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Cycling on rural roads

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Setting the scene

Providing bicycle facilities on rural roads is challenging due to the high vehicle speeds (generally with speed limits of 70km/h or above) and often physical constraints of the road reserve. International guidelines and practice in ‘cycling’ countries such as the Netherlands and the UK provide cyclists with paths separated from high speed traffic. A summary of international practice is provided in Table 1.

In Australia and New Zealand guidelines and practices for higher speed roads vary between jurisdictions. However, the majority of jurisdictions are providing more off-road paths along urban motorways and generally sealed shoulders along high speed rural roads. The NSW Bicycle Guidelines are focused primarily on providing guidance for the design of cycling facilities in urban environments.

High speed roads present an increased safety risk to all road users including cyclists. There are inherent risks where cyclists and high speed vehicles share road space, primarily due to:

- the high differential in operating speeds between cyclists and vehicles
- increase in crash severity
- often large amount of heavy vehicle traffic.

Providing off-road paths as an alternative to on-road facilities on higher speed rural roads as is done in the Netherlands and the UK is often not feasible in Australia and New Zealand due to the high financial cost, long distances of facilities required and land ownership issues.

As cycling is a legitimate transport mode and cyclists are legally permitted to use roads, there is a need to improve facilities and conditions for cyclists riding on-road in higher speed rural roads environments. Techniques for improving space and conditions for cyclists on high speed rural roads can be infrastructure related as well as non-infrastructure related and can include:

- **Providing an alternative route** – such as using a lower speed route

Table 1. International practice in providing for cyclists on high speed roads

Country	Practice	Reference
UK	Where the 85 th percentile speed is greater than 40 mph (64.4 km/h), segregated bicycle facilities (tracks/paths) should generally be provided. For high speed roads with low traffic volumes (less than 3,000 vehicles per day/less than 300 vehicles in the typical AM peak hour), on-road bicycle lanes may also be considered.	TfL (2005)
Germany and Denmark	Provision of fully integrated off-road paths and bicycle lanes along roads and at intersections in cities and surrounding areas.	Pucher and Buehler (2008)
The Netherlands	Cyclists should always be separated from high speed traffic by providing a separate path or alternative (cycling) route. Consideration should also be given to lowering traffic speeds.	CROW (2007)
New Zealand	On urban roads with a speed limit of 80 km/h or more, cycle paths should be provided. Where speed limits are 70 km/h, sealed shoulders may be acceptable where there are fewer than 2,000 vehicles per day.	LTSA (2004)

- **Reducing the speed limit**
- **Technology** – such as providing bicycle activated signs to alert drivers to the presence of cyclists
- **Using non-infrastructure solutions** – such as education (advertising campaigns), enforcement (policing) and encouragement programs (behaviour change).

On-road treatments for cyclists on higher speed rural roads include:

- **Exclusive bicycle lanes** – these should be a minimum of 2 metres wide
- **Sealed road shoulders (Figure 1)** – similar to bicycle lanes, sealed shoulders should be a minimum of 2 metres wide with additional width provided where there is a large number of heavy vehicles.



Figure 1. Typical motorway sealed shoulder treatment

On-road bicycle facilities

Road shoulders

Road shoulders are provided to carry out two key functions; traffic and structural. Structurally road shoulders provide lateral support to the road pavement. In terms of traffic, road shoulders serve several key functions by providing:

- operating space for cyclists outside of the vehicle travel lanes
- a refuge for stopped vehicles on a firm surface, a safe distance from the adjacent traffic lanes
- an initial recovery area for an errant vehicle
- clearance to lateral obstructions.

The minimum sealed width requirements for road shoulders are outlined in Austroads guidelines. The width requirements vary depending on the intended function and road type as summarised in Table 2 and Table 3 respectively.

Table 2. Minimum sealed shoulder widths by function

Function of shoulder	Minimum sealed width (m)
Lateral support of pavement	0.5
Control of moisture or on outside of curves	1.0
Initial recovery area	0.5
Discretionary stopping	
Cars	2.5
Trucks	3.0
Bicycle demand	2.0/3.0

As shown in Table 3, for single carriageway, rural roads, the Austroads guidelines recommend a minimum sealed shoulder between of 0 and 1.5 metres, increasing with traffic volumes.

As shown in Table 3, these guidelines recommend a minimum sealed shoulder width of 2.0 – 3.0 metres, depending on bicycle demand. It is also noted that a shoulder width of 2.5 metres is needed for a passenger vehicle to stop clear of the traffic lanes.

Where sealed road shoulders are of sufficient width to permit cycling (i.e. wider than 2.0 metres), signage and PS-2 bicycle logos can be used to designate the shoulder's shared use for motor traffic and cycling, and to increase driver awareness. An example of such a treatment is shown in Figure 1.

While for the purposes of cycling it is desirable to seal road shoulders where a width of 2.0 metres can be achieved, such treatments have high financial cost as all road shoulders need to be constructed to cater for heavy vehicle usage.

Edge lines

Where sealed road shoulders are provided edge lines are used at the edge of the traffic lane to distinguish the traffic lane from the shoulder. These markings reduce the likelihood of moving traffic travelling in the road shoulder. The requirements for providing edge lines are contained in the relevant Australian Standard and vary depending on the road type as summarised in Table 4.

Advisory bicycle lanes

Advisory bicycle lanes (also known as suggestion lanes) are semi-formal facilities which indicate an area of the carriageway that is intended for use by cyclists and is

Table 3. Minimum sealed shoulder widths by road type

Road type	Minimum sealed shoulder width
Urban freeway	Between 2.0 and 3.0 m (3.0 m allows enough room for a truck to pull off clear of the traffic lane) 3.0 m adjacent to a safety barrier or on a freeway with 3 or more lanes
Rural road - single carriageway	Between 0 and 1.5 m, increasing with increasing traffic volumes
Rural road - divided carriageway	1.5 m where design AADT < 20,000, or 2.5 m if it is beside safety barriers and on the high side of superelevation 3.0 m where design AADT > 20,000, or 3.0 m if it is beside safety barriers and on the high side of superelevation
General	A minimum of 0.5 m where AADT < 1,000 Consideration should be given to sealing the full width of the shoulder under certain conditions (see p. 38 of Austroads AGRD03 2009a for a more extensive list) A minimum of 2.0 to 3.0 m to cater for bicycles

Table 4. Requirements for marking edge lines on rural roads

Road type	Divided?	Further description	Requirements regarding edge lines
Rural	No	Sealed pavements less than 5.5m wide	Edge lines shall not be used
		Sealed pavements between 5.5m and 6.8m wide	Edge lines are generally not used unless the conditions are poor (e.g. poor alignment, frequent fog, etc). Edge lines shall not be used unless: a dividing line is also marked and the lane widths within the edge lines are at least 3.0m or if there is a high proportion of heavy vehicle traffic, 3.2m There are some exceptions, for example at localised pavement narrowing.
		Sealed pavements 6.8m wide or greater	Edge lines are normally required
	Yes	Including rural expressways	Edge lines shall be marked

delineated from the adjacent traffic lane by a ‘broken’ longitudinal line with gaps. Motorists are advised, but not required to keep out of advisory cycle lanes, unlike formal bicycle lanes. Contrasting coloured pavement is often used on bicycle advisory lanes to improve delineation. Parking is not permitted in advisory cycle lanes.

Advisory cycle lanes are used where there is insufficient road width to provide formal bicycle lanes (which are delineated from the adjacent traffic lane by a continuous line with no gaps.) On roads with advisory cycle lanes, no centre line is provided, resulting in vehicles generally travelling in the centre of the carriageway. When vehicles from opposing directions pass one another, they can enter the bicycle lane where it is safe to do so. As such advisory cycle lanes are shared by cyclists with vehicles.

Advisory cycle lanes also give the perception that the carriageway is narrower than it is which in turn functions as a method of traffic calming by reducing vehicle speeds.

Advisory cycle lanes are used widely on urban and rural roads in the US and Europe, and in particular in the UK, Netherlands, Denmark and the Republic of Ireland. The Netherlands mainly utilise shared bicycle lanes on narrow urban and rural collector roads with low to moderate traffic to allow roads to remain two-way and still provide bicycles

with a safe lane of travel. An example layout of advisory cycle lanes contained in guidelines from Europe is shown in Figure 2.

There is little formal guidance on the use of advisory cycle lanes in Australian and NZ jurisdictions. In NSW, bicycle shoulder lanes would be the most similar facility with the shared use status being indicated by bicycle logos (PS-2) and solid edgelines rather than unbroken lines. Examples of advisory cycle lanes from Europe are shown in Figure 3 and Figure 4.

In many respects vehicle movements on roads with advisory cycle lanes are similar to historical rural road environments whereby a 3.7 metre wide sealed road width was provided and drivers would use unsealed shoulders to pass oncoming traffic.

On many roads in rural areas of Australia and NZ, traffic volumes do not exceed 150 vehicles per day (Average Annual Daily Traffic, AADT). In such environments, current Australian guidance permits the use of single lane carriageways with a minimum width of 3.7 metres. A carriageway width of less than 3.7 metres can result in excessive shoulder wear. A carriageway width greater than 4.5 metres but less than 6.0 metres may lead to two vehicles attempting to pass while remaining on the seal, potentially

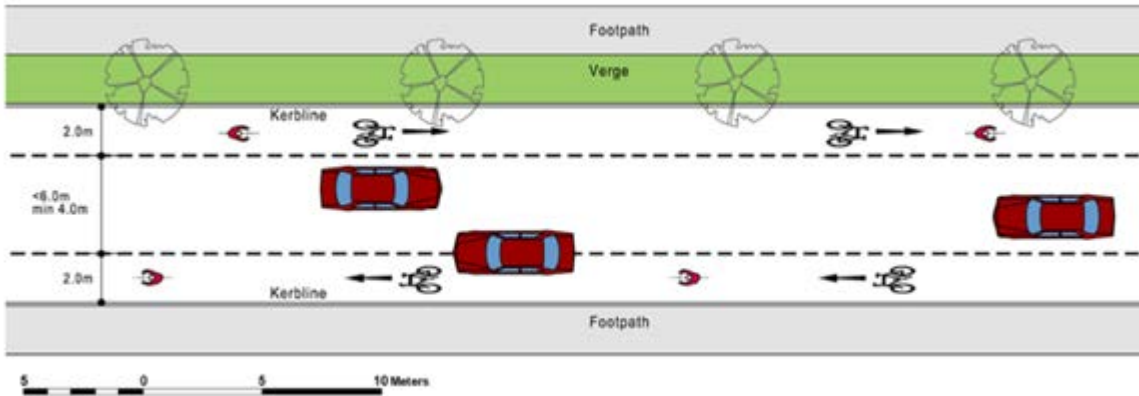


Figure 2. Advisory cycle lanes



Figure 3. Advisory cycle lanes



Figure 4. Advisory cycle lanes

resulting in head-on accidents. The width requirements for single carriageway rural roads are contained in Austroads guidelines and are summarised in Table 5.

Conformity with Australian Road Rules

A review of current Australian Road Rules indicates there are no road rules that would prevent the implementation of advisory cycle lanes. The following road rules are of particular importance with respect to advisory cycle lanes:

- **150 Driving on or across a continuous white edge line**
(1A) A driver may drive on or over a continuous white edge line on a road if the driver is:
(e) avoiding an obstruction.
- **129 Keeping to the far left side of a road**
(1) A driver on a road (except a multi-lane road) must drive as near as practicable to the far left side of the road.
This rule does not apply to the rider of a motor bike. In this rule – road does not include a road-related area.
Note: Road related area includes the shoulder of a road.

Schedule 4 of the NSW Road Rules provides the following definition of an obstruction:

“obstruction includes a traffic hazard, but does not include a vehicle only because the vehicle is stopped in traffic or is travelling more slowly than other vehicles.”

In recently developing a Council Bike Plan, consultation with a State Road Authority was undertaken in relation to the legality of advisory cycle lanes. A preliminary assessment indicates that advisory cycle lanes are permissible.

Minimum passing laws

A recent Queensland parliamentary inquiry investigated ways to improve the interaction between cyclists and

Table 5. Single carriageway rural road widths (metres)

Element	Design AADT				
	1 – 150	150 – 500	500 – 1,000	1,000 – 3,000	> 3,000
Traffic lanes ⁽¹⁾	3.7 (1 x 3.7)	6.2 (2 x 3.1)	6.2 – 7.0 (2 x 3.1/3.5)	7.0 (2 x 3.5)	7.0 (2 x 3.5)
Total shoulder	2.5	1.5	1.5	2.0	2.5
Minimum shoulder seal ^{(2),(3),(4),(5),(6)}	0	0.5	0.5	1.0	1.5
Total carriageway	8.7	9.2	9.2 – 10.0	11.0	12.0

1. Traffic lane widths include centre-lines but are exclusive of edge-lines.
2. Where significant numbers of cyclists use the roadway, consideration should be given to fully sealing the shoulders. Suggest use of a maximum size 10mm seal within a 20 km radius of towns.
3. Wider shoulder seals may be appropriate depending on requirements for maintenance costs, soil and climatic conditions or to accommodate the tracked width requirements for Large Combination Vehicles.
4. Short lengths of wider shoulder seal or lay-bys to be provided at suitable locations to provide for discretionary stops.
5. Full width shoulder seals may be appropriate adjacent to safety barriers and on the high side of superelevation.
6. A minimum 7.0 m seal should be provided on designated heavy vehicle routes (or where the AADT contains more than 15% heavy vehicles).

other road users. The report made 68 recommendations to improve interactions between motorists and cyclists, and also the safety of cyclists on the road.

Following the inquiry, new legislation was introduced in Queensland related to the minimum passing distance for cyclists riding on-road. In 2014, new legislation came into force where, by law, motorists must stay wider of a cyclist riding on-road by giving:

- a minimum of 1.0 metre when passing cyclists in a speed zone of 60km/h or less; and
- 1.5 metres where the speed limit is over 60km/h.

Under the law motorists can cross centre lines (including double unbroken centre lines), straddle lane-lines and drive on painted islands to pass cyclists, provided the driver has a clear view of any approaching traffic and it is safe to do so. Motorists who break the rule will receive three demerit points and a fine of \$330. A maximum fine of \$4,400 can apply if the matter goes to court. The law applies to all vehicles on the road including motorcycles, heavy vehicles and public transport vehicles.

These new road rules will initially be trialled over two years. This law is the first of its kind in Australia and will road-test the impact the rules have on saving lives.

Many cyclist fatalities on the road are caused by cyclists being hit from behind by vehicles travelling in the same direction. Introducing a minimum distance for passing cyclists is intended to reduce confusion about how much space is safe when passing a cyclist and to raise awareness of the vulnerability of cyclists on the road.

Increasing driver awareness

Increasing driver awareness of the presence of cyclists is important for improving the safety of on-road cyclists. There are currently few bicycle warning signs or share the road signs in many rural road locations across Australia and NZ. This factor, coupled with the lack of dedicated on-road bicycle infrastructure results in a road environment whereby many motorists are not anticipating encountering cyclists, let alone groups of training cyclists which can be found in many locations.

Static signage

Providing bicycle warning signage on key on-road routes and in particular those popular with bunch riders/ training cyclists will increase driver awareness of the presence of cyclists. Such signage also assists to legitimise cyclists riding on-road. Bicycle facility warning and guidance signage used in NSW are shown in Figure 5.

Of the warning signs shown in Figure 5, the bicycle warning sign (W6-7) and the share the road sign (W6-214) are the appropriate signs for use on the roads outside the shire's main centres. Such signs are used extensively across Australia.

Electronic bicycle activated warning signs

Electronic bicycle activated warning signs have recently been installed at several locations in Australia and New Zealand to increase driver awareness of the presence of cyclists. The sign illuminates the LED warning sign once activated by a cyclist, generally using induction loops under the carriageway.



Figure 5. Warning and guidance signage for bicycle facilities (source: NSW Bicycle Guidelines)

Such signs have been used at physically constrained locations such as on bridges, where bicycle lanes are present on approach but due to the limited road width it is not possible to provide formal bicycle lanes across the bridge. Examples of electronic bicycle activated warning signs in Australia are shown in Figure 6 and Figure 7, with an example from New Zealand shown in Figure 8.

These signs can feature solar power; bicycle induction loops located under the carriageway which detect bicycle movements, activating the sign; and a push button for manual call-up.

There is significant opportunity for the implementation of such signs on roads which connect the towns and villages of the shire. Solar powered versions offer a cost-effective solution where cabling to supply mains power is unnecessary.

Bicycle awareness zone pavement symbols

Bicycle awareness zones are treatments used to highlight the presence of cyclists at locations where cyclists transition from road shoulders to the vehicle travel lane. Such treatments generally use line marking and signage to highlight the presence of cyclists at specific locations and are used in both urban and rural road environments.



Figure 6. Bicycle activated warning sign

There is a real opportunity to implement bicycle awareness zone treatments at locations where road shoulders terminate, such as at bridges, culverts and adjacent to safety barriers. At these squeeze point locations, there is generally not a viable alternative route and cyclists are forced to merge into the vehicle travel lane. Bicycle awareness zones are used specifically to increase driver awareness of the transition of cyclists from the road shoulder to the vehicle travel lane.



Figure 7. Bicycle activated warning sign push button



Figure 8. Bicycle activated warning sign (source: Opus International Consultants Ltd)

Sharrow road markings

Previously used in the US, sharrow road markings have been used in several jurisdictions in Australia to raise awareness of cyclists on the road where the road narrows and cyclists must ride in traffic lanes. Sharrows are used in similar scenarios to bicycle awareness zones.

An example sharrow road marking treatment on approach to a single lane roundabout in Australia is shown in Figure 9.

A study commissioned by a State road authority indicates that use of sharrows at other locations has improved safety and comfort of cyclists and enabled cyclists to ‘claim the lane’. This allows cyclists to comfortably ride in the middle of the lane which removes cyclists from the ‘door-opening’ zone adjacent to parked cars.

While Figure 9 shows the application of sharrows in an urban environment, there is opportunity to utilise sharrow road markings in rural roads. Sharrows could be used where sealed road shoulders terminate such as at bridges, culverts and guard rails to highlight locations where cyclists are merging to travel in the vehicle lane.



Figure 9. Sharrow road markings

International guidance and research

The majority of research related to the planning, design and implementation of advisory cycle lanes in rural road environments originates from Europe. The below section summarises key international guidance on the use of, and effects of the implementation of, advisory cycle lanes on rural roads.

United Kingdom

The primary guidance document for bicycle facilities design in the UK provides the following guidance on the use of advisory cycle lanes:

- used to signify that vehicles other than cyclists should not enter the lane unless it is safe to do so
- not recommended where they are likely to be blocked by parked vehicles
- are useful treatments across intersections to help raise driver awareness of the likely presence of cyclists.

Table 6 summarises the guidance for advisory cycle lanes based on half-carriageway width. It is important to note that cycling is not permitted on motorways in the UK.

The Republic of Ireland

Irish national cycling guidelines on the use of advisory cycle lanes in the Republic of Ireland include:

- advisory cycle lanes are to be a minimum of 2.0 metres wide
- the adjacent carriageway is to be a minimum of 4.0 metres wide and less than 6.0 metres wide where traffic flow is two-way
- road centrelines shall not be provided
- the maximum speed limit shall be 50 km/h or less

Table 6. Options for advisory cycle lanes on two-way roads based on half-carriageway width

	Half-road width (m)	Minimum cycle lane width (m)	General traffic lane width (m)	Notes	Drawing number
No parking/loading	3.5–4.4	1.5	2.0-2.9	2-way motor vehicle flows<5000vpd 30mph max speed limit	CCE/B6
	3.5–4.0	1.5	2.0-2.5	2-way motor vehicle flows<5000vpd 30mph max speed limit with central refuge/islands Diag 1010 marking	CCE/B7
	≥4.0	1.5	≥2.5	alongside refuge/islands	CCE/B7
	4.5-5.0	1.5-2.0	≥3.0	All cases (mandatory lanes preferred)	-
With parking/ loading bay 1.8m wide	5.3–6.3	1.5-2.0	2.0-2.5	2-way motor vehicle flows<5000vpd 30mph max speed limit Coloured surface lane only with no road markings – minimum width of 1.5m	CCE/B9
	≥6.3	1.5 plus 0.5m gap to parking bay	≥2.5	2-way motor vehicle flows<10000vpd 30mph max speed limit	CCE/B9

Notes:

- Lane widths are measured from kerb face to centreline of markings
- Cycle lanes on roads with 40mph or higher speed limit should preferably be wider than 1.5m

- they are most effective where there is no demand for kerbside parking
- coloured surfacing is only required at conflict points or where an area may be confused with on-street parking
- only to be used in exceptional circumstances where formal bicycle lanes are inappropriate.

The Netherlands

The comprehensive guide for the planning and design of bicycle facilities in the Netherlands outlines that advisory cycle lanes are an appropriate treatment where:

- the speed limit is 60 km/h or less
- the road has less than 3,000 vehicles per day and less than 300 vehicles per hour
- edge lines should be marked along the edge of the sealed road pavement no more than 0.3 metres from the road edge.

It is noted that the Dutch guidance related to maximum vehicle volumes for roads where advisory cycle lanes are appropriate is 3,000 vehicles per day. This volume is higher than that provided in Austroads for single carriageway roads (Table 5) of 150 vehicles per day where no sealed shoulder is provided.

The research from the Netherlands noted that the crux of advisory cycle lanes was the method of how to mix bicycles

and vehicles in a safe manner which directly related to three key parameters:

- vehicle speed
- vehicle volumes
- physical size differential (i.e. difference in size between cyclists and heavy vehicles).

Reducing the speed of the motorised traffic should not be done radically. The low profile speed humps used in locations in The Netherlands (Figure 10) on roads with a speed limit of 60 km/h can be negotiated comfortably by vehicles travelling at or below the speed limit. These speed humps are typical in height (100mm above the pavement) but the ramps extend up to 5.0 metres in length. Such low profile speed humps with extended ramp lengths enable good rideability for cyclists.

Reducing vehicular traffic volumes is difficult and often requires considerable effort to persuade drivers to choose alternate routes. When the volumes are too high, it is necessary to consider cycle paths with a physical segregation from motorised traffic. Sometimes there is a need to consider both speed and volume reductions.

No formal evaluation was carried out, but private communications with the project manager are summarised in Table 7.

Table 7. Advisory rural cycle lanes - before and after traffic patterns

Parameter	Before	After
Example 1		
Traffic Calming and Cycling	-	Stage 1) 60km/h speed humps Stage 2) two-way shared path, separated from the road
Traffic Volume	2,500 vehicles per day	2,500 vehicles per day
Bicycle Volumes	not provided, mainly recreational/	weekend cyclists
Speed Limit	80 km/h	60 km/h
Speed Travelled	100 km/h	65 – 70 km/h
Example 2		
Traffic Calming and Cycling	-	60km/h speed humps spaced at 300-500m, red bicycle (suggestion) lanes, single car lane for two way traffic
Traffic Volume	3,000 vehicles per day	3,000 vehicles per day
Bicycle Volumes	150 cyclists per day (commuters)	150 cyclists per day (commuters)
Speed Limit	80 km/h	60 km/h
Speed Travelled	80 – 100 km/h	65 – 70 km/h

**Figure 10. A 60km/h speed hump**

Sweden

The Swedish conducted trials of advisory bicycle lanes on two rural roads, including before and after traffic surveys and user interviews. Similar to Australia and NZ, advisory lanes in Sweden are classified as road shoulders (i.e. “vägren”), the key parameters of which include:

- Pavement width – 6 metres
- Bicycle lane width - 1.25 metres
- Vehicle travel lane width (two-way) - 3.5 metres
- Speed limit – 70 km/h
- Vehicle volumes – 1,500 vehicles per day.

The travel lane is designed to carry traffic in both directions, i.e. one lane for two way traffic, with vehicles using both shoulders to pass. This is akin to historical rural road environments with very low volumes, where the main carriageway is sealed and the shoulders are gravel. Two sites were investigated, with the results of the formal before and after evaluation summarised in Table 8.

Conclusion

High speed rural roads present an increased safety risk to all road users including cyclists. In many rural road environments in Australia and New Zealand there is little provision for cyclists. Where road shoulders are available, they provide operating space for cyclists outside of the vehicle travel lanes, however on many two-lane, two-way rural roads, there are no road shoulders.

Providing off-road paths as an alternative to on-road facilities on higher speed rural roads is often not feasible in Australia and New Zealand due to the high financial cost, long distances of facilities required and land ownership issues. Advisory cycle lanes are an internationally established, relatively low-cost treatment for cyclists on rural roads, where there is insufficient width for dedicated bicycle lanes. Such facilities also have the potential to reduce vehicle speeds, thereby increasing safety for all road users.

It is hoped that Australia and New Zealand may be able to trial advisory cycle lanes in the future.

Table 8. Advisory rural cycle lanes - before and after traffic patterns in Sweden

Parameter	Before	After
Example 1		
Traffic Calming and Cycling	-	bicycle suggestion lanes (road shoulders)
Traffic Volume	864	848
Bicycle Volumes	56	56
Speed Limit	70 km/h	
Speed Travelled – 85th%ile		
- cars	80.0 km/h	80.0 km/h
- trucks	73.2 km/h	71.1 km/h
Lateral Clearance		
- car to bike	-	-
- bike to berm	-	-
Crashes	5 (5 years to 2010)	4 (22 months to August 2013)
Example 2		
Traffic Calming and Cycling	-	bicycle suggestion lanes (road shoulders)
Traffic Volume	1,745 vehicles per 16 hours	1,426 vehicles per 16 hours
Bicycle Volumes	49 bicycles per 16 hours	56 vehicles per 16 hours
Speed Limit	70 km/h	70 km/h
Speed Travelled – 85th%ile		
- cars	75.5 km/h	75.0 km/h
- trucks	70.7 km/h	62.8 km/h
Lateral Clearance		
- car to bike	2.3 metres	2.9 metres
- bike to berm	0.45 metres	0.86 metres
Crashes	4 (5 years to 2010)	0 (22 months to August 2013)