Traffic Management Study

Gulgong Centre

Final Report

Mid-Western Regional Council

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1. Introduction

1.1 Background

Gulgong is located within the Mid-Western Regional Council Local Government Area (LGA) and the Central West of NSW. Gulgong had in 2001 a total population of 2,100; In 2006, it had reduced to about 1,910.

Council has commissioned Gennaoui Consulting Pty Ltd to undertake this study to review the following traffic management issues within the Gulgong Town Centre:

- The narrow carriageways along Mayne Street and part of Medley Street with parking on both sides resulting in one traffic lane for two way traffic movements;
- Traffic further delayed by parking and un-parking manoeuvres;
- Poor sight distance for vehicles right turning into and out of Mayne Street at Medley Street;
- Capacity of the street system;
- Pedestrian access, particularly at road crossing points.

1.2 Study Area

For the purpose of the study, the evaluation and analysis has been limited to the Gulgong Town Centre. The area will be bounded and include Medley Street, Bayly Street, White Street and Robinson Street as defined in **Figure 1**.

1.3 Objectives of Study

The objective of this study is the preparation of an effective Traffic Management Plan for the Gulgong Town Centre. This objective was achieved through:

- Establishing traffic conditions incorporating existing problem areas.
- Determination of current traffic infrastructure and treatment measures required resulting from present day traffic volumes.
- Assessment of pedestrian facilities into any existing or recommended treatment measures.
- Investigation of the suitability and treatments required for Gulgong Town Centre to be zoned "40km/hr high pedestrian activity" area.
- Assessment of pedestrian facilities.

1.4 Study Approach

The main objective of the study is to provide a means of managing traffic within the Gulgong Town Centre . The Traffic Management Plan for the Gulgong Town Centre was produced in the context of the following three (3) phases:

- Assessment and review of all available technical data and planning information; relevant Council policies and strategies and existing planning controls.
- Establish existing traffic and pedestrian conditions within the Study area.
- Development of a Traffic Management Plan to resolve identified problems and a Strategy Plan for its implementation.

These phases and associated tasks will generally include a three -stage process of:

- Data collection, collation and review and analysis;
- derivation of a range of options; and
- formulation of preferred strategy and action plans.

1.5 Collection and Review of Available Information

The following information was collected from Council, reviewed and taken into account during the course of the study:

- Recent (2006) aerial photography of Gulgong in digital format (ECW format)
- Crash statistics
- Gulgong Road Hierarchy Plan;
- A scale map of the road network.

1.6 Scope of Report and Study Output

The main output of the study is a Traffic Management Plan for the Gulgong Town Centre to achieve the agreed objectives by combining our appreciation of the issues raised by residents and factors relating to traffic and safety conditions within the township.

Section 2 describes the present traffic and pedestrian conditions in the Gulgong Town Centre.

Issues and problems identified during the course of the study are presented in Section 3 together opportunities for their resolution. The preferred Traffic Management Plan is presented in Section 4.

2. Existing Traffic Conditions

2.1 Existing Street System

An inventory of all streets within the Gulgong Town Centre, including traffic control and circulation, was carried out. The number of effective traffic lanes for streets within the Gulgong Study Area is illustrated in **Figure 2**.

Between White Street and Bulga Street, Mayne Street has a predominantly very narrow carriageway consisting of two parking lanes and one effective lane catering for two-way traffic; a 10 tonne limit also applies along Mayne Street. The section of Medley Street, between Mayne Street and Bayly Street, also consists of two parking lanes and one effective lane catering for two-way traffic. Robinson Street and Queen Street have two traffic lane carriageway roads. All other streets within the Gulgong Town Centre have two traffic lanes and two parking lanes.

Stop and Give-Way signs control most intersections within the Study area; the remaining intersections are subject to the T-junction rule. . Similarly, there are no formalised pedestrian facilities, except for a children crossing in Bayly Street.

Two 40 kmh School zones are provided near the Schools in Bayly Street and White Street. The locations of traffic controls at all intersections within the Gulgong Town Centre are noted in **Figure 3.**

2.2 Existing Road Hierarchy

Council has adopted the functional classification, illustrated in **Figure 4,** for all streets in Gulgong. Streets within the Gulgong Town Centre are classified as follows:

Collector

- Herbert Street, south of Robinson Street
- Herbert Street, north Queen Street
- Mayne Street, west of Medley Street
- Mayne Street, east of White Street

CBD Roads

- Mayne Street, between Medley Street and White Street
- Herbert Street, between Robinson Street and Queen Street

Local Roads

- All other roads

Based on the traffic analysis, the location of major traffic generators, and the existing inter-connections of roads, the existing Road Hierarchy was reviewed and is considered appropriate.

2.3 Crash Analysis

2.3.1 Crash Statistic

Council provided statistics for all reported crashes in the Study area during the period 1 January 2002 to 31 December 2006. Minor crashes not reported to the police are not included. All reported crashes occurred at intersections; no crashes were recorded at mid-block (between intersections) along all streets within the Study Area. The location, frequency and consequence of crashes are shown in **Figure 5**.

A total of eight (8) recorded crashes occurred at six intersections in the Gulgong Town Centre during the five (5) years period; these crashes resulted in four (4) injuries and one (1) fatality. A summary of the number of yearly crashes is included in **Table 1**.

Table 1: Yearly Frequency of Crashes

Intersection	2002	2003	2004	2005	2006	Total	Inj	Fat
Mayne Street								
Herbert Street	1			1		**2**		
Medley Street				1		**1**	1	
White Street					1	**1**		
Bayly Street								
Herbert Street					1	**1**	1	
Medley Street			1			**1**	1	
White Street		1	1			**2**	1	1
Total	**1**	**1**	**2**	**2**	**2**	**8**	**4**	**1**

The most common type of crashes involved vehicles crossing an intersection from the intersecting streets (right angle crash) which accounted for over 87 percent of total intersection crashes and resulting in four (4) injured persons (100% of all injuries) and one (1) fatality (a motor cyclist). No crashes involved pedestrians or cyclists. The type and frequency of crashes at each location are included in **Table 2.**

Table 2: Crashes at intersections

Intersection	Cross Traffic			U-Turn		TOTAL		
	A	I	F	A	I	A	I	F
Mayne Street with								
Herbert Street	1	0		1	0	**2**		
Medley Street	1	1				**1**	**1**	
White Street	1	0				**1**		
Bayly Street with								
Herbert Street	1	1				**1**	**1**	
Medley Street	1	1				**1**	**1**	
White Street	2	1	1			**2**	**1**	**1**
TOTAL	**7**	**4**	**1**	**1**	**0**	**8**	**4**	**1**

I Injuries F Fatality

Fifty percent of crashes (4 crashes with 1 injury) occurred at intersections along Mayne Street through the Town Centre. The remaining fifty percent of crashes (4 crashes with 3 injuries and 1 fatality) occurred at intersections along Bayly Street between Medley Street and White Street.

The intersection of Bayly Street with White Street which is controlled by Give-Way signs in White Street was the location of two crashes resulting in an injury and one fatality.

2.4 Existing Traffic Patterns

2.4.1 Carriageway Volume Counts

Weekly carriageway traffic counts at seven (7) locations within the Gulgong Town Centre were carried out by Mid-western Regional Council, in June and July 2007. Average weekday, weekend and weekly daily traffic volumes, at these locations, are included in **Table 3** and noted in **Figure 6**.

Table 3: Daily Traffic Volumes (vehicles)

Street	Location			Average Weekly Daily Traffic		
				Weekday	Weekend	Weekly
Bayly St	Medley	&	Herbert	367	273	340
Herbert St	Holtermann	&	Robinson	1535	1105	1412
Mayne St	Medley	&	Herbert	1688	1548	1648
Medley St	Short	&	Robinson	935	767	887
Queen St	Herbert	&	White	281	190	255
Robinson St	Medley	&	Herbert	348	219	311
White St	Robinson	&	Mayne	397	320	375

The highest volume of traffic within the study area is along Mayne Street between Medley Street and Herbert Street with about 1,700 vpd on weekdays, reducing to about 1,550 vpd on weekends. Mayne Street has the narrowest carriageway in the study area.

On weekdays Herbert Street carries over 1,500 vpd south of Robinson Street; on weekends, a much lesser volumeof about 1,100 vpd have been recorded.

Medley Street carries about 935 vpd. Streets carrying daily volumes between 280 and 400 vpd include Bayly Street, White Street, Robinson Street and Queen Street.

2.4.2 Classification Counts

The type of vehicles was also recorded at the seven locations. The results are also noted in **Figure 6** and summarised in **Table 4.** The highest daily number of trucks travelled along Herbert Street (over 60). Mayne Street and Medley Street carry between 35 and 50 medium rigid trucks per day. No heavy trucks were recorded on any streets except along Herbert Street where three (3) heavy vehicles were recorded.

Table 4: Daily Traffic Volumes and Proportion Heavy Vehicles (weekday)

Street	Location			Total	Medium trucks		Heavy trucks	
				Volumes	Vol	%	Vol	%
Bayly St	Medley	&	Herbert	367	21	5.7%	0	0.0%
Herbert St	Holtermann	&	Robinson	1535	60	3.9%	3	0.2%
Mayne St	Medley	&	Herbert	1688	47	2.8%	0	0.0%
Medley St	Short	&	Robinson	935	36	3.8%	0	0.0%
Queen St	Herbert	&	White	281	11	4.0%	0	0.0%
Robinson St	Medley	&	Herbert	348	18	5.3%	0	0.0%
White St	Robinson	&	Mayne	397	21	5.3%	0	0.0%

2.4.3 Vehicle Speeds

Vehicle speeds were also recorded in conjunction with the classification counts. The mean and $85^{\%tle}$ speeds are summarised in **Table 5** and noted in **Figure 6.** A 50 km/h speed limit applies on all streets within the Gulgong Town Centre.

Table 5: Spot Speeds (km/h) in Gulgong (Speed limit 50 km/h)

Street	Between			Speed		% exceeding	
				Mean	$85^{\%tle}$	50km/h	60km/h
Bayly St	Medley	&	Herbert	33.2	40.0	0.5%	0.0%
Herbert St	Holtermann	&	Robinson	38.7	47.9	9.9%	1.0%
Mayne St	Medley	&	Herbert	26.1	34.6	0.4%	0.1%
Medley St	Short	&	Robinson	38.3	46.1	5.4%	0.3%
Queen St	Herbert	&	White	19.5	23.8	0.0%	0.0%
Robinson St	Medley	&	Herbert	18.3	21.6	0.0%	0.0%
White St	Robinson	&	Mayne	25.7	30.6	0.1%	0.0%

The only streets with speeds exceeding the speed limit are Herbert Street (~9%) and Medley Street (~5%).

2.4.4 Intersection Traffic Counts

In order to gauge the traffic conditions within the study area, traffic movements were counted at nine (9) locations within the study area. The surveys were carried out during the afternoon peak periods between 3:30 pm and 5:30 pm in June and early July 2007. Counts were also undertaken at the same intersections between 10.00 and 12 noon on Saturday morning. Overall peak on weekdays occurred between 3.30 and 4.30pm; on Saturday morning the peak occurred between 11.00am and 12.00pm.

The peak hourly volumes recorded at each intersection are shown in **Figure 7**.

2.4.5 Pedestrian Counts

The number of pedestrians crossing at all surveyed intersections was also recorded. The number of pedestrians crossing at different locations during the duration of survey is included in **Table 6** together with the conflicting traffic volumes.

Table 6: Pedestrian & Vehicular Volumes (2 hour period)

	Weekday PM		Saturday AM	
Street	**Pedestrian**	**Veh**	**Pedestrian**	**Veh**
Mayne Street				
west of Medley St	15	133	10	82
east of Medley St	8	176	62	177
mid block between Medley & Herbert	236	176	182	197
west of Herbert St	30	173	55	216
east of Herbert St	84	149	112	151
mid block between Herbert & White	96	163	91	158
west of White St	27	176	26	164
east of White St	1	153	6	130
Medley Street				
south of Mayne St	28	115	40	128
north of Mayne St	51	86	56	107
Herbert Street				
south of Mayne St	75	174	107	138
north of Mayne St	181	213	204	229
White Street				
south of Mayne St	12	42	25	50
north of Mayne St	8	63	65	91

2.5 Evaluation of Existing Traffic Conditions

2.5.1 Carriageway Level of Service

An evaluation of the capacity of most streets in the Gulgong Town Centre was carried out to identify current and potential deficiencies in the road system so that appropriate steps could be taken to remedy such situations.

The capacity of roads was based on an assessment of their operating level of service. The concept of level of service, together with the recommended traffic flows at different levels of service, is described in **Appendix A**.

In regional town such as Gulgong, it is reasonable to base the roadwork improvements on a requirement to achieve no worst than a level of service "C" (Stable flow with acceptable delays). The assessment of all streets within the Gulgong study area has therefore been based on this premise; the improvements identified in the following sections should be considered as minimum requirements to achieve a Level of Service "C" or better.

One-way peak hourly volumes along the different streets were obtained from the intersection counts and are summarised in **Table 7** together with the corresponding levels of service.

Table 7: Existing Traffic Volumes & Carriageway Levels of Service

Street	Between			PM Peak Hour				Saturday Morning			
			Lanes	N/E	S/W	Total	LoS	N/E	S/W	Total	LoS
Robinson	west of Medley		2U	11	12	23	A	3	4	7	A
Robinson	Medley	Herbert	2U	19	25	44	A	12	24	36	A
Robinson	Herbert	White	2U	12	18	30	A	16	13	29	A
Mayne	West of Medley		2P1T	71	81	152	NA	111	64	175	NA
Mayne	Medley	Herbert	2P1T	97	96	193	NA	120	105	225	NA
Mayne	Herbert	White	2P1T	97	82	179	NA	85	85	170	NA
Mayne	East of White		4UP	64	91	155	A	71	68	139	A
Bayly	West of Medley		4UP	27	19	46	A	2	8	10	A
Bayly	Medley	Herbert	4UP	25	25	50	A	16	22	38	A
Bayly	Herbert	White	4UP	36	55	91	A	34	39	73	A
Bayly	East of White		4UP	20	43	63	A	10	14	24	A
Medley	s of Robinson		4UP	50	42	92	A	37	42	79	A
Medley	Robinson	Mayne	4UP	58	53	111	A	74	56	130	A
Medley	Mayne	Queen	2P1T	59	55	114	NA	83	57	140	NA
Medley	Queen	Bayly	2P1T	39	53	92	NA	72	54	126	NA
Herbert S	s of Robinson		4UP	61	60	121	A	47	59	106	A
Herbert S	Robinson	Mayne	4UP	87	102	189	A	68	88	156	A
Herbert	Mayne	Queen	4UP	97	125	222	A	106	119	225	A
Herbert	Queen	Bayly	4UP	115	128	243	A	100	80	180	A
White	s of Robinson		2U	4	9	13	A	8	9	17	A
White	Robinson	Mayne	4UP	20	40	60	A	25	38	63	A
White	Mayne	Queen	4UP	54	32	86	A	44	60	104	A
White	Queen	Bayly	4UP	27	15	42	A	50	28	78	A

Interrupted Flow NA Not applicable to one lane two way traffic

Mayne Street, between Medley Street and Herbert Street carries up to 225 veh/hr;. The provision of short term parking on both sides of Mayne Street results in one traffic lane catering for two-way traffic. As a result of this arrangement, delays along this road have been observed exacerbated by vehicles parking and un-parking. The application of the level of service approach along streets with one lane two-way traffic such as Mayne Street is not applicable.

A similar situation, but to a lesser extent, was observed along Medley Street, between Mayne Street and Queen Street which carried about 115 veh/hr on weekdays, increasing to about 150 veh/hr on Saturdays.

within the Gulgong Town Centre, Herberet Street also carries high volume of traffic between Mayne Street and Bayly Street, with over 220 veh/hr on weekdays, reducing to about 200 veh/hr on Saturdays; its wide carriageway width results in a very good level of service "A". All other streets operate at a level of service "A".

2.5.2 Intersection Capacity

The concepts of intersection capacity and level of service, as defined in the Guidelines published by the RTA (1995), are discussed in **Appendix B** together with criteria for their assessment. The assessment of the level of service of signed controlled intersections and roundabouts is based on the average delay (seconds/vehicle) of the critical movement.

An analysis of the operation of all surveyed intersections in the Gulgong Town Centre was carried out using the **INTANAL** computer modelling program (version 2004-001). This software allows comparisons between different forms of intersection control, and different forms of intersection configurations to be readily evaluated. The results of this analysis are summarised in **Table 8**.

Table 8: Existing Operation of Intersection in Gulgong Town Centre

Intersections	Afternoon Weekday		Saturday Morning	
	Ave Delay	LoS	Ave Delay	LoS
Medley St with Robinson St	2.3	A	2.7	A
Medley St with Mayne St	5.8	A	6.1	A
Medley St with Bayly St	3.5	A	2.9	A
Herbert St with Robinson St	3.8	A	3.9	A
Herbert St with Mayne St	6.7	A	6.3	A
Herbert St with Bayly St	5.2	A	7.3	A
White St with Robinson St	2.4	A	2.3	A
White St with Mayne St	4.1	A	3.9	A
White St with Bayly St	3.2	A	2.9	A

All intersections operate at a very good level of service Level of Service "A".

Nevertheless, non capacity problems and unsafe manoeuvres have been observed at the intersections of Mayne Street with Medley Street and with Herbert Street as a result of the one two way traffic lane along Mayne Street and Medley Street, north of Mayne Street. These issues and problems identified at other intersections are discussed in section 3.

3. Issues and opportunities in Town Centre

3.1 Traffic Issues in Gulgong Town Centre

The existing road network and all intersections operate at a very good level of service Level of Service "A". Furthermore, there is no real speeding problem in the study area. Nevertheless, the crash and traffic analysis have identified the following issues within the Gulgong Town Centre:

- Fifty percent of crashes (4 crashes with 1 injury) occurred at intersections along Mayne Street through the Town Centre.
- The only fatality occurred at the intersection of Bayly Street with White Street.
- One of the highest volume of traffic within the study area is along Mayne Street which has a narrow carriageway; this section of road is also crossed by the highest numbers of pedestrian within the centre.
- About nine (9%) and five (5%)percent of vehicles exceed the speed 50 kmh speed limit along Herbert Street and Medley Street respectively.

The following matters were further identified from extensive observations by the consultant and Council officers:

- Difficulty to access Mayne Street from Medley Street particularly the right turning movements into and out of Mayne Street.
- Head on conflict between vehicles travelling in opposite direction along Mayne Street between Medley Street and White Street as a result of the very narrow carriageway consisting of parking on both sides and one effective lane catering for two-way traffic; further delays along Mayne Street due to parking manoeuvres.
- A similar situation but to a lesser extent was observed along Medley Street, between Mayne Street and Queen Street.
- Elderly pedestrians have difficulty crossing Herbert Street at Mayne Street
- Give Way signs in Queen Street at White Street are missing.

3.2 40 km/h Area in Town Centre

The RTA Guidelines (RTA, -----) stipulates that *the 40 km/h speed limit is appropriate in areas with relatively high volumes of pedestrians. These areas are typically characterised by commercial and recreational land uses. These areas typically generate pedestrian traffic in additions to vehicular traffic.*

The following sections of roads meet this criterion:

- Medley Street, between Robinson Street and Queen Street
- Herbert Street, between Robinson Street and Queen Street
- Mayne Street, between Medley Street and White Street
- Queen Street, between Medley Street and White Street
- Robinson Street, between Medley Street and White Street

The current 85%tle vehicle speed along the above sections of Mayne Street, Robinson Street and Queen Street is below 50 km/h. The 85%tle speeds along Herbert Street and Medley Street are nearer 50 km/h; the installation of traffic calming devices such as entry threshold along these streets north of Queen Street and south of Robinson Street would considerably reduce speeds along these roads and improve safety.

These traffic control devices along these two streets will be supplemented by 40 km/h signage and marking required at all streets approaches to the 40 km/h area.

3.3 Possible Traffic Improvements in Town Centre

3.3.1 Intersection of Bayly Street with White Street

The intersection of Bayly Street with White Street was the location of two crashes resulting in an injury and one fatality involving a motor cyclist. Give-Way signs in White Street give priority to traffic along Bayly Street.

The Give way Signs are currently installed on a small median in the middle of the White Street carriageway; normally, drivers would expect the sign to be on the nearest footpath. The provision of a one lane roundabout with mountable curb and incorporating pedestrian refuges would considerably enhance the safety of this intersection.

3.3.2 Intersection of Herbert Street with Mayne Street

About 10 percent of vehicles appear to exceed the 50 km/h speed limit along Herbert Street. Concern has therefore been expressed about the safety of elderly pedestrians in crossing Herbert Street at Mayne Street, particularly between Coles and the Commercial Hotel.

The provision of a pedestrian crossing across Herbert St just north of Mayne Street (on the corner) may assist this situation. However, a warrant cannot be established even though this location is crossed by the highest number of pedestrian on Saturdays. A well lit pedestrian refuge together with a mid-block threshold to considerably reduce the speed along Herbert Street may be sufficient to address this problem.

3.3.3 Intersection of White Street with Queen Street

The east and west junctions of Queen Street with White Street are marginally offset and therefore appear to be controlled by the T-junction rule. Several drivers in Queen Street accessing White Street were observed doing so without slowing down assuming they had right of way. As White Street provides a major access to and from the north to the Town Centre, it is recommended that Give Way signs be installed in Queen Street.

3.3.4 Mayne Street and Medley Street

Mayne Street has a very narrow carriageway between Medley Street and White Street consisting of parking on both sides and one effective lane catering for two-way traffic. This has resulted in potential head-on conflict between vehicles travelling in opposite direction along Mayne Street. Furthermore, during parking and un-parking manoeuvre along Mayne Street all through traffic along these roads effectively stop and hence delayed. A similar situation but to a lesser extent was observed along Medley Street, between Mayne Street and Queen Street.

As a result and due to poor sight distance vehicles have difficulty turning right into and out of Mayne Street east of Medley Street. Furthermore, a vehicle right turning from Medley Street into Mayne Street cannot see oncoming vehicle until it is in Mayne Street; in this event, the vehicle temporarily park in the short 'No Parking' zone at the beginning of the street. Whilst this is an appropriate course of action, any following vehicle right turning into Mayne Street finds itself in direct conflict with vehicles travelling in the opposite direction; the only option is then to reverse back on to Medley Street. This is an unsafe and unacceptable practice. A similar situation occurs for vehicles right turning from Mayne Street into Medley Street north, and for vehicles right tuning into Mayne Street from Herbert Street.

Preferred Option 1

To resolve both the access problem into Mayne Street from Medley Street and Herbert Street and conflicts between vehicles travelling in opposite directions along Mayne Street and the narrow parts of Medley Street, consideration should be given to prohibit parking for about 10m at the following locations:

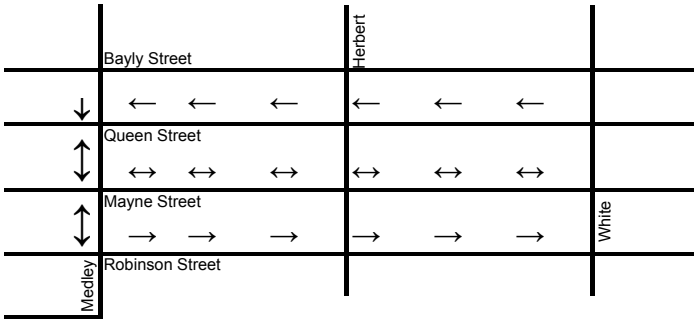
- **North side of Mayne Street**, just east of Medley Street, at two third of way to Herbert Street , just east of Herbert Street and at one-third of way from White Street
- **South side of Mayne Street** one third of way from Medley Street, just west of Herbert Street, one third of way from Herbert Street, and just west of White Street
- **Medley Street** on both sides, north of Mayne Street.

The areas where parking is prohibited could then be temporarily used by vehicles travelling in one direction as a waiting area whilst the oncoming vehicle drives past. The number of parking spaces along Mayne Street between Medley Street and White Street would be reduced by up to 12 spaces. In order to offset this loss, it is suggested that Queen Street and Robinson Street be restricted to one way traffic in the westbound and eastbound direction respectively; additional on-street parking spaces could then be formalised on one side of these two narrow roads.

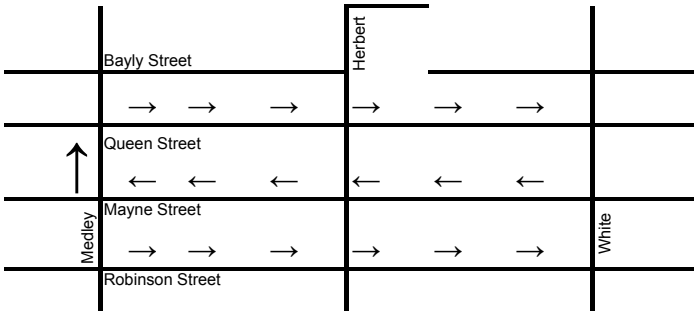
Alternative Circulation Options

In the event the measures recommended in Option 1 do not resolve the conflicts along Mayne Street and Medley Street and the intersections along them, a number of options, illustrated on the next page have been identified and discussed below.

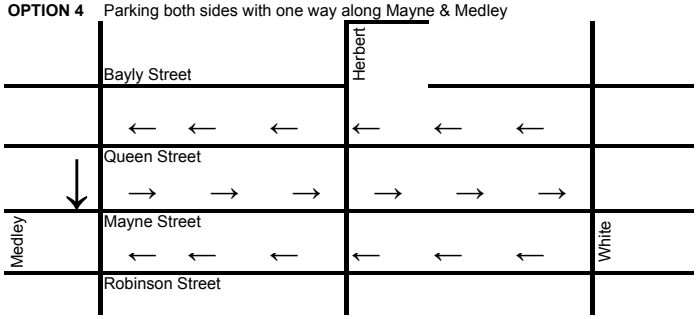
OPTION 2 No parking one side along Mayne & Medley



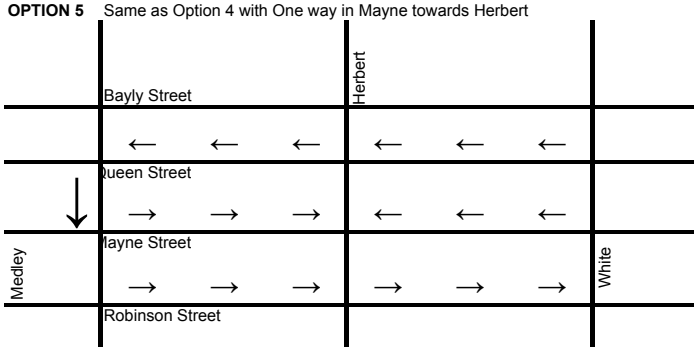
OPTION 3 Parking both sides with one way along Mayne & Medley



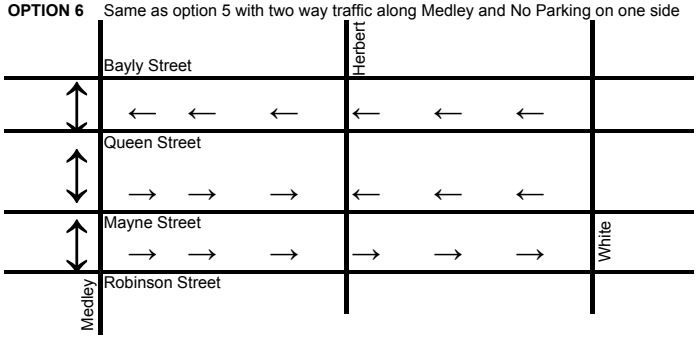
OPTION 4 Parking both sides with one way along Mayne & Medley



OPTION 5 Same as Option 4 with One way in Mayne towards Herbert



OPTION 6 Same as option 5 with two way traffic along Medley and No Parking on one side



TRAFFIC CIRCULATION OPTIONS

- **Option 2 –**
  - On-street parking prohibited on one side of Mayne Street resulting in two narrow traffic lanes for two-way movements, between Medley Street and White Street
  - On-street parking prohibited on one side of Medley Street resulting in two narrow traffic lanes for two-way movements, between Mayne Street and Queen Street
  - One way movement along Queen Street in the eastbound direction between White Street and Medley Street with parking on one side.
  - One way movement along Robinson Street in the eastbound direction between White Street and Medley Street with parking on one side.
- **Option 3**
  - Parking retained on both sides of Mayne Street with traffic permitted in the westbound direction only between Medley Street and White Street
  - Parking retained on both sides of Medley Street with traffic permitted in the northbound direction only between Mayne Street and Queen Street
  - One way movement along Queen Street in the eastbound direction between White Street and Medley Street with parking on one side.
  - One way movement along Robinson Street in the eastbound direction between White Street and Medley Street with parking on one side.
- **Option 4 -** Same as Option 2 but all one way movements along Mayne Street and Medley Street are reversed.
  - Parking retained on both sides of Mayne Street with traffic permitted in the eastbound direction only between Medley Street and White Street
  - Parking retained on both sides of Medley Street with traffic permitted in the southbound direction only between Mayne Street and Queen Street
  - One way movement along Queen Street in the westbound direction between White Street and Medley Street with parking on one side.
  - One way movement along Robinson Street in the westbound direction between White Street and Medley Street with parking on one side.
- **Option 5**
  - Parking retained on both sides of Mayne Street with traffic permitted in the eastbound direction between Medley Street and Herbert Street and in the westbound direction between White Street and Herbert Street
  - Parking retained on both sides of Medley Street with traffic permitted in the southbound direction only between Mayne Street and Queen Street
  - One way movement along Queen Street in the westbound direction between White Street and Medley Street with parking on one side.
  - One way movement along Robinson Street in the eastbound direction between White Street and Medley Street with parking on one side.
- **Option 6 -** Same as option 4 with two-way traffic movements retained along Medley Street between Mayne Street and Queen Street, and parking prohibited on one side of this section of road.

The **benefits** and ***disadvantages*** of each circulation option are summarised in **Table 9**.

Table 9: Traffic Circulation Options in Town Centre

Impact	Option 2	Options 3 & 4	Option 5	Option 6
Mayne Street				
Head on conflict	**Removed**	**Removed**	**Removed**	**Removed**
Parking supply	***Reduced by ~50%***	Unchanged	Unchanged	Unchanged
Impact on traffic	**Improved**	**Improved**	**Improved**	**Improved**
Total traffic volumes	***Marginal increase***	Unchanged	**Marginal reduction**	**Marginal reduction**
Medley Street				
Head on conflict	**Removed**	**Removed**	**Removed**	**Removed**
Impact on traffic	**Improved**	**Improved**	**Improved**	**Improved**
Parking supply	***Reduced by ~50%***	Unchanged	Unchanged	***Reduced by ~50%***
Total traffic volumes	***Marginal increase***	***Marginal increase***	**Marginal reduction**	Unchanged
Queen Street				
Parking supply	**Increased**	**Increased**	**Increased**	**Increased**
Traffic volumes	Unchanged	***Marginal increase***	***Marginal increase***	***Marginal increase***
Robinson Street				
Parking supply	**Increased**	**Increased**	**Increased**	**Increased**
Traffic Volumes	***Marginal Increase***	***Marginal Increase***	***Marginal Increase***	***Marginal Increase***
Herbert Street				
Traffic Volumes	Unchanged	Unchanged	Unchanged	Unchanged
Parking supply	Unchanged	Unchanged	Unchanged	Unchanged

- In summary, Options 2 to 6 would remove the head-on conflicts in Mayne Street and in Medley Street.
- The retention of two-way traffic in Option 2 is offset by the loss of about 50% of parking on the relevant sections of Mayne Street and Medley Street. However, the provision of additional parking in Robinson Street and Queen Street more than offset this parking loss.
- Options 3 to 6 reduce traffic movements at the intersection of Mayne Street with Medley Street and with Herbert Street. The restriction of traffic to one way movements in Queen Street and Robinson Street allows the provision of additional on street parking along these two streets.
- Options 5 and 6 may require the provision of a roundabout with mountable curb at the intersection of Mayne Street with Herbert Street to facilitate the increase in right turning movements out of Mayne Street into Herbert Street. If it is not possible to provide a roundabout and traffic conditions worsen than the exiting traffic from Mayne Street should be restricted to left turning only into Herbert Street.

Option 6 is the preferred one-way circulation option along Mayne Street as it allows direct access to the core of the Town Centre along Mayne Street and retains two way movements along Medley Street.

4. Draft Traffic Management Plan

4.1 Recommended Traffic Management Measures

The following improvements, illustrated in **Figure 8,** are likely to improve the traffic and safety conditions within the Gulgong Town Centre:

- Provision of traffic calming devices such as entry and/or mid-block threshold in Herbert Street and in Medley Street north of Queen Street, and south of Robinson Street.
- Introduce 40 km/h speed limits along the following section of roads together with 40 km/h signage and appropriate marking at the approaches:
  - Medley Street, between Robinson Street and Queen Street
  - Herbert Street, between Robinson Street and Queen Street
  - Mayne Street, between Medley Street and White Street
  - Queen Street, between Medley Street and White Street
  - Robinson Street, between Medley Street and White Street
- Provision of a one lane roundabout with mountable curbs at the intersection of Bayly Street with White Street incorporating pedestrian refuges.
- Installation of Give Way signs in Queen Street at White Street.
- Prohibit parking for about 10m at the following locations:
  - North side of Mayne Street, just east of Medley Street, at two third of way to Herbert Street , just east of Herbert Street and at one-third of way from White Street
  - South side of Mayne Street one third of way from Medley Street, just west of Herbert St, one third of the way from Herbert St, and just west of White St.
  - Medley Street on both sides, north of Mayne Street.
- Restriction of traffic to one way movement with parking on one side along the following section of roads:
  - westbound in Queen Street between White Street and Medley Street.
  - eastbound in Robinson Street between White Street and Medley Street.

4.2 Alternative Recommended Option

In the event the parking prohibition along Mayne Street and Medley Street do not improve the current situation, serious consideration should be given to implement the circulation Option illustrated in **Figure 9** which includes the following additional measures:

- Restriction of traffic to one way movement along the following section of roads:
  - eastbound in Mayne Street between Medley Street and Herbert
  - westbound in Mayne Street between White and Herbert Street
- Prohibition of parking on western side of Medley Street between Mayne Street and Queen Street.
- Provision, if physically possible, of a roundabout with mountable curbs at the intersection of Mayne Street with Herbert Street with pedestrian refuges on all approaches. Alternatively the right turning movements from Mayne Street into Herbert Street should be banned.

5. References

Roads & Traffic Authority (----). *"40 km/h Speed Limits in High Volume Pedestrian areas"*.

Appendices

Appendix A

Guidelines for Evaluation of
Carriageway Capacity

APPENDIX A

CONCEPT OF CARRIAGEWAY CAPACITY AND LEVEL OF SERVICE

The capacity of major streets within an urban area can be based on an assessment of their operating Level of Service. Level of service is defined by AUSTROADS (1988) as a "qualitative measure of the effects of a number of features, which include speed and travel time, traffic interruptions, freedom to manoeuvre, safety, driving comfort and convenience, and operating costs. Levels of service are designated from A to F from best (free flow conditions) to worst (forced flow with stop start operation, long queues and delays) as follows:

LEVELS OF SERVICE

- A - Free flow (almost no delays)
- B - Stable flow (slight delays)
- C - Stable flow (acceptable delays)
- D - Approaching unstable flow(tolerable delays)
- E - Unstable flow(congestion; intolerable delays)
- F - Forced flow (jammed)

A service volume, as defined by AUSTROADS (1988), is the maximum number of vehicles that can pass over a given section of roadway in one direction during one hour while operating conditions are maintained at a specified level of service.

One-way hourly volumes for traffic flow at different level of service, in urban situations are summarised in Tables A1 and A2 for interrupted and uninterupted flow conditions respectively.

It is suggested that ideally arterial and sub-arterial roads should not exceed service volumes at level of service C. At this level, whilst most drivers are restricted in their freedom to manoeuvre, operating speeds are still reasonable and acceptable delays experienced. However, in urban situations, arterial and sub-arterial roads operating at Level of Service D, are still considered adequate.

TABLE A1
LEVEL OF SERVICE INTERRUPTED FLOW CONDITIONS ALONG URBAN ROADS (One Way Hourly Volumes)

ROAD CLASS				LEVEL OF SERVICE					
Type	Descriptiion		Description	A	B	C	D	E	F
U1	URBAN	2	2 Lane Undivided	540	630	720	810	900	F
U1	URBAN	4U	4 Lane Undivided with some parking	900	1050	1200	1350	1500	O
U1	URBAN	4UC	4 Lane Undivided with Clearways	1080	1260	1440	1620	1800	R
U1	URBAN	4D	4 Lane Divided with Clearways	1140	1330	1520	1710	1900	C
U1	URBAN	6U	6 Lane Undivided	1440	1680	1920	2160	2400	E
U1	URBAN	6D	6 Lane Divided with Clearway	1740	2030	2320	2610	2900	D

TABLE A2
LEVEL OF SERVICE UNINTERRUPTED FLOW CONDITIONS ALONG URBAN ROADS (One Way Hourly Volumes*)

ROAD CLASS				LEVEL OF SERVICE					
Type	Descriptiion		Description	A	B	C	D	E	F
U2	URBAN	2	2 Lane Undivided	760	880	1000	1130	1260	F
U2	URBAN	4U	4 Lane Undivided with some parking	1260	1470	1680	1890	2100	O
U2	URBAN	4UC	4 Lane Undivided with Clearways	1510	1760	2010	2270	2520	R
U2	URBAN	4D	4 Lane Divided with Clearways	1600	1860	2130	2400	2660	C
U2	URBAN	6U	6 Lane Undivided with Clearways	2020	2350	2690	3020	3360	E
U2	URBAN	6D	6 Lane Divided with Clearway	2440	2840	3250	3660	4060	D

* 40% higher than base volumes in Table A1

Appendix B

Guidelines for Evaluation of
Intersection Capacity

Appendix B Guidelines for Evaluation of Intersection Capacity

The RTA has included in the latest "Guide to Traffic Engineering Developments (Dec 1993, Issue 2) has included a section on the assessment of intersections. The assessment of the level of service of an intersection is based on the evaluation of the following Measures of Effectiveness:

- average delay (secs/veh) (all forms of control)
- delay to critical movement (secs/veh) (all forms of control)
- degree of saturation (traffic signals and roundabouts)
- cycle length (traffic signals)

INTANAL was used to calculate the relevant intersection parameters. INTANAL is a software which allows comparisons between different forms of intersection control and different forms of intersection configurations to be readily evaluated. That is at each intersection the priority control, roundabout and signal control options will be examined to determine the most efficient form of control.

The best indicator of the level of service at an intersection is the average delay experienced by vehicles at that intersection. For traffic signals, the average delay over all movements should be taken. For roundabouts and priority control intersections (with Stop and Give Way signs or operating under the T-junction rule) the critical movement for level of service assessment should be that with the highest average delay.

With traffic signals, delays per approach tend to be equalised, subject to any over-riding requirements of signal co-ordination as well as to variations within individual movements. With roundabouts and priority - control intersections, the critical criteria for assessment is the movement with the highest delay per vehicle. With this type of control the volume balance might be such that some movements suffer high levels of delay while other movements have minimal delay. An overall average delay for the intersection of 25 seconds might not be satisfactory if the average delay on one movement is 60 seconds.

The average delay for level of service E should be no more than 70 seconds. The accepted maximum practical cycle length for traffic signals under saturated conditions is 120 - 140 seconds. Under these conditions 120 seconds is near maximum for two and three phase intersections and 140 seconds near maximum for more complex phase designs. Drivers and pedestrians expect cycle lengths of these magnitudes and their inherent delays in peak hours. A cycle length of 140 seconds for an intersection which is almost saturated has an average vehicle delay of about 70 seconds, although this can vary. If the average vehicle delay is more than 70 seconds, the intersection is assumed to be at Level of Service F.

Table B1 sets out average delays for different levels of service. There is no consistent correlation between definitions of levels of service for road links as defined elsewhere in this section, and the ranges set out in **Table B**. In assigning a level of service, the average delays to the motoring public need to be considered, keeping in mind the location of the intersection. For example, drivers in inner-urban areas of Sydney have a higher tolerance of delay than drivers in country areas. **Table B1** provides a recommended baseline for assessment.

Table B1: Level of service criteria for intersections

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 – 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays Roundabouts require other control mode	At capacity, required other control mode

Source: RTA (1995b)

The figures in **Table B1** are intended as a guide only. Any particular assessment should take into account site-specific factors including maximum queue lengths (and their effect on lane blocking), the influence of nearby intersections and the sensitivity of the location to delays. In many situations, a comparison of the current and future average delay provides a better appreciation of the impact of a proposal, and not simply the change in the level of service.

The intersection degree of saturation (DS) can also be used to measure the performance of isolated intersections. At intersections controlled by traffic signals, both queue length and delays increase rapidly as DS approaches 1.0. An upper limit of 0.9 is appropriate. When DS exceeds 0.8 - 0.85, overflow queues start to become a problem. Satisfactory intersection operation is generally achieved with a DS of about 0.7 - 0.8. (Note that these figures are based on isolated signalised intersections with cycle lengths of 120 seconds. In co-ordinated signal systems DS might be actively maximised at key intersections). Although in some situations additional traffic does not alter the level of service, particularly where the level of service is E or F, additional capacity may still be required. This is particularly appropriate for service level F, where small increases in flow can cause disproportionately greater increases in delay. In this situation, it is advisable to consider means of control to maintain the existing level of absolute delay. Suggested criteria for the evaluation of the capacity of signalised intersections based on the Degree of Saturation are summarised in **Table B2**.

Table B2: Criteria For Evaluating Capacity Of Signalised Intersections*

Level Of Service	Optimum Cycle Length (Secs) (CO)	VOLUME/ SATURATION Y	Intersection Degree Of Saturation X
A/B Very good operation	< 90	< 0.70	< 0.80
C Satisfactory	90-120	0.70-0.80	0.80-0.85
D Poor but manageable	120-140	0.80-0.85	0.85-0.90
E/F Bad, extra capacity req'd	>140	>0.85	> 0.90

Source: Roads & Traffic Authority (2002)

Figures

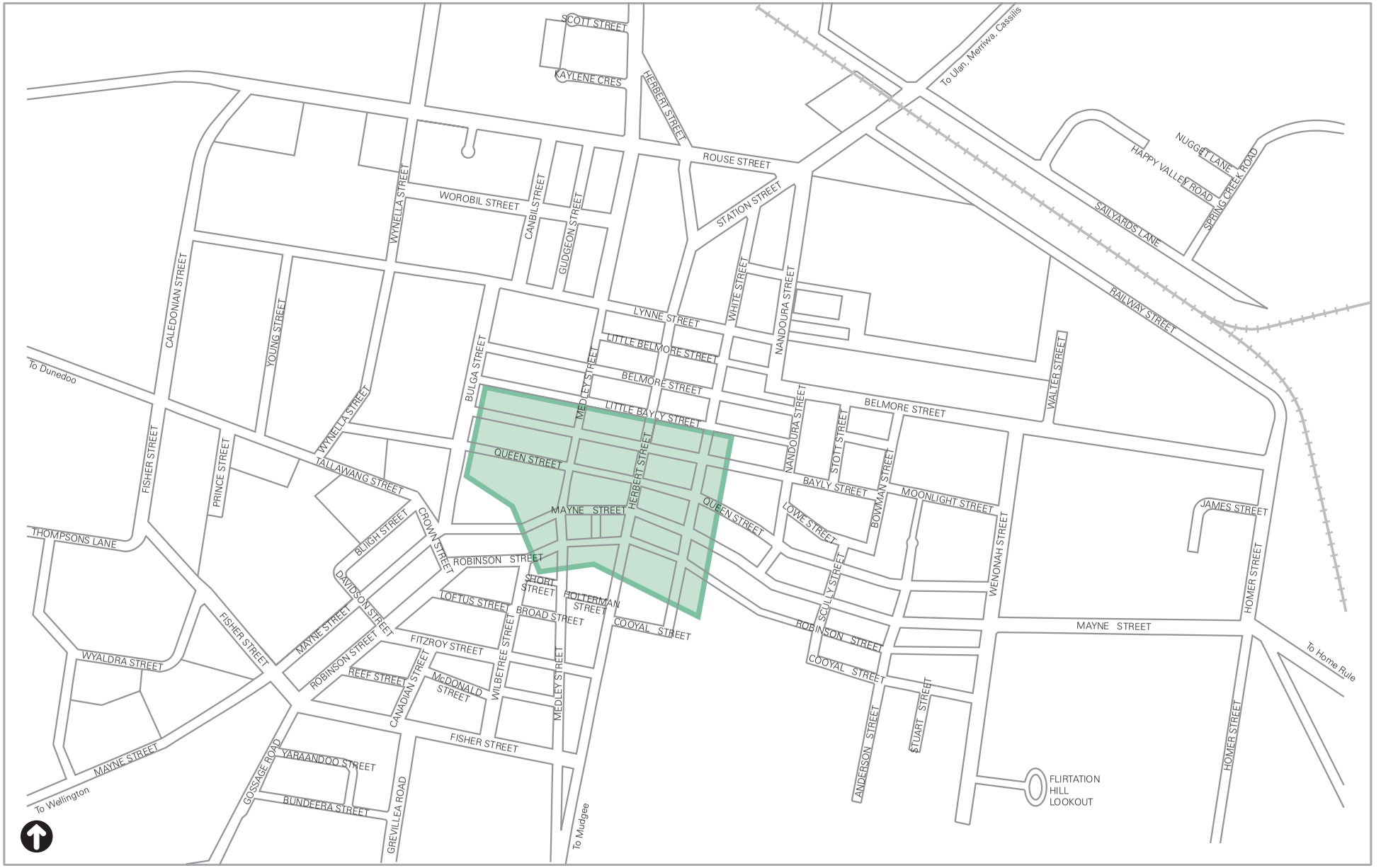


Figure 1 **Gulgong Town Centre study area**

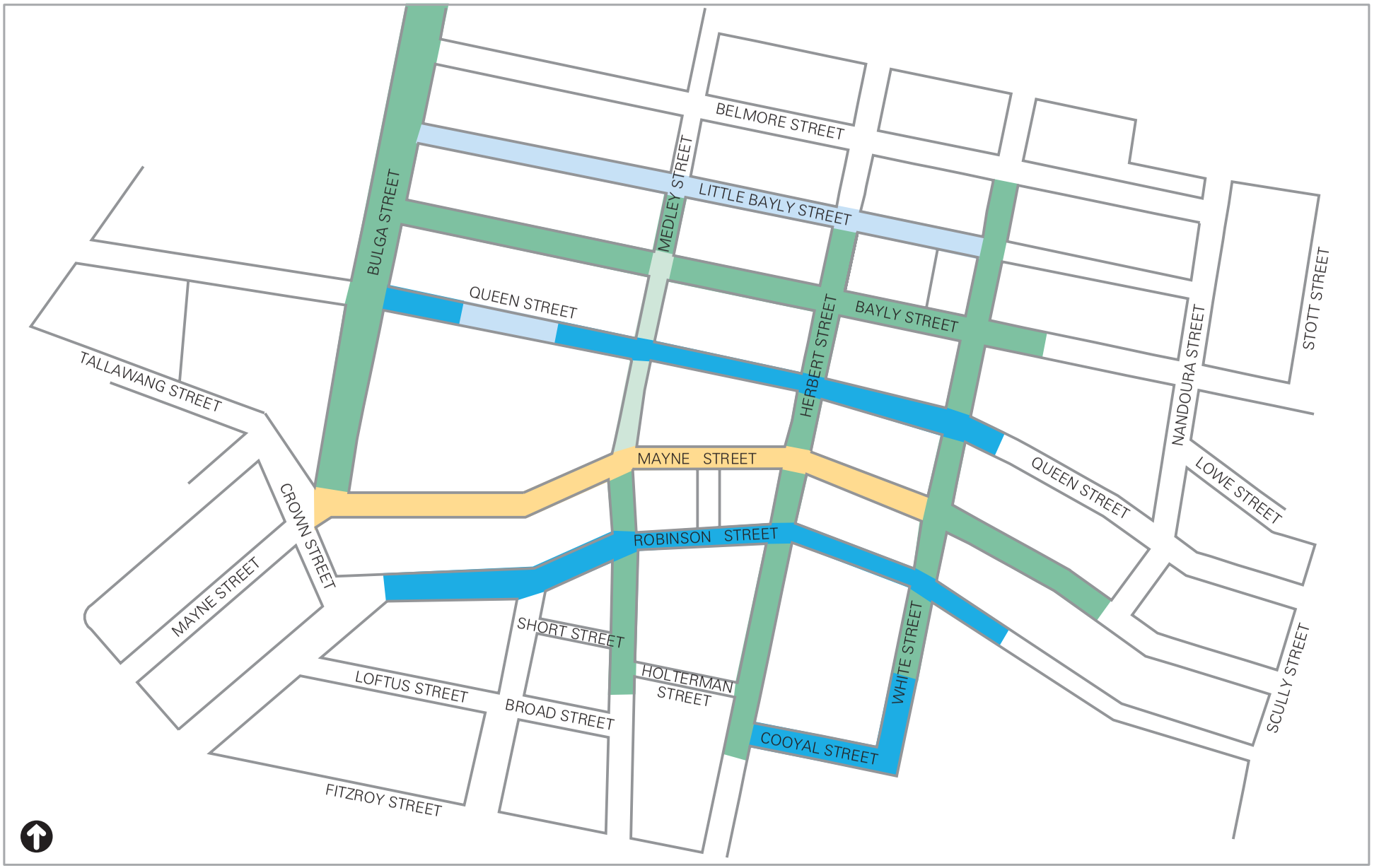


Figure 2 **Gulgong Town Centre road inventory**

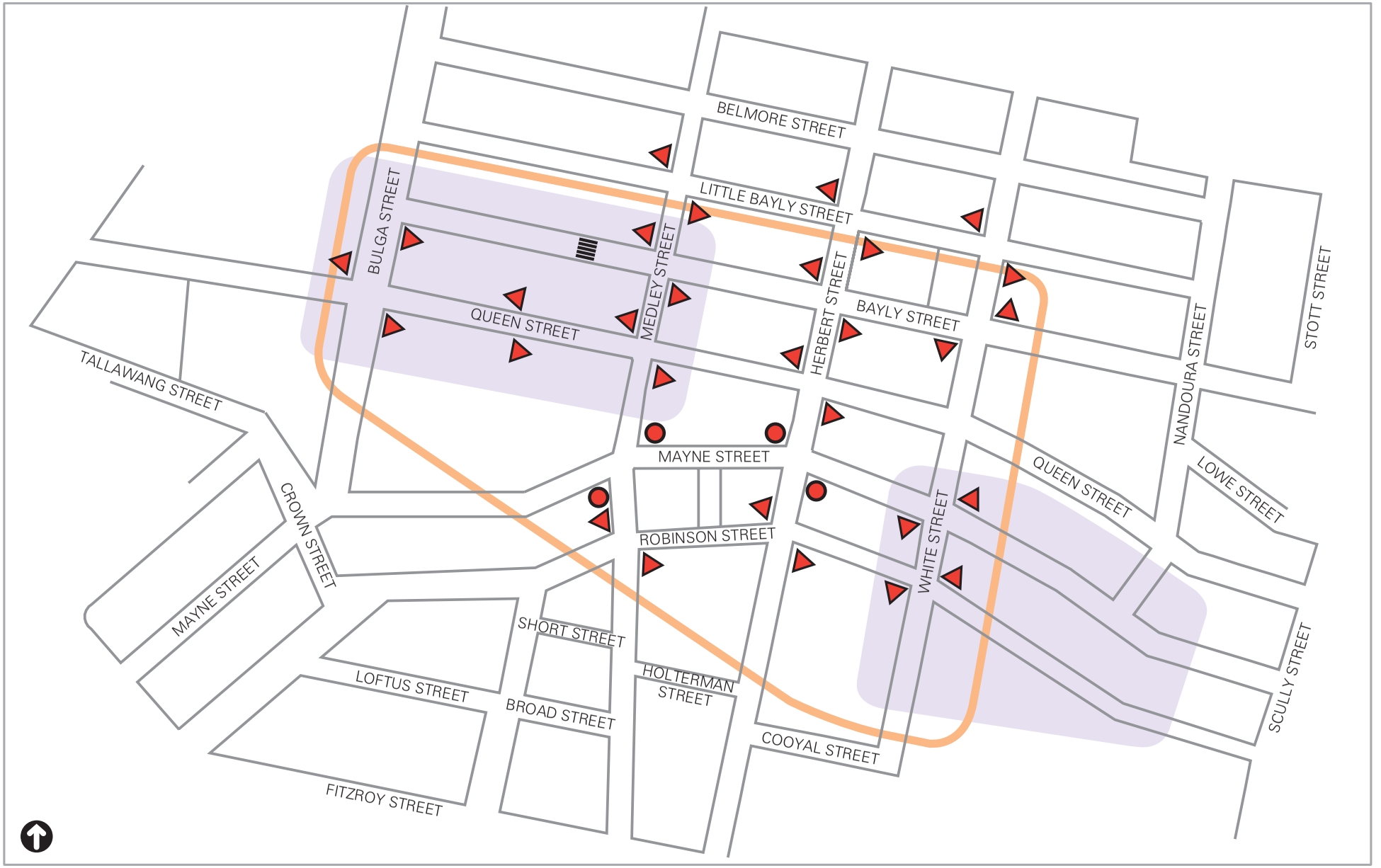
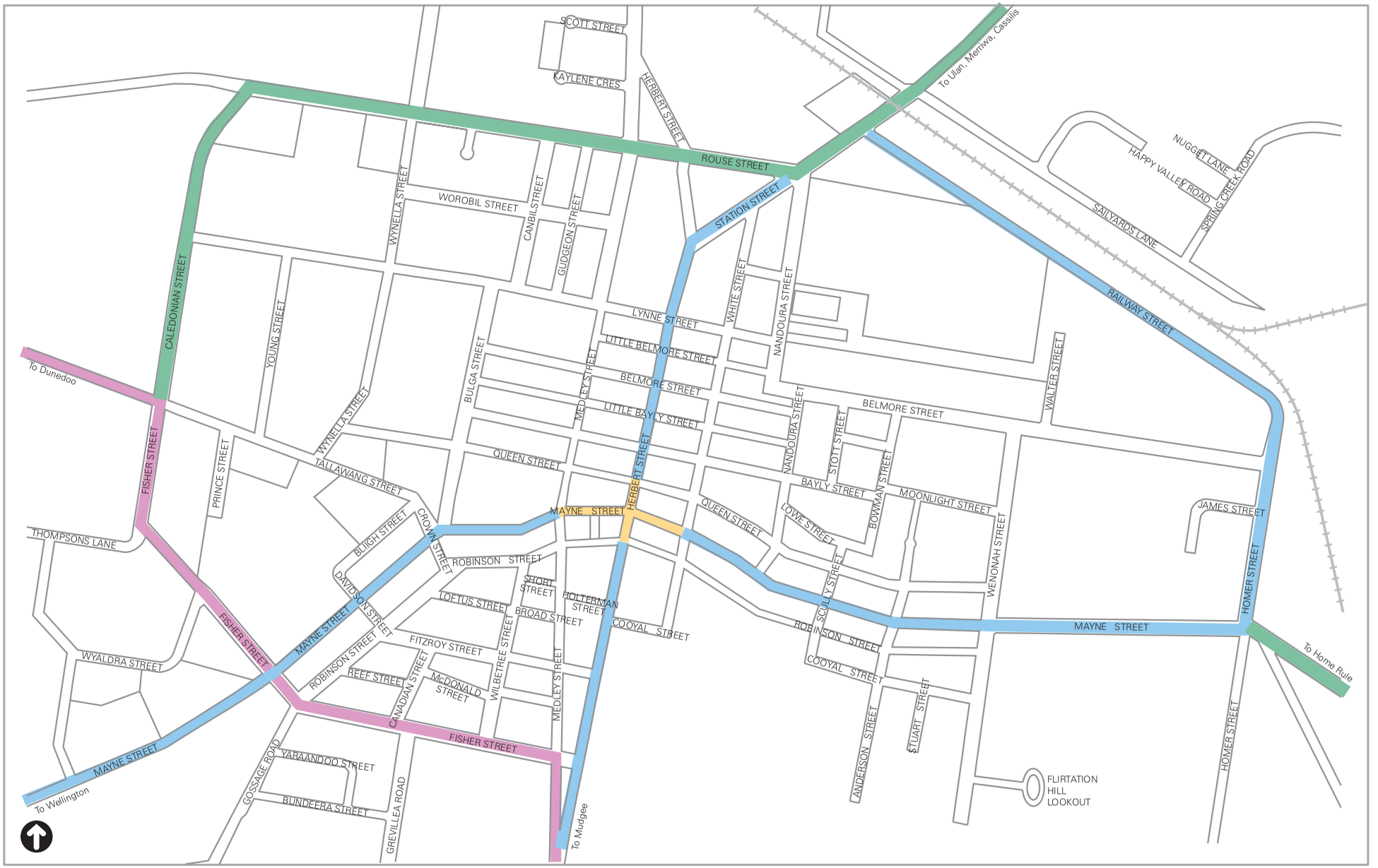


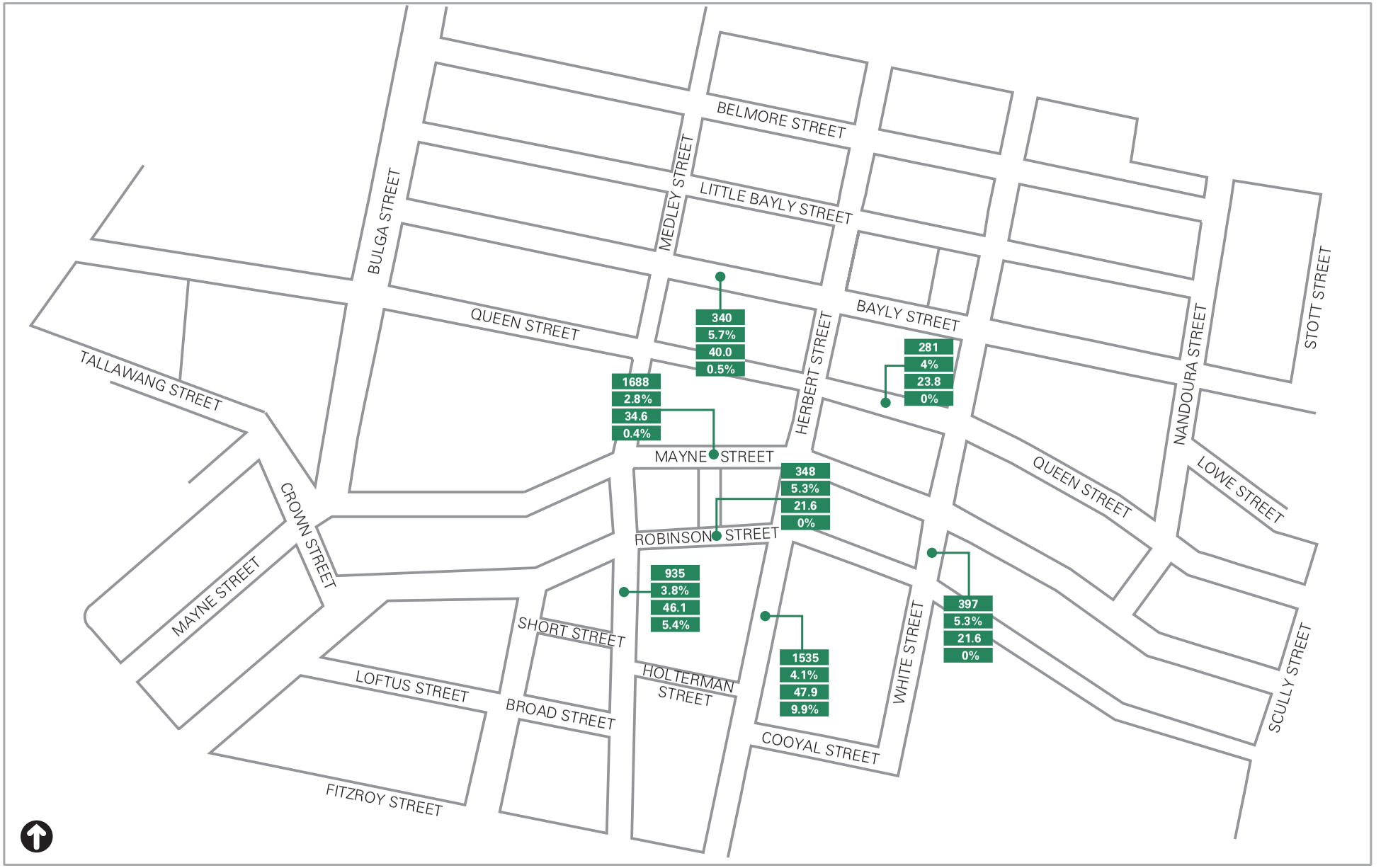
Figure 3 **Gulgong Town Centre traffic controls**



Arterial
Sub arterial
Collector
CBD roads
Local roads

Figure 4 **Gulgong Town Centre road hierarchy**

Figure 5 **Gulgong Town Centre crashes 2002-2006**



Weekday volume — 397
% HV — 5.3%
85%tile speed — 21.6
% speeds >50km/hr — 0%

Figure 6 **Gulgong Town Centre existing traffic pattern**

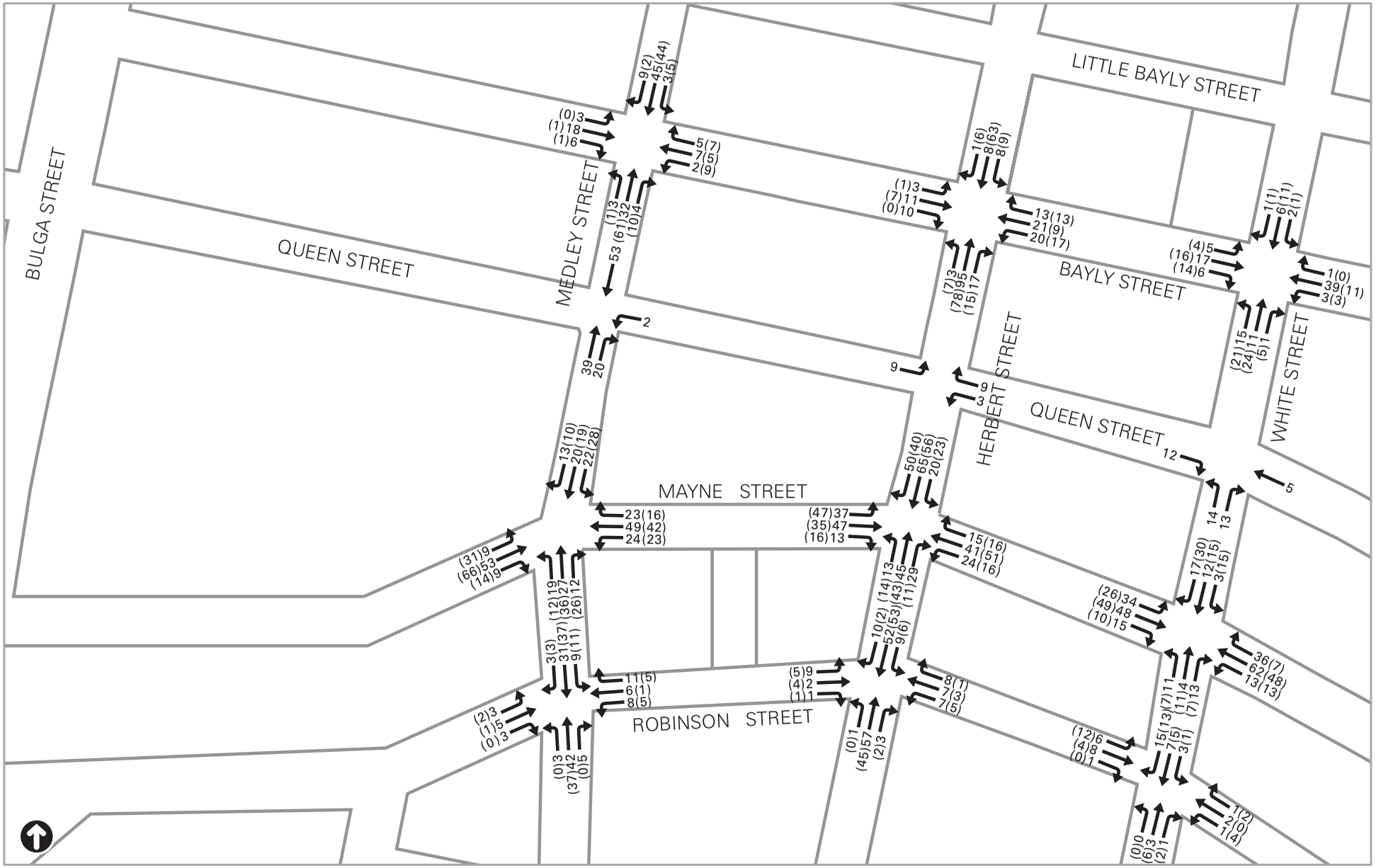


Figure 7 **Gulgong Town Centre intersection counts**

53 Weekdays (3.30pm - 4.30pm)
(45) Saturday (11.00am - 12.00pm)

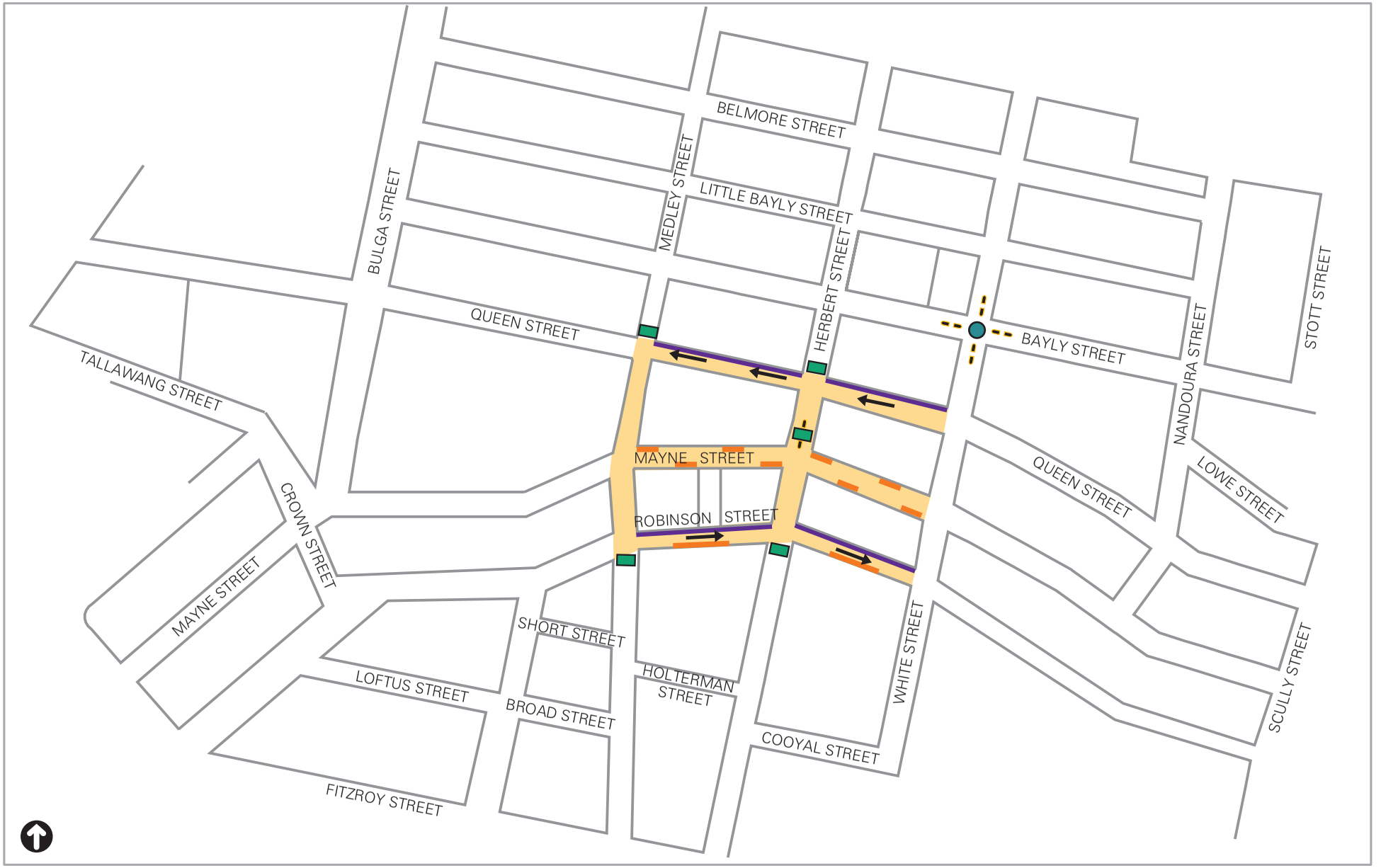


Figure 8 **Gulgong Town Centre preferred traffic management plan**

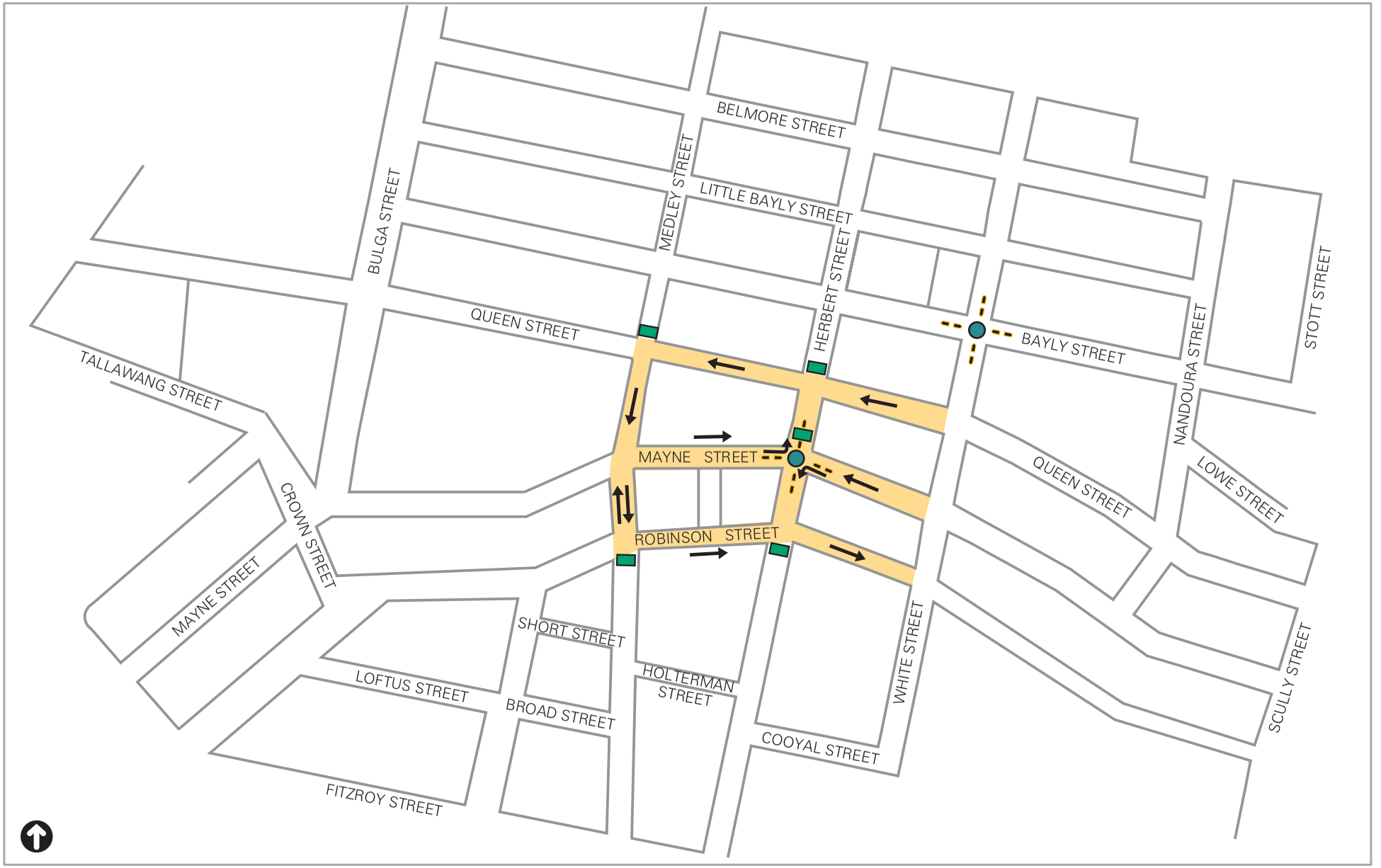


Figure 9 **Gulgong Town Centre alternative traffic management plan**

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