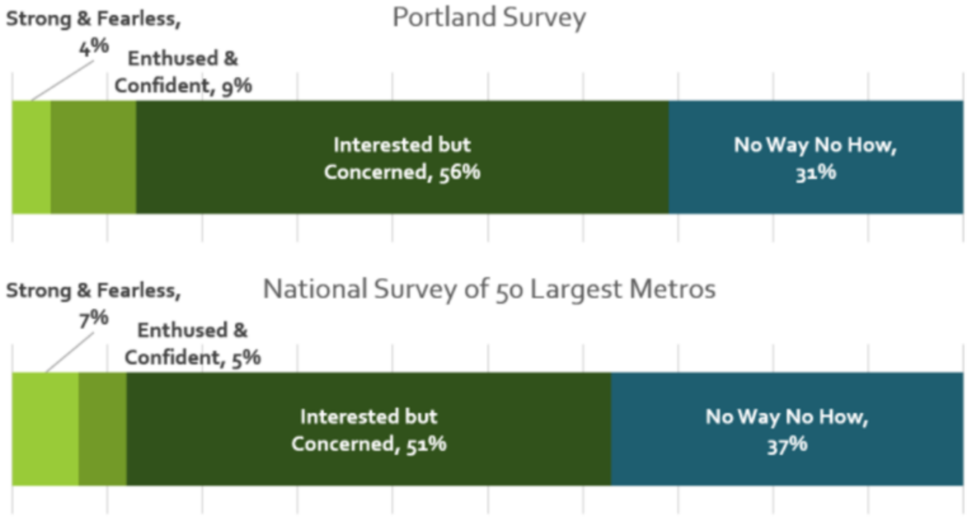
Better engineering standards for cyclists at intersections

This document is prepared in relation to common and recurring issues for cyclists identified at DPTI projects involving widening of arterial roads at signalised intersections.

BISA's philosophy is that if an arterial intersection is being upgraded for motor vehicles, facilities for cyclists should be provided that aim to increase cycling rather than only providing for existing cyclists. One way to look at this is in terms of attitudes to cycling as shown by two U.S. surveys in the following graphic – with surveys in other jurisdictions finding very similar results.



Graphic from Jennifer Dill, Ph.D., Portland State University

While much of the cycling currently occurring on arterial roads involves the "strong and fearless" undertaking long-distance travel, bicycle facility design should cater as much as possible to the "interested but concerned", with the aim being to transition these people to being "enthused and confident" through positive cycling experiences.

As well as attracting new cyclists, such facilities also cater for those who are cycling on arterial roads from necessity rather than choice: traffic signals provide places where cyclists can cross busy arterials, a short length of travel on arterial roads will often be necessary to link local streets, and some land uses are difficult to reach except off arterial roads. New cyclists and tourists often won't know the local routes that offer alternatives to arterial roads, or how to find these.

Further, even experienced cyclists who use arterial roads (those already "enthused and confident") have provided feedback that they would prefer to have greater safety/separation from traffic and can see obvious issues with trying to encourage "interested but concerned" friends and family to cycle in the absence of bicycle lanes designed around safety. Currently, while arterial road bicycle lanes can be seen as providing a modicum of space, the traffic situation encountered at signalised intersections is far more daunting and unpleasant and is often where the worst cycle facilities exist. Providing good quality facilities at intersections presents a significant opportunity to improve network conditions, and the risk that lost opportunities will be embedded into infrastructure for the next several decades.

1) Kerbside bicycle lanes

Where a bicycle lane is provided adjacent to the kerb, the minimum width for a kerbside bicycle lane is 1.5m in a 60km/h zone. However, greater width (e.g. 1.8m) is desirable on arterial roads:

- …because bike lane width is supposed to be measured from the edge of seal, not face of kerb.
  To the extent that this isn't achieved on local streets, lower traffic speeds and volumes present a more forgiving environment. On arterial roads, however, the following situations often occur:
    - bitumen reseals add material and do not plane seal level to match gutter level, creating a step at the join
    - untidy reseals deposit material in the gutter area
    - buses pulling in at bus stops put a vertical load on one edge of the L-shaped concrete kerb and gutter structure. This tends to rotate the kerb and gutter as a unit, creating differential movement between the gutter and road bitumen that leads to the join area breaking up
    - the gutter tends to collect debris to a greater degree than local roads due to greater traffic volumes but, as arterial roads are under the care and control of DPTI rather than councils, they are not swept.

  In these situations, the gutter cannot be considered to be part of the usable bicycle lane width – although it does provide a buffer clearance to vertical hazards and therefore makes an appropriately sized bicycle lane more comfortable to use.
  A 1.5m bicycle lane provides only about 1.0m of cyclable road width clear of the gutter.

- …where speed limits are higher, there are high volumes of heavy vehicles or an uphill gradient. In particular, large trucks travelling at high speed create 'suck' and make it harder for cyclists to maintain their position on the road i.e. centrally in the bike lane. Additional bike lane width helps cyclists accommodate this externally-induced wobble.

The cross section following illustrates the issues facing a cyclist in a (much) too-narrow bicycle lane with poor tracking in the adjacent travel lane.

The cyclist has very little room to manoeuvre and no escape given an adjacent kerb. The truck's wing mirror is at the edge of the bicycle lane and a hazard to the cyclist, who is working side-to-side out of saddle (perhaps travelling uphill, as yet unaware of the truck coming up from behind). Even if not hit by the truck, any loose straps on the rear of the truck could swing out and hit the cyclist, potentially leading to swerving and/or crashing.

The red arrows illustrate the distance between the lane line and vehicular wheel path. Under central vehicular tracking, the wheels would be some distance from lane lines. This gives rise to an opportunity to enhance cyclist protection by using wider line marking for the bike lane, or by providing dark (i.e. not intended to be visible) audio-tactile line marking on the outside of the bicycle lane. The latter in particular would provide feedback to drivers when they get too close to the bicycle lane.

This type of enhanced treatment is particularly indicated for grades of 5% or above. Here, the alternative of widening bicycle lanes to above 2.0m may encourage cars to enter the bicycle lane.

2) Forward bicycle holding line

Bicycle lanes should extend 1.2-1.8m forward of the holding line provided for general traffic. (More than 2.5m leads to cars ignoring their holding line.)

Cyclists are less stable when starting off; at least one South Australian cyclist has died at an intersection after wobbling when starting off and being run over by the adjacent truck. They are also pretty much invisible to truck drivers when located adjacent to them at a red stop signal. Being forward of a truck helps a cyclist stay out of the way – particularly as once they have cleared the pedestrian crosswalk, cyclists can track slightly left and further out of the way as they traverse the intersection.

In recognition of the safety benefits of a forward cyclist holding line, under design standards, the minimum distance between a cyclist holding line and the pedestrian crosswalk is smaller than for vehicular traffic.

Having distance between the cyclist holding line and traffic holding line also creates space in which cyclists can hook turn using the pedestrian signals, if desired – in which case the manoeuvre will be made at low speed and cyclists will benefit from the space provided by a forward cyclist holding line. To facilitate such hook turns, it is also desirable to enable cyclists to easily reach the pedestrian button. The following diagram illustrates the hook turn (green) with the approximate location of the traffic pole and pedestrian push button circled in yellow.

This push button can be difficult for a cyclist to reach from the bike lane, and awkward in any other way. A pedestal with **bicycle push button** installed just before the cyclist holding line should be provided to enable the cyclist to call a through green phase, where these are not automatically called. A similar push button being used to call a transverse pedestrian crossing phase is likely to be confusing. Instead, a minor cut-back of the kerb forming a mini-cyclist turn bay (as shown in dashed aqua) would enable a cyclist to reach the pedestrian button, call the pedestrian phase and be well-positioned to undertake the hook turn. A small right turn arrow would help clarify its purpose. While this area is more prone to attracting debris, such debris would be likely to build up anyway and an indent that helps to clear this from the cyclist path still facilitates the hook turn.

3) Stand-up lanes

Where a through bicycle lane is provided through the intersection with through traffic on one side and left-turn traffic on the other, this is known as a stand-up lane (see diagram in Example 2). Regarding these:

1) For an arterial road environment, both traffic lanes are likely to have high speed traffic and a relatively large amount of truck traffic. Typical bicycle lane widths assume no potential conflict to the left of the

cyclist, which is not the case for stand-up lanes. Therefore, stand-up lanes should be 1.8m in width to provide an additional 0.3m as a buffer on the left side, and coloured green to highlight their presence.

2) If the left turn comprises a double left turn, the speed limit is 70km/h or higher or the stand-up lane is greater than about 60m in length, or cyclist volumes have significant potential to grow (e.g. due to land use/bicycle network interactions) then “sheltered” bike lanes should be provided, along with convenient access to signalised crossing opportunities. This can be achieved in different ways, as per examples 1 and 2 (following).

3) Where a bicycle lane transitions into a stand-up lane, there should be a minimum “no conflict” length between the two. Example 3 shows this concept.

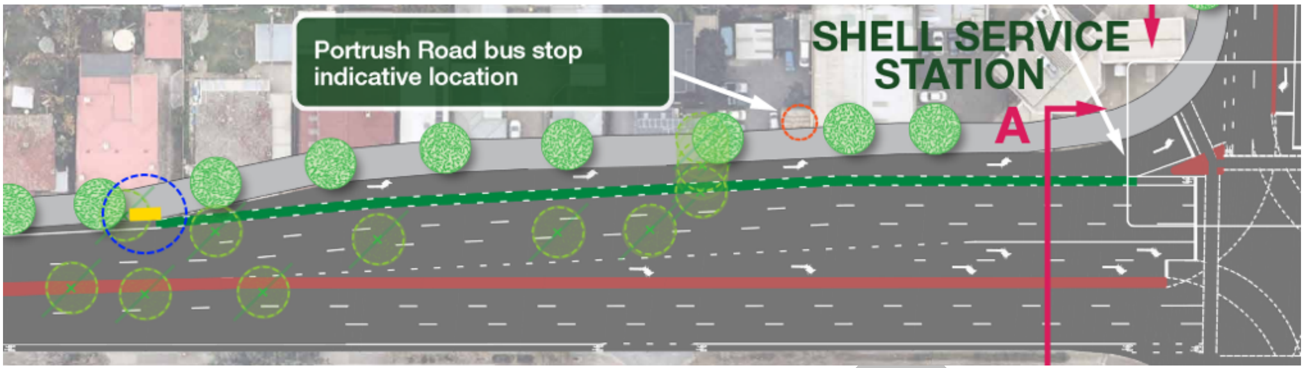
Example 1: An alternative design to a stand-up lane: the only access is via the footpath/signals.

This would typically be in constrained conditions. While road cyclists aren’t fond of this design approach when travelling through the intersection, it does enable them to bypass signals entirely when turning left. It can also facilitate safe access through signalised intersections, especially when these are complicated. Adjacent footpath width needs to be adequate for pedestrians and, as cyclists use footpaths in this design, it’s not suitable for high-pedestrian areas.

Compared to the example shown, the design should:

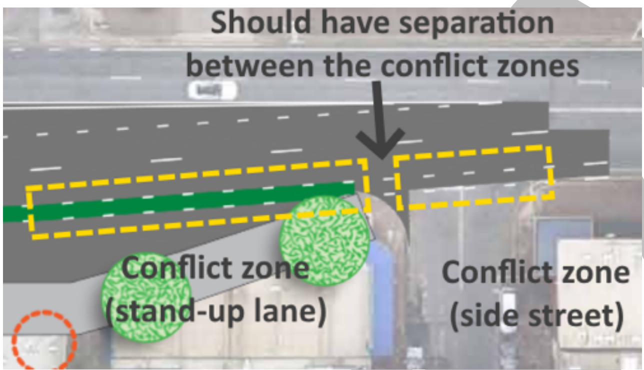
- have adequate turning radii between intersecting paths rather than the 90° turns from footpath to splitter island via kerb ramps shown. Austroads specifies a minimum turning radius of 2m.
- have wider footpath crossings, where width exists, to provide a) capacity for both pedestrians and cyclists to wait for signals b) cyclists to pass pedestrians without squeezing these. (The green route shown through the signals provides no room for pedestrians.)

Example 2: Stand-up lane alternative design where land acquisition gives additional space.



The long stand-up lane provides access for high-speed ("strong and fearless") road cyclists who are comfortable riding in traffic. For others, providing a convenient kerb ramp in the area shown in yellow (and circled in blue) would enable a footpath-level bike path to be provided, separate to both the footpath and roadway. (The design of cyclist kerb ramps is discussed in the next section.) As the resulting bike path would be adjacent to the kerb, a small additional buffer should be provided between the kerb face and bike path. (This can be as simple as a white line delineating the space or be part of an attractive streetscape design.)

Example 3: Bicycle lane transitioning into a stand-up lane: minimum "no conflict" area between two conflict zones.



The likely conflicts in the two zones shown are different. In the example shown, a driver turning left out of the side street and then left at the signals would be tempted to 'nip around the corner', increasing the likelihood that they do not adequately pause and check for cyclists before turning, or yield to an approaching cyclist – drivers often assume they travel much faster than cyclists even when turning, giving rise to a poor sense of relative speeds and distance requirements to safely yield.

A safer design is to provide a section of solid line-marking with no conflict zone between the two types of conflict areas. This indicates that cars need to yield when exiting the side street, and then when crossing the stand-up lane. It also enables a cyclist to better focus on detecting conflicts. To be effective, the length of separation needs to be at least as long as a car park space, but longer depending on the speed environment (i.e. 6-10m). In this example, this could be achieved by constructing a kerb protuberance in the 'no stopping' area forward of parking in the side street.

4) Cyclist ramps

For ramps giving access from road to footpath levels/areas (as in **Example 2**), Austroads' Guide to Road Design Part 6A: Paths for Walking and Cycling advises that:

> *"For bicycles to be most effective as a means of transport, cyclists must be able to maintain speed without having to slow or stop often… Once slowed or stopped it takes considerable time and effort to regain the desired operating speed.*

“Bicycle routes, especially off-road, should be designed for continuous riding, minimising the need to slow or stop for any reason.”

Austroads’ Guide to Road Design Part 3: Geometric Road Design (2017), Section 4.8.7 further advises that:

“Ramps linking a road carriageway and a path located in the area of the roadside verge may be required in association with … path treatments adjacent to roads. The exit ramp from the road should be oriented to enable the cyclist to leave the road at a speed appropriate to the abutting development and the level of pedestrian usage of the path.”

AGRD Part 3 illustrates the appropriate design for exit ramps, being aligned at 20° to the roadway. In contrast, as cyclists have a turning circle requirement, using a pedestrian ramp angled at 90° to the roadway requires cyclists to hook out into traffic to achieve the turning circle – an awkward and unsafe manoeuvre.

(In **Example 1**, high angle bicycle ramps (45° to the roadway) <u>may</u> be acceptable to slow cyclists to an appropriate shared path speed, although other design indications do not appear to cater for pedestrians. Again, AGRD Part 3 illustrates design details for such an application.)

Where cyclists are expected to enter the road from the footpath adjacent to pedestrians, either a wider pedestrian kerb ramp should be provided to enable this or a separate ramp be provided for cyclists – pedestrians should not be expected to share a minimum-width kerb ramp with cyclists (or vice versa). The minimum width ramp for cyclists is 1.5m compared with 1.2m for pedestrians. (It should be noted that while standard, 1.2m is actually narrow for people on gophers and wheelchairs or using prams and 1.5m kerb ramps should be provided wherever possible.) Steep wings should not be provided on either pedestrian or cyclist kerb ramps. These are only acceptable where travel can be assumed to always be directly straight to/from the kerb ramp, and even in these cases their use compared to shallow wings must be justified as it does not comply with Australian Standards.

5) Slip lanes

- Slip lanes are hazardous to pedestrians and must not be provided in high pedestrian areas, with DPTI’s current policy being to remove such slip lanes due to high pedestrian crash risks. Where provided, slip lanes should employ a high angle (70°) design that encourages traffic using the slip lane to see and yield to pedestrians and opposing vehicles.
- Where a large-radius or large-width slip lane must be provided to enable heavy vehicle to negotiate the left turn, the area not required by cars and smaller trucks should be line-marked with chevrons to create the impression of a high angle slip lane. As this area will be used by left-turning cyclists, it should not include pavement bars or similar to more actively direct traffic.
- A cyclist turn bay should be provided near the pedestrian crosswalk of a signalised slip lane, forming a forward storage area outside the line of traffic for cyclists to wait in if a truck is turning, and also facilitating a hook turn.
- Where bicycle lanes are provided on the departure side of an intersection over a slip lane, this bicycle lane should be coloured green to highlight its presence and encourage traffic using the slip lane to yield to cyclists.

The following diagram shows a slip lane without and with these features.

Yellow = chevroned area, green = bicycle lane, blue = cyclist turn bay.

Example of a cyclist turn bay.

6) Connection to local routes

As noted, signalised crossings can provide access across arterial roads and therefore form a useful part of a local cycling route. Here, 'local cycling routes' applies to:

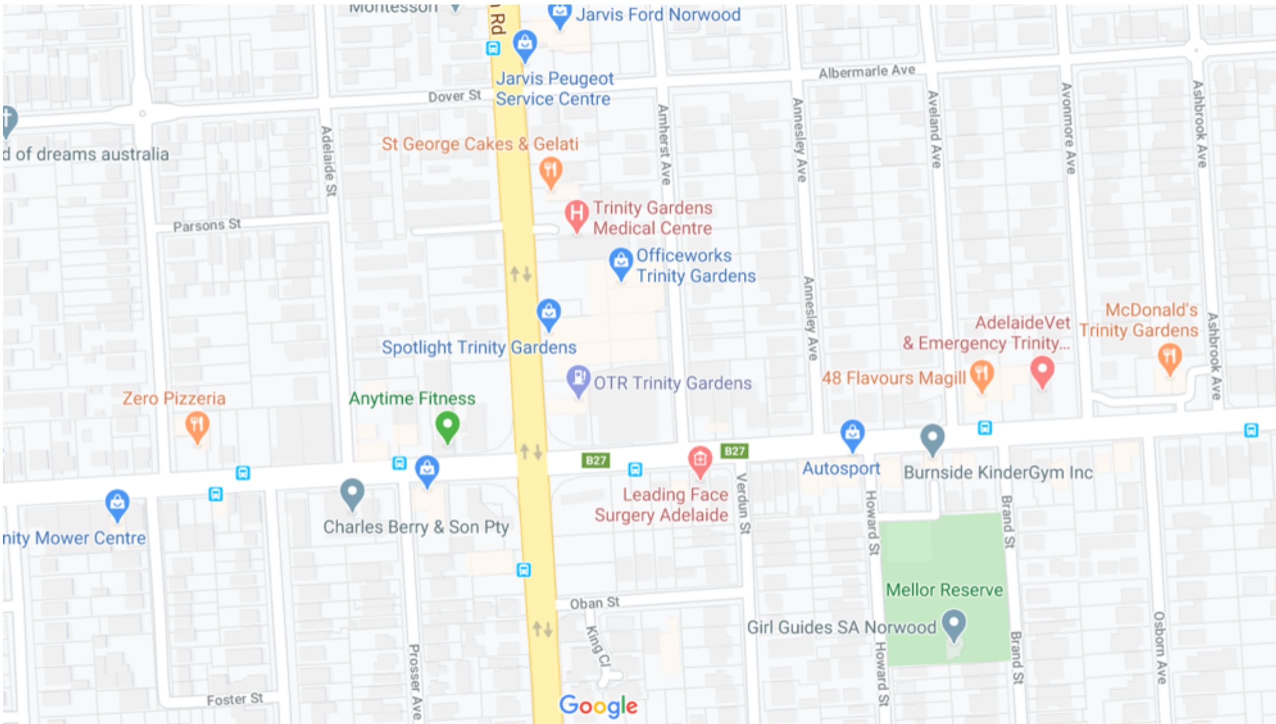
- Commuting to/from the CBD, local activity centre or schools, noting that the 'to' route may be slightly different to the 'from' route
- Utility trips to local shops, reserves, recreational centres and public transport nodes
- Network-level access across and between suburbs, notably as per the BikeDirect network.

BikeDirect and Council routes should be reviewed for local route connections within the project footprint, while BISA and local bicycle user groups (BUGs) can provide information about actual travel patterns.

Such routes may indicate supplementary travel patterns and therefore works that should be delivered as part of the project. **Example 4** highlights how examining local cycling patterns can identify a need for cycling facilities that isn't apparent if only traffic movements are considered.

Example 4: Magill Road/Portrush Road intersection project.

Nearby land uses as per Google maps are shown following.



Retail on the north-east corner of the intersection (St George's Cakes and Gelati, Trinity Gardens medical centre, Officeworks and Spotlight) are all likely to produce relatively local travel. There are no nearby pedestrian crossings of Magill Rd, which also doesn't have a median that would help make crossing it easier. Therefore, in terms of accessing these local shops:

- Cyclists from the south-west need to cross both Magill Road and Portrush Road. While Portrush Road has a median for much of its length, at the approach to Magill Road this is used to provide turn lanes. Cyclists are likely to ride down Portrush Road to cross Magill Road (e.g. from Beulah Road), then U-turn using the median when it becomes available or at Dover St/ Abermarle St and backtrack along Portrush Road; or use local streets to reach Prosser Ave, then cycle along the Magill Road footpath to the lights and onto the north-eastern Portrush Road footpath to their destination.

- For cyclists from the north-west, using the traffic signals involves back-tracking. They are more likely to use local streets to reach Dover St and cross Portrush Road using the road opening; or use local streets to Adelaide Street, then cycle along Magill Road to the lights and onto the north-eastern Portrush Road footpath to their destination.

- Cyclists from the north-east would have few difficulties, accessing these local shops via Abermarle Street and either the southbound bicycle lane or footpath on Portrush Road. The north-eastern footpath would provide a route back, otherwise cyclists would have to cross the Portrush Road median to access the northbound bicycle lane, then cross Portrush Road at Dover Street back to Abermarle Street.

- Cyclist from the south-east also need to cross both Magill Road and Portrush Road. Cyclists are likely to use local streets to access Verdun Street. Road cyclists could then travel down Magill Road to right turn (or hook turn) into Portrush Road, then U-turn using the median when it becomes available or at Dover St/ Abermarle St and backtrack along Portrush Road; or use the lights and Portrush Road footpath. Returning would be simple to the traffic signals, then road cyclists could use Portrush Road to Oban Street while footpath cyclists would use either Portrush Road south-eastern footpath (but probably not as it is very narrow) or Magill Road south-eastern footpath, to the local street network.

Also, cyclists from the north-east have relatively poor route choices to the City. Portrush Road to Beulah Road is arguably one of the better routes.

The most significant implication of the intersection redesign is that crossing Portrush Road at Dover Street/ Abermarle Street will be markedly less safe and convenient for cyclists. To cater for existing cyclists who use the north-eastern footpath, and to provide a safe alternative for cyclists who currently cross Portrush Road at Dover Street:

- cycle paths should be provided on footpaths along Magill Road from Prosser Avenue and Adelaide Street to the lights
- a cyclist median crossing of Portrush Road should be provided at Clifton Street (the next street north of Dover St) as an alternative for some people
- the north-eastern footpath of Portrush Road should be widened between Abermarle Street and Magill Road
- the pedestrian splitter islands should be increased in size.

In comparison, the original project scope excludes Portrush Road's north-eastern and south-eastern footpath as road widening involves land acquisition only to the west of the original road alignment and changes to pedestrian/ cyclist use of existing footpaths are not considered.