Concept Design Options Report

Beech Street Traffic Calming

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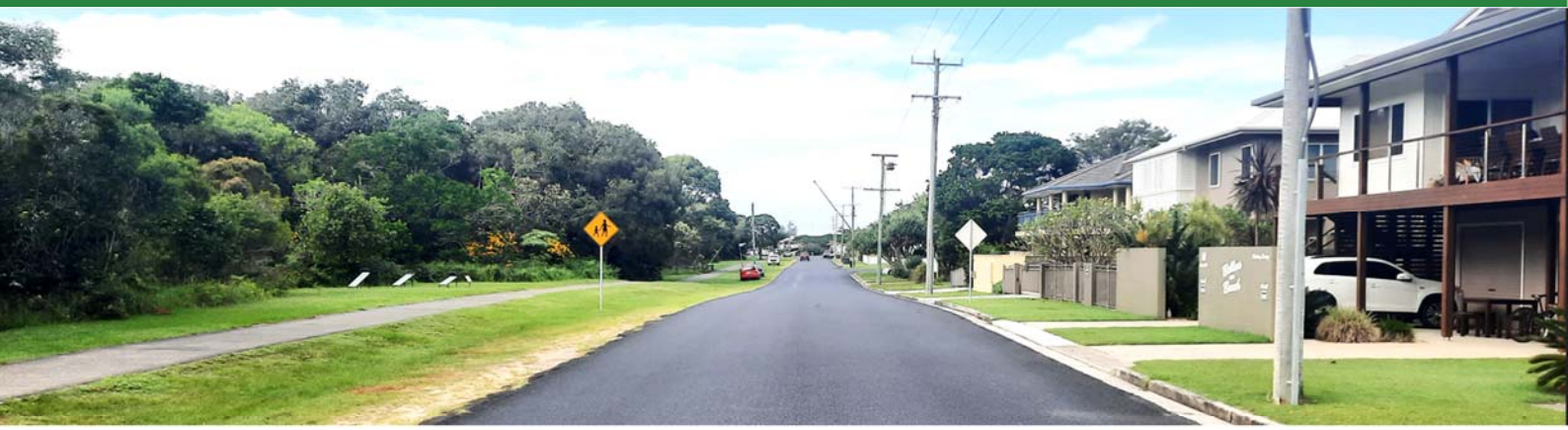

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1. Introduction

1.1 Background

Richmond Valley Council require investigation and design of appropriate traffic calming infrastructure for Beech Street in Evans Head, which is currently experiencing motorists travelling well above the 50 km/h sign posted speed limit, particularly during the morning and afternoon peak periods.

Potential options may include sections of narrowed roadway, chicanes, raised intersections etc. but should not include devices such as speed hump which are known to negatively impact the amenity due to noise.

A speed cushion was installed by Council adjacent to No. 59 Beech Street in 2017. However, this was removed shortly thereafter following complaints of noise caused by the device.

1.2 Objectives

The objectives of this project include:

- Physically altering the carriageway within the study area to slow traffic.
- Maintaining or improving safety for all road users, including cyclists and pedestrians.
- Maintaining an acceptable level of efficiency for motorised traffic given the estimated daily traffic volumes of around 2,500 vehicles per day.
- Maintaining a comfortable bus route.
- Improving the overall amenity of the street.
- Minimising capital and maintenance costs.

1.3 Study Area

The study area for this project is the Beech Street carriageway between Currajong Street and Booyong Street, refer to **Figure 1.1** below.

Beech Street is commonly used as a thoroughfare for commuter and tourist traffic travelling from Broadwater in the north to village centre of Evans Head in the south, and vice versa. Its carriageway comprises a sealed pavement approximately 8.0 m wide measured between the edges of bitumen. There is upright kerb and gutter for the full length on the western side, and no kerb or gutter on the eastern side. The alignment is relatively straight running parallel to the ocean, with a minor change of horizontal direction at the Ash Street intersection. The vertical alignment includes a number of gentle crests and sags. Drainage is provided by several kerb inlet pits and a piped stormwater network.

There is a shared path parallel to Beech Street on the eastern side of the carriageway separated from the road by between 2 and 7 m of grassed verge. The shared path forms part of Richmond Valley Council's extensive path network, connecting the recreational areas near Evans Head's southern breakwall to Woodburn-Evans Head Road and Broadwater-Evans Head Road. Plans are underway to extend the network to provide unbroken access for pedestrians and cyclists all the way into Woodburn and Broadwater.

As there is no kerb on the eastern side of the road, several vehicles were observed to park on this verge space during the site investigation. The carriageway width also allows for parking on the western side of the road adjacent to the kerb. However, few cars were observed to be parking here.

Figure 1.1 Study Area

The section of Beech Street within the study area provides direct access to approximately 33 residential dwellings, some of which include two driveway crossovers onto Beech Street.

This section also includes four intersections, from north to south: Cudgerie Street, Carrabeen Street, Ash Street and an unnamed laneway. All side streets meet Beech Street with a standard 'give way' controlled t-intersection, with traffic travelling on Beech Street having priority.

The western side of Beech Street includes overhead powerlines with frequent power poles, spaced at approximately every 40 m. The poles close to the intersections include street lights. A Dial Before You Dig search also confirmed the presence of underground water supply and telecommunication services, both running within the western verge.

There are two 50 km/h speed limit signs for southbound traffic (one just south of Currajong Street and one just south of Cudgerie Street). There are also two 50 km/h speed limit signs for northbound traffic: one just north of Ash Street and one just south of Cudgerie Street, the latter sign installed on the right hand side of the carriageway. There is a 'Children' (W6-3) sign for north and southbound traffic located between Carrabeen and Cudgerie Streets, adjacent to No. 59 Beech Street.

The Northern Rivers Buslines operates three routes (660, 690 and 690) through Evans Head, totalling six services in each direction per day. School bus services and long distance regional services also operate within Evans Head. A number of these utilise Beech Street as part of their route.

1.4 Site Investigation

A site investigation was undertaken between 8:00 and 9:00 AM on Friday 12th of April 2024. The roadway was observed to be moderately busy, with several cars passing every minute.

Many cars were observed parking on the grassed verge between the roadway and the shared path. In particular, there were numerous construction vehicles parked between Ash and Booyong Streets

associated with redevelopment works taking place at No. 23 Beech Street. Only one car was observed parked on the western side of the road adjacent to the kerb and gutter.

Many garbage bins were observed on the western verge as the site visit coincided with the Council's kerbside bin collection day.

A small number of pedestrians were observed utilising the shared path, including members of the public walking dogs. One such local resident confirmed that speeding along Beech Street is an issue and that a similar problem exists on Heath Street, which runs parallel to Beech Street to the west.

1.5 Traffic Data

Richmond Valley Council has provided traffic data collected from various locations within the study area in the last five years. The data received is summarised in the following table.

Table 1.1 Summary of Traffic Data

Date and Location	AADT (veh/day)	Recorded Speeds (km/h)	Exceeding 50 km/h limit
2017 No. 59 Beech Street (assumed)	2083	Mean speed: 52.6 85th percentile speed: 59.0	64.5%
2019 (16/04 to 30/05) During speed cushion installation No. 65 Beech Street	2149 9.8% HV	Mean speed: 42.3 85th percentile speed: 49.3 Approach to cushion: 44.1 Departure from cushion: 51.8	12.8%
2019 (16/04 to 30/05) During speed cushion installation No. 53 Beech Street	2172 4.4% HV	Mean speed: 41.5 85th percentile speed: 47.8 Approach to cushion: 44.6 Departure from cushion: 53.1	8.9%
2019 – After speed cushion removal No. 65 Beech Street	2140	Mean speed: 50.4 85th percentile speed: 56.5	51.5%
2019 – After speed cushion removal No. 53 Beech Street	2179	Mean speed: 48.9 85th percentile speed: 55.1	42.5%
2024 (15/01-21/02) No. 83 Beech Street	2451 9.1% HV	85th percentile speed: 51.0	Approx. 30%

Notes: Speed cushion was installed at No. 59 Beech Street.
AADT = Estimate of the average annual daily traffic volume
HV = Heavy vehicles

The data shows that there has been a significant proportion of motorists exceeding the 50 km/h speed limit within Beech Street. It also shows that this issue was dramatically lessened in the vicinity of the speed cushion for the duration that the speed control device was installed. Of particular interest is that the speeds of vehicles departing the speed cushion were measured to be above the speed limit, suggesting that the device is only providing speed attenuation in the short distance approaching the cushion.

Also of interest is the most recent data, which indicates the 85th percentile speed is only slightly above the speed limit, at 51 km/h. However, it is important to note the location of the tube counter, being very close to the northern end of Beech Street, only 50 m or so from the roundabout intersection with Currajong Street. Motorists would be unlikely to speed so close to the intersection. It is possible that the 85th percentile speed is higher further south along Beech Street where there are no physical impediments to influence traffic to maintain the sign posted speed limit.

2. Discussion of Options

2.1 Relevant Standards and Guidelines

The relevant guidelines relating to the selection and use of traffic calming devices is the Austroads Guide to Traffic Management, specifically *Part 8: Local Street Management* (AGTM08, Ed. 3.0, Austroads, 2020) (formerly *Local Area Traffic Management*).

2.2 Traffic Calming

The AGTM08 provides the Shorter Oxford English Dictionary definition of 'traffic calming', as follows: *"The deliberate slowing of road traffic, especially through residential areas, by narrowing or obstructing roads."* Another definition offered by AGTM08 is, "*…the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behaviour and improve conditions for non-motorised street users*." Thus, it is understood that traffic calming, particularly within a local street setting, deals with the installation of physical devices to cause traffic to slow down.

The primary aim of traffic calming is to change driver behaviour, both directly by physical influence on vehicle operation, and indirectly by influencing the driver's perceptions of what is appropriate behaviour in that street.

At present, Beech Street offers a relatively wide, flat, and straight thoroughfare for motorists, with good sight distances, and 800 m of priority roadway. Although there are several intersections within this length, unless the motorist needs to turn into one of these side streets, they have little cause to slow down.

Traffic calming measures can be implemented to slow traffic by:

- Shortening forward sightlines for drivers, by landscaping, for example.
- Limiting sections of street between slow/stop conditions to under 200 m.
- Reducing the available carriageway width and/or introduce deflections in the vehicle path.

2.3 Vertical Versus Horizontal Controls

Several options for traffic calming are presented and discussed at detail in the AGTM08. The devices fall into two primary categories:

- Vertical speed controls, such as:
  - Roam humps
  - Speed cushions
  - Raised intersections / plateaus
- Horizontal displacement devices, such as:
  - Lane narrowing
  - Slow points
  - Chicanes
  - Central islands / median
  - Roundabouts

The guide provides data regarding the expected effectiveness of each device, generally with respect to the speed differential and the zone of influence.

2.3.1 Vertical Controls

In general, the devices that involve a vertical change in the roadway (e.g. speed humps) offer the greatest reduction in speed, as they necessitate motorists to drop their operating speeds to 20-35 km/h. However, they have a relatively small zone of influence (i.e. they are typically only effective in reducing speeds within 50 m of the approach to each speed hump).

Vertical controls are not recommended on bus routes or streets without adequate lighting, and have a negative side effect of noise generation, especially for utility vehicles with metal trays etc.

Beech Street forms part of a daily bus route and only has minimal street lighting (i.e. a single lantern) at each intersection, with no lighting between intersections. A previously installed speed cushion resulted in complaints from residents regarding the resultant noise. It is for these reasons that vertical controls have been excluded from this options assessment.

2.3.2 Horizontal Controls

Horizontal displacement devices such as slow points, kerb blisters, chicanes, and central medians can be retrofitted to an existing road carriageway for the purpose of traffic calming. Roundabouts also offer horizontal displacement and are effective at slowing traffic. Full sized roundabouts require considerable space and can be very costly to construct, however there are ‘mini roundabouts’ typically made from prefabricated recycled rubber modular components which can be installed at existing intersections in a matter of days.

Several horizontal controls have been considered as part of this project, as detailed in subsequent sections of this report. Horizontal controls that narrow the carriageway to a single lane have not been considered. Although such treatments are generally expected to result in a lower speed compared to options that retain two-way traffic, the traffic volumes on Beech Street are not conducive to one-lane narrowing and the impact on efficiency is expected to be unacceptably severe.

2.4 Materials and Construction

Many of the horizontal control devises such as blister islands, central medians and small diameter roundabouts can be installed using prefabricated recycled rubber components, thus significantly reducing construction costs and times. Multiple kerbed islands and/or roundabouts can be constructed in one day, whereas their traditional concrete counterparts would require a number of weeks. They are also easier to remove, if required, as they don’t require excavation or removal of the existing road surface.

The recycled rubber kerbs, available from a number of manufacturers, can be produced in semi-mountable (230 mm wide x 125 mm high) or semi-barrier (150 mm wide x 150 mm high) kerb profiles. Curved sections are also available to allow for various shaped blister or median islands to be created. Each component is installed by drilling directly into the existing road surface and fixing in place with epoxy and coach bolts. The infill of each constructed island can be compacted gravel with landscaping or an impermeable surface.

It is recommended that prefabricated recycled rubber products be used where possible for the construction of traffic calming devices in Beech Street for the following reasons:

- Significantly reduced construction costs.
- Significantly reduced construction times.
- Reduced disruption to road users and loss of amenity to residents during construction.
- Sustainable materials.
- Durable materials requiring little to no maintenance if properly installed.

2.5 Other Considerations

Changes made to the street for the purpose of traffic calming provide opportunities for supplementary benefits. These may include the provision of landscaping resulting in street beautification, and pedestrian refuge islands to aid movement of pedestrians. However, traffic calming, particularly frequent narrowing and widening of the road carriageway can result in a reduced level of safety for on-road cyclists. Although there is an off-road shared path adjacent to Beech Street, the safety and efficiency for cyclists choosing to travel within the road carriageway must be considered as part of the design and options assessment.

Another aspect to be taken into consideration during the design process is to ensure that the final design does not introduce confusion for any road users, as this can lead to collisions. As such, it is recommended that the range of devices and treatments selected are kept to a minimum (i.e. apply the same treatment to each intersection rather than a different treatment to each intersection). It is also recommended to ensure that priorities for all road users is clearly delineated.

Finally, it is important to consider all traffic, including trucks (such as garbage trucks), buses and other heavy vehicles. The design will need to check that heavy vehicles are able to safely and efficiently navigate any proposed traffic calming devices without causing damage to the device, discomfort to the vehicle occupants, or unnecessary delays to the flow of traffic.

3. Proposed Options

3.1 Midblock Treatments

Several mid-block options are considered to be appropriate to slow traffic within the study area. The options include:

3.1.1 Continuous Central Island

Narrowing the existing travel lanes can be achieved by adding a painted 2 m wide central median island, reducing the lane widths on either side of the median to 3.0 m. Short sections of raised central median islands can also be employed in locations where they will not impact existing driveways, and/or at the approach to each intersection (Cudgerie, Carrabeen and Ash Streets). All parking on the western side of the road would be lost and parking on the eastern side of the road would need to remain on the grassed verge (i.e. parking could not be accommodated within the sealed carriageway).

Figure 3.1 Continuous Central Island

3.1.2 Blister Islands

Kerb extensions or blister islands can be installed on both sides of the road at intervals of 60-90 m, narrowing the carriageway for a short distance and providing a visual break in the roadway for drivers. Between the pairs of blister islands the carriageway would remain as it currently is.

Alternatively, blister islands could be installed on the eastern side of the road only, and combined with banks of formalised parking bays, thereby narrowing the full length of the road to provide two 3 m travel lanes. This may require some minor widening of the existing pavement to ensure sufficient width is available.

Another alternative would be to combine the pairs of blister islands with the painted central median island, again reducing the travel lane width for the full length of the road as well as introducing a more defined horizontal deflection in the required travel path for drivers. In this alterative, it would likely be sufficient to include only one set of blister islands between each intersection (i.e. 4 sets in total), whereas it would be recommended to have a higher frequency with Alternatives 1 and 2.

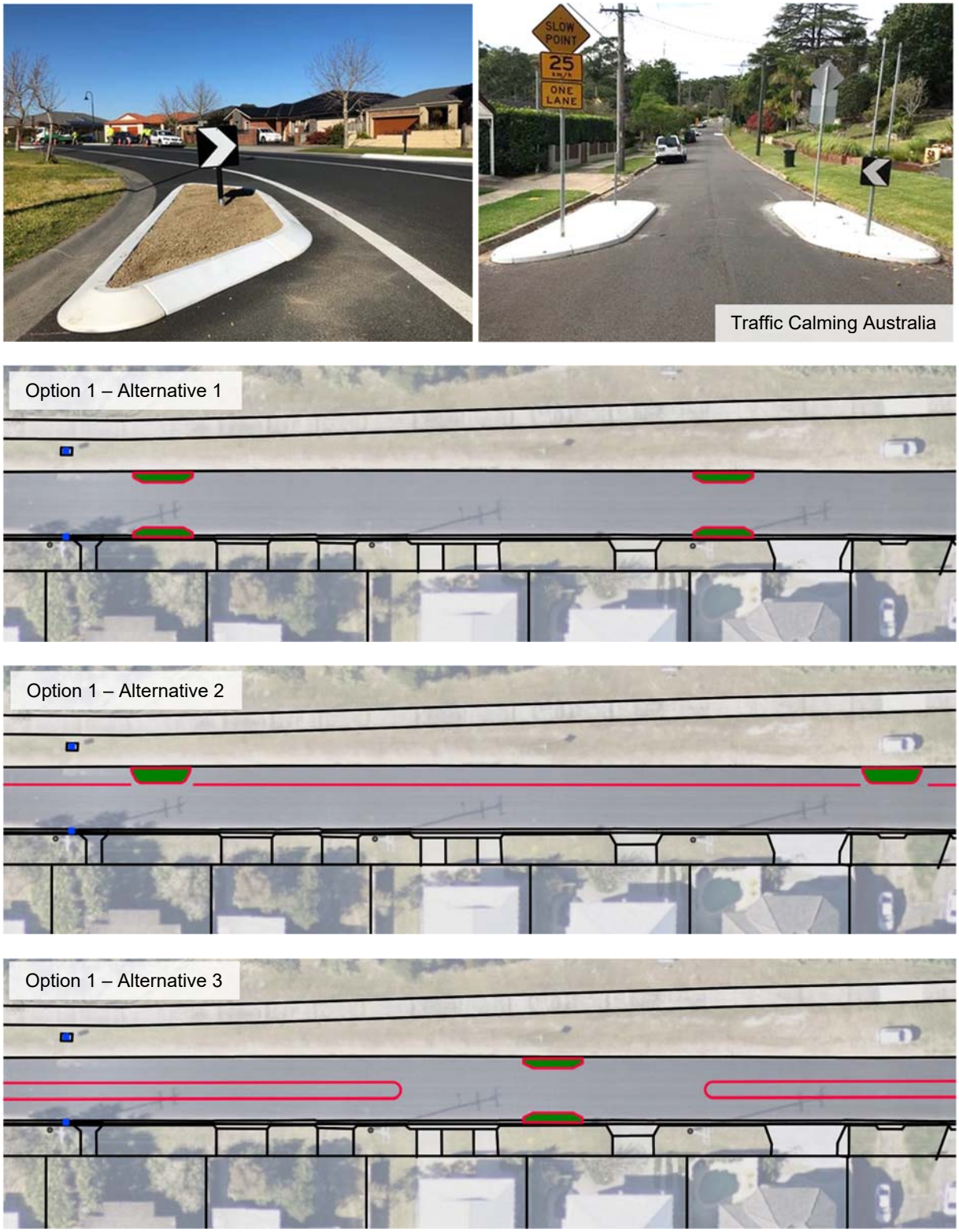

Figure 3.2 Blister Islands

3.1.3 Central Islands

Similar to kerb blister islands, these would be installed at intervals of 60-90 m. They would also narrow the carriageway for a short distance and provide a visual break to the forward sightline available for drivers. For best results, the central islands would be accompanied by small kerb blisters on the approach to the central island to generate a greater deviation in the horizontal path of the vehicle. Central islands with kerb blisters on the departure side of the island (i.e. four blisters per central island) were also considered, however the frequency of driveways on the western side of the road meant this arrangement would not be possible.

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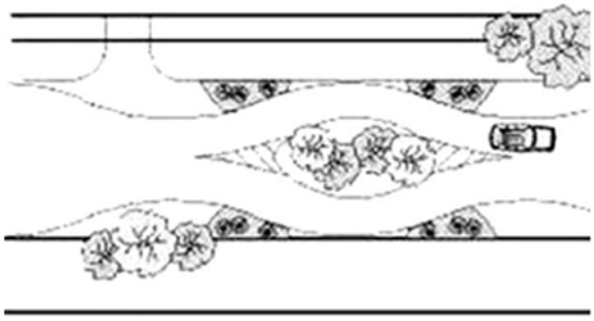

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Figure 3.3 Central Islands

A variation to central island is the chicane, which elongates the horizontally deflected vehicle path. Both variations of the central island can be further varied to include formalised parking on the eastern side of the road, if this is desirable to Council. This arrangement is shown in **Figure 3.5**.

An alternative to reduce works (and therefore costs) is to provide only one central island or chicane between each intersection, making it more elongated to extend its zone of influence. If this option is chosen, it is highly recommended to combine it with an intersection treatment (refer to **Section 3.2**).

Figure 3.4 Chicanes

3.1.4 Comparison of Midblock Treatments

The following table aims to provide a comparison of the three options and alternatives (where offered) proposed in this section. Quantitative rankings of cost and effectiveness are based on information provided in AGTM08 and the relative quantity of materials and works.

Table 3.1 Comparison of Mid-block Traffic Calming Options

Assessment Criteria	Option 1 Continuous Central Island	Option 2 Kerb Blister Islands	Option 3 Central Islands / Chicanes
Location	Painted island along full length Raised islands at each intersection (i.e. one pair at each intersection)	Alt. 1: One pair between Carrabeen and Ash, two pairs between each other intersection. Alt. 2: One island between Carrabeen and Ash, two between each other intersection. Alt. 3: One pair between each intersection.	Alt. 1 and 2: One set between Carrabeen and Ash, two sets between each other intersection.
Number. of islands	3 pairs. Total no. Islands = 6	Alt. 1: 7 pairs = 14 Alt. 2: 7 islands total Alt. 3: 4 pairs = 8	7 sets, each set comprising one larger central island and two smaller kerb extension islands. Total no. Islands = 21
Total area of islands	50 m²	Alt. 1: 116 m² for 7 x pairs of blisters Alt. 2: 92 m² for blisters on east side only Alt. 3: 120 m² if combined with Option 1)	Alt. 1: 160 m² Alt. 2: 260 m² if combined with formalised parking lane)
Number of signs *KL = Keep Left R2-3, UHM = Unidirectional Hazard Marker D4-1-2*	12 KL	Alt. 1: 14 UHM Alt. 2: 7 UHM Alt. 3: 8 UHM	Alt. 1 and 2: 28 (14 KL, 14 UHM)
Impact on parking	Informal (on grass verge) parking retained on eastern side. Parking on western side will not be possible.	Alt. 1: Informal (on grass verge) parking retained on eastern side, with small loss in in the vicinity of blister islands. Kerbside parking retained on western side, with small loss in the vicinity of blister islands. Alt. 2: Formalised parking on the eastern side, loss of all parking on the western side. Alt. 3: Informal parking retained on eastern side, loss of all parking on the western side.	Alt. 1: Retain informal parking on both sides with some loss in vicinity of the islands. Alt. 2: Combine with a formalised (linemarked) on-road parking lane on the eastern side, which would result in loss of all parking on the western side.
Compatible intersection treatments	Compatible with Symmetrical Modified T-Intersection and Roundabout. Incompatible with Asymmetrical Modified T-Intersection.	Compatible with all three intersection options and recommended to be combined with an intersection treatment.	Compatible with all three intersection options and recommended to be combined with an intersection treatment, however, could be used without an intersection treatment.

Assessment Criteria	Option 1 Continuous Central Island	Option 2 Kerb Blister Islands	Option 3 Central Islands / Chicanes
Advantages	■ Low cost. ■ Reduces lane width fore full road length. ■ Retains all informal parking to the east. ■ Can be combined with Option 2 to introduce horizontal displacement. ■ Can be combined with intersection treatment (refer **Section 3.2**) to improve effectiveness or utilised without additional intersection treatments.	■ Lower cost compared to Options 3 due to less materials and signage. ■ Provides opportunities for landscaping. ■ Retains most parking on the eastern and western sides of the road. ■ Alt. 2 and 3: Reduces lane widths for full length of roadway, providing additional traffic calming.	■ More effective at reducing traffic speeds than kerb blister islands (Option 2). ■ Breaks up forward sightline better than Option 2. ■ Provides opportunities for landscaping. ■ Alt. 2: Reduces lane widths for full length of roadway, providing additional traffic calming.
Disadvantages	■ No horizontal displacement, therefore low effectiveness rating. ■ Does not break up forward sightline for motorists. ■ Loses all parking on western side of the road (i.e. greater loss than Options 2 and 3)	■ Needs to be combined with one of the intersection treatment options for best results, increasing costs. ■ Alt. 2 and 3: Loss of all parking on the western side of the road.	■ Loss of parking to both sides off the road (greater than Option 2) ■ If combined with one of the intersection treatment options, costs would increase to make this option the most expensive. ■ Creates pinch point for on-road cyclists. ■ Alt. 2: Loss of all parking on the western side of the road.
Effectiveness ranking (1 = low, 4 = high)	1 (without intersection treatment) 2 (with intersection treatment)	Alt. 1: 2 (with intersection treatment) Alt. 2: 3 (with intersection treatment) Alt. 3: 3 (with intersection treatment)	Alt. 1: 3 (without intersection treatment) Alt. 1: 3.5 (with intersection treatment) Alt. 2: 3.5 (without intersection treatment) Alt. 2: 4 (with intersection treatment)
Construction cost ranking (1 = low, 4 = high)	1 (without intersection treatment) 2 (with intersection treatment)	Alt. 1: 2 (with intersection treatment) Alt. 2: 4 (assuming some pavement widening is required) (with intersection treatment) Alt. 3: 3 (with intersection treatment)	Alt. 1: 3 (without intersection treatment) Alt. 1: 3.5 (with intersection treatment) Alt. 2: 3.5 (without intersection treatment) Alt. 2: 4 (with intersection treatment)

3.2 Intersection Treatments

There are several options for intersection treatments to slow through traffic considered suitable for this area. To avoid confusion and maximise amenity, each option proposes to employ the same traffic calming device at all three intersections within the study area.

3.2.1 Central Median Islands

Median islands (as shown in **Section 3.1** Option 1) can be used at each of the three intersections within the study area (Cudgerie Street, Carrabeen Street and Ash Street). These would not alter the travel path of vehicles, however they will provide a narrowing of the travel lanes periodically along Beech Street which would act as a traffic calming device.

Figure 3.5 Central Median Islands

3.2.2 Asymmetrical Modified T-intersection

Installation of two kerb extension islands as shown in **Figure 3.6** to narrow the roadway and slightly divert the course of traffic through the intersection. This option is best suited to include an alteration of the pavement through the intersection in some way, (e.g. stencilled with a solid colour or a paver pattern) to reinforce the presence of the altered carriageway.

This option is also best suited to being combined with one of the midblock treatments that includes formalised parking on the eastern side of the road, such as Option 2 Alternative 2 (**Figure 3.2**) or Option 3 Alternative 2 (**Figure 3.4**).

3.2.3 Symmetrical Modified T-intersection

Similar to the asymmetrical version, this treatment involves the installation of raised traffic islands to divert the traffic flow path through the intersection (refer to **Figure 3.7**). Applying a treatment to the pavement surface may also be advantageous to slow traffic.

This treatment can easily be combined with any of the midblock treatments.

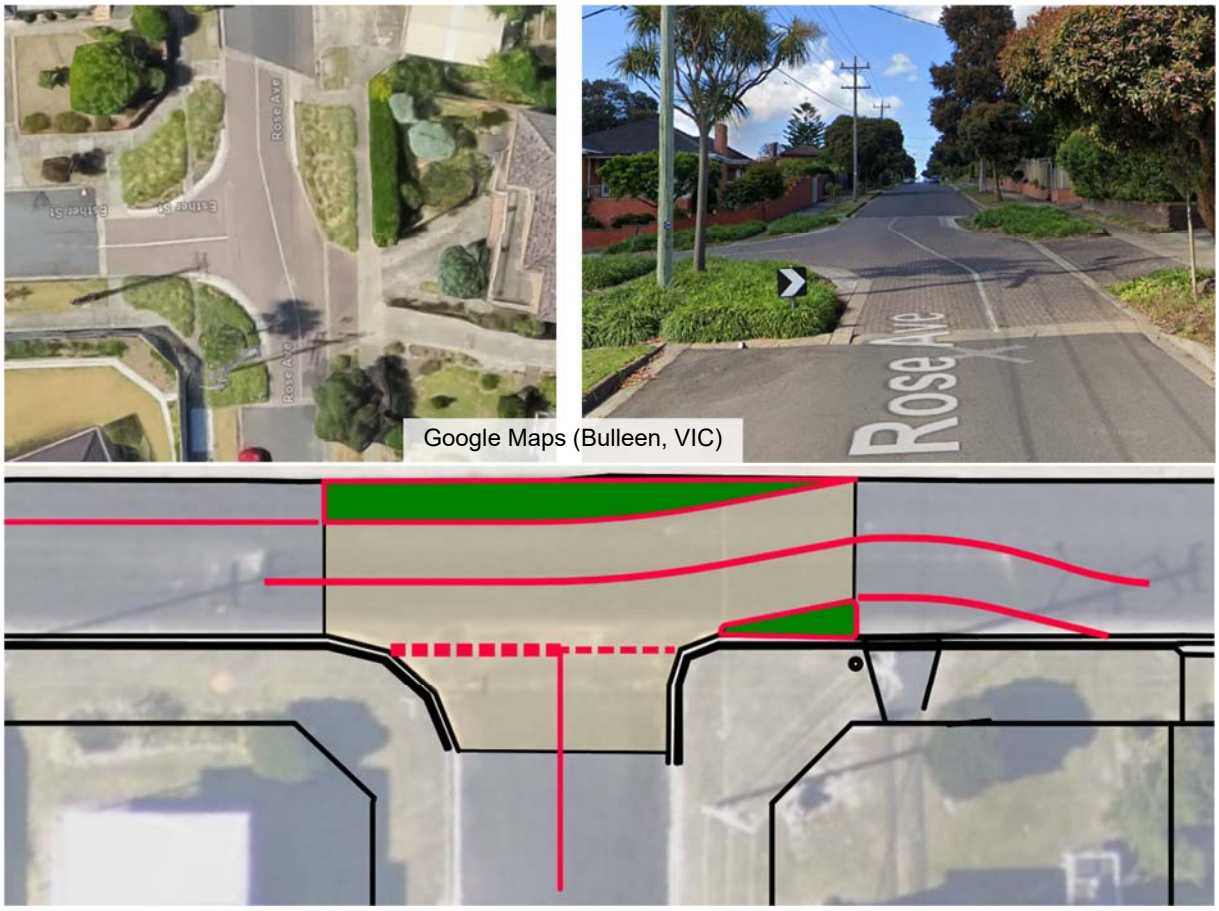

Figure 3.6 Asymmetrical Modified T-intersection

Figure 3.7 Symmetrical Modified T-intersection

3.2.4 Rubber Roundabout

'Mini' rubber roundabouts with a central annulus radius of around 4-5 m could be constructed at each of the three intersections within the study area along Beech Street. In addition to the central annulus, the treatment would also require a small splitter island on each leg and small kerb blister islands, as shown below, to generate sufficient deflection for southbound vehicles. Thus, this option would result in the greatest capital cost. However, it would also be the most effective in terms of slowing traffic.

Given the high cost and high efficiency, it would be considered satisfactory to pair this intersection treatment option with a scaled-back variation of the midblock treatment options. For example, one set of kerb blister islands, central island or chicane between each intersection in lieu of two.

Figure 3.8 includes an example of the rubber roundabout paired with formalised parking on the eastern side of the road.

Figure 3.8 Roundabout

3.2.5 Comparison of Intersection Treatments

The following table aims to provide a comparison of the four options proposed in this section. Quantitative rankings of cost and effectiveness are based on information provided in AGTM08 and the relative quantity of materials and works.

All intersection treatment options are proposed to be applied at all three intersection within the study area: Cudgerie Street, Carrabeen Street and Ash Street.

All options are considered to provide small opportunities for landscaping and street beautification.

Table 3.2 Comparison of Intersection Traffic Calming Options

Assessment Criteria	Option A Median Islands	Option B Asymmetrical Modified T	Option C Symmetrical Modified T	Option D Roundabout
Number. of islands and total area of islands	3 pairs. Total no. Islands = 6	3 pairs. Total no. Islands = 6	3 sets, each set comprising two median islands, a splitter islands and a large kerb blister island. Total no. Islands = 12	3 sets, each set comprising a central annulus, three splitter islands and two kerb blisters. Total no. Islands = 18
Total area of islands	50 m²	150 m²	160 m²	132 m²
Number of signs	15 (3 GW, 12 KL)	9 (3 GW, 6 UHM)	15 (3 GW, 12 KL) *Could omit the Keep Left signs*	33 (9 RAB, 9 KL, 15 UHM)
GW = Give Way R1-2, KL = Keep Left R2-3, UHM = Unidirectional Hazard Marker D4-1-2, RAB = Roundabout R1-3				
Compatible mid-block treatments	Compatible with all options. Best suited to Option 1.	Incompatible with Option 1 (continuous central island). Best combined with formalised on-road parking.	Compatible with all options.	Compatible with all options.
Effectiveness ranking (1 = low, 4 = high)	1	2	3	4
Construction cost ranking (1 = low, 4 = high)	1	2 (or 3 if pavement widening is required)	3	4
Advantages	■ Low cost.	■ Easily combined with formalising parking on eastern side of the road.	■ Easily combined with any midblock treatment options to maximise effectiveness. ■ Could remove splitter island to reduce costs.	■ Most effective at reducing traffic speed. ■ Provides break is forward sightline for motorists.
Disadvantages	■ Least effective at reducing traffic speeds. ■ Does not assist with reducing forward sightlines.	■ Only mildly effective at reducing traffic speeds. ■ Does not assist with reducing forward sightlines.	■ Not well suited to chicanes.	■ High cost due to number of components and signs required.

4. Options Assessment

4.1 Assessment Matrix

The following matrix has been prepared in an effort to evaluate the various combinations of options. Scores have been provided for effectiveness ('E') and construction costs ('$'), where a low 'E' score signifies relatively low effectiveness with respect to slowing traffic, and a low '$' score represents relatively low construction costs.

	Option 1 Continuous Central Island	**Option 2 (alt. 1)** Kerb Blister Islands	**Option 2 (alt. 2 & 3)** Kerb Blister Islands and lane narrowing	**Option 3** Central Islands / Chicanes
Option A Median Islands	E = 1 $ = 1	E = 2 $ = 1.5	E = 2.5 $ = 1.5	E = 3 $ = 2
Option B Asymmetrical Modified T	*Not recommended*	*Not recommended*	E = 3 $ = 2	E = 3.5 $ = 3
Option C Symmetrical Modified T	E = 2 $ = 2	E = 2.5 $ = 2.5	E = 3 $ = 3	E = 3.5 $ = 3
Option D Roundabout	E = 3 $ = 3	E = 3 $ = 3.5	E = 3.5 $ = 4	E = 4 $ = 4

It is important to note that all options above are considered to be somewhat effective, with even the lowest scoring combination of a continuous painted central island and straight median islands at the intersections (E = 1) is expected to slow traffic.

It should also be noted that the treatments expected to be highly effective at slowing traffic are likely to also deter through traffic. This will result in the side effect of pushing more traffic onto alternative routes, such as Heath Street, which may simply transfer the problem from one location to another. As such, consideration should be given to excluding the combination of treatments with high 'E' ratings. The 'highly effective' options are also associated with the highest construction costs, as they require the most components added to the roadway, which is another reason to consider exclusion.

4.2 Recommendations

There are many options available to slow traffic within Beech Street, without using vertical deflection (e.g. speed humps) and without the need for major roadworks. All options considered in this report are expected to be easily retrofitted into the existing road carriageway, with construction costs minimised by using prefabricated recycled rubber kerbing to construct traffic islands to vary the horizontal travel path of vehicles.

When selecting the right treatment for this project, the following aspects are to be considered:

- Minimise the variety of controls used to avoid confusion e.g. use the same treatment at all intersections rather than different treatments at different intersections.
- Ensure priority at the intersections is made clear.
- Avoid highly unusual arrangements that may result in distraction, confusion and collision.
- Ensure heavy vehicles movements (including garbage trucks and buses) are possible through all slow points and intersections (symmetrical modified t-intersections with raised median islands are not compatible with bus or truck turning movements, but painted islands can be used).
- Avoid creating pinch points that could be hazardous for on-road cyclist (e.g. chicanes).
- Avoid over-treating the study area, thereby pushing through traffic onto other local streets and effectively relocating the problem from one location to another.
- The issue is affecting the local residents living in Beech Street and/or utilising the Beech Street shared path. It is important to ensure that whatever is proposed is amenable to the existing residents.

Also of importance is the impact on parking within Beech Street. Some options result in significant loss of parking, some utilise the existing informal parking on the grass verge to the east of the roadway, and some formalise the parking within the carriageway.

Considering all of the above, the following combination of options are recommended:

- To retain as much parking as possible:
  - Kerb blister islands (Alternative 1), with 7 pairs of islands
  - Symmetrical Modified T-Intersection with painted islands in lieu of raised islands at Cudgerie, Carrabeen and Ash Streets
  - Spacing between slow points = 55 to 75 m

  Or to reduce works:

  - Kerb blister islands (Alternative 1), with 4 pairs of islands
  - Symmetrical Modified T-Intersection with painted islands in lieu of raised islands at Cudgerie, Carrabeen and Ash Streets
  - Spacing between slow points = 80 to 100 m

- If parking for the majority of one side of the road is deemed sufficient:
  - Kerb blister islands (Alternative 2), with 7 islands in total
  - Asymmetrical Modified T-Intersection at Cudgerie, Carrabeen and Ash Streets
  - Spacing between slow points = 55 to 75 m

  Or to reduce works:

  - Kerb blister islands (Alternative 2), with 4 islands (i.e. one between each intersection)
  - Asymmetrical Modified T-Intersection at Cudgerie, Carrabeen and Ash Streets
  - Spacing between slow points = 80 to 100 m

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