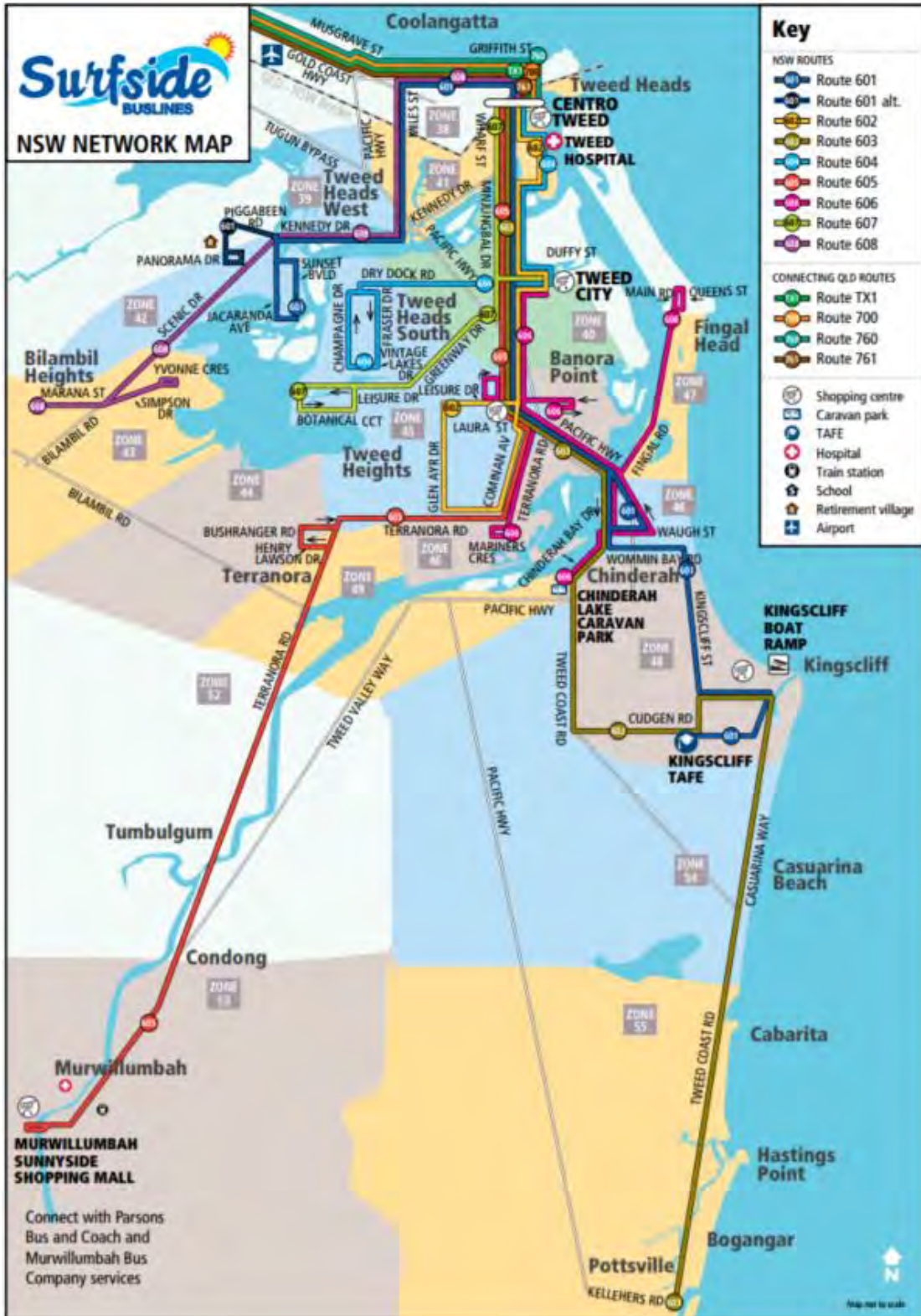


Figure 2.1: Tweed Road Network and Hierarchy

2.2 PUBLIC TRANSPORT

All bus services within the Tweed Shire are operated by Surfside Buslines, Parsons Bus and Coach and Murwillumbah Bus Co. The existing bus network is shown in Figure 2.2.



Source: Surfside Buslines

Figure 2.2: Year 2017 Bus Routes

Table 2.1 lists the current bus routes for the region and their associated service frequencies.

Table 2.1: Surfside Bus Route Numbers and Frequencies

Route Number	Servicing	Time of Service*		Frequency*
		First	Last	
Surfside Services				
601	Kingscliff to West Tweed Heads	6:00	20:00	Hourly
602	Centro Tweed Heads to Banora Point	7:00	19:00	Hourly
603	Centro Tweed Heads to Pottsville	8:00	20:00	Hourly
604	Centro Tweed Heads to Hillcrest	7:00	18:00	Hourly
605	Centro Tweed Heads to Murwillumbah	7:00	18:00	Hourly
606	Tweed City, Oxley Cove, Chinderah and Fingal Head	9:00	16:02	Hourly
607	Tweed Heads Centro to Flame Tree Park	8:00	5:00	Hourly
608	Tweed City to Bilambil Heights	7:30	4:30	Hourly
TransLink-Surfside Services (Old Based)				
700	Australia Fair to Tweed Heads Mall	5:30	20:30	Half Hourly
760	Pacific Fair to Tweed Heads Mall	5:40	20:30	Half Hourly
761	Tweed Heads Mall to Robina Railway Station	5:00	19:00	Hourly
762	The Pines Shopping Centre (Elanora) to Palm Beach	6:40	18:00	Hourly
763	The Pines Shopping Centre (Elanora) to Elanora	6:40	18:00	Hourly
764	The Pines Shopping Centre (Elanora) to Currumbin Park	6:40	18:00	Hourly
765	The Pines Shopping Centre (Elanora) to Robina Railway Station	5:00	22:00	Half Hourly
766	The Pines Shopping Centre (Elanora) to Currumbin Waters	6:40	18:00	Hourly
767	The Pines Shopping Centre (Elanora) to Tugun Heights	6:40	18:00	Hourly
768	Tweed Heads to John Flynn Hospital	7:30	18:30	Hourly
769	The Pines Shopping Centre (Elanora) to Reedy Creek	6:00	20:00	Hourly
TX1	Theme Parks Service (to Burleigh Heads) – same service 7 days	8:10 & 8:40	16:45 and 17:10	2 services per peak only
TX2	Theme Parks Service (to Tweed Heads) – same service 7 days	8:00	19:05	Half Hourly

*Time of First and Last Service and Frequency are those of the first stop in the described direction on a normal Weekday expect for TX1 and TX2 which have the same timetables every day.

2.3 WALKING AND CYCLING ROUTES

The existing cycleways and pedestrian pathways for Tweed Heads, Kingscliff, Murwillumbah, Bray Park and some surrounding areas are shown in Figure 2.3.



Source: Tweed Shire Council

Figure 2.3: P2017 Pedestrian and Cyclist Facilities Network

3. REVIEW OF PREVIOUS STUDIES

3.1 BACKGROUND

A review of previous studies was undertaken to confirm the currency, detail and importance of elements of the network proposed in previous infrastructure planning for the Tweed. This work included a review of the previous traffic volume forecasts for recently constructed roads such as the Banora Point Bypass, Kirkwood Road extension and the Kennedy Drive upgrade.

The previous studies which were reviewed include:

- Tweed Road Development Strategy – Veitch Lister Consulting (2007);
- Tweed Road Development Strategy (2007);
- Tweed Urban and Employment Land Release Strategy – Tweed Shire Council (2009);
- Gold Coast Transport Strategy 2031 - City of Gold Coast Council (2013);
- Cross Border Traffic Master Plan – Bitzios Consulting (2011);
- Lower Tweed and Pacific Highway Traffic Master Plan – Parsons Brinckerhoff (2006);
- The Lower Tweed and Pacific Highway Traffic Master Plan (2006); and
- Distributor Road Network Planning (by TSC).

3.2 TWEED ROAD DEVELOPMENT STRATEGY – VEITCH LISTER CONSULTING (2007)

Prior to the finalisation of the Lower Tweed and Pacific Highway Master Plan, Veitch Lister Consulting was commissioned to model additional options and undertake scenario testing considering “ultimate development” levels. This work included:

- a review of demographic assumptions to determine the “ultimate development” number of households under the latest land use plans;
- updates to the base case and ultimate development road network;
- an examination of the benefits of the new local access link east of Tweed City connecting to Kirkwood Road East and Lakes Drive and also due to the Darlington Drive interchange; and
- testing an option to provide a new interchange where Cobaki Parkway/Boyd Street intersects the Tugun Bypass, including one option of north-facing ramps only and a secondary option with both north-facing and south-facing ramps.



The strategy recommends a number of works throughout the Tweed Shire based on the Zenith model outputs. Then, using the previously-adopted “consumption model” used in the 1997 TRDS the “Standard Contribution” rates for Version 5 of the Contribution Plan were updated.

Figure 3.1 lists details the previous road network inclusions with the 2007 TRDS.

West Tweed Heads Area - Refer to Figure 6.1, and details below.

Table 6.1: Additions and Improvements (West Tweed Heads)

Road / Section	Type	Funding	Standard
A. Pacific Highway (Tugun-Nerang)	Impr.	MRD	6 lanes @ 110 kph
B. Stewart Road	Impr.	GCC	4 lanes @ 70 kph
C. Tugun Bypass (Stewart Rd to Boyd St)	Add.	MRD	6 lanes @ 100 kph
D. Boyd Street (GC Highway to Inland Dr)	Impr.	MRD	4 lanes @ 60 kph
E. Boyd Street Extn. (Tugun Bypass to Inland Dr)	Add.	MRD	4 lanes @ 70 kph
F. Tugun Bypass (Boyd St to Tweed Bypass)	Add.	RTA	4 lanes @ 100 kph
G. Cobaki Parkway (Tugun Bypass – Piggabeen Rd)	Add.	TSC	4 lanes @ 70 kph
H. Cobaki Parkway Extn (Scenic Dr – Piggabeen Rd)	Add.	TSC	2 lanes @ 70 kph
I. Cobaki Collector 1 (Town Centre Section)	Add.	TSC	4 lanes @ 60 kph
J. Cobaki Collector 1 (Balance)	Add.	TSC	2 lanes @ 60 kph
K. Cobaki Access Streets (various)	Add.	Dev.	2 lanes @ 60 kph
L. Cobaki Collector 2 (Collector 1 – Cobaki Parkway)	Add.	Dev.	2 lanes @ 70 kph
M. Piggabeen Road (Skyline Dr – Cobaki Parkway)	Impr.	TSC	2 lanes @ 70kph
N. Kennedy Drive (Cobaki Creek – Barrett St)	Impr.	TSC	Pk Hour Clearways
O. McAllisters Road Extension	Add.	TSC	2 lanes @ 60 kph
P. McAllisters Road (Existing Section)	Impr.	TSC	2 lanes @ 60 kph

Banora Point Area – refer to Figure 6.2 and details below.

Table 6.2: Additions and Improvements (Banora Point)

Road / Section	Type	Funds	Standard
A. Tugun Bypass / Tweed Heads Bypass Interchange	Add.	RTA	various
B. Northbound Service Road (Nth Section)	Add.	TSC	2 lanes Nb @ 70 kph
C. Southbound Service Road (Nth Section)	Add.	TSC	2 lanes Sb @ 70 kph
D. Northbound Service Road (Sth Section)	Add.	TSC,RTA	2 lanes Nb @ 70 kph
E. Southbound Service Road (Sth Section)	Add.	TSC,RTA	2 lanes Sb @ 70 kph
F. Kirkwood Road Extension	Add.	TSC	2 lanes @ 60 kph
G. Kirkwood Road On/Off Ramps	Add.	RTA	1 lane @ 70 kph
H. Fraser Drive (Botanical Circuit – Kirkwood Rd)	Impr.	TSC	4 lanes @ 70 kph
I. Enterprise Avenue Extension	Add.	TSC	2 lanes @ 60 kph
J. Tweed Heads Bypass (Darlington Dr – Kirkwood Rd)	Impr.	RTA	6 lanes @ 100 kph
K. Davey Street Extension (to Soorley St)	Add.	TSC	2 lanes @ 60kph
L. Darlington Drive / Minjungbal Dr Interchange	Impr.	RTA	various
M. East Lakes Drive Extension	Add.	TSC	2 lanes @ 60 kph
N. Elsie Street Extension	Add.	TSC	2 lanes @ 50 kph
O. Leisure Drive (Fraser Dr – Woodlands Dr)	Impr.	TSC	4 lanes @ 60 kph
P. Leisure Drive (Advocate Pl – Darlington Dr East)	Impr.	TSC	4 lanes @ 60 kph
Q. Darlington Drive East (Leisure Dr – Pacific Hwy)	Impr.	TSC	4 lanes @ 60 kph
R. Old Pacific Hwy (Sexton's Hill) incl. Laura St Opass	Add.	RTA	4 lanes @ 70 kph
S. New Pacific Highway (Sexton's Hill)	Add.	RTA	6 lanes @ 100 kph
T. New Collector (Area E)	Add.	LAC	2 lanes @ 70 kph
U. New Collectors (Area E)	Add.	Dev.	2 lanes @ 60 kph

Tweed Coast Area – refer to Figure 6.3 and details below.

Table 6.3: Additions and Improvements (Tweed Coast)

Road / Section	Type	Funds	Standard
A. Tweed Coast Road (Pacific Hwy – Cabarita)	Impr.	TSC	4 lanes @ 80 kph
B. Ozone Street Extn (Elrond Dr – Chinderah Rd)	Add.	TSC	4 lanes @ 60 kph
C. Ozone Street Realignment (Kingscliff St – Elrond Dr)	Add.	TSC	2 lanes @ 60 kph
D. Elrond Drive Extension (Beach St – Ozone St)	Add.	TSC	2 lanes @ 60 kph
E. New Collector Street (Turnock St – Kingscliff St)	Add.	Dev.	2 lanes @ 60 kph
F. Crescent Street Realignment	Add.	Dev.	2 lanes @ 60 kph
G. New Access Streets	Add.	Dev.	2 lanes @ 50 kph
H. New Distributor (Chinderah Rd – Turnock St)	Add.	TSC	2 lanes @ 70 kph
I. John Robb Way Extension (to Crescent St)	Add.	Dev.	2 lanes @ 50 kph
J. Kingsforest Collector 1	Add.	Dev.	2 lanes @ 60 kph
K. Kingsforest Parkway (Duranbah Rd – Town Ctr.)	Add.	LAC	2 lanes @ 70 kph
L. Kingsforest Parkway (Chinderah Rd – Town Ctr.)	Add.	LAC	4 lanes @ 70 kph
M. Kingsforest Collector 2	Add.	Dev.	2 lanes @ 60 kph
N. Casuarina Collector	Add.	LAC	2 lanes @ 50 kph
O. Koala Beach – Seabreeze Connector	Add.	LAC	2 lanes @ 50 kph
P. New Access Streets	Add.	Dev.	2 lanes @ 50 kph
Q. Tweed Coast Road	Impr.	TSC	2 lanes @ 70 kph
R. Extension of Collector Road	Add.	Dev.	2 lanes @ 60 kph

Murwillumbah Area – refer to Figure 6.4 and details below.

Table 6.4: Additions and Improvements (Murwillumbah)

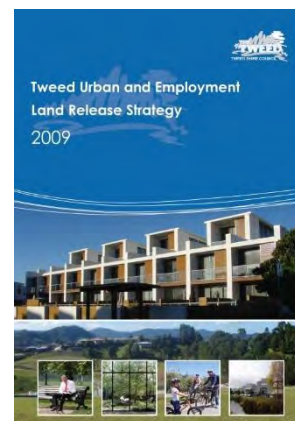
Road / Section	Type	Funds	Standard
A. Cane Road (Old. Rd – Tweed Valley Way)	Impr.	TSC	2 lanes @ 100 kph
B. Numinbah Road (Tomewin Rd – North Arm Rd)	Impr.	TSC	2 lanes @ 80 kph
C. Cane Road Extn. (Old. Rd – West End St Extn.)	Add.	TSC	2 lanes @ 80 kph
D. West End Street Extn (incl. link to Frances St)	Add.	TSC/Dev.	2 lanes @ 60 kph
E. Joshua Street Extn (to West End St Extn.)	Add.	TSC	2 lanes @ 60 kph
F. New Access Streets	Add.	Dev.	2 lanes @ 50 kph
G. Riverview Street (Eyles Ave – Wollumbin St)	Impr.	TSC	2 lanes @ 60 kph
H. North Arm Road (Numinbah Rd – Castlefield Dr)	Impr.	TSC	2 lanes @ 100 kph
I. Castlefield Drive Extension	Add.	Dev.	2 lanes @ 60 kph
J. Old Lismore Road (Riveroak Dr – North Arm Rd)	Impr.	TSC	2 lanes @ 60 kph
K. Riveroak Drive Extension	Add.	Dev.	2 lanes @ 60 kph

Source: VLC Tweed Road Development Strategy (2007)

Figure 3.1: TRDS (2007) Inclusions

3.3 TWEED URBAN AND EMPLOYMENT LAND RELEASE STRATEGY – TWEED SHIRE COUNCIL (2009)

The Tweed Urban and Employment Land Release Strategy was the response to the Far North Coast Regional **Strategy's** requirement for TSC to prepare a local Growth Management Strategy prior to rezoning further land for urban, commercial and industrial uses. The report addresses both future employment lands and future urban residential lands in two separate but interconnect parts of the report. The report recommends that employment and population land should be considered together to ensure the long-term sustainability of Tweed Shire.



The Tweed Shire Employment Land Release Strategy identifies potential employment land areas and provides an indication of when the re-zoning process will need to be considered for these areas to be able to supply employment land to the market at the appropriate time.

The Tweed Urban and Employment Land Release Strategy also guides the location of further urban development over the life of the strategy. It outlines nine key potential urban developments with indicative time frames for when the rezoning process will need to be considered if these areas are to supply residential land to the market at the appropriate time.

3.4 GOLD COAST CITY TRANSPORT STRATEGY 2031 - CITY OF GOLD COAST COUNCIL (2013)



The Gold Coast City Transport Strategy 2031 provides a “**blueprint for the city's** transport network over the next 20 years”. The strategy includes six key objectives including one under the heading of “Maximising Road and Freight Performance” with the following objective statement:

“To develop and manage an efficient road network that meets the city's needs for the movement of people and goods, and can be safely shared by all road uses”.

The key themes associated with this objective are stated in the Gold Coast Transport Strategy 2031 as follows:

- *Theme 17: Plan and manage the Gold Coast Road Network as “one network” regardless of ownership;*
- *Theme 18: Plan, invest and manage the road network to provide a match between the transport function of each road with the places it goes and the users who needs priority;*
- *Theme 19: Make the most of existing infrastructure and promote greater use of public transport and active transport;*
- *Theme 20: Improve the legibility of the Gold Coast Road network so motorists take preferred traffic routes and avoid unnecessary trips through activity centres, strip shopping areas and beachside areas;*
- *Theme 21: Provide adequate loading zones and off-street loading facilities for freight; and*
- *Theme 22: Maintain the local road network to a high standard.*

Importantly, the Gold Coast City Transport Strategy recognises that the focus should be on managing the available road space to support a more sustainable transport system whilst at the same time providing for the expansion of the road network in areas where it is reasonable to do so.

The strategy details themes that apply to the Gold Coast's maturing road network, which is also particularly evident for sections of Tweed's road network where urban development is established and future road capacity is limited.

3.5 CROSS BORDER TRAFFIC MASTER PLAN – *BITZIOS CONSULTING (2011)*

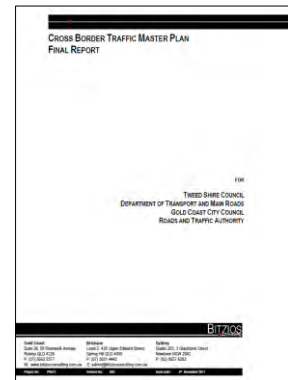
The Cross Border Traffic Master Plan was a joint effort of TSC, Gold Coast City Council, NSW Roads and Maritime Services (formally RTA) and the Queensland Department of Transport and Main Roads (TMR).

The need for a Cross Border Traffic Master Plan was identified as the Pacific Motorway/Tugun Bypass/Pacific Highway corridor is the primary cross border connection between Queensland and New South Wales. Due to the absence of alternative routes, this corridor is forecast to carry significant traffic volumes in the future with a mix of interstate, inter-regional and local traffic.

The Master Plan objectives included:

- identifying and assessing options for optimising the interaction of the Pacific Highway with the adjacent urban arterial road network with the aim of promoting local function trips on the local network and minimising reliance on the Pacific Highway/Pacific Motorway;
- optimising highway interchanges to provide the most appropriate levels of service and outline implementation arrangements to provide connectivity between the growth areas and local and regional facilities such as the Gold Coast Airport and John Flynn Hospital; and
- improving pedestrian and public transport connectivity including integration with the proposed future extension of the Gold Coast Rail Line to the Gold Coast Airport.

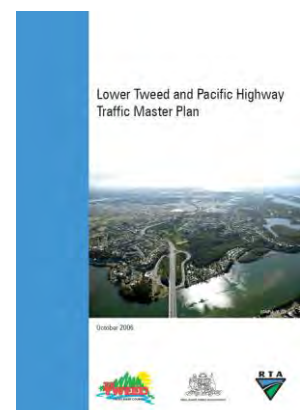
The Master Plan identified 14 key upgrades for the cross border region based on the transport modelling conducted. The recommendations included widened road corridors and the inclusion of additional ramps for the Pacific Motorway. Each upgrade also had a recommended implementation year identified.



3.6 LOWER TWEED AND PACIFIC HIGHWAY TRAFFIC MASTER PLAN – *PARSONS BRINCKERHOFF (2006)*

The Lower Tweed and Pacific Highway Traffic Master Plan was developed to address concerns from the community and stakeholders regarding local traffic conditions and the road hierarchy in the greater Tweed Heads area. These concerns were heightened in reaction to announcement of the Tugun Bypass and the Banora Point upgrades. The study aimed to identify an arrangement which would:

- maintain acceptable levels of service on the Pacific Highway and local arterials;
- improve local access to, and surrounding the Pacific Highway;
- prevent bottle-necks on the local road network through the provision of multiple accesses to key traffic generators;
- cater for the continuing commercial and residential development of the Tweed area; and
- improve road safety through the separation of highway and local traffic and the deterrence of short local trips on the highway.



An option analyses undertaken as part of the Master Plan concluded that an appropriate balanced ultimate arrangement for the development of both the Pacific Highway and adjoining local road network should be implemented. Indicative target completion dates and estimated costs were documented for these elements.

Figure 3.2 shows the proposed Terranora Inlet upgrades to incorporate the Kirkwood Road interchange and additional service road connections to Kennedy Drive. For the current TRDS, the costs for these works were considered to be substantial and alternative options have been considered as part of this 2017 TRDS review.



Source: *The Lower Tweed and Pacific Highway Traffic Master Plan (2006)*

Figure 3.2: Lower Tweed and Pacific Highway Traffic Master Plan – Kirkwood Road to Kennedy Drive

3.7 DISTRIBUTOR ROAD NETWORK PLANNING (2007)

TSC prepared a separate report focussing on traffic generated by the Cobaki Lakes/Bilambil Heights development areas to:

- identify the short and long term management options of Kennedy Drive and Cobaki Parkway as distributor roads;
- strengthen the relationship of this development with the TRDS;
- determine a management strategy to avoid overloading the interim road network (until the Cobaki Parkway is fully constructed); and
- inform future revisions of the Tweed Road Contributions Plan.

In the Tweed Heads West/Cobaki area, the major development areas of Cobaki Lakes and Bilambil Heights will have a significant impact on how and when the TRDS distributor roads are constructed; and management of this process will control how development can occur. The recommendations in this report are summarised in Table 3.1.

Table 3.1: Distributor Road Planning Recommendations

No.	Report Recommendation
1	Until Cobaki Parkway is constructed continuously between Boyd Street and the Piggabeen Road, development west of Cobaki Bridge at Kennedy Drive is to be restricted.
2	<p>The Cobaki Lakes Development to have unrestricted access to Piggabeen Road subject to:</p> <ul style="list-style-type: none"> ▪ the Developer entering into a legally binding agreement with Council that indemnifies Council from any financial liability in regards to obligations under the Boyd Street Road Works Deed dated 16 June 1993; and ▪ the Developer dedicating all the Cobaki Parkway Road Reserve (Boyd Street to Piggabeen Road) as part of Stage 1 of any new or amended Development Consents.
3	<p>The proposed Pacific Highlands project part of the Bilambil Heights land release, may be permitted to progress beyond current restrictions based on the traffic thresholds on Cobaki Bridge provided:</p> <ul style="list-style-type: none"> ▪ Cobaki Parkway is continuously constructed from Piggabeen Road to Boyd Street; ▪ the new "spine" road proposed through the site from Marana Street to Cobaki Road is constructed; and ▪ Cobaki Road from the "spine" road to Cobaki Parkway is upgraded.
4	The remainder of the Bilambil Heights Land Release Area can only proceed beyond the current road volume allowances on Kennedy Drive (24,650 vpd) when the Cobaki Parkway between Boyd Street and Piggabeen Road is continuously constructed and then development must progress in a manner that progressively constructs the Scenic Drive diversion from Piggabeen Road southward (i.e. all new development must have access to the Scenic Drive diversion).
5	The next review of Section 94 Contributions Plan No. 4, Tweed Road Contribution Plan to include in its works program, widening of Kennedy Drive between Cobaki Creek Bridge and Gray Street to four lanes.

The report also concluded that to minimise the impact of incremental development of the study area on Kennedy Drive, it is considered desirable to upgrade Kennedy Drive to four lanes from the Cobaki Creek Bridge to Gray Street. These works were completed in 2016.

4. BASE YEAR (2016) MODELS DEVELOPMENT

4.1 INTRODUCTION

Two separate models have been developed for the TRDS, specifically:

- a link-based strategic EMME Model for the whole major road network; and
- an “Inner Core” Meso-simulation AIMSUN model.

The existing 2016 GCSTM-MM was used as the basis for developing the TRDS EMME base model (referred to as the TSTM-MM V1.0). The GCSTM-MM model was first reduced to only include the road network and zoning system south of Currumbin Creek and then it was extended into the Tweed. Additional model zones and road links were created using GIS layers provided by TSC. Population, employment and enrolment demographics **were input into the model. The model's zones use the ABS - SA1 Level Zoning system.**

The AIMSUN model was created with a common link and node numbering system to the TSTM-MM model to allow ease of integration. The use of two models has allowed interrogation of detailed intersection requirements within the inner core as well as link capacities across the wider road network.

Year 2016 was used for the base year for both models. Traffic survey data at key locations including both 24hr “tube count” surveys and two-hour peak period turning movement traffic surveys at key intersections was used for model calibration purposes.

The model development calibration and validation processes for both the TSTM-MM models is summarised in the following sub-sections. More detailed model development information is provided in:

- the *Tweed Strategic Transport Model – 2016 Model Development Report* (attached as Appendix A); and
- the *TRDS AIMSUN Base Model Calibration and Validation Report* (attached as Appendix B).

4.2 TWEED STRATEGIC TRANSPORT MODEL – MULTI MODAL (TSTM-MM)

4.2.1 Model Background – Source Model

The Gold Coast Strategic Transport Model (GCSTM) is a strategic travel demand forecasting tool developed by the City of Gold Coast Council to support strategic transport planning, infrastructure and policy testing.

The model was updated (by Consultants SKM) in 2009 to:

- update the software platform from EMME/2 to EMME/3;
- update the model relationships to reflect the latest travel behaviour as evident in the most recent household and visitor travel surveys;
- update the model zoning system and boundaries to reflect the changes to the Census Collection District (CCD) boundaries used in the 2006 census;
- incorporate the public transport mode share results from the separate Gold Coast Rapid Transit base year modelling; and
- re-validate the base year model to 2006 traffic count data.

The GCSTM-MM V2.0 was created in 2014 by Bitzios Consulting involving re-basing the model to 2011 trip patterns (from Household Travel Survey data), adding a mode choice model and public transport trip assignment, updating demographics and re-calibrating/re-validating to traffic survey data.

Following this, some other improvements have also been implemented by Bitzios Consulting, including better representation of Gold Coast Airport traffic demands and more network detail in the rapidly growing Coomera area.

4.2.2 Model Structure Overview

The TSTM-MM is a “four-step” model incorporating trip generation, trip distribution, modal choice and trip assignment steps. Trip generation is based on trip generation equations primarily related to population, employment and enrolments. Trip distribution using a form of gravity model with its deterrence functions,

drawing on cost skims from within the model. Modal choice is based on “factors” to strip out walk/cycle trips but uses a logit-based choice model to split motorised person trips into public transport and private vehicle trips which are assigned to the network. Commercial vehicle trips are separately included:

4.2.3 Model Boundary and Zone System

The existing 2016 GCSTM-MM was used as the base for developing the TSTM-MM base model. Figure 4.1 shows the study area and zone boundaries for the strategic model.

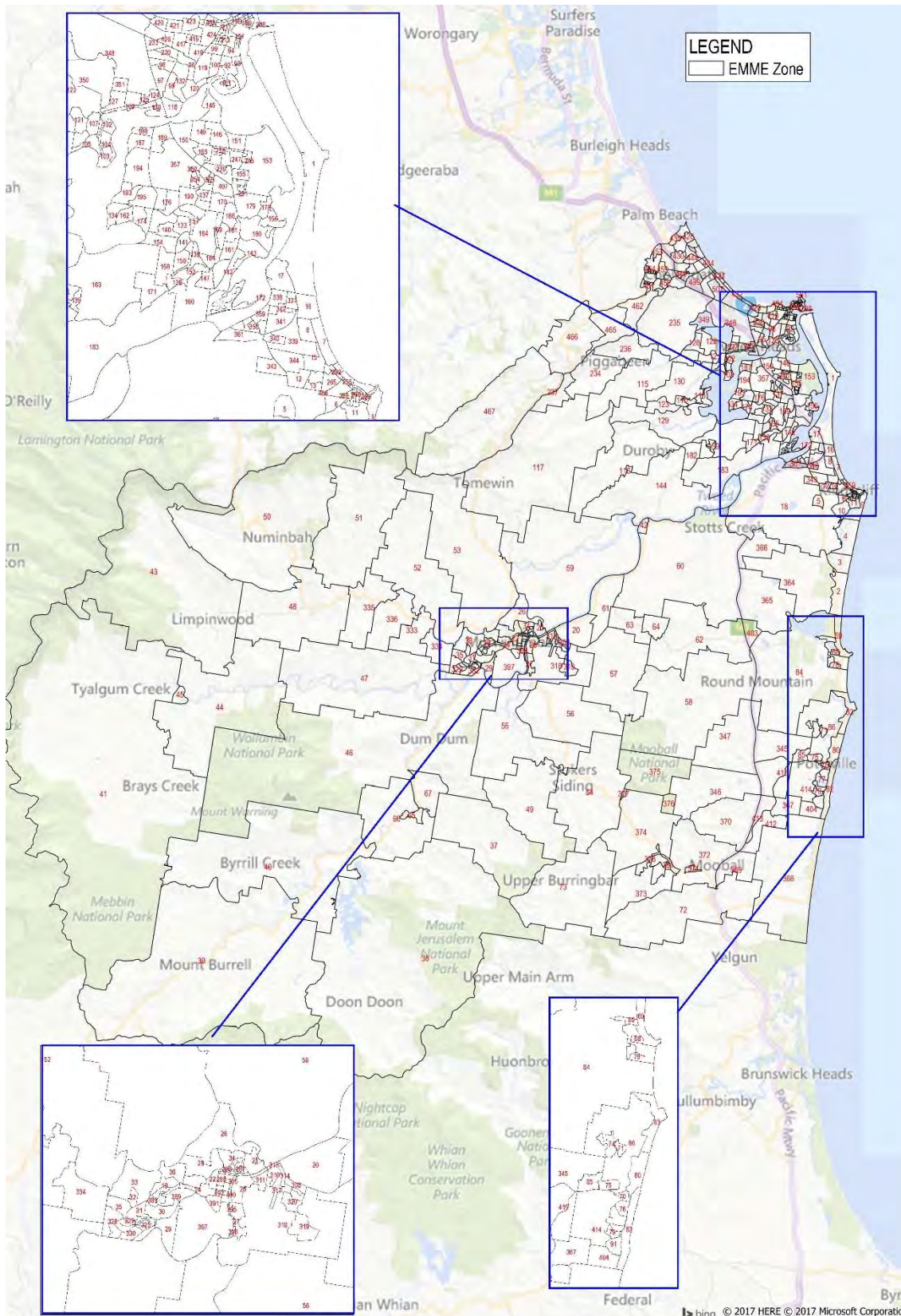


Figure 4.1: Strategic Model Study Area

Demographic data for the study area was sourced from Australian Bureau of Statistics (ABS) datasets. In the absence of demographic data for 2016, the datasets sourced from 2011 Australian Bureau of Statistics (ABS) have been extrapolated using representative growth rates. These growth rates have been sourced from various TSC documents.

The demographic data is maintained in a spreadsheet and exported into the formats needed for the trip generation models in the TSTM-MM. The demographic inputs are contained within the four primary categories of:

- population (Figure 4.2);
- employment (Figure 4.3);
- education (Figure 4.4); and
- visitors (Figure 4.5).

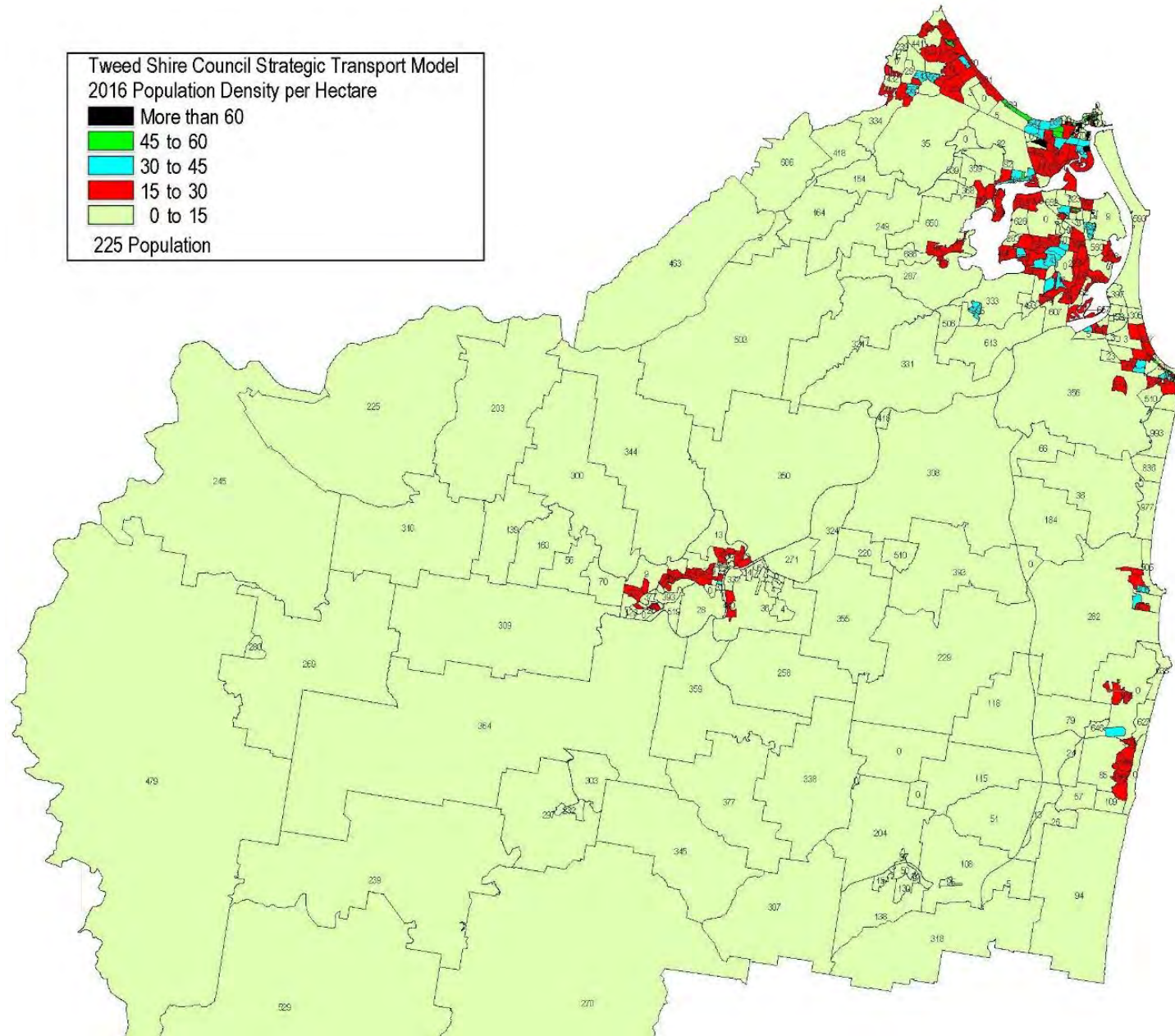


Figure 4.2: Tweed Shire Population Density (2016)

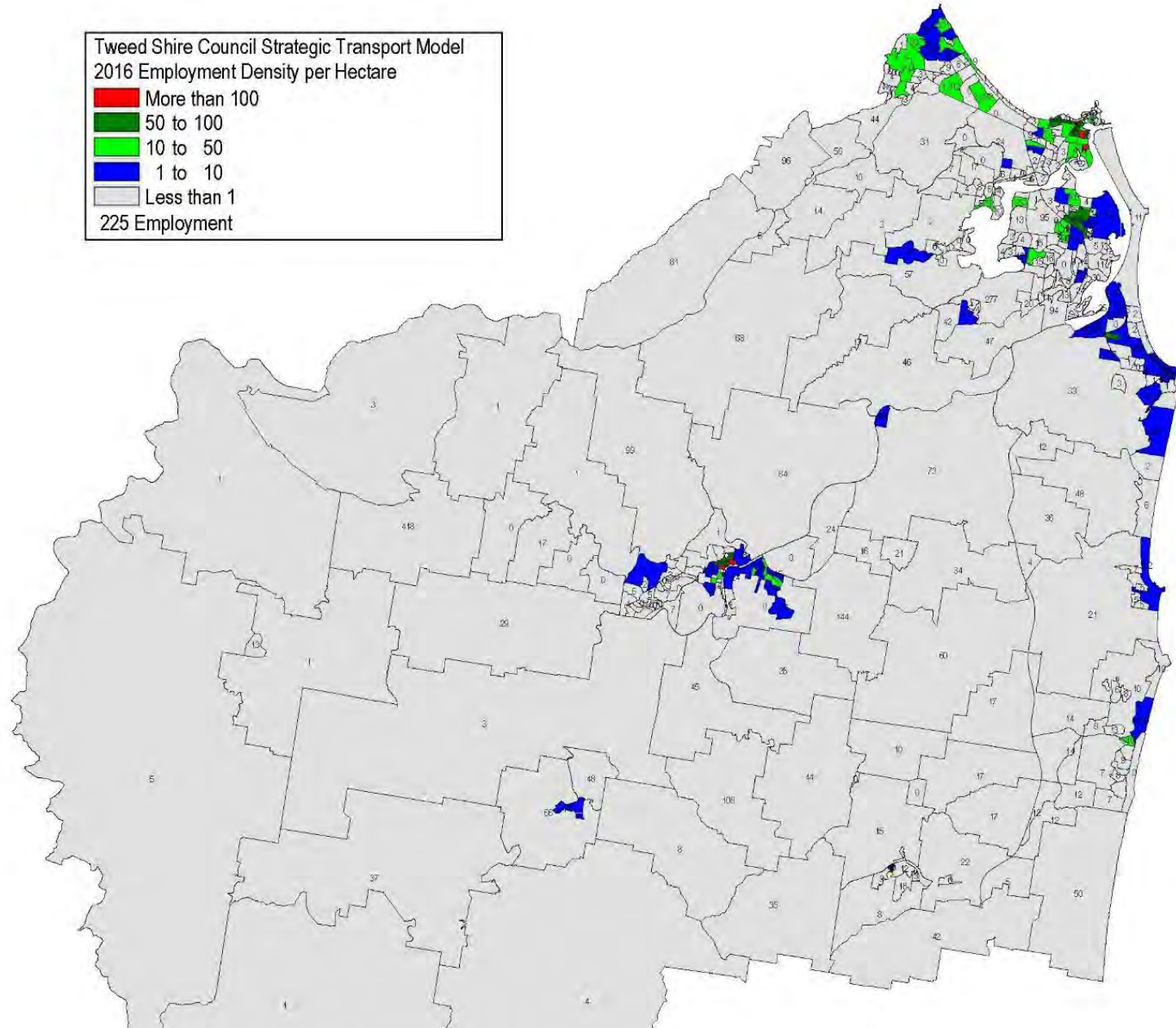


Figure 4.3: Tweed Shire Employment Density (2016)

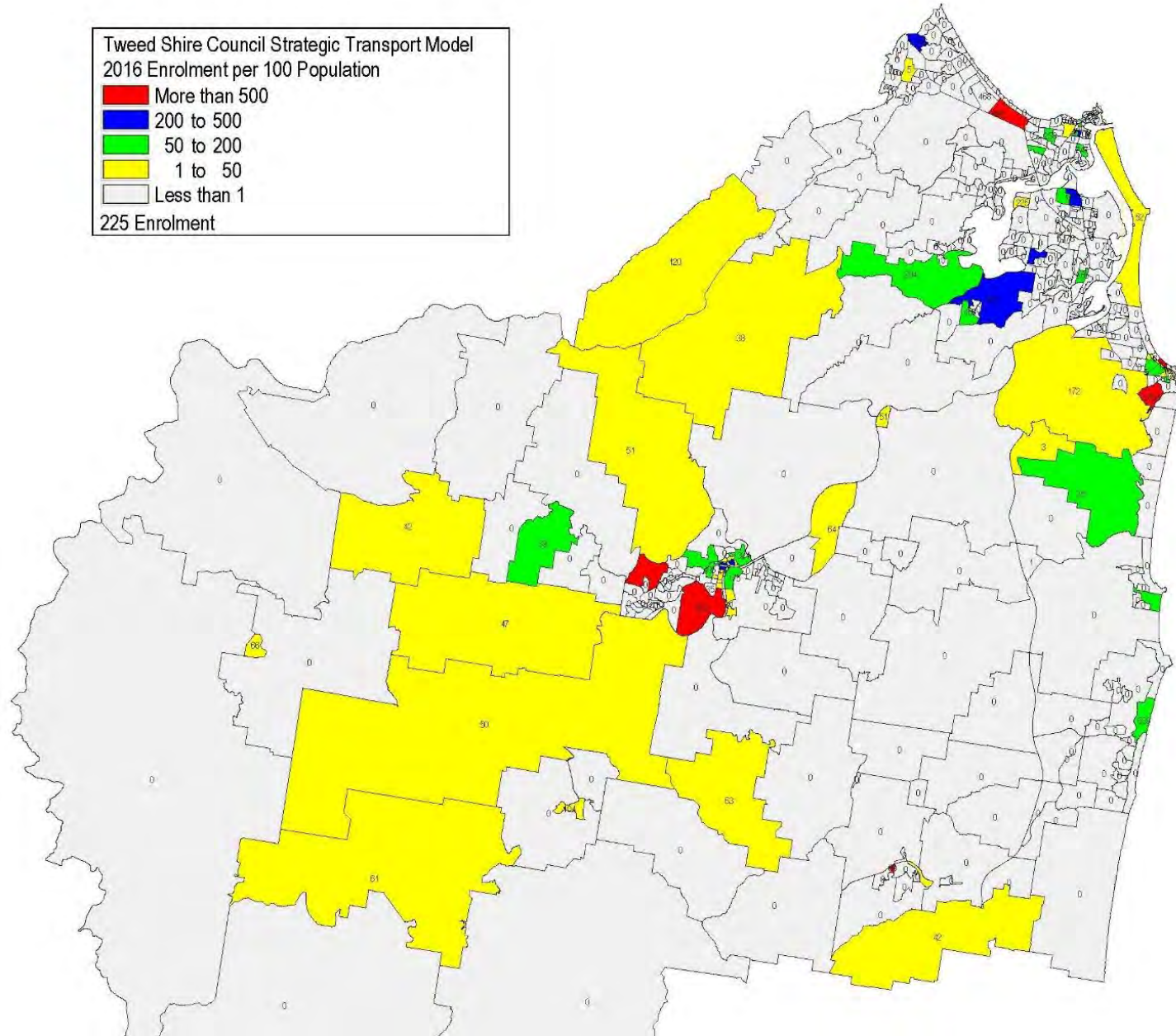


Figure 4.4: Tweed Shire Enrolment Density (2016)

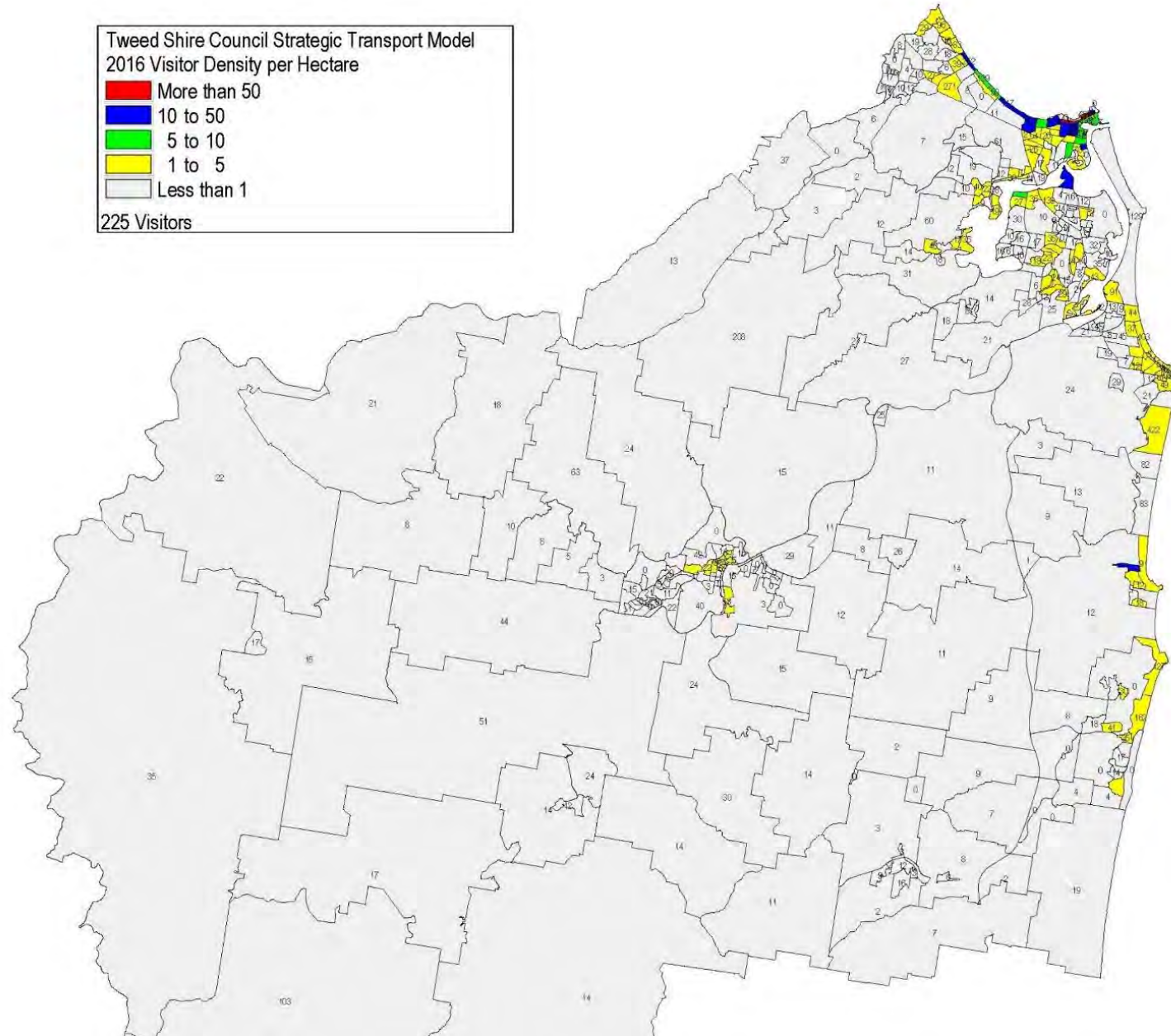


Figure 4.5: Tweed Shire Visitors (2016)

4.2.4 Model Calibration and Validation and

The transport modal choice and trip assignment parts of the model have not been calibrated beyond the calibration was done for the GCSTM-MM. Localised validation of bus passenger volumes is a future task to upgrade/refine the model. This section focusses on the traffic assignment calibration and validation.

The Roads and Maritime Services Traffic Modelling Guidelines stipulates the following network-wide and screenline/cordon criteria for the validation of a strategic traffic assignment. These criteria, which have been adopted for the validation of the 2016 Base TSTM-MM are:

- 95 percent of individual link volumes to have a GEH ≤ 5.0 ;
- all individual link and turn volumes should have GEH ≤ 10 ;
- coefficient of determination, R^2 to be >0.9 ;
- all counts RMSE should be 30.0 or lower; and
- in each direction; the screenline or cordon total to have GEH <4.0 .

Both screenline volume outputs and peak period travel time outputs are within the strategic model validation tolerances contained in the RMS guidelines. The level of validation is considered fit for the purpose of strategic network modelling, assessment of daily link volumes and for input into local area models (including the AIMSUN Model).

Notwithstanding the above, there may be specific roads where traffic volumes are not within 20% of observed volumes as is the nature and the limitations of strategic network modelling. The precision of models evolves over time as it is expected that further updates to traffic assignment will be needed as specific parts of the network are interrogated in more detail; and to suit the needs of specific local network studies.

4.3 TWEED MESOSCOPIC AIMSUN MODEL DEVELOPMENT

4.3.1 Model Overview

Whilst the EMME model incorporates the entirety TSC area, the level of detail required in the AIMSUN modelling as well as the intersection-based nature of this model suggested the need for a refined study area. The refined study area is bounded by the state border, Casuarina/Kings Forest and the Terranora Broadwater. This area incorporates several key regional roads including the Pacific Motorway, Wharf Street, Minjungbal Drive, Kennedy Drive and Fraser Drive.

An area of the road network north of the Queensland state border has been included within this model to ensure cross border interactions are reflected.

The study area and extent of modelled network is shown in Figure 4.6.

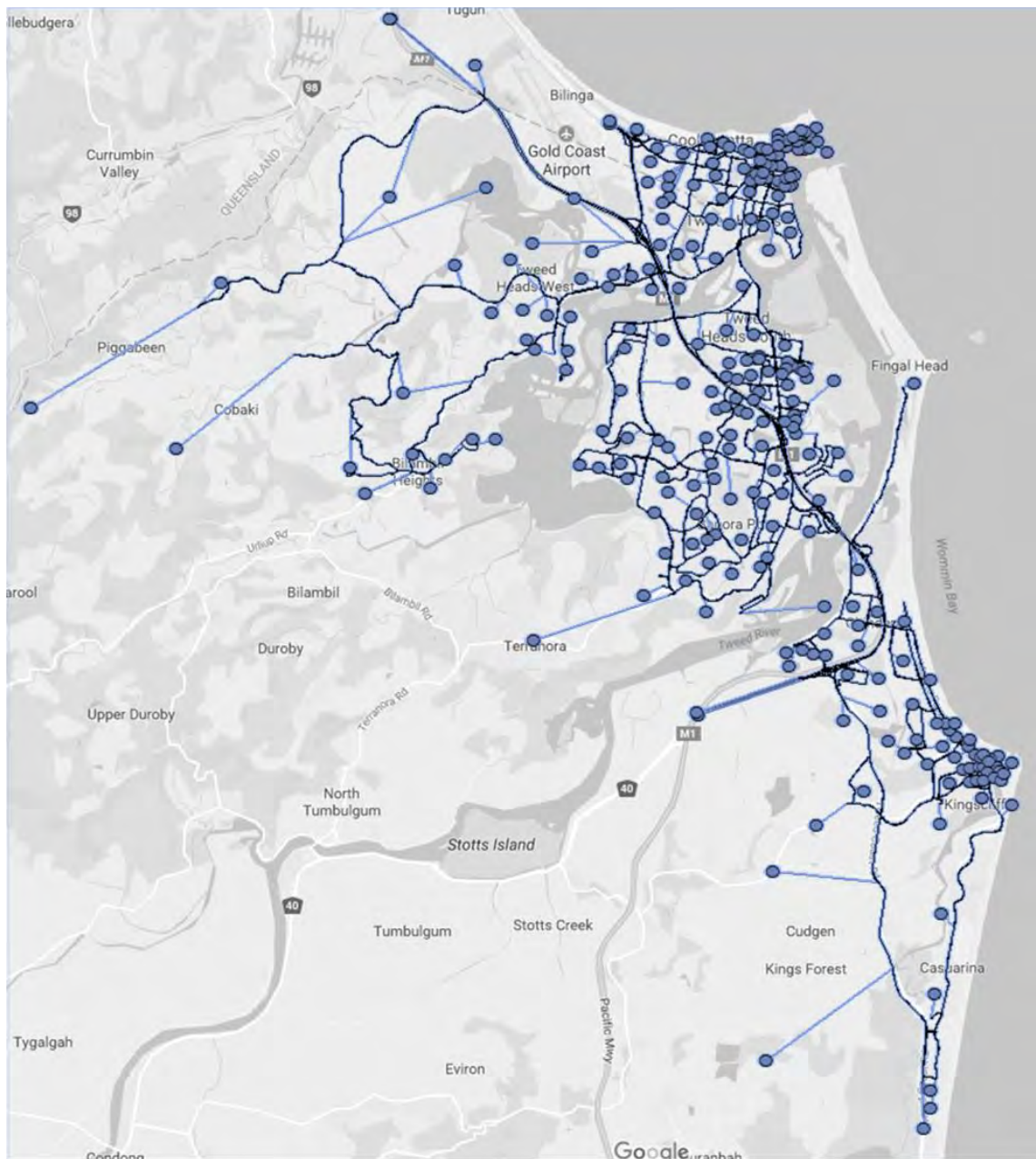


Figure 4.6: AIMSUN Model Study Area

4.3.2 Model Inputs

Key model inputs and the key characteristics of the AIMSUN model are summarised as follows:

- the network geometry and lane configurations were coded based on the Tweed Strategic Transport Model – Multi Modal (TSTM-MM) and intersection geometry was based on aerial photography;
- the base models were developed for the typical commuter peak periods which align to the corresponding strategic model time periods:
 - AM Base model peak period: 7:00 am to 9:00 am; and
 - PM Base model peak period: 4:00 pm to 6:00pm.

The models include a 30 minute “warm up” period prior to the peak period and a 30 minute “cool down” period after the peak period;

- the traffic demands used within the TRDS AIMSUN base model have been firstly adopted from the TSTM-MM. Traffic demands have been separated into light vehicles and heavy vehicles. A static OD adjustment process was then undertaken in AIMSUN to manipulate the TSTM-MM “prior” matrices using datasets of turn and link counts at multiple locations;
- the traffic release profile used in the Aimsun modelling was based on a sample of six representative intersections within the study area; and

- vehicle classes used in the models are based on the default AIMSUN template vehicle classes. The vehicles/classes were split into “cars” and “trucks” with separate demands developed for each. The vehicle properties were amended to more accurately represent the average Australian vehicle sizes;

4.3.3 Model Calibration and Validation

The calibration and validation of the Base AM and Base PM weekday AIMSUN models was undertaken using:

- intersection survey counts;
- SCATS signal data;
- travel time surveys; and
- informal queue observations (including local knowledge).

The Base 2016 AIMSUN models developed for the AM and PM peak hour periods are considered to be appropriately calibrated and validated to 2016 traffic conditions given the data available. The models are considered fit-for-purpose given the context of this particular study.

The Aimsun models could be refined and improved in the future as more data becomes available.

Appendix B contains further details on the AIMSUN model calibration and validation.

5. EXISTING CONDITIONS ASSESSMENT

Figure 5.1, Figure 5.2, Figure 5.3 and Figure 5.4 present the identified existing issues with the Tweed Shire road network based on existing constraints and travel patterns. Traffic congestion and delays within the network are present during typical morning and afternoon peak periods. In addition, it is noted that traffic congestion is also apparent during the middle of the day within specific urban and commercial areas as well as on weekends and during holiday/seasonal periods. Key constraints on the existing road network are present.

Table 5.1: Existing Road Network Constraints

No.	Location	Road Network Constraint / Issue
1	Tweed Heads	Kennedy Drive, associated with peak periods traffic congestion at the Pacific Highway Interchange and Ducat Street signalised intersection.
2		Kennedy Drive/Norman Street/Boat Ramp access. The priority controlled intersection exhibits delays and queues during peak times and weekend periods.
3		Wharf Street/Boyd Street intersection. Peak period queues on all approach. Left turn slip lane from Kennedy Drive exhibits queues and conflicts with left turning traffic to Boyd Street.
4		Golan Drive / Kennedy Drive / Inlet Drive / Piggabeen Road intersection. Capacity limitations and proximity to bridge. Peak period queuing and turn movement delays.
5	South Tweed Heads	Minjungbal Drive between Kirkwood Road and Darlington Drive. Limited turn movement green time for side streets (i.e. Machinery Drive, Shallow Bay Drive, Blundell Blvd, Kirkwood Road) occurs throughout the day including the middle of the day, School peak periods weekends and seasonal/holiday periods.
6		Greenway Drive and Machinery Drive. Delays at priority controlled intersections and multiple high use commercial/industrial driveway crossovers.
7		Dry Dock Road/Minjungbal Drive. Congested intersection during AM and PM peak periods.
8	Banora Point	Greenway Drive/Leisure Drive roundabout intersection. School peak period traffic movements and secondary access to/from South Tweed Heads.
9		Sextons Hills Drive/Darlington Drive/Minjungbal Drive intersection. Peak period queues on all approaches, attributed to being the primary access to/from South Tweed Heads from the south as well as access to the Pacific Highway for Banora Point, South Tweed Heads and Terranora catchments.
10		Leisure Drive. Major east-west through route as well as servicing Schools and retail developments. Incorporates priority controlled intersections as well as shared through-right turn lanes.
11	Terranora	Mahers Lane / Terranora Road intersection. School peak queues and turn movement delays.
12	Kingscliff	Tweed Coast Road/Cudgen Road intersection. Queues during morning and afternoon peak periods. Intersection includes short kerbside through lanes which limit utilisation and intersection throughput.
13		Wommin Bay Road and Phillip Street intersections. Peak period tidal traffic flow and queuing. This is also evident during weekend and holiday periods.
14	Chinderah	Tweed Coast Road / Morton Street intersection. Short weave to access left turn to Morton Street.
15	Tweed Coast	Coronation Avenue. Periods of slow moving queuing and congestion during peak periods, weekends and holiday periods. This is attributed to the high pedestrian activity and high traffic impedance associated with the Pottsville town centre.
16	Murwillumbah	Wollumbin Street on entry to the Murwillumbah CBD over the Tweed River bridge. Peak period queuing. This is attributed to the turning traffic at Commercial Road roundabout intersection on the western side of the bridge.
17		Riverview Street and Nullum Street priority controlled intersection to Wollumbin Street. Right turn queues and delays which occurs during School peak times.
18		Byangum Road / Wollumbin Street Roundabout. Peak period queues and delays.

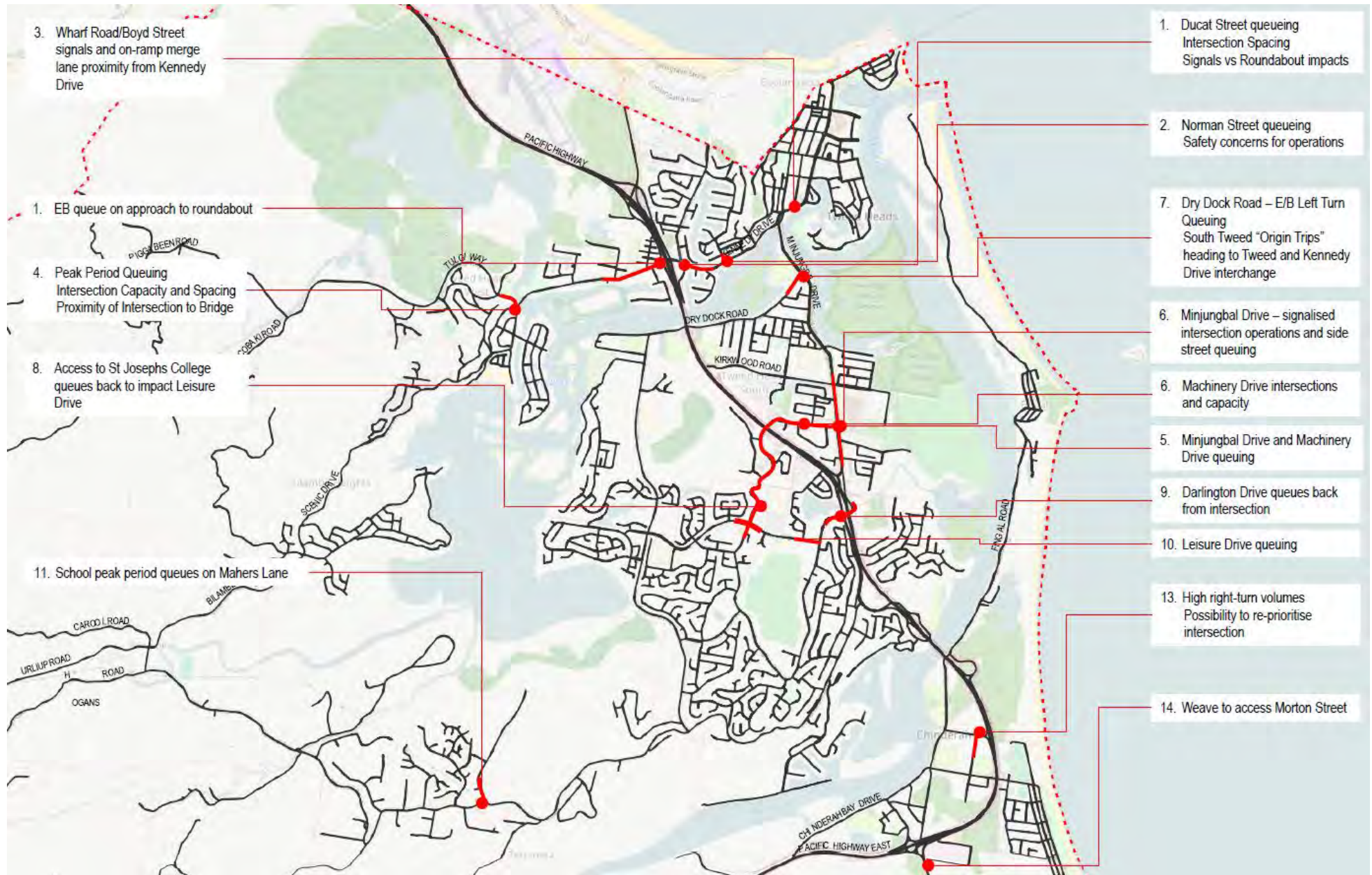


Figure 5.1: Existing Network Issues 2016 – Tweed Heads/Chinderah

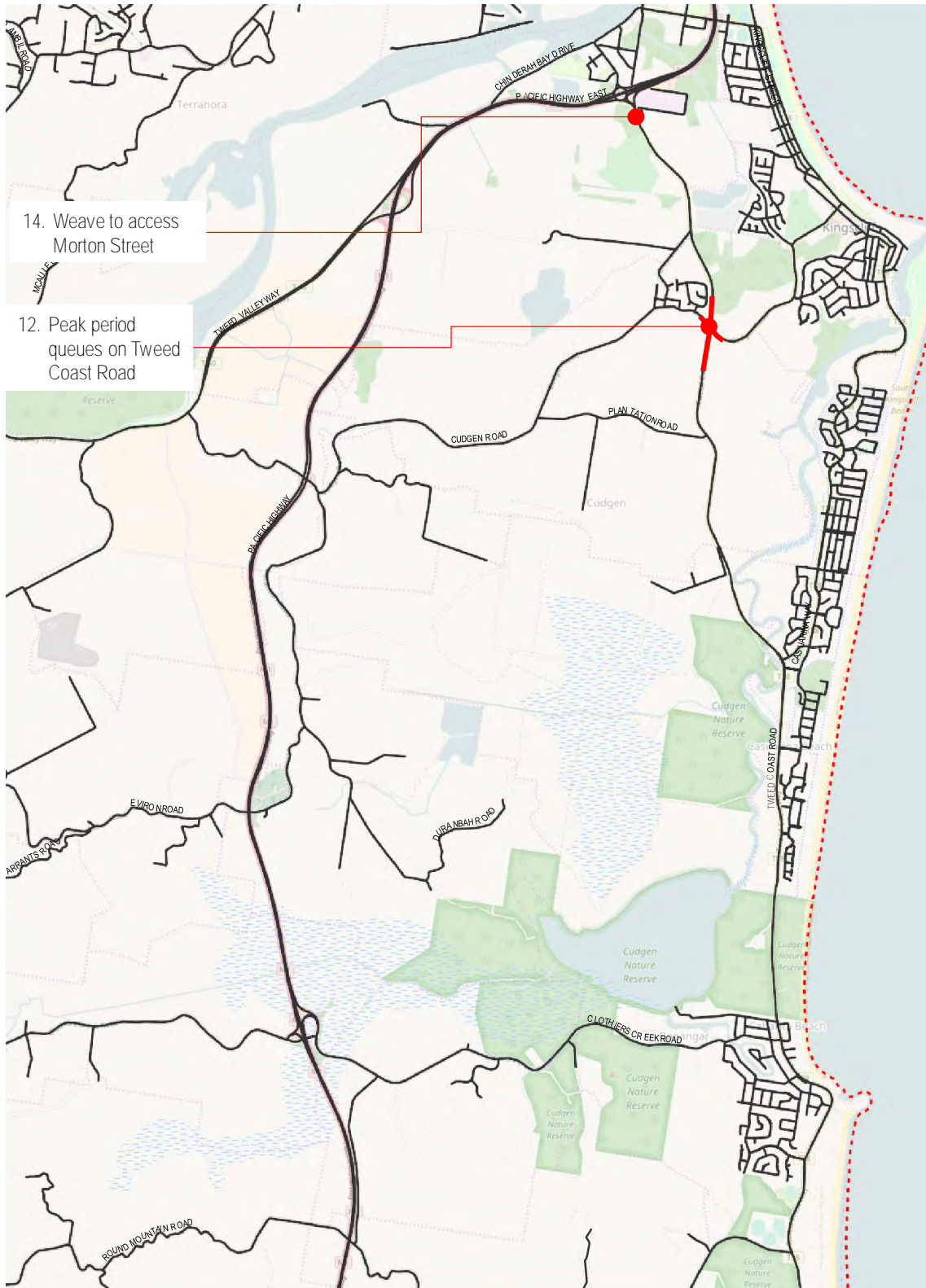


Figure 5.2: Existing Network Issues 2016 – Kingscliff/Cabarita

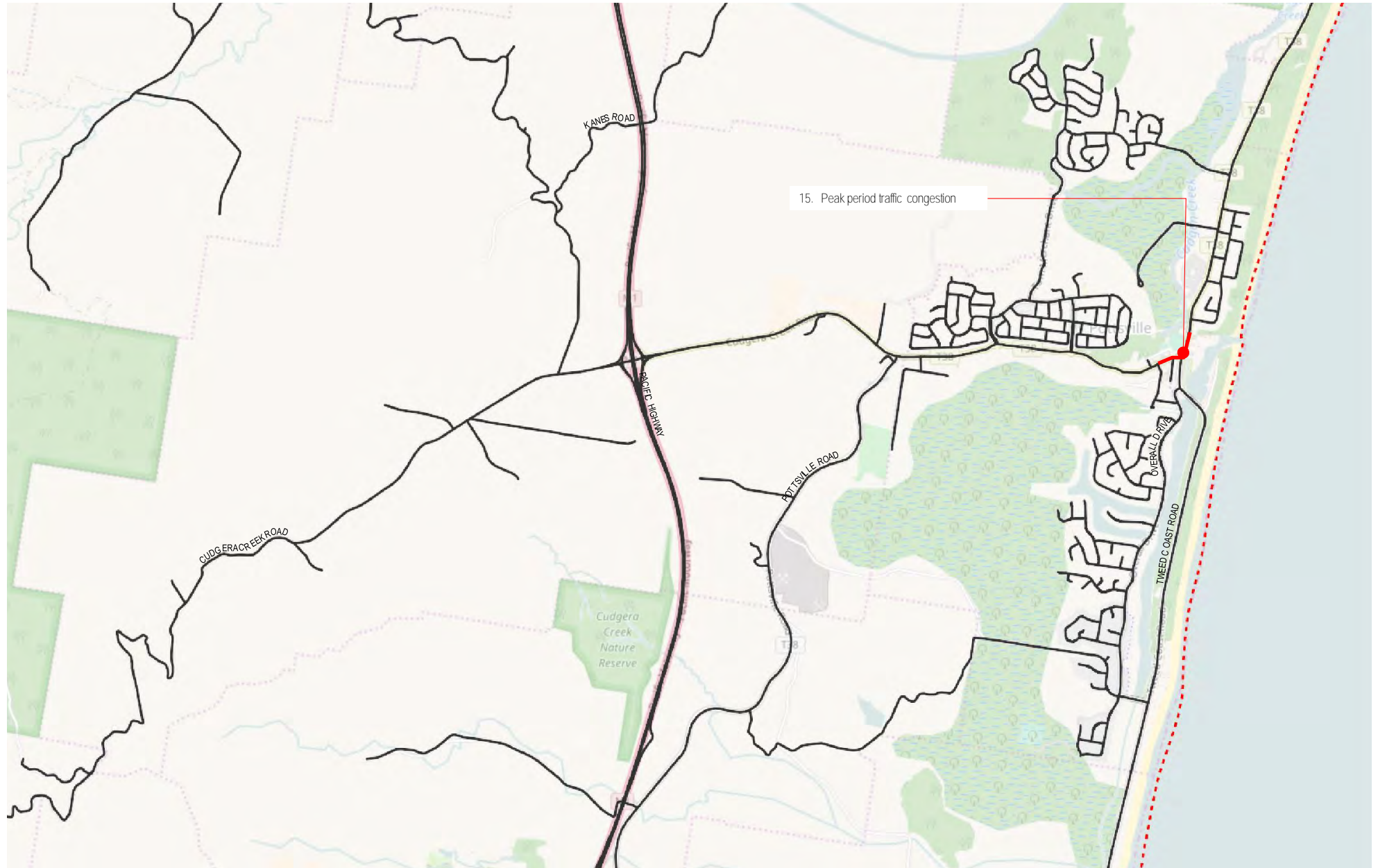


Figure 5.3: Existing Network Issues 2016 – Pottsville

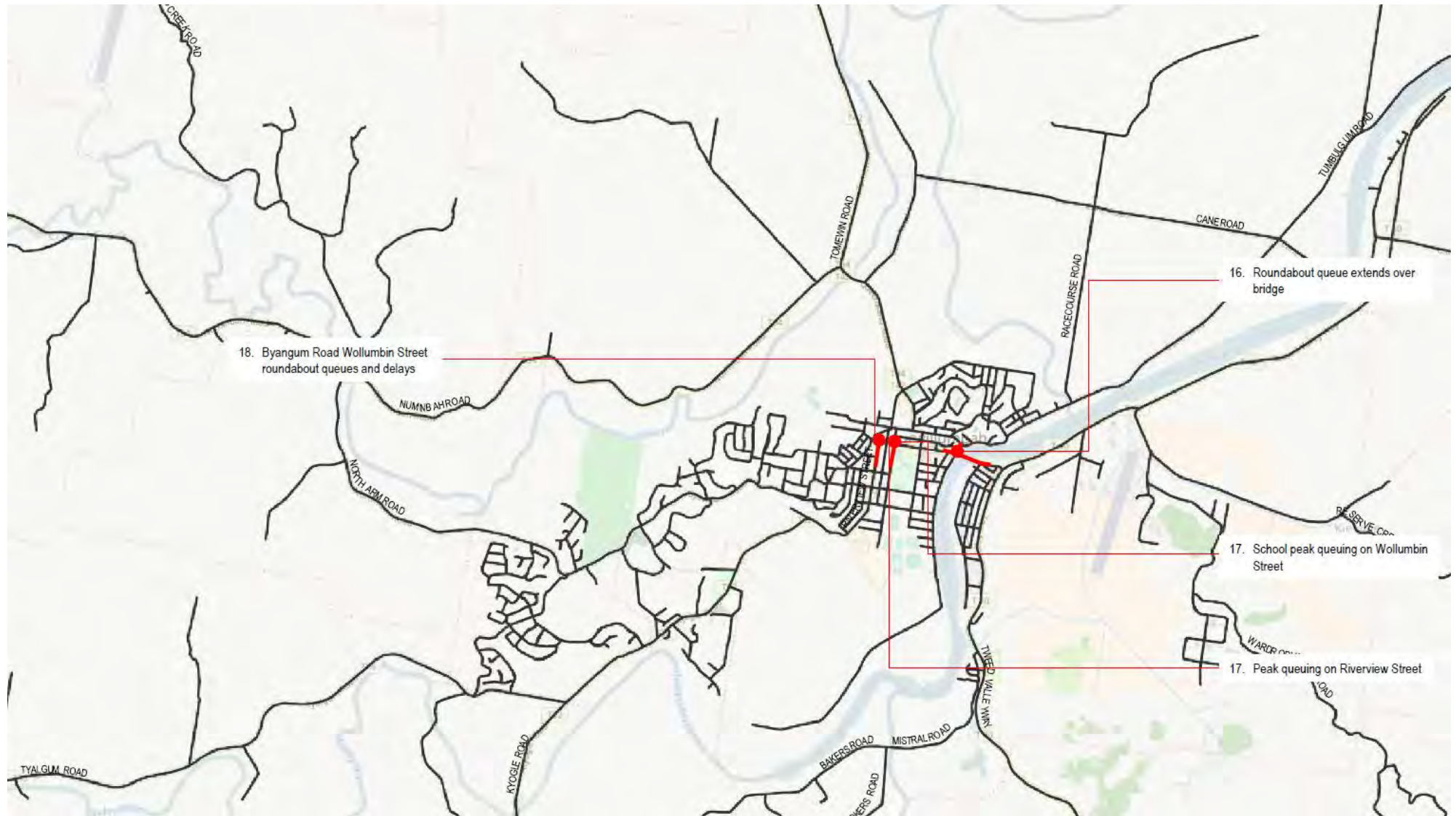


Figure 5.4: Existing Network Issues 2016 – Murwillumbah

6. YEAR 2041 FORECAST DEMOGRAPHICS

6.1 FORECASTING STRUCTURE AND SUMMARY

The TSTM-MM requires demographic inputs and future land release and development information needed to be converted into population, employment and enrolment data for an assumed ultimate year of 2041.

TSC future development planning information and current growth trends were used to determine the additional population, employment and enrolments to 2041. This “growth” data has then been added to the 2016 base data for each individual model zone0

This chapter describes the processes used and provides a summary for each of the key demographics types. Detailed zone-by-zone results are available in Appendix C.

Areas of the TSTM-MM in Queensland (i.e. Currumbin/Tallebudgera and Billonga/Tugun) have been taken into consideration but are not included in the final forecast totals for the Tweed Shire and use projections from the GCSTM-MM.

Demographic forecasts based on TSC’s data inputs are the maximum values expected representing an “ultimate” development scenario based on future planning. However, **Council’s land development** strategy may take longer than 25 years to be released and the year 2041 should be considered as a notional future year. To allow some testing of this, the following forecast scenarios were created:

- High scenario - has applied the Gold Coast City rate of growth (5-year average) to the expected ultimate scenario totals, reflecting a compounding growth rate of 1.88% per annum;
- Medium scenario - has applied the Profile.ID rate of growth reflecting a compounding growth rate of 1.54% per annum; and
- Low scenario - has applied the NSW Department of Planning (DoP) projection rate of growth reflecting a compounding growth rate of 1.10% per annum.

6.2 POPULATION FORECASTS

6.2.1 Data Inputs

Population forecasting was based on the number of additional dwellings expected across the Tweed Shire based on future development planning. Future development information was provided by TSC and included the following:

- Vacant Residential Land - land that is part of existing development expansion areas where dwellings are yet to be built. These values were based on wastewater/water connections provided by Council;
- Infill Development - additional future dwelling growth expected in established areas. These values were based on wastewater/water connections as well as forecast ID data provided by Council; and
- New Land/Development - planned development areas outlined by Councils and zoned residential. These values were based on data from Council’s Strategic Planning.

The data was interpreted using the following process:

- the calculated additional dwellings were placed into the relevant zones outlined in the TSTM-MM to provide an “ultimate” number of additional dwellings (the maximum known growth ability of the area);
- the zone by zone data was reviewed by **Council’s Strategic Planning**. Manual balancing of certain large future developments was undertaken to provide a more reasonable dataset based on the expected time or probability of developments occurring during the 25-year design period and to what extent;
- PopulationID data (provided by TSC) was used to cross check total volumes and the zone by zone application of population data;
- the “ultimate” number of additional dwellings was converted to additional population by applying a “**number of persons per dwelling**” rate to each TSTM-MM zone’s additional dwellings. This rate was defined based on the existing 2016 population and dwelling data for each zone. It should be noted that where an existing rate was not available for a zone, a Council specified rate of 2.4 persons per household was used; and
- Zone by Zone population data was also compiled into the relevant 13 Tweed Shire sectors defined by the TSTM-MM.

6.2.2 Scenario Totals

The scenarios totals are summarised below:

- High Scenario – results in an additional population of 55,408 across the Tweed Shire;
- Medium Scenario – results in an additional population of 41,518 across the Tweed Shire; and
- Low Scenario – results in an additional population of 28,027 across the Tweed Shire.

Equation 1: Zone by Zone Population Calculation

Zone X Pop (scenario)

$$= \text{Total Additional Pop (scenario)} \times \frac{\text{Zone X Pop (ultimate)}}{\text{Total Additional Pop (ultimate)}}$$

*Pop = Population

The above High, Medium and Low scenario results were applied to the TSTM-MM as the 2041 forecast data. **Each zone's population is calculated as the product of the population percentage (where percentage is based on the ultimate scenario population results) and the total additional population as per Equation 1.**

6.2.3 Forecast Summary

Table 6.1 summarises the estimated 2041 population (2016 Base plus Growth Projections) by sector for the High, Medium and Low scenarios.

Table 6.1: Population Forecast Summary by Sector

Growth by Sector	2016 Population	2041 Population Forecast		
		Low	Medium	High
Tweed Heads	8,675	9,853	10,419	11,003
Tweed Heads South-Banora Point	25,047	26,740	27,555	28,395
Currumbin Valley -Tallebudgera	1,486	1,486	1486	1486
Cobaki-Piggabeen	602	9,812	14,246	18,811
Terranora - Bilambil	6,917	8,755	9,639	10,550
North Coast-Kingscliff	10,129	13,008	14,393	15,820
Cabarita	3,660	4,376	4,721	5,076
Mid Coast-Casuarina	2,099	7,669	10,351	13,112
South Coast - Pottsville	7,408	10,172	11,503	12,873
Murwillumbah	10,499	11,999	12,722	13,465
North East Hinterland - Tumbulgum	2,973	3,030	3,057	3,085
West Tweed - Uki - Tyalgum	5,500	5,849	6,017	6,190
Tweed Heads West	6,365	6,440	6,476	6,513
South East Hinterland - Burringbah	3,559	3,709	3,780	3,854
Bilinga - Tugun	22,814	22,862	22,885	22,908
<i>Total*</i>	93,433	121,413	134,880	148,749

*Excludes OLD sectors, as marked in grey.

Forecast population density for each scenario is presented in Appendix C.

6.3 EDUCATION/ENROLMENTS FORECAST

6.3.1 Data Inputs

Enrolments growth was based on a proportion of the estimated population growth across the Tweed Shire (see Section 6.2) for each sector as well as considering expected new education developments. Education enrolments are defined in the TSTM-MM as follows:

- Pre-Primary and Primary – 8.5% of population (based on 2016 data);
- Secondary – 6.7% of population (based on 2016 data); and
- Tertiary – 2.6% of population (based on 2016 data).

Based on the above percentages and the additional population for each forecast scenario the enrolment demand from each sector was calculated. The enrolment data was interpreted using the following process:

- the enrolment demand from each sector was allocated to sectors where education facilities currently exist. This allocation was based on the proximity of Schools to the demand and an understanding of local education facility catchment areas. The allocation to each sector is further defined in Appendix C;
- enrolments were then redistributed to consider new educational facilities such as Primary Schools in Cobaki and Kings Forest, a new High School in Pottsville and the expansion of the Southern Cross University in Bilinga (i.e. 4,500 Equivalent full time students); and
- zone by zone enrolments were then calculated by proportioning each sector's enrolments based on existing 2016 enrolment data splits.

6.3.2 Zonal Apportionment Methodology

As outlined above future enrolments have essentially been based on growth proportions using population forecast data for the Low, Medium and High scenarios and then added to the 2016 base enrolment data.

The zone by zone high, medium and low growth enrolment data have been applied as per Equation 2. The resulting total enrolments have then been cross checked for each sector and manual adjustments made for each zone that contains a new education facility.

Equation 2: Zone by Zone Enrolments Calculation

$$\begin{aligned} \text{Zone X Enrol (scenario)} \\ &= \frac{\text{Zone X Enrol (2016 Base)}}{\text{Corresponding Sector Enrol (2016 Base)}} \\ &\times \text{Sector Enrol 2041 (scenario)} \end{aligned}$$

*Enrol = Enrolments

The High, Medium and Low scenario results were applied to the TSTM-MM as the 2041 forecast data.

6.3.3 Forecast Summary

Table 6.2 summarises the total estimated 2041 enrolments for each sector under the High, Medium and Low scenarios. A full breakdown of totals by education type is available in Appendix C.

Table 6.2: Total Education/Enrolments Forecast Summary by Sector

Growth by Sector	2016 Enrolments	2041 Enrolments Forecast		
		Low	Medium	High
Tweed Heads	1,466	1,591	1,651	1,713
Tweed Heads South-Banora Point	4,539	5,152	5,446	5,792
Currumbin Valley -Tallebudgera	120	120	120	120
Cobaki-Piggabeen	0	734	1,087	1,451
Terranora - Bilambil	1,453	2,152	2,488	2,835
North Coast-Kingscliff	3,778	4,817	5,317	5,832
Cabarita	278	339	369	399
Mid Coast-Casuarina	28	503	731	967
South Coast - Pottsville	639	1,097	1,318	1,544
Murwillumbah	3,615	3,930	4,082	4,238
North East Hinterland -Tumbulgum	141	146	148	150
West Tweed - Uki -Tyalgum	460	491	506	522
Tweed Heads West	0	0	0	0
South East Hinterland - Burringbah	207	213	216	219
Bilinga - Tugun	2,396	6,369	6,369	6,369
Total*	16,604	21,164	23,359	25,661

*Excludes QLD sectors, as marked in grey.

6.4 EMPLOYMENT FORECASTS

6.4.1 Data Inputs

Employment forecasting was primarily based on the areas of new employment lands planned across the Tweed Shire as well as the expansion of existing zones. Information regarding future employment zones was provided by Tweed Shire Council's **Strategic Planning** area.

Forecasting calculations have been based on the actual "useable" area of each set of new employment lands. Employment areas were analysed based on aerial imagery and a local understanding of the landscape to **determine the percentage of "useable" area.**

Four employment types were developed and **applied within each "useable" area, as per proportions in the Base 2016 data.** Table 6.3 outlines the splits for each area type.

Table 6.3: Employment Area Type Splits for Forecasting Purposes

Typical Split	Retail	Services	Professional	Industry
For retail skewed zones	62%	21%	12%	5%
For services skewed zones	12%	35%	32%	21%
For professional skewed zones	18%	30%	35%	17%
For industry skewed zones	27%	15%	14%	44%

In order to estimate the number of additional employees expected in each **"usable" area**, employees per 100m² rates have been developed to convert areas to number of employees. Employee rates for each of the four employment types applied in the forecasts include:

- Retail – 1.64 employees per 100m²;
- Services – 7.5 employees per 100m²;

- Professional – 6.0 employees per 100m²; and
- Industry – 0.44 employees per 100m².

The above rates were based on various sources including the RMS Guide to Traffic Generating Developments (2002), ITE Trip Generation and existing employment areas within the Tweed Shire. It should be noted that where an employment type presented several different rates an average rate was developed.

In summary, employment forecasts were generated using the following process:

- approximated total land area values were designated zones outlined in the TSTM-MM based on their location;
- **the percentage of total “usable” area or actual developable land for each zone was determined based on aerial imagery and a local understanding of the topography;**
- **each “useable” area was designated as skewed towards a particular “employment type” depending on its location, surrounding land uses, known development applications and discussions with Council.** Following this the splits shown in Table 6.3 were applied;
- employment rates per 100m² of usable **area were applied for each zone to determine the “ultimate”** additional number of employees expected in each EMME Zone; and
- Zone by Zone employment data was then compiled into the relevant 13 Tweed Shire sectors defined by the TSTM-MM model.

6.4.2 Scenario Considerations

The “ultimate” design scenario forecasts were based on the 2016 “Base” employment data and the estimated maximum additional employment for each zone then added, for each scenario.

The methodology involved:

- **each zone’s** additional employees being calculated as the product of the percentage difference between scenarios ultimate additional population scenarios and the number of additional ultimate scenario employees. See Equation 3. Additional employees are then added to the 2016 Base data to determine the total number of employees estimated out to the 2041 design year.0

Equation 3: Zone by Zone Employees Calculation

$$\text{Zone X Emp (scenario)} = \frac{\text{Total Additional Pop (scenario)}}{\text{Total Additional Pop (ultimate)}} \times \text{Zone X Emp (ultimate)}$$

*Emp = Employees, Pop = Population

The above High, Medium and Low scenario results were applied to the TSTM-MM as the 2041 forecast data.

6.4.3 Forecast Summary

Table 6.4 summarises the total estimated 2041 employment data for each model sector under in High, Medium and Low scenarios. A full breakdown of totals by employment type is available in Appendix C.

Table 6.4: Total Employment Forecast Summary by Sector

Growth by Sector	2016 Employment	2041 Employment Forecast		
		Low	Medium	High
Tweed Heads	5,894	8,416	9,637	10,714
Tweed Heads South-Banora Point	8,503	9,486	9,959	10,447
Currumbin Valley -Tallebudgera	232	232	232	232
Cobaki-Piggabeen	59	258	353	452
Terranora - Bilambil	795	795	795	795
North Coast-Kingscliff	3,750	5,091	5,736	6,401
Cabarita	476	476	476	476
Mid Coast-Casuarina	104	104	104	104
South Coast - Pottsville	1,165	2,521	3,173	3,845
Murwillumbah	5,362	8,862	10,547	12,282
North East Hinterland -Tumbulgum	470	470	470	470
West Tweed - Uki -Tyalgum	741	741	741	741
Tweed Heads West	707	1,263	1,531	1,806
South East Hinterland - Burringbah	558	558	558	558
Bilinga - Tugun	12,831	12,831	12,831	12,831
<i>Total*</i>	<i>28,582</i>	<i>39,039</i>	<i>44,079</i>	<i>49,090</i>

**Excludes QLD sectors, as marked in grey.*

7. FUTURE ROAD INFRASTRUCTURE TESTING

7.1 OPTIONS ANALYSIS APPROACH

7.1.1 Strategic Modelling

The TSTM-MM was used to incrementally test a series of road network and infrastructure options to determine an appropriate preferred suite of upgrades required by 2041. These options were based on consultation with TSC and RMS, and designed to target known or expected network constraints as well as considering projects identified in the previous TRDS.

The options analysis used daily and peak hour traffic data to determine network performance statistics such as VHT and VKT. In addition, link volume and Degree of Saturation (DOS) plots were compared to determine the expected performance of major traffic routes within the network.

7.1.2 Mesoscopic Modelling

As the TSTM-MM base model provides only link-based performance outputs, the mesoscopic (AIMSUN) modelling was used to review intersection performance and test upgrades to generate the preferred configurations.

7.2 ROAD UPGRADE SCENARIOS

The Tweed Road Network was modelled under several upgrade scenarios to allow comparison of various road network upgrades under 2041 traffic volumes. A summary of each upgrade scenario is provided in Table 7.1.

Table 7.1: Upgrade Scenario Summary

Upgrade Scenario	Description/Inclusions
Base Case	No improvements on the 2016 road network.
Scenario 1	Do Minimum – Pacific Highway upgraded to six-lanes from Tugun to South Tweed.
Scenario 2	Interim Critical Infrastructure Requirements – Scenario 1 plus infrastructure upgrades which are considered critical to the road network such as the partial construction of the Kirkwood Road (NBD) interchange, four lane on Tweed Coast Road to Kings Forest and new east-west connections between Chinderah and Kingscliff.
Scenario 3	Kirkwood Road Interchange – Scenario 2 plus upgraded Kirkwood Road/Kennedy Drive interchange utilising existing bridge infrastructure (no service road bridges).
Scenario 4	Previous Road Development Strategy – network upgrades specified in the existing TRDS plus north-facing Boyd Street ramps and Broadwater Parkway connection.
Scenario 5	Localised Link Testing – Scenario 4 with some local area modifications to assess the benefits of adding/removing links.
Scenario 6	Preferred Network – Scenario 4 with modified Kennedy Drive/ Kirkwood Road interchange (as per Scenario 3).
Scenario 7	Preferred Network with Constrained Pacific Highway – Scenario 6 with four lane Pacific Highway from Tugun and South Tweed.

7.3 NETWORK STATISTICS

The network-wide statistics from the future year modelling provide an overall insight into the operations of the road network under the different scenarios. A summary of the network statistics from the TSTM-MM is provided in Table 7.2.

Table 7.2: Strategic Modelling Network Statistics (2041)

Network Statistics	Base Scenario	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
Total Private Vehicle Trips – persons	612,635	612,931	611,767	612,025	611,838	612,147	612,164	611,854
Total Public Transport Trips – persons	10,471	10,439	8,291	8,297	8,554	8,359	8,531	8,585
Daily Private Vehicle Trips	448,093	448,291	448,775	448,972	448,816	449,024	449,061	448,858
Daily Commercial Vehicle Trips	19,985	21,041	21,042	21,043	21,044	21,045	21,046	21,047
Daily Vehicle Kilometres Travelled (VKT)	5,686,774	5,707,157	5,709,263	5,688,259	5,656,266	5,624,252	5,650,509	5,625,802
Daily Vehicle Hours Travelled (VHT)	131,205	121,120	117,224	116,664	118,063	116,080	116,928	124,702

7.4 SCENARIO TESTING

Seven (7) scenarios were tested for **development of the 2017 TRDS as well as the existing 'Base Case'** (no infrastructure upgrades) for comparison. This section provides additional detail on the major infrastructure upgrades proposed within each scenario and their likely impact on the network at a strategic level. The final recommended potential upgrades (including recommended localised upgrades) and the issues addressed by each are provided in Table 8.1.

7.4.1 2041 Base Case

The 2041 Base Case provides a benchmark using the performance of the existing 2016 road network when subjected to 2041 traffic demands. This scenario assumes that no road infrastructure upgrades will be undertaken in the future. As such, the 2041 Base Case does not represent a pragmatic option but simply provides a point of comparison for upgrade options as well as for identifying the and extent of impacts to the road network should no upgrades be undertaken.

The TSTM-MM was run using the three forecast demographic scenarios. The performance of the road network under these three scenarios compared to 2016 traffic demands on the 2016 network are provided in Table 7.3 with network plots presented in Appendix D.

Table 7.3: Base Case Modelling Results

Network Statistics	2016 Base Case	2041 Base Case (Low Yield)	2041 Base Case (Medium Yield)	2041 Base Case (High Yield)
Total Private Vehicle Trips – persons	425,619	562,895	612,635	663,078
Total Public Transport Trips – persons	6,611	8,075	10,471	10,772
Daily Private Vehicle Trips	305,061	412,148	448,093	484,510
Daily Commercial Vehicle Trips	11,257	18,961	19,985	21,039
Daily Vehicle Kilometres Travelled (VKT)	3,477,044	5,334,902	5,686,774	6,046,132
Daily Vehicle Hours Travelled (VHT)	68,432	120,829	131,205	146,835
Average Speed (VKT / VHT)	50.8 km/h	44.2 km/h	43.3 km/h	41.2km/h
Average Trip Time (VHT / Total Vehicle Trips)	0:13:28	0:17:35	0:17:34	0:18:11

An additional 187,000 trips per day are expected to use the Tweed road network by 2041 under the Medium Yield scenario. These additional trips increase average trip times by over four minutes and decrease average

speed by 7.5 km/h compared to 2016 Base Case. This represents a significant loss in network performance. Specifically, this reflects congestion issues growing for major road links such as the Pacific Highway, Tweed Coast Road, Tweed Valley Way and Kennedy Drive.

To assess the effectiveness of upgrade scenarios and for the purpose of determining road network requirements, the Medium Yield scenario was adopted for comparisons to the Base Case network performance indicators. The effect of the Low and High scenarios would essentially change the recommended timing for particular upgrades (i.e. Low Scenario would delay the need and High Scenario would bring forward the need).

7.4.2 Scenario 1: Do Minimum (6 Lanes on the Pacific Highway Only)

Scenario 1 maintains the conditions of the 2041 Base Case with the exception of a six-lane upgrade for the Pacific Highway with three lanes in each direction from Tugun to South Tweed. It is anticipated that the TMR will upgrade the Pacific Highway north of Stewart Road (Currumbin) by 2041 consistent with current Queensland Government planning.

The key function of this Scenario is for interstate and inter regional movements and to improve freight efficiency **promoting regional and state economic growth. However, the Pacific Highway also acts as a key 'trunk route'** for access in and around Tweed Shire. It is acknowledged that for the TRDS the Highway provides the dual role of **'local function' within the Tweed Shire road network and 'state/national function' connecting interstate travel and freight movement. Any integration of the 'local functions' should also preserve the higher 'state/national function' of the Highway.**

The performance of the road network under Scenario 1 is shown in Table 7.4 with Network Plots provided in Appendix D.

Table 7.4: Scenario 1 Modelling Results

Network Statistics	2016 Base Case	2041 Base Case (Medium Yield)	2041 Scenario 1 (Medium Yield)
Total Private Vehicle Trips – persons	425,619	612,635	612,931
Total Public Transport Trips – persons	6,611	10,471	10,439
Daily Private Vehicle Trips	305,061	448,093	448,291
Daily Commercial Vehicle Trips	11,257	19,985	21,041
Daily Vehicle Kilometres Travelled (VKT)	3,477,044	5,686,774	5,707,157
Daily Vehicle Hours Travelled (VHT)	68,432	131,205	121,120
Average Speed (VKT / VHT)	50.8 km/h	43.3 km/h	47.1 km/h
Average Trip Time (VHT / Total Vehicle Trips)	0:13:28	0:17:34	0:16:13

The network statistics show that the six-laning of the Pacific Highway encourages its use and hence facilitates longer average trip distances (VKT). This suggests that, in aggregate, the network is less constrained as a result of the upgrade, allowing longer trips to be undertaken with less delay. This would also suggest reduced use of the local road network for longer trips compared to the 2041 Base Case.

Whilst Scenario 1 increases the volume of traffic utilising the road network, the average trip time decreases. Under the 2041 Base Case, the Pacific Highway is forecast to exceed a DOS of 1.00, however, the increase in capacity provided under Scenario 1 reduces the DOS below 0.9 between Tugun and Tweed Heads South.

This improvement to traffic flow decreases the extent of overall delay within the network, providing both economic and environmental benefits through “value of time” savings and emission reductions.

7.4.3 Scenario 2: – Interim Critical Infrastructure Requirements

Scenario 2 builds on Scenario 1 and adds upgrades to the network to cater for immediate and short term network deficiencies. Under Scenario 2, the Kirkwood Road interchange (northbound) is partially constructed to include an overpass over the Pacific Highway, a northbound off-ramp and connection to Fraser Drive, as shown in Figure 7.1.

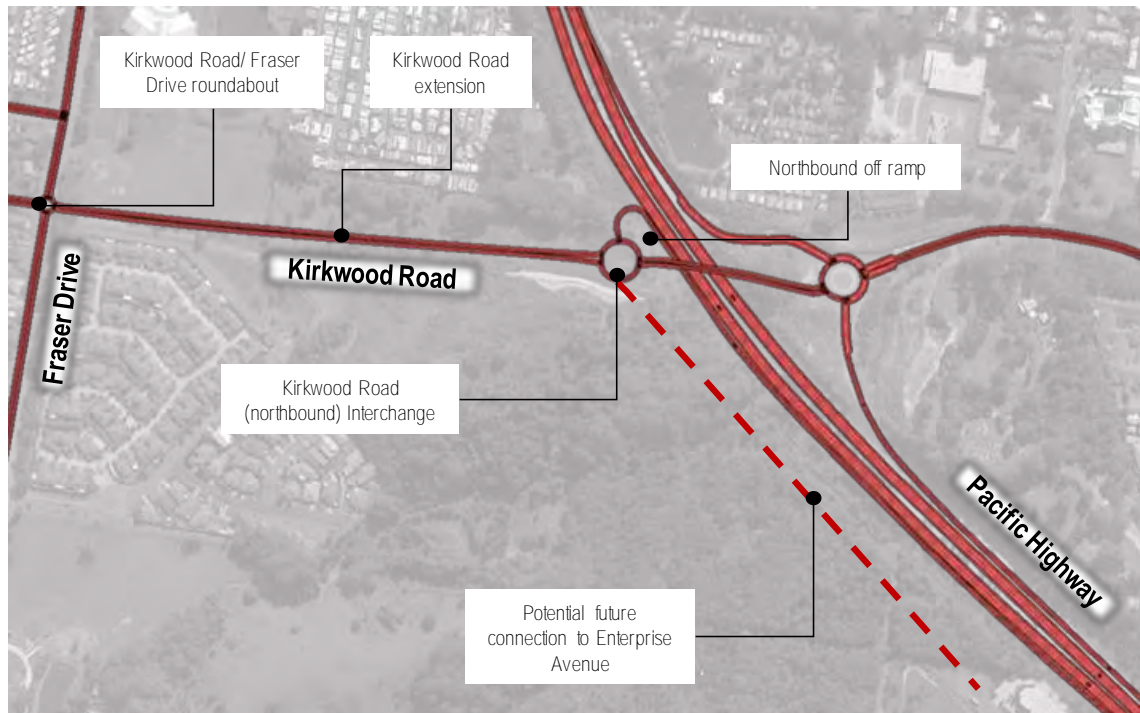


Figure 7.1: Scenario 2 Upgrade – Kirkwood Road Interchange

For the purposes of intersection modelling and staging assessment, the northbound off-ramp is extended underneath the Kirkwood Road overpass to cater for the future connection to Enterprise Avenue and to cater for northbound to eastbound flows across the Kirkwood overpass.

Scenario 2 also includes several improvements in Chinderah/Kingscliff. These recommendations include:

- four-laning of Tweed Coast Road from the Pacific Highway to Casuarina Way intersection;
- **providing a northern ‘east-west’ link** in proximity to Ozone Street to Tweed Coast Road. Option tested involves connecting in proximity to the Chinderah Golf Club Access via new roundabout;
- **providing a southern ‘east-west’ link from** Turnock Street to Tweed Coast Road. Option tested involves connecting via new roundabout at Crescent Street/Tweed Coast Road intersection;
- **providing a new ‘north-south’ link by** extending Elrond Drive to connect to Ozone Street/Sand Street;
- retain the connection from the Pacific Highway off-ramp (southbound) to Morton Street;
- modify existing Morton Street/Tweed Coast Road intersection, restricting to left-in/left-out only; and
- re-align the separated left turn from the Pacific Highway off-ramp (southbound) to increase its separation from the new intersection.

The performance of the road network under Scenario 2 is shown in Table 7.5 with Network Plots provided in Appendix D.

Table 7.5: Scenario 2 Modelling Results

Network Statistics	2016 Base Case	2041 Base Case (Medium Yield)	2041 Scenario 1 (Medium Yield)	2041 Scenario 2 (Medium Yield)
Total Private Vehicle Trips – persons	425,619	612,635	612,931	611,767
Total Public Transport Trips – persons	6,611	10,471	10,439	8,291
Daily Private Vehicle Trips	305,061	448,093	448,291	448,775
Daily Commercial Vehicle Trips	11,257	19,985	21,041	21,042
Daily Vehicle Kilometres Travelled (VKT)	3,477,044	5,686,774	5,707,157	5,709,263
Daily Vehicle Hours Travelled (VHT)	68,432	131,205	121,120	117,224
Average Speed (VKT / VHT)	50.8 km/h	43.3 km/h	47.1 km/h	48.7 km/h
Average Trip Time (VHT / Total Vehicle Trips)	0:13:28	0:17:34	0:16:13	0:15:40

Scenario 2 improves the local road network and better to caters for forecast traffic at the Pacific Highway/Tweed Coast Road interchange compared to previous scenarios. The additional capacity at this interchange coupled with new east-west linkages between Kingscliff and Chinderah improves accessibility to Kingscliff town centre and reduces the dependence on constrained intersections at Cudgen Road/Tweed Coast Road as well as at the Kingscliff north interchange with the Pacific Highway at Waugh Street/Phillip Street intersection.

The partial construction of the Kirkwood Road (northbound) interchange and connection to Fraser Drive provides a benefit to the Kennedy Drive and the Darlington Drive interchanges. This is a result of providing a more direct route for traffic travelling to the western areas of South Tweed (i.e. Banora Point west, Hillcrest, Flame Tree Park) that would otherwise use other routes such as Leisure Drive or Dry Dock Road.

7.4.4 Scenario 3: Kirkwood Road Interchange

Scenario 3 builds on Scenario 2 and incorporates further network improvements to Tweed Coast Road and includes the complete Kirkwood Road Interchange upgrade. Under this option, two (2) separate scenarios have been considered which include:

- Scenario 3A: Kirkwood Road northbound on-ramp located north of overpass, which requires closure of Kennedy Drive northbound off-ramp and two-way conversion of Sugarwood Drive;
- Scenario 3B: Kirkwood Road northbound ramps located further south and integrated with Enterprise Drive extension. Kennedy Drive and Sugarwood Drive to be maintained.

Under Scenario 3A, the Kirkwood Road northbound on-ramp is expected to enter the Pacific Highway in proximity to the abutment over Dry Dock Road and Terranora Inlet. This location will result in the Kennedy Drive northbound off-ramp to be removed due to its proximity and associated weaving issues. To maintain a northbound off-ramp facility to Kennedy Drive, it is proposed that Sugarwood Drive is converted to a two-lane service road (bi-directional), as shown in Figure 7.4. The rationale for this upgrade compared to the previous TRDS service road bridge plan is to make better use of existing infrastructure (i.e. the northern off-ramp and dual lane service road) given its under-utilisation and to provide a more efficient signalised configuration at the

Kennedy Drive intersection. This is achieved by having three (3) approaches instead of four (4) and providing complimentary turn movement flows during peak periods.

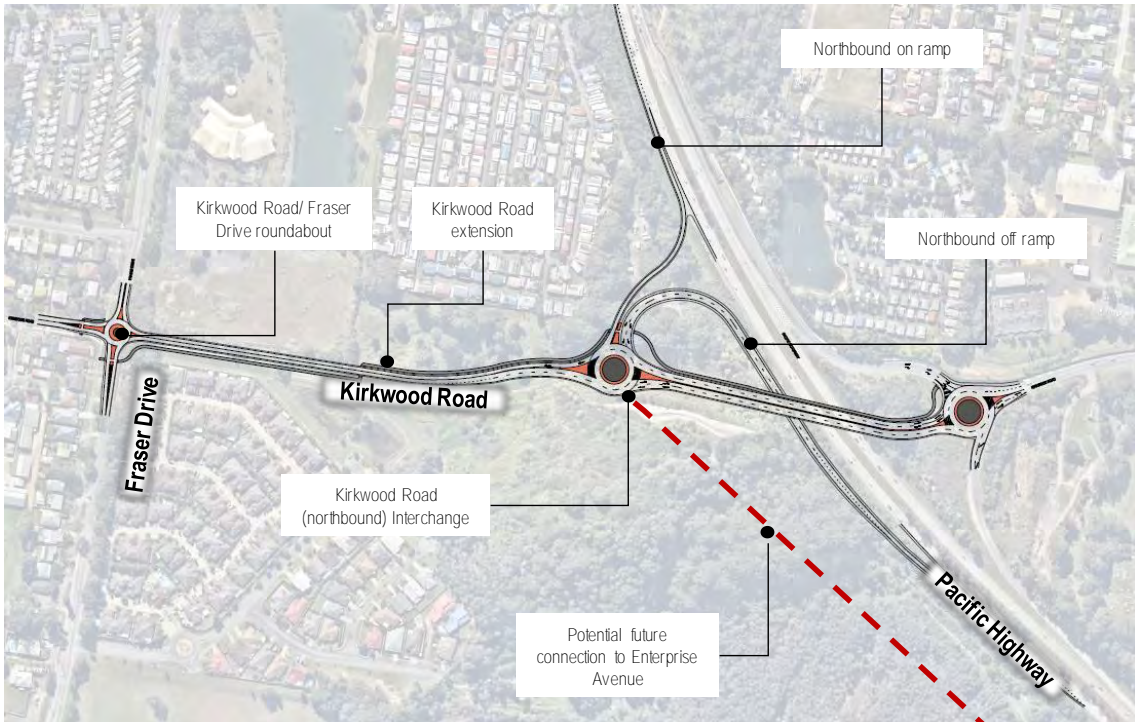


Figure 7.2: Scenario 3A Upgrades – Kirkwood Road Interchange

The alternative upgrade (Scenario 3B) shifts the Kirkwood Road ramps further south along the Pacific Highway and incorporates a new signalised intersection with the future extension of Enterprise Avenue as presented in Figure 7.3. The alternate location of Kirkwood Road northbound ramps further south is expected to remove the need for the Kennedy Drive off-ramp closure and subsequent two-way conversion of Sugarwood Drive.

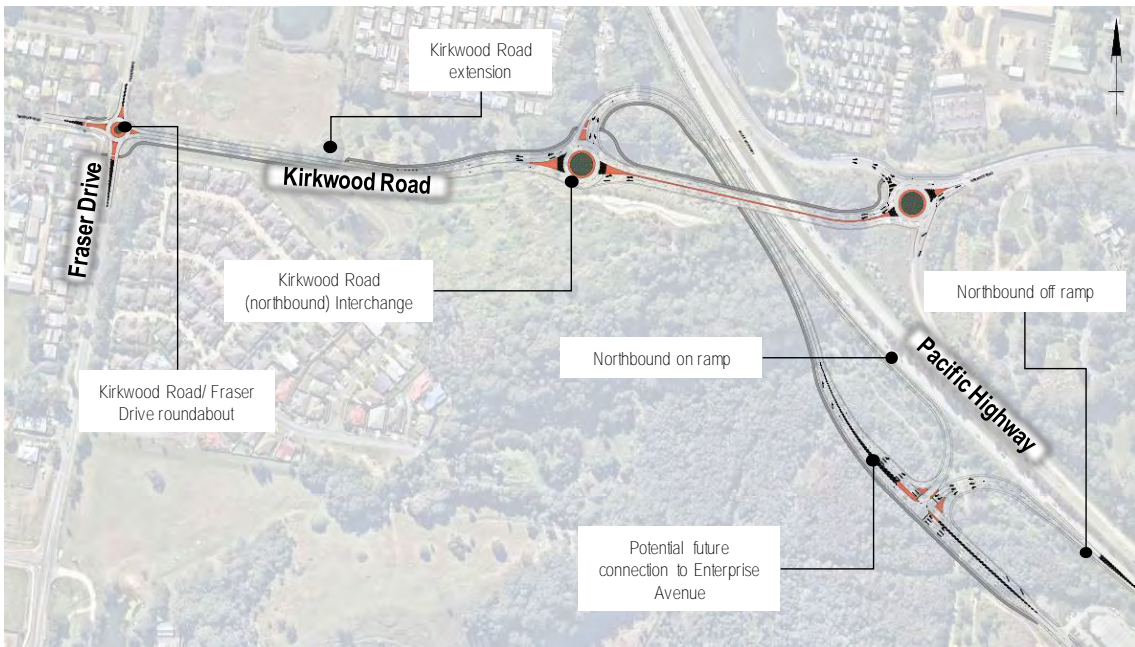


Figure 7.3: Kirkwood Road Alternate Interchange Configuration

Considering the strategic purpose of the TRDS, both options 3A and 3B provide a similar strategic road function and are recommended to be carried through for further investigation in consultation with RMS.

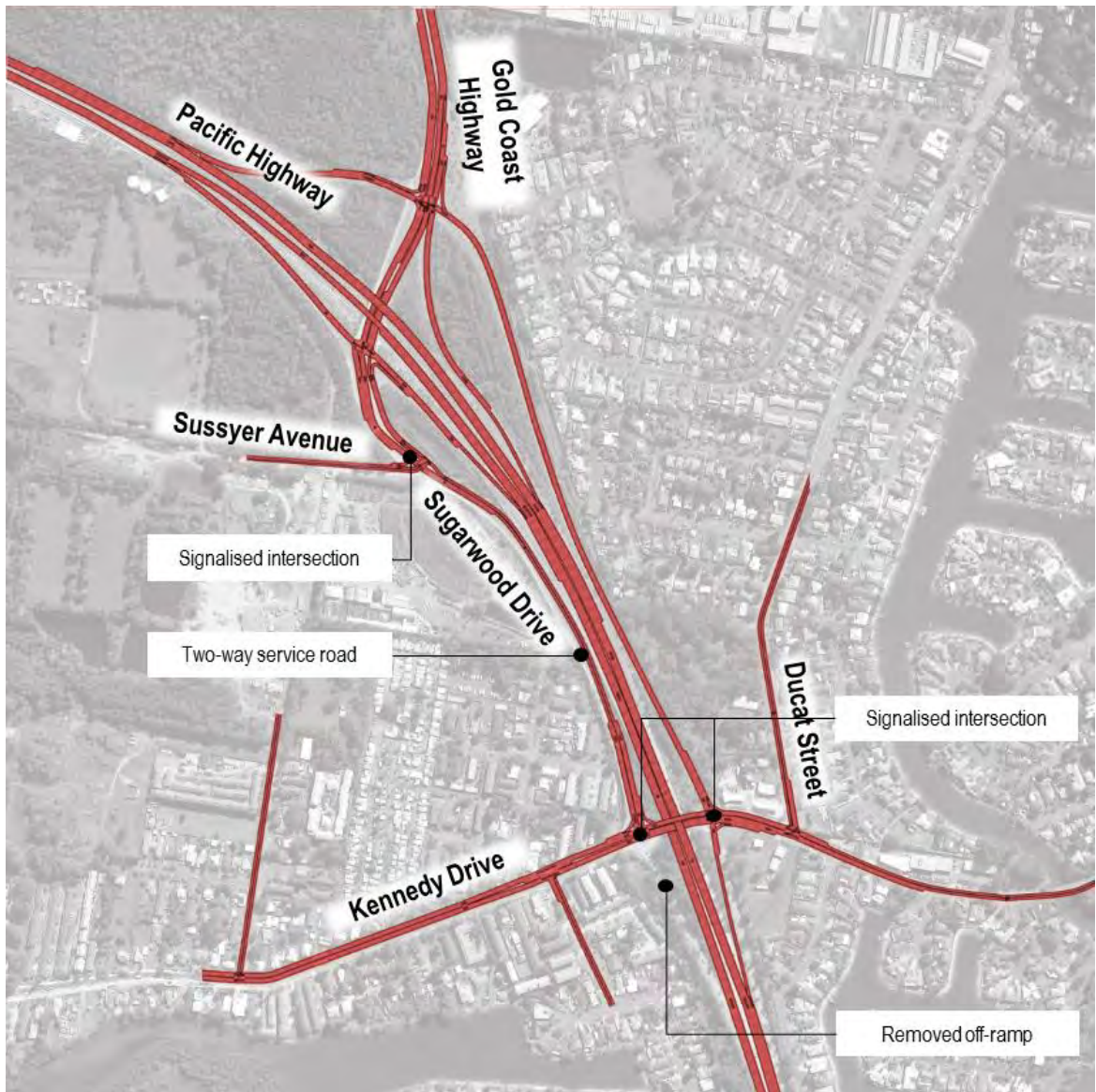


Figure 7.4: Scenario 3A Upgrades – Kennedy Drive Interchange Options

The network performance under Scenario 3 is shown in Table 7.6 with Network Plots provided in Appendix D.

Table 7.6: Scenario 3 Modelling Results

Network Statistics	2016 Base Case	2041 Base Case (Medium Yield)	2041 Scenario 2 (Medium Yield)	2041 Scenario 3 (Medium Yield)
Total Private Vehicle Trips – persons	425,619	612,635	611,767	612,025
Total Public Transport Trips – persons	6,611	10,471	8,291	8,297
Daily Private Vehicle Trips	305,061	448,093	448,775	448,972
Daily Commercial Vehicle Trips	11,257	19,985	21,042	21,043
Daily Vehicle Kilometres Travelled (VKT)	3,477,044	5,686,774	5,709,263	5,688,259
Daily Vehicle Hours Travelled (VHT)	68,432	131,205	117,224	116,664
Average Speed (VKT / VHT)	50.8 km/h	43.3 km/h	48.7 km/h	48.8 km/h
Average Trip Time (VHT / Total Vehicle Trips)	0:13:28	0:17:34	0:15:40	0:15:35

The implementation of the complete Kirkwood Road interchange upgrade increases the permeability of the road network taking pressure of other east-west connectors such as Dry Dock Road, Kennedy Drive and Leisure Drive..

Southbound on/off ramps at the Kennedy Drive interchange are proposed to be retained with the signalisation of the Kennedy Drive / southbound on-ramp intersection. These will continue to provide the best connectivity for southbound traffic from Tweed Heads, Coolangatta and the Gold Coast. It should be noted that the inclusion of the previously proposed service road (*The lower Tweed and Pacific Highway Master Plan 2006*), shown in Figure 3.2, between the southbound on-ramp and Kirkwood Road interchange parallel to the highway will be investigated further in conjunction with these upgrades.

7.4.5 Scenario 4: Previous Road Development Strategy

Scenario 4 incorporates all the road infrastructure upgrades proposed under the previous TRDS. Planned road links such as Davey Street and Bilambil links to Piggabeen Road are included within the model.

The network performance under Scenario 4 is shown in Table 7.7 with Network Plots provided in Appendix D.

The implementation of the previous TRDS is forecast to significantly improve the performance of the local road network with a 4.5 km/h increase in average travel speeds compared to the 2041 Base Case.

Compared to Scenario 3, average trip time was noted to increase and average speed to decrease. Whilst normally symptomatic of a more congested road network, it is expected that this reduction in speed is due to the inclusion of several lower-speed roads into the model, essentially forcing speeds downwards. By providing improved local road connections, the reliance on the Pacific Highway is reduced and more trips are assigned across the local road network but with a decreasing average travel speed as a result.

Table 7.7: Scenario 4 Modelling Results

Network Statistics	2016 Base Case	2041 Base Case (Medium Yield)	2041 Scenario 3 (Medium Yield)	2041 Scenario 4 (Medium Yield)
Total Private Vehicle Trips – persons	425,619	612,635	612,025	611,838
Total Public Transport Trips – persons	6,611	10,471	8,297	8,554
Daily Private Vehicle Trips	305,061	448,093	448,972	448,816
Daily Commercial Vehicle Trips	11,257	19,985	21,043	21,044
Daily Vehicle Kilometres Travelled (VKT)	3,477,044	5,686,774	5,688,259	5,656,266
Daily Vehicle Hours Travelled (VHT)	68,432	131,205	116,664	118,063
Average Speed (VKT / VHT)	50.8 km/h	43.3 km/h	48.8 km/h	47.9 km/h
Average Trip Time (VHT / Total Vehicle Trips)	0:13:28	0:17:34	0:15:35	0:15:47

7.4.6 Scenario 5: Sensitivity Testing

Scenario 5 has not been used to assess the overall network performance but rather to test and compare the impacts of various road upgrade options suggested by Council. The links added/ removed as part of this scenario are:

- Sensitivity Test 1 - an additional interchange on the Pacific Highway at Round Mountain Road/Reserve Creek Road; and
- Sensitivity Test 2 - the removal of the Kellehers Road extension (proposed under the TRDS).

Scenario 5 maintains the road infrastructure upgrades proposed under the previous TRDS and hence runs the sensitivity test against the Scenario 4 network.

When reviewing the sensitivity test results, it is important to recognise that these are strategic modelling outcomes only and do not take into consideration other factors, including but not limited to, detailed intersection requirements and civil, environmental, economic, social, amenity or land use planning considerations.

Sensitivity Test 1 – Impacts of a Round Mountain Interchange with Pacific Highway

A new interchange at the existing Round Mountain Road bridge over the Pacific Highway has been tested to investigate the attractiveness of a more direct east-west connection between the highway and Murwillumbah and in particular to/from Wardrop Valley urban release area. The proposed interchange may also provide a more direct route to/from Hastings Point, reducing pressure on Clothiers Creek Road and Tweed Coast Road. A comparison of daily volume plots with and without the proposed interchange is provided in Figure 7.5.



Figure 7.5: Sensitivity Test 1 Round Mountain Interchange – Daily Volume Comparison

An increase of 2,300 trips per day are expected on Reserve Creek Road with the inclusion of the Round Mountain Interchange at the Pacific Highway. This volume increase is not considered significant enough to warrant the need for the interchange.

Given the intent of this upgrade would be to provide improved connectivity to Murwillumbah for commercial vehicles, the configuration of Reserve Creek Road would also need to be considered and this road would be likely to require significant upgrade works.

Sensitivity Test 2 – Impacts to Pottsville without Kellehers Road Extension to Black Rocks

A road link proposed under the previous TRDS is the connection of Kellehers Road to Pottsville Road. The Kellehers Road extension connects the proposed Dunloe Park Urban Release Area (DPURA) to Black Rocks estate as well as providing a bypass for the centre of Pottsville (Coronation Drive).

A comparison of daily volume plots with and without the proposed Kellehers Road extension is provided in Figure 7.6.

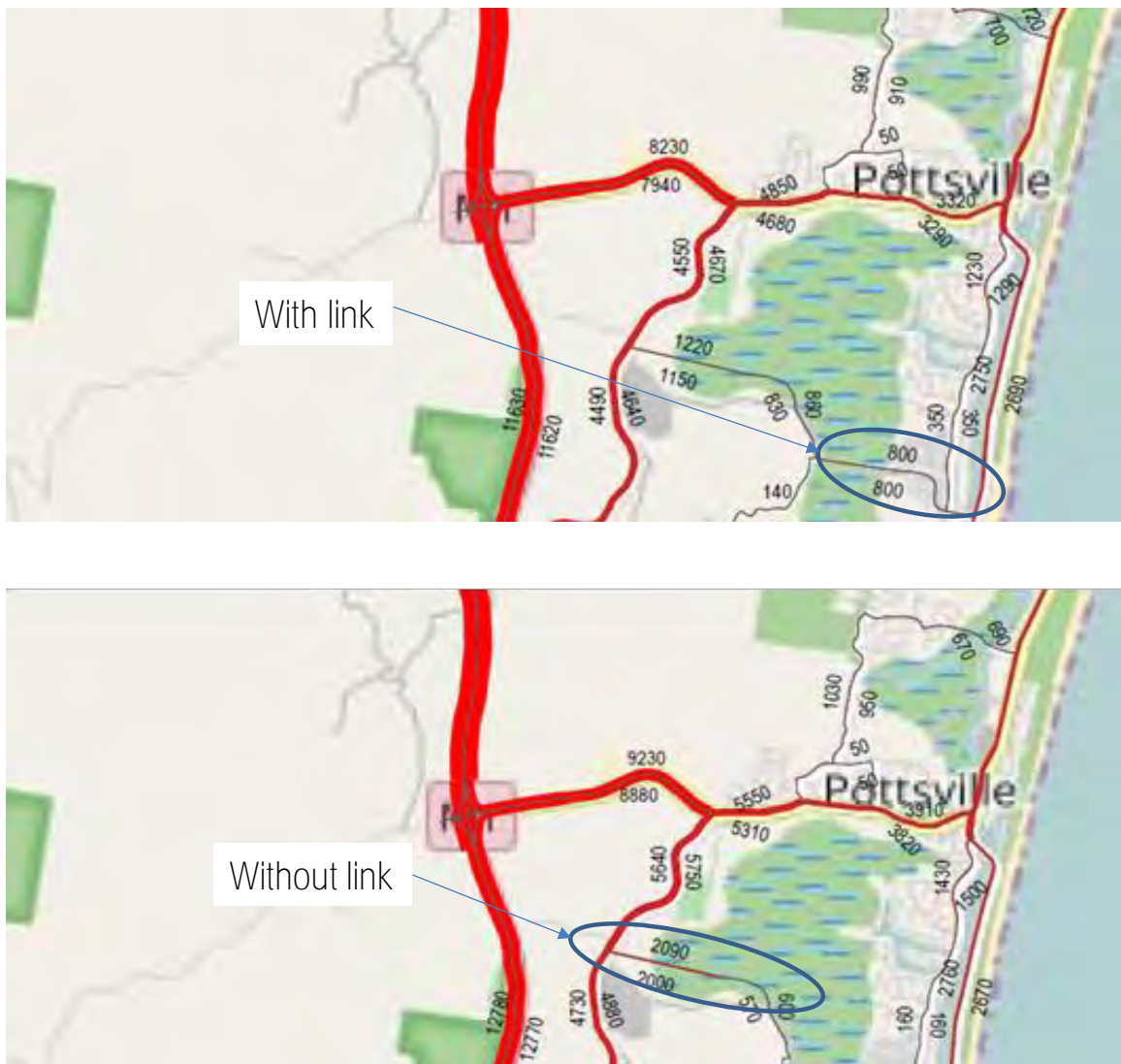


Figure 7.6: Sensitivity Test 2 With and Without Kellehers Road – Daily Traffic Volume Comparison
 Traffic on Coronation Drive without the Kellehers Road link increases of around 1,100 vehicles per day through Pottsville Town Centre, which equates to around a 17% increase. It is important to note that this is for a typical weekday operation only. Traffic use of the proposed link may be much higher during weekday peak periods.

It is important to note that based on the 2041 population projections DPURA does not include full development projections. Therefore, beyond the 2041 design horizon based on current projections or in the event that DPURA is fully developed prior, traffic volumes utilising the Kellehers Road connection are expected to be higher than the forecast 1,600 vehicles per day.

7.4.7 Scenario 6: Preferred Network

The Preferred Network is a variation of previous TRDS (Scenario 4) but with the Kirkwood Road and Kennedy Drive interchanges modified to reflect the upgrades proposed under Scenario 3 for the purpose of this assessment modelling was undertaken based on the Scenario 3A option (i.e. closure of northbound off-ramp to Kennedy Drive and two-way conversion of Sugarwood Drive) as this represents the highest impact to road infrastructure. Mesoscopic Aimsun modelling was used to determine the form of the intersections proposed to be upgraded under Scenario 6 with a detailed list of upgrades provided in Section 8.

The network performance under Scenario 6 is presented Table 7.8 with network plots provided in Appendix D.

Table 7.8: Scenario 6 Network Statistics

Network Statistics	2016 Base Case	2041 Base Case (Medium Yield)	2041 Scenario 4 (Medium Yield)	2041 Scenario 6 (Medium Yield)
Total Private Vehicle Trips – persons	425,619	612,635	611,838	612,164
Total Public Transport Trips – persons	6,611	10,471	8,554	8,531
Daily Private Vehicle Trips	305,061	448,093	448,816	449,061
Daily Commercial Vehicle Trips	11,257	19,985	21,044	21,046
Daily Vehicle Kilometres Travelled (VKT)	3,477,044	5,686,774	5,656,266	5,650,509
Daily Vehicle Hours Travelled (VHT)	68,432	131,205	118,063	116,928
Average Speed (VKT / VHT)	50.8 km/h	43.3 km/h	47.9 km/h	48.3 km/h
Average Trip Time (VHT / Total Vehicle Trips)	0:13:28	0:17:34	0:15:47	0:15:37

The Preferred Network (Scenario 6) offers a slight improvement compared to previous TRDS (Scenario 4) with improvements to both average speed and travel time despite having more vehicles on the network. Whilst the network-wide performance statistics of Scenario 3 would appear better than Scenario 6, it is important to note that the inclusion of several lower-order roads within Scenario 6 improves accessibility and route choice, reducing trip lengths and hence reducing overall VKT.

Unlike the previous TRDS proposal, the Scenario 6 network does not necessitate the construction of additional “separate” bridges over Terranora Creek and Kennedy Drive for the proposed collector-distributor roads. Accordingly, the interchange upgrades proposed under Scenario 6 are expected to be implemented at a lower cost compared to the previous TRDS.

Furthermore, several localised upgrades are recommended within Scenario 6 in addition to those outlined in Scenario 3 and Scenario 4. These upgrades and the issues addressed by each are provided in Table 8.1, they include upgrades such as the Tweed Coast Road / Depot Road roundabout upgrade, a new connection to West End Road in Murwillumbah or the Wharf Street / Boyd Street / Kennedy Drive intersection upgrade.

For example, the proposed Wharf Street / Boyd Street / Kennedy Drive intersection upgrade may include median dividing the Kennedy Drive on-ramp to the Wharf Street/Boyd Street intersection and providing a short kerbside lane for eastbound traffic to merge on to Wharf Street once through the intersection. Wharf Street traffic bound for Boyd Street would utilise the Brett Street intersection to the north due to the resulting left turn ban. This removes traffic weaving and conflict between Boyd Street bound vehicles from Wharf Street and through traffic from Kennedy Drive.

7.4.8 Scenario 7: Preferred Network with Constrained Pacific Highway

Whilst the planning and ultimate need for widening of the Pacific Highway need is acknowledged by RMS within previous studies, the proposed widening of the Pacific Highway to six lanes is not yet designed or funded. This upgrade will require state funding and falls outside the mechanisms of **Council's** TRDS and TRCP. Scenario 7 has been tested to assess the effects of implementing the preferred upgrades in Scenario 6, but without the inclusion of the six-laning of the Pacific Highway between Sextons Hill and Stewart Road.

The timing of six-laning of the Pacific Highway in Tweed Shire will be dependent on future review and analysis from RMS as well as ongoing works occurring on the Gold Coast south of Reedy Creek. It is likely that there will need to be coordination of timing Pacific Highway works with the works programmed in Queensland.

The performance of the network under Scenario 7 is presented in Table 7.9 with network plots provided in Appendix D.

Table 7.9: Scenario 7 Network Statistics

Network Statistics	2016 Base Case	2041 Base Case (Medium Yield)	2041 Scenario 6 (Medium Yield)	2041 Scenario 7 (Medium Yield)
Total Private Vehicle Trips – persons	425,619	612,635	612,164	611,854
Total Public Transport Trips – persons	6,611	10,471	8,531	8,585
Daily Private Vehicle Trips	305,061	448,093	449,061	448,858
Daily Commercial Vehicle Trips	11,257	19,985	21,046	21,047
Daily Vehicle Kilometres Travelled (VKT)	3,477,044	5,686,774	5,650,509	5,625,802
Daily Vehicle Hours Travelled (VHT)	68,432	131,205	116,928	124,702
Average Speed (VKT / VHT)	50.8 km/h	43.3 km/h	48.3 km/h	45.1 km/h
Average Trip Time (VHT / Total Vehicle Trips)	0:13:28	0:17:34	0:15:37	0:16:40

The results highlight that not upgrading the existing four lane configuration of the Pacific Highway from Stewart Road (Currumbin) to Sextons Hill (Banora Point) to six lanes significantly affects the performance of the Tweed road network. Arguable, this is the single-most important road project in the region to cater for traffic growth over the next 25+ years.

Without the upgrade, the overall network VKT reduces whilst the overall VHT increases significantly reducing the attractiveness for movements to/from the Gold Coast, particularly during morning and afternoon peak periods.

The overall VHT increases by an additional 7,800 vehicle hours per day compared to the preferred network (Scenario 6). This represents losing over half of the overall network benefits of the Preferred Scenario when compared to the 2041 Base Case VHT.

8. TWEED ROAD DEVELOPMENT STRATEGY POTENTIAL IMPROVEMENTS

Table 8.1 details a total of 54 potential road infrastructure upgrades for inclusion within the 2017 TRDS. This table also identifies the roads authority responsible for the upgrade, the likely priority or trigger for the upgrade and the issue/s addressed.

Figure 8.1 to Figure 8.4 show the locations of each proposed upgrade with Appendix E providing conceptual intersection layouts. It is again noted that the upgrades outlined have been developed at a strategic levels and future conditions and assessment may change final outcomes.

Table 8.1: TRDS Road Proposed Network Inclusions

ID#	Recommendation	Road Authority	Priority/ Trigger	Inclusions	Issue/s Addressed	Comments
1	Construct Cobaki Parkway	TSC	Timing of land release area	Boyd St overpass (Pacific Mwy) to Piggabeen Rd connection, passes through Cobaki development area. 2-lane Piggabeen Rd to Town Centre. 4-lane section from Town Centre, north.	Future development, Kennedy Dr capacity and Piggabeen Rd/Inlet Dr intersection (Issues 1 & 4).	Construct as part of Cobaki development, planned to provide new connection to QLD road network.
2	Cobaki Interchange	RMS (with TMR, CoGC)	Long Term	Pacific Motorway interchange at Boyd St, Northbound-on and Southbound-off ramps.	Future development, Kennedy Dr capacity and Piggabeen Rd/Inlet Dr intersection (Issues 1 & 4).	Requires Cross-Border agency collaboration (RMS, TSC, CoGC, TMR). Inclusion in future planning is subject to funding and RMS policy and timing.
3	Piggabeen Road to McAllisters Road extension	TSC	Timing of land release area	McAllisters Rd (Item 5) to Piggabeen Rd connection, two lanes.	Capacity on Scenic Dr and Piggabeen Rd due to future development in area.	
4	McAllisters Road extension to Scenic Drive	TSC	Timing of land release area	Scenic Dr to McAllisters Rd connection, in conjunction with Item 4.	Kennedy Dr capacity and Piggabeen Rd/Inlet Dr intersection (Issues 1 & 4).	Provides improved connection to Bilambil and an alternate route to Kennedy Dr.
5	Upgrade Kennedy Drive/ Piggabeen Road intersection to roundabout	TSC	Medium Term	Single lane roundabout intersection.	Piggabeen Rd/Inlet Dr intersection (Issue 4).	
6	Upgrade Pacific Highway ramp (southbound)/ Gold Coast Highway intersection.	RMS	Medium Term / Kennedy Dr NBD off-ramp removal	Additional westbound through lane on Gold Coast Highway. Realignment of southbound motorway on-ramp as exit lanes.	Kennedy Dr roundabouts capacity (Issue 1). Pacific Mwy interchange capacity.	
7	Upgrade Pacific Highway ramp (northbound)/ Sugarwood Drive intersection	RMS	Medium Term / Kennedy Dr NBD off-ramp removal	Dual right and left turn lanes and extension for northbound on-ramp northbound off-ramp left turn moved to intersection.	Pacific Mwy interchange capacity.	
8	Six-laning of the Pacific Highway	RMS	Long Term	Motorway upgrade 6-lanes, Tugan to South Tweed Heads/Sextons Hill interchange.	Interstate highway capacity.	
9	Signalise Sugarwood Drive/ Parkes Drive intersection	TSC	Medium Term / Dependent on land release area	Signalise Parkes Dr/Sugarwood Dr intersection. Northbound off-ramp leg moved as part of Item 9.	Future network capacity.	
10	Convert Sugarwood Drive to a two-way service road	RMS/ TSC	Medium Term / Kennedy Dr NBD off-ramp removal	Upgrade Sugarwood Dr to two-way road, from motorway interchange to Kennedy Dr.	Future network capacity and Kennedy Dr roundabouts capacity (Issue 1).	Caters for westbound traffic upon closure of NB Kennedy Dr motorway off-ramp in coordination with Item 18.

ID#	Recommendation	Road Authority	Priority/ Trigger	Inclusions	Issue/s Addressed	Comments
11	Signalise Kennedy Drive/ Sugarwood Drive intersection	RMS/ TSC	Medium Term / Kennedy Dr NBD offramp removal	Signalise Kennedy Dr/ Sugarwood Dr, adds southbound movement from Sugarwood Dr in conjunction with Item 12 and Item 10.	Future network capacity and Kennedy Dr roundabouts capacity (Issue 1)	Signals and interchange upgrades mitigate congestion. Signal coordination modelled with increased turn lane capacity demonstrates improved operation compared to existing roundabout configuration. Improves safety for pedestrians.
12	Signalise Pacific Highway (southbound)/ Kennedy Drive intersection	RMS/ TSC	Short Term / Kennedy Dr NBD offramp removal	Upgrade existing southbound on-ramp/Kennedy Dr roundabout in coordination with Item 11. Includes additional westbound trap lane for northbound traffic.	Future network capacity and Kennedy Dr roundabouts queuing (Issue 1).	In coordination with Item 11.
13	Upgrade Kennedy Drive/ Ducat Street intersection	TSC	Short Term / Kennedy Dr NBD offramp removal	Ducat St dual right turn and 3 rd lane extension westbound on Kennedy Dr.	Future network capacity and Kennedy Dr /Ducat St intersection queuing (Issue 1)	In coordination with Items 11 and 12.
14	Upgrade Wharf Street / Boyd Street / Kennedy Drive on-ramp intersections	TSC	Short Term	Option tested includes median separation of Kennedy Dr on-ramp and 70m extension of northbound kerbside lane on Wharf St.	Weave, queuing and capacity issues for traffic entering Wharf St/Boyd St intersection from Kennedy Dr on-ramp (Issue 3)	Wharf St /Boyd St upgrade was tested and option proposed. Median dividing left turn lane into Boyd St will reduce weaving.
15	Upgrade Wharf Street/ Florence Street intersection	TSC	Medium Term	Add lane to western leg and new southbound left turn pocket.	Future network capacity.	
16	Remove NBD off/ramp on Pacific Highway at Kennedy Drive	RMS/ TSC	Medium Term	Remove northbound motorway off-ramp. Westbound vehicles to exit at Sugarwood Dr off-ramp. In conjunction with Items 10, 11 and 18.	Future network capacity, Kennedy Dr roundabouts queuing (Issue 1).	Reliant on Kirkwood Rd interchange configuration (Item 18).
17	Kirkwood Road extension to Fraser Drive	TSC	Medium Term	4-lane connection from Fraser Dr to Kirkwood Rd. Includes two-lane overpass.	Machinery Dr and Leisure Dr queuing and intersections capacities (Issues 5, 6 and 8)	
18	Pacific Highway (northbound)/ Kirkwood Road interchange (northbound)	RMS/ TSC	Medium Term	New roundabout interchange with northbound on and off ramps. In conjunction with Item 17.	Future network capacity Leisure Dr/Darlington Dr intersection queuing and Darlington Dr/Sextons Hill Interchange capacity (Issues 8 and 9)	Alignment and configuration of ramps to consider associated upgrade timing including Kennedy Dr (NB) off-ramp closure (Item 16) and Enterprise Ave extension (Item 19).
19	Extend Enterprise Avenue to Kirkwood Road	TSC	Medium Term	North-south 2-lane connection to new Kirkwood Rd interchange (Item 18)	Machinery Dr intersections at capacity and have significant queuing (Issues 5 and 6)	Enterprise Ave to Kirkwood connection and interchange provides alternate route for Banora Point and industrial area traffic. Reduces congestion in coordination with Item 18.
20	Four-laning of Fraser Drive	TSC	Medium Term	Kirkwood Rd/Fraser Dr (Item 17) intersection to Fraser Dr/ Amaroo Dr intersection. Approx 3.4km 4-lane section.	Network capacity, specifically for Terranora and Bilambil developments.	
21	Signalise Greenway Drive/ Traders Way intersection	TSC	Medium Term	New signalised intersection.	Network capacity as well as Machinery Dr and Leisure Dr queuing and intersections capacities (Issues 5, 6 and 8)	In coordination with Enterprise Avenue extension (Item 19).

ID#	Recommendation	Road Authority	Priority/ Trigger	Inclusions	Issue/s Addressed	Comments
22	Four-laning of Greenway Drive	TSC	Medium Term	Traders Way to Doyal Dr (St Joseph's College entrance). Approx 850m 4-lane section.	Network capacity as well as Machinery Dr and Leisure Dr queuing and intersections capacities (Issues 5, 6, 8).	In coordination with Items 19 and 21.
23	Signalise Leisure Drive/ Darlington Drive intersection	TSC	Short Term	Replaces existing roundabout.	Darlington Dr/Leisure Dr queuing and intersection capacity. Improve pedestrian safety (Issue 8).	
24	Construct Fraser Drive/ Broadwater Parkway intersection	TSC	Timing of land release area	Priority controlled intersection in conjunction with Broadwater Parkway connection (Item 25).	Network capacity and Area E access. Reduce reliance on Terranora Road.	
25	Construct Broadwater Parkway	TSC	Timing of land release area	Terranora Rd to Fraser Dr 2-lane connection via Altitude Aspire development.	Network capacity and Area E access. Reduce reliance on Terranora Road.	
26	Upgrade Terranora Road/ Mahers Lane intersection (roundabout)	TSC	Timing of land release area	Roundabout intersection. In conjunction with upgrade Item 25.	Network capacity and queuing issues on Mahers Ln (Issue 11).	
27	Extend Davey Street to Minjungbal Drive	TSC	Long Term	Davey St extension to Minjungbal Dr Interchange/ Underpass. Via Soorley St to the east of Eastlake Dr.	Machinery Dr intersections at capacity and have significant queuing (Issues 5 and 6). Darlington Dr queuing (Issue 9).	Connection to East Banora investigated. Davey St link to consider connection to Elsie St to improve access to East Banora Point).
28	Upgrade Minjungbal Drive/ Machinery Drive intersection	TSC	Medium Term	Upgrade signal cycle times and phasing.	Machinery Dr Intersections at capacity and have significant queuing (Issues 5 and 6).	
29	Upgrade Sexton Hill Drive/ Darlington Drive intersection	TSC	Medium Term	Add left turn slip lane to Darlington Dr from Sexton Hill Dr.	Darlington Dr queuing and capacity on Sextons Hill Interchange (Issue 9).	
30	Upgrade Waugh Street/ Phillip Street intersection (roundabout)	TSC	Short Term	New roundabout intersection.	High right-turn volumes at intersection (Issue 13). Increase intersection capacity for future traffic growth	
31	Upgrade Wommin Bay Road/ Sand Street intersection (roundabout)	TSC	Medium Term / Timing of Land Release Area	New roundabout intersection.	Increase intersection capacity for future traffic growth	
32	Upgrade Pacific Highway/ Tweed Coast Road interchange	RMS/ TSC	Medium Term	Southbound off-ramp (Item 35) access to Morton St and short additional lane on roundabout between northbound motorway on and off ramps.	Removes weave to access Morton St (Issue 14). Increase intersection capacity and improve operations and safety.	
33	Construct direct connection between Pacific Highway offramp and Morton Street. Retain existing Morton Street access as left-in/left-out only.	TSC	Medium Term	Morton St access from southbound off-ramp and restriction of existing Morton St/Tweed Coast Rd intersection to left-in/left-out only. Completed in conjunction with Item 32.	Weave to access Morton St (Issue 14) and future development in area.	Restricting Morton St/Tweed Coast Rd intersection to left-in/left-out reliant on new roundabout on Tweed Coast Rd as part of development access to provide U-turns.

ID#	Recommendation	Road Authority	Priority/ Trigger	Inclusions	Issue/s Addressed	Comments
34	East-west link to Tweed Coast Road	TSC	Timing of land release area	New east-west link from north Kingscliff to Tweed Coast Rd. Further investigation required, proposed option includes Ozone St extension to Tweed Coast Rd via new Sand St intersection (Item 37).	Future development and traffic capacity of Tweed Coast Rd / Cudgen Rd intersection (Issue 12).	Configuration and alignment of this link is subject to further detailed assessment. Key outcome of the upgrade is providing a northern east-west link between Kingscliff and Tweed Coast Rd (from Elrond St or Sand St to Tweed Coast Rd).
35	Four-laning of Tweed Coast Road	TSC	Timing of land release area	Pacific Motorway interchange to Tweed Coast Rd/ Casuarina Way intersection. Approx. 6.2km 4-lane section.	Future network capacity.	
36	Construct Tweed Coast Road/ East-west Link Road intersection (roundabout)	TSC	Medium Term / Timing of land release area	2-lane roundabout intersection in conjunction with Item 34.	Future network capacity and growth in the Kingscliff area. No existing east-west links between North Kingscliff and Tweed Coast Rd forces traffic to utilise Cudgen Rd intersection (Issue 12).	In coordination with Items 32 and 34. Location reliant on development layout.
37	Upgrade Ozone Street/ Sand Street intersection (roundabout)	TSC	Timing of land release area	2-lane roundabout in conjunction with Item 34.	Provides network capacity to cater for growth in the Kingscliff area. New east-west link between North Kingscliff and Tweed Coast Rd to reduce reliance on Cudgen Rd intersection (Issue 12).	
38	Extend Elrond Drive to Ozone Street	TSC	Timing of land release area	Elrond Dr to Ozone St connection, further investigation to be undertaken.	Provides network capacity to cater for growth in the Kingscliff area. New east-west link between North Kingscliff and Tweed Coast Rd to reduce reliance on Cudgen Rd intersection (Issue 12).	These are noted as potential links for further assessment, same traffic function achieved. Key outcomes for links are: 1) northern east-west link (Elrond to TCR). 2) southern east-west link (Turnock to TCR). 3) North-south link (Elrond to Sand).
39	Upgrade Tweed Coast Road/ Crescent Street intersection (roundabout)	TSC	Timing of land release area	2-lane roundabout intersection.	Future network connectivity and capacity. In conjunction with Item 41.	Location reliant on Crescent St and Turnock St extension (Item 40).
40	Extend Turnock Street to Tweed Coast Road	TSC	Timing of land release area	New east-west link between south Kingscliff and Tweed Coast Rd. Completed in conjunction with Item 39.	Future development in area and traffic capacity of Tweed Coast Rd / Cudgen Rd intersection (Issue 12).	Alignment reliant on development layout.
41	Upgrade Tweed Coast Road/ Depot Road intersection (roundabout)	TSC	Timing of land release area	2-lane roundabout intersection.	Future network capacity and access to land release area.	
42	Upgrade Pacific Highway (northbound)/ Cudgera Creek Road intersection (roundabout)	RMS/ TSC	Medium - Long Term / Timing of Land Release Area	Single lane roundabout intersection.	Future network capacity.	
43	Upgrade Pacific Highway (southbound)/ Cudgera Creek Road intersection (roundabout)	RMS/ TSC	Medium – Long Term / Timing of Land Release Area	Single lane roundabout intersection.	Future network capacity.	
44	Upgrade Cudgera Creek Road/ Pottsville Road intersection (roundabout)	TSC	Long Term / Timing of land release areas	Single lane roundabout intersection.	Future network capacity.	

ID#	Recommendation	Road Authority	Priority/ Trigger	Inclusions	Issue/s Addressed	Comments
45	Extend Kellehers Road to Pottsville Road	TSC	Timing of Land Release Area	Kellehers Rd extension to Pottsville – Mooball Rd. Completed in conjunction with Item 46.	Future network capacity and new development areas connectivity. Reduce reliance of through traffic via Pottsville Town Centre (Issue 15).	
46	Construct Pottsville Road/ Kellehers Road (extension) intersection	TSC	Timing of Land Release Area	New priority controlled intersection. Completed in conjunction with Item 45.	Future network capacity and new development areas connectivity. Reduce reliance of through traffic via Pottsville Town Centre (Issue 15).	
47	Extend Cane Road to Rous River Way	TSC	Long Term / Timing of land release area	Cane Rd/Queensland Rd intersection to Rous River Way connection.	Future network capacity and new development area connectivity. Bypass route for Murwillumbah Town Centre	
48	Extend West End Street to Frances Street	TSC	Medium Term	West End St to Frances St connection.	Improve future network capacity and Wollumbin St queuing (Issue 17).	Connection to West End St preferred to provide direct connectivity to primary traffic route through Murwillumbah via Wollumbin St.
49	Four-laning of Tweed Valley Way (River Street to Quarry Road)	TSC	Medium Term / Timing of Land Release Area	Alma St/ Tweed Valley Way roundabout to 150m east of the Quarry Rd /Tweed Valley Way intersection. Approx 1.4km 4-lane section.	Future network capacity.	
50	Upgrade Tweed Valley Way/ Quarry Road intersection	TSC	Medium Term/ Timing of land release area	Signalise intersection.	Future network capacity west of Murwillumbah.	

Note: Short Term generally 0-5 years
Medium Term generally 6-15 years
Long Term generally > 15 years

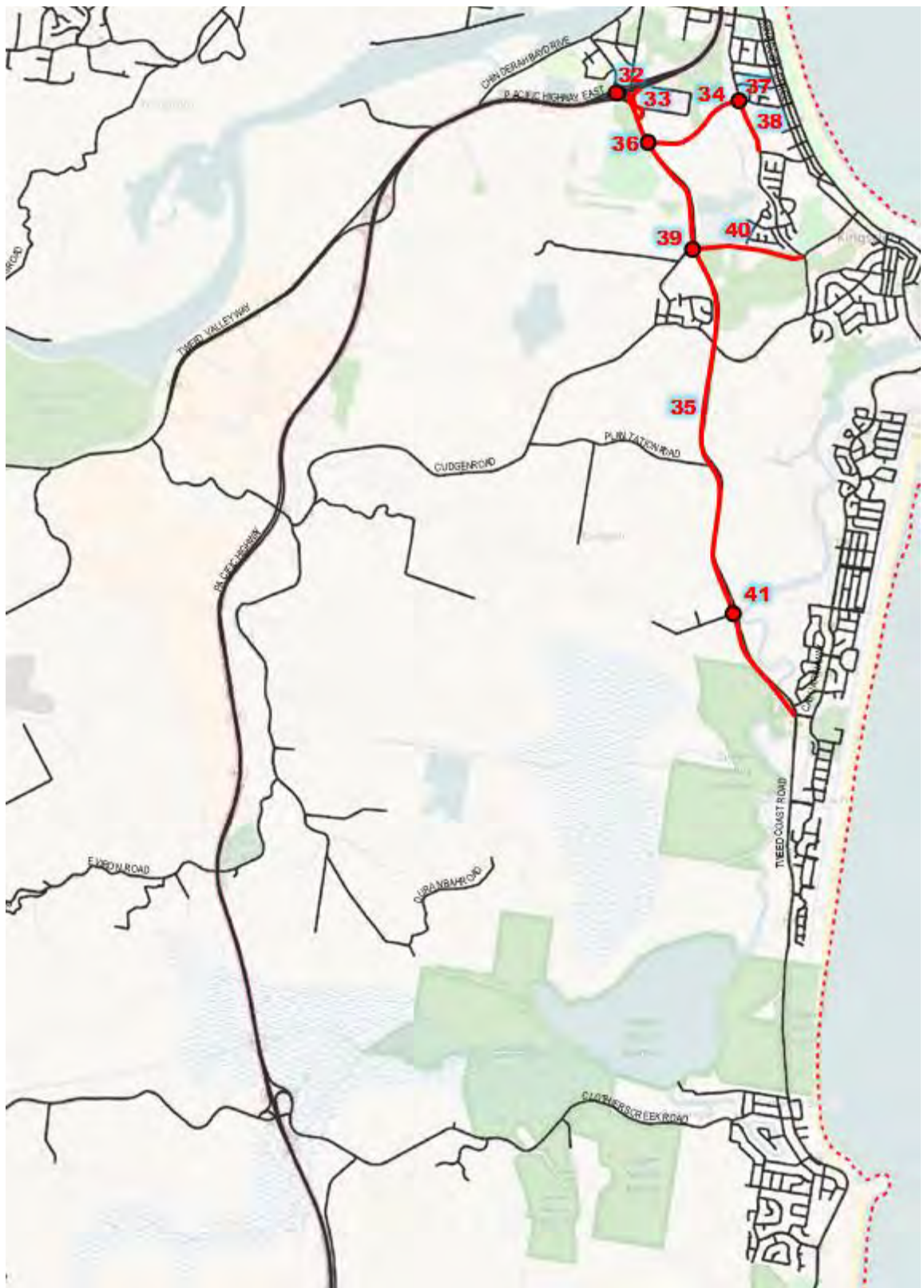


Figure 8.2: TRDS Inclusions – Kingscliff

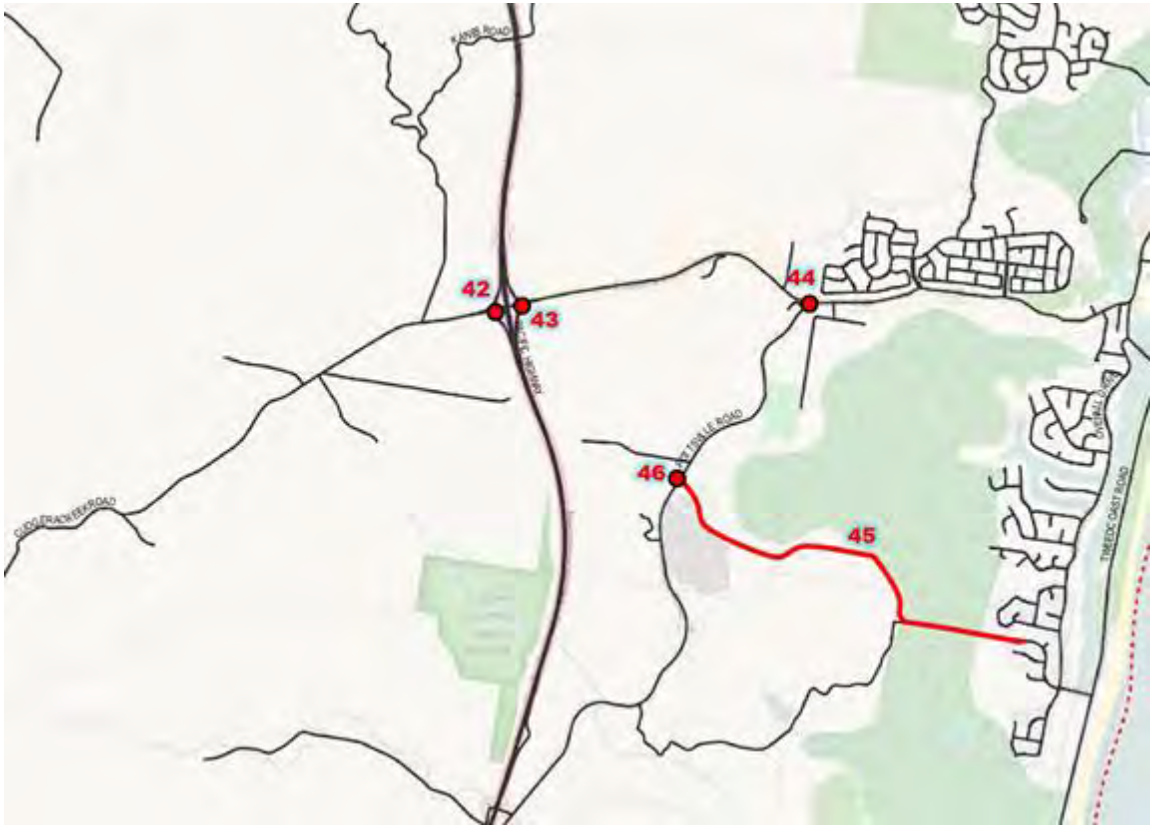


Figure 8.3: TRDS Inclusions – Pottsville

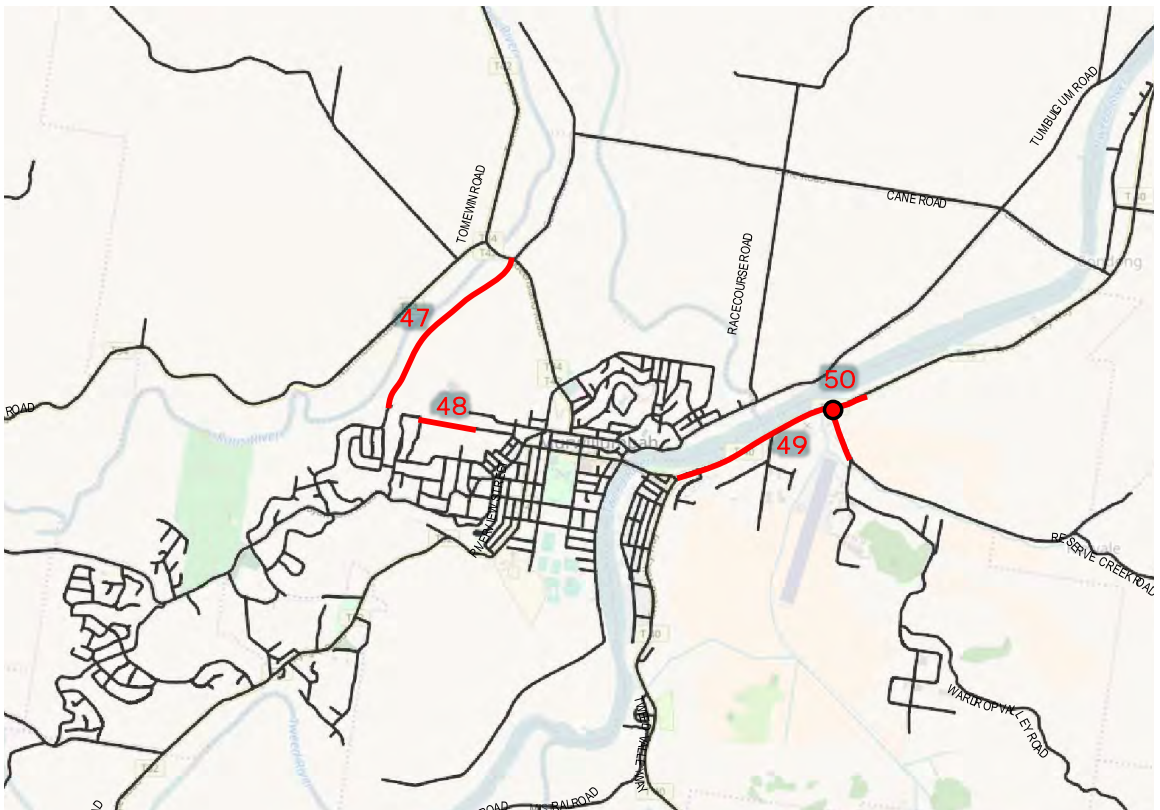


Figure 8.4: TRDS Inclusions – Murwillumbah

APPENDIX A

EMME BASE MODEL CALIBRATION AND VALIDATION

APPENDIX B

AIMSUN BASE MODEL CALIBRATION AND VALIDATION

APPENDIX C

2041 DEMOGRAPHIC FORECASTS

APPENDIX D

STRATEGIC SCENARIO TESTING – NETWORK OUTPUTS

APPENDIX E

PRELIMINARY INTERSECTION CONCEPTS