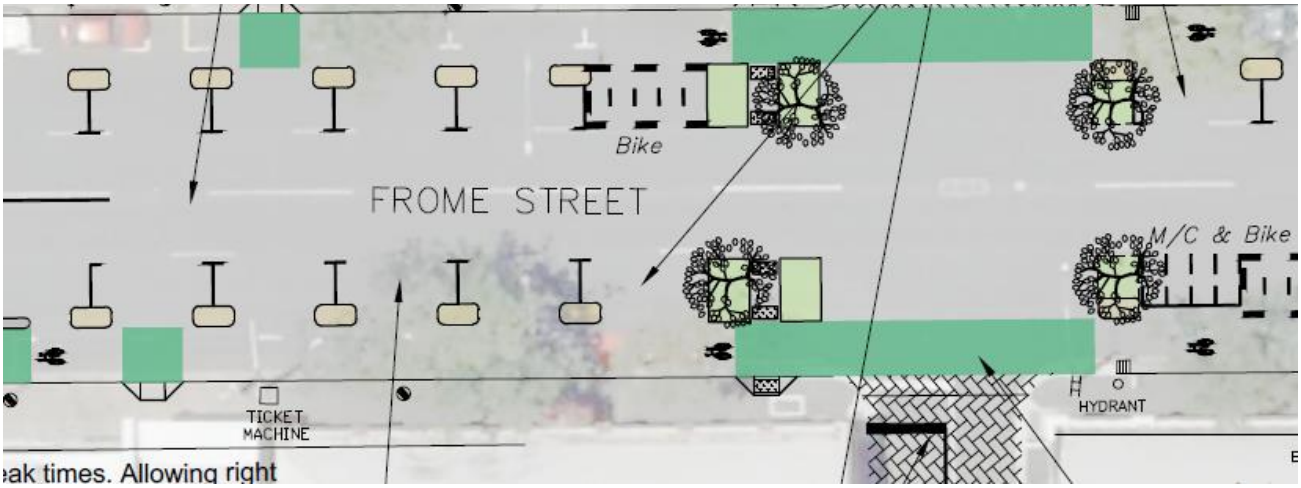
Bikeway Design Charrette – design discussion paper

At ACC's Bikeways Design Charrette, attendees were asked to assess several typologies (basic layouts) for future bikeways – including suggesting any typologies not already covered. These boiled down to three configurations for a one-way bikeway on both sides of the street:

1. At road level, separated from the footpath by the existing kerb and separated from the car lane by a new kerbed separator
2. At footpath level, separated from the footpath by paint or a tactile surface and separated from the car lane by a new kerb
3. At mid-level, separated from the footpath by a half-height kerb and from the car lane by another half-height kerb.

A fourth typology, that of a two-way bikeway on one side of the street, was strongly opposed for reasons of safety and convenience.

The existing Frome Bikeway falls into the first typology, more or less as shown in this image from the original design concept:



This concept showed a separator between the bike lane and parking, which widened out in some places (next to side streets) to accommodate trees. A complaint of those opposed to the existing Frome Bikeway is that this did not occur and the landscaping areas that were provided were not constructed to allow trees to be planted at a later date.

The other major consideration is, of course, that Councillors want to retain two through traffic lanes in peak hour, which means widening the car parking to a traffic lane width.

Designs presented by ACC in the Charrette to help inform discussion took as a starting point a new bikeway width of 2.0m. The existing bikeway width is 2.7m. So is 2.0m enough? This is not actually a straight-forward question, and nor is whether or not the bikeway would in fact be 2.0m wide, even under the ACC assumptions.

This is the main subject of this examination.

1) Design guidance

There is no Australian Standard for separated bikeways. An "Australian Standard" is a document in a particular series prepared by Standards Australia. Standards Australia is basically a publishing house that commissions a group of experts to put together a national standard in response to an identified need, and knows the appropriate processes to develop a Standard to gain industry acceptance. Formal Australian Standards have standard formats and a numbering system starting with an AS designation for 'Australian Standard', e.g. *AS2890.1:2004 Off-street parking*.

For traffic engineering in Australia, Australian Standards for certain things exist – such as bike parking – but the guidance relied upon by practitioners is given in other documents prepared by Austroads. Austroads is an organisation comprising representatives from Australia and New Zealand at local, state/ territory and commonwealth levels, to promote safety and uniformity in the Australasian road systems.

Austroads has produced three guides for the planning, design and traffic management of the road system: the *Guide to Road Design*, the *Guide to Traffic Management* and the *Guide to Road Safety*. These *Guides* are an update and replacement for a previous series called the *Guide to Traffic Engineering Practice*. Part 14 of this covered cycling and was generally referred to as GTEP14. (NB This was published by Standards Australia, but was not in itself an "Australian Standard".)

Each of the *Guides* has several parts. The *Guide to Road Design* set costs $951 for the pdf version and $1,206 for the hardcopy, so purchasing all of these is a costly proposition. To make the cycling information more accessible, Austroads has summarised these bits in a document called *Cycling Aspects of Austroads Guides*, which is available in pdf version for free.

The Austroads *Guides* are guidelines to be interpreted, not standards to be adhered to. (In particular, as Austroads members tend to come from state government level, they're better at arterial roads and treatments tend to focus on these, so some guidelines should be interpreted for use on local streets.) However, Australian legislation that permits authorised people to (and stops unauthorised people from) changing public roads can require that certain guidelines be followed. In SA, the legislation references a DPTI document, which for cycling requires compliance with the Austroads *Guides*.

Currently, the Austroads *Guides* aren't very thorough in terms of separated or exclusive bike lanes – the treatment underpinning the Frome Bikeway. ("Bikeway" is a label applied to identify a route, not a type of treatment.) For this reason, Queensland's Dept of Transport and Main Roads (TMR) has developed its own guidelines: *Separated Cycleways Guideline* (March 2014). This is expanded upon somewhat by *Technical Note 128, Selection and Design of Cycle Tracks* (2015), and both of these reference the Traffic and Road Use Management (TRUM) manual *Technical Note: Calculating the Widths of Shared Paths and Separated Bicycle Paths*, which seems to be basically the same as TMR's *Technical Note 133 Guidance on the widths of shared paths and separated bicycle paths* (November 2014). All except the TRUM Technical Note are easily and freely available.

The Qld TMR guidance is more or less best practice in Australia at the present time and its advice has been accepted by DPTI. Qld TMR calls separated bike lanes 'cycle tracks'.

2) Capacity and width

From permanent counters embedded in the Frome Bikeway, combined with Super Tuesday counts, we know that:

- at its most popular point (between Flinders Street and Pirie Street)
- on average over the last two years
- on a weekday

the Frome Bikeway was used by about 97 north-bound cyclists in the peak hour (8am-9am), and 87 south-bound cyclists (5pm-6pm). This average was about the same for 2014-15 compared to 2015-16.

However, averages aren't that useful. These lumps together different seasons, public holidays, days of bad weather, etc. The highest volumes, occurring during the Clipsal closures, reached 220 cyclists/hour. Is this a better design base? Maybe, but in the end, both approaches only provide for what cycling currently exists, not for growth in cyclist levels. A more relevant question is, what width provides for what capacity?

Cycling Aspects of Austroads Guides is silent on how capacity is related to width (though more information may be available in the Guides it references). In Section 4.4.3 (regarding separated bicycle lanes – the formal name for the treatment, and including kerb separated bike lanes and protected bike lanes), the information provided is basically:

- Figure 4.6 shows a 'typical' cross-section for a one-way bike lane of 1.8m to 2.0m. This is at footpath level and also shows a 1m flush concrete strip to provide clearance to the footpath, to reduce conflict with pedestrians.
- Figure 4.7 shows a 'typical' cross-section between two kerbs, being 2.0m in width.

So 1.8m to 2.0m is 'typical', but there is no indication of the capacity this will cater for. Also, what about things that might erode this width?

Section 4.3.2 (exclusive bicycle lanes) notes that it is desirable for the channel (typically 0.4m in width) not to be included as part of the measured bicycle lane width due to potential safety concerns related to the join between roadway and channel, but also because of the risk of pedal strike. (This is where a cyclist riding close to the kerb hitting the pedal on the kerb. In the worst case, this could throw a cyclist off.) Figure 4.3 Typical bicycle/car parking lanes layout (parallel parking) shows the safety strip continuing past the face of kerb where parking is absent beside a kerb build out, indicating a required clearance of 0.6m to 1.0m to the face of kerb, although this is not shown in Figure 4.4 regarding angle parking. Hence there is some indication of kerbs and pedal strike being relevant to width, but this is far from being authoritative.

The (now superseded) GTEP14 contains better information linking width and capacity – and kerbs:

- Section 6.3.3: The capacity of a 1.5m path in one direction is about 150 cyclists/ hour; this is sufficient for a single stream of cyclists. Opportunities for passing require additional path width (minimum of 1.8m-2.0m) or passing using the other side of the path [in the case of a two-way path]

- Section 4.2.4: Capacity for bike paths can be applied to bike lanes. Surface conditions and edge clearances to kerb need to be considered in the assessment of capacity of bike lanes.
- Figure 3-1 Bicycle operating space: To the basic bicycle design envelope, a minimum 0.2m clearance must be provided to a kerb. [The basic bicycle design envelope is 1.0m, incorporating the rider/bicycle (0.8m) and essential manoeuvring space clearances on either side (0.1m). This is the same in the *Cycling Aspects of Austroads Guides*.]
- Figure 4-4 Vehicle positions on road carriageway associated with Exclusive Bicycle Lanes: This is consistent with Figure 3-1, showing a cyclist at 0.2m from a kerb but 0m where no kerb is provided (and presumably a smooth, clean surface is provided). With no kerb, two cyclists travelling abreast take up 2.0m i.e. double the design envelope for a single cyclist.

TMR's *Separated Cycleways Guideline* recommends in Section 3.4.1 a minimum cycle track width of 2.0m. A 2.0m wide one-way cycle track allows comfortable overtaking and allows bicycle riders to ride side by side. It then gives quite definitive width/capacity guidance:

Table 2: One-way cycle track dimensions (on each side of the road)

Peak hour Volume - (bicycle riders/hour)	Width (m)	Separator (without parking)	Separator (with parking)
0 – 150	2.0 m – 2.5 m	0 m – 1.0 m+	0.75 m – 1.5 m+
150 – 500	2.5 m – 3.5 m	0 m – 1.0 m+	0.75 m – 1.5 m+
>500	3.5 m – 4.5 m	0 m – 1.0 m+	0.75 m – 1.5 m+

This does not mention whether, or to what extent, the form of the separator (earlier defined as "a median, kerb, verge or buffer planting") might affect required width, and hence how authoritative the width requirements of Table 2 actually are.

Nor is it at all obvious where Table 2 came from. Research undertaken on 10 two-way shared paths and 2 two-way cycle-only paths in Queensland is the proximate base[1], and a model based on a threshold for delay of 12 delayed passages per hour. Looking at the research underlying this[2], Norwegian guidance would allow a segregated cycle path of 1.5m-2.0m for volumes of over 300 cyclists/hour – with the higher width relating to high pedestrian volumes on the adjacent footpath rather than cyclist volumes. Under Dutch guidance, for a path accommodating more than 150 cyclist an hour, the recommended bicycle path width is 3.5m-4.0m (the Queensland reviewers noted that this appears generous.)

In assessing bicycle only paths, the research took at its starting point a 2.5m path, based on Austroads guidance. They then calculated a capacity of 670 to 880 cyclists/ hour for one-way bike-only travel, depending on the acceptability level for delay; and noting that their model could not be applied to bike lanes of a width lower than 2.5m. (NB The researchers also note that Nørrebrogade in Copenhagen has two 2.5m wide one-way cycle tracks. These were conservatively calculated to have a capacity of 2,200 cyclists/hour – 'close to capacity'.)

[1] TN133 Guidance on the widths of shared paths and separated bicycle paths, Technical Note, Transport and Main Roads, November 2014

[2] Bicycle and Pedestrian Capacity Model: North Brisbane Cycleway Investigation Model Validation and Implementation Draft Report, SKM, 5 February 2010

Of particular note:

- The fundamental proposal underlying the research is that the bicycle design envelope is 1.0m and paths are multiples of this. Hence 2.0m would give two lanes of travel, 2.5m would give more comfort but very little additional capacity, and 3.0m would be required to give three lanes of travel and hence a step-increase in capacity.
- In the Frome Street situation, the relatively frequent intersections and side streets would give a different flow profile to the Queensland paths, and hence different results. In particular, the fundamental assumptions of the model (Poisson distribution with random cyclist arrival times) would not apply.
- The Queensland paths researched various kerb arrangements, but none were one-way bicycle paths, and the kerb arrangements – and clearances – were not taken into account in the research.

From Appendix B1.04 Cycle track cross sections of the *Separated Cycleways Guideline*, the cycle track width is measured to face of kerb (where relevant); the width in Table 2 is not in addition to any clearance to kerbs (or buffer planting, or an awkwardly-cambered gutter). The impact of kerbs is mentioned in advice about different cycle track types:

- Section 3.4.4.1 dual kerb cycle track: This recommends kerb heights for a dual kerb cycle track of 50mm (absolute minimum) to 100mm (desirable), but also to minimise the kerb height on the footpath side to reduce risk of pedal strike (i.e. where the pedal hits the kerb). No clearance is suggested to avoid pedal strike, and as a standard pedal height is about 50mm above ground level, only the 50mm kerb height could avoid this.
- Section 3.4.4.2 median-separated cycle track: This also recommends minimising kerb height to reduce risk of pedal strike, but no heights or clearances are given.
- Section 3.4.4.3 cycle track at footpath level: With no kerb to the footpath, there is no risk of pedal strike, however a minimum 0.5m planting strip is recommended to separate the cycle track from the footpath, to prevent pedestrian intrusion onto the cycle track.

In Queensland, the standard kerb height is 150mm, compared to 100mm in South Australia, with the difference related to different intensity rain events. This is likely to be associated with greater clearance to kerb by riders as pedal strike issues increase with kerb height. (A 150mm kerb height is provided over the Montefiore Bridge, at Morphett Street.)

It should be noted that the existing Frome Bikeway retained the standard 100mm kerb between the bikeway and the footpath, and added a median separator with the same kerb height.

From all of this:

- The one-way 2.0m bike lanes shown between kerbs in the *Cycling Aspects of Austroads Guides* would have a capacity equivalent to a single stream of cyclists, i.e. up to 150 cyclists/hour, because these function as a 1.6m bicycle lane with 0.2m clearance to the (high, upright) kerb on either side. The capacity would be about the same as a 1.5m one-way bicycle path with no kerbs on either side.
- The one-way 1.8m-2.0m bike lanes shown at footpath level in the *Cycling Aspects of Austroads Guides* begin to allow for overtaking, especially if cyclists stray into the flush

separator strip. These would have roughly double the capacity of the 2.0m bike lanes between kerbs.

- The one-way bike lane widths shown in Table 2 of the *Separated Cycleways Guideline* do not address kerb clearances, but a kerb on one side is envisaged for all configurations except that of a bicycle path at footpath level. Assuming a 0.2m clearance to kerbs, this gives an effective width of 1.8m-2.3m. The actual clearance experienced in Queensland conditions may be greater (the development of GTEP14 was spearheaded by South Australia), hence the effective width may be less. Still, from presented research, the effective 1.8m would not actually allow 'comfortable overtaking'. This may be why a design that is stated as allowing for comfortable overtaking and side-by-side riding is also presented as having the same capacity as a single stream of cyclists: the lower width could be approaching the single stream situation.
- More generally, the width/capacity correlations shown in Table 2 do not appear to be supportable as proscriptive guidance in the South Australian situation.

3) BISA's position re: bikeway width

ACC's background information started with a concept of a 2.0m bikeway width, as per the *Cycling Aspects of Austroads Guides*.

BISA's position re: bikeway width, which was also expressed/endorsed by other participants, is:

- 2.0m is only acceptable if it is understood as being the effective (= usable), not nominal (=total) width. So where a kerb is provided with a height of over 50mm, an additional clearance is required to prevent pedal strike on that side. We assume that a kerb of 50mm or less would not require an additional clearance. A semi-mountable design would further reduce the need for clearance to a low kerb, while still providing guidance to child cyclists and pedestrians. (Note that for a high kerb design such as the existing Frome Bikeway design, a 2.0m effective width + clearances would require the nominal bikeway width to be 2.4m.)
- It is desirable for motor vehicle occupants to unload from vehicles onto a pavement that is at the same height as the bikeway, with kerbing being located at the front and/or rear of the parking space rather than obliging unloading occupants to balance on a separator. This kerbing is where a tree would be planted. The separator is a nominal 1.0m wide in the existing Frome Street section; further north, it would reduce to 0.8m.
  When no cars are parked – such as at peak hour, when the parking is used as a traffic lane – the space between the kerb and bikeway is not only at the same level as the bike lane, it is empty and not intruded upon by car doors, etc. While spacing of trees and other landscaping details were not covered during the charrette, trees spaced at one per two car parking spaces and no intermediate kerbing would be acceptable if the bikeway is at a higher level to the roadway. This would give a distance of about 10m between the landscaping areas. So where the bikeway is higher than the roadway and assuming a 2.0m effective width out of peak periods, this means that the effective bikeway width during peak periods would be 2.7m-2.9m (assuming, as per the *Separated Cycleways Guideline*, that no buffer to the roadway is required for a speed limit below

60km/h, but still excluding the 100mm width of the top of kerb.) We believe that these 10m sections could be used by cyclists to overtake other cyclists if they found the 2.0m too narrow, e.g. due to cargo bikes. We note that the Queensland research found average overtaking lengths on shared paths of 10m.

The regular tree placings would moderate faster cyclists' speeds, which is reasonably appropriate given the frequency of side streets and intersections.

- It is desirable for a bikeway that is at a higher level than the roadway to be carried at that level over side streets, for safety reasons. Depending on where trees are planted, these areas could also form passing areas.

Adding this to the preceding examination of width and capacity, the peak hour capacity of a well-treated bikeway with an effective width of 2.0m would be quite similar to the existing bikeway, despite the larger nominal width of the latter of 2.7m between kerbs.

Even outside of peak periods, the narrower width is likely not to represent a major reduction in capacity due to the effect of intersections and as 2.0m is the minimum effective width that will allow two 'lanes' of cyclist travel.

However, this would be less comfortable and possibly affect the ability to easily pass cargo bikes, which have a larger design envelope than for a cyclist.

Another proviso is regarding child cyclists: their design envelope is related to bike handling skills and could be larger than that of adult cyclists, despite their smaller physical size. Against this, with a passenger occupancy of around 1.1, the likelihood of parked cars needing to open car doors into the area allowed for them is relatively low and even outside of peak periods, careful cyclists could use the door zone to pass occasional exceptional cyclist types – or simply follow and wait to accelerate off more rapidly at an intersection location, which is something that could perhaps be taken into consideration in further design work.