A Guide to the Use of Kerbside Running Bike Lanes

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"Kerbside running bike lanes" provide a safe, cost-effective, practical, and proven on-road cycling solution.

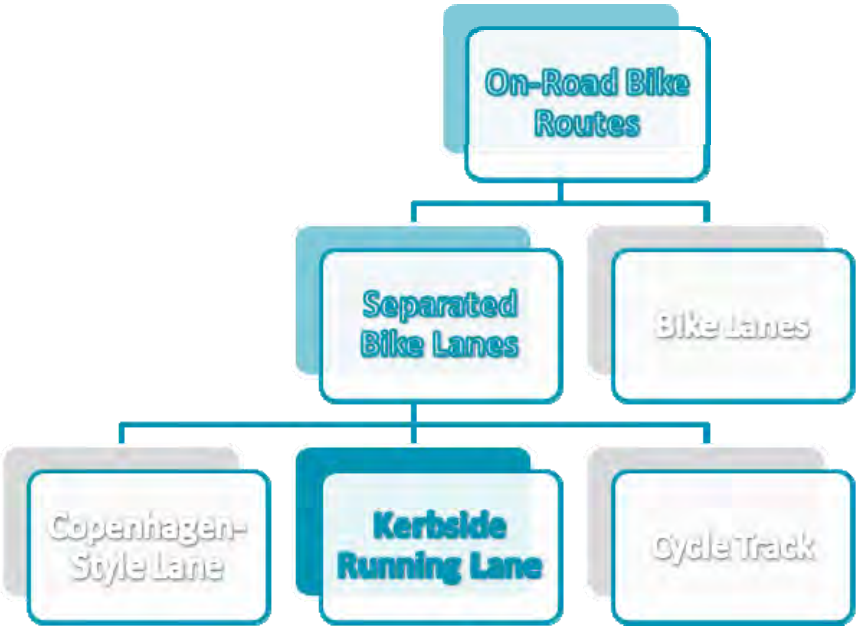
Traditional bike lanes are placed between parking and moving traffic lanes. Numerous studies have shown that riders, particularly inexperienced ones, feel uncomfortable using these lanes given their proximity to moving traffic and the frequency of door openings on the driver's side of the parking lane[1].

"Separated bike lanes" are recognized in the Austroads Guide to Road Design[2]. They feature a marked buffer or physical separation between the bike lane and moving vehicles. Where there is on-street car parking the parked cars can be used to separate riders from moving traffic. A marked or physical buffer is also used to provide protection from (less frequent) passenger door openings.

> "Kerbside running bike lanes are a form of separated bike lane that provides a safe, cost-effective, practical, and proven on-road cycling solution"

The increased rider comfort provided by separated bike lanes has been recognized for many years in European cities. More recently, the push to attract new and inexperienced riders has seen cities in other parts of the world embrace these facilities.

Kerbside running bike lanes are a form of separated bike lane. They are formed by a painted and marked one-way bike lane separated from moving traffic by a parking lane as well as a buffer area that can consist of painted markings, textured line marking, roll-over kerbs, peg-down plastic lane separators and/or other inexpensive elements that can be ridden or driven over. Numerous cities, including Melbourne (Australia), New York, Minneapolis and Portland (United States), have added these facilities to their toolbox of on-road cycling treatments.



Kerbside Running Bike Lanes

Albert Street, Melbourne

Grand Street, New York (USA)

1st Avenue, Minneapolis (USA)
Note: Buffer has since been added

Broadway Avenue, Portland (USA)

Other Separated Bike Lanes

Copenhagen-Style" Bike Lane on Swanston Street, Melbourne
Key Difference. Median separation cannot be ridden or driven over. Less space for riders to pass other riders or avoid hazards

Two-way separated bike lane on Dunsmuir Street, Vancouver (CA)
Key difference: apart from being two-way, many of the features of this facility are similar.

Cycle Track in Toronto (Canada)

Key difference: vertical separation and no buffer for door opening.

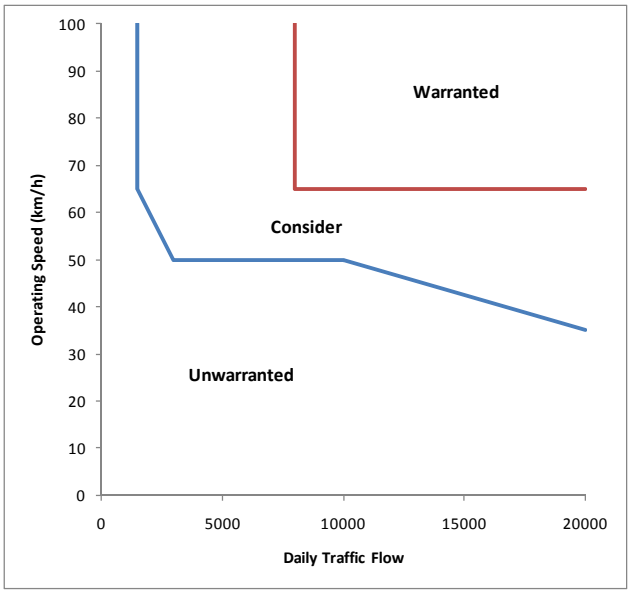
Two-Way Centre Cycle Track, Sands Street, New York (USA)
Key difference: physically separated, located in centre of roadway.

Difference between kerbside running bike lanes and other separated bike lane treatments.

Planning Considerations

The location and design of separated bike lanes can greatly impact their effectiveness. Typically, these facilities are most effective along roads that have higher traffic volumes and speeds and that have fewer intersections and driveways[3]. However, this does not preclude these treatments on other corridors provided appropriate designs are employed.

Guidelines adapted from Transport for London's *Cycling Design Standards* show traffic flows and speeds for which a separated bike lane could be considered[4].



Advantages

Increased Rider Protection

Kerbside running bike lanes provide a more protected and therefore more comfortable space for bike riders than conventional bike lanes. This is particularly relevant in trying to attract new or inexperienced riders that are typically less likely to ride in mixed traffic or next to moving traffic. They also reduce or remove the risk of riders crashing into an open car door.

Space Definition

Kerbside running bike lanes provide a clearer definition of bicycle and vehicle spaces. They reduce or eliminate blocking of the bikeway by motor vehicles and the swerving of bike riders into mixed traffic.

Cost

These treatments are cost-effective, particularly compared to other separated bike lane treatments. Existing road space is reorganized and defined with pavement marking, delineators, and signage so no new pavement or kerbing construction is necessary. These treatments do not interrupt existing drainage.

Disadvantages

Some of the disadvantages of kerbside running bike lanes are that they:

- May require reconfiguration of the carriageway including travel lanes and on-street parking.
- Can add delays to turning bike riders (and potentially to turning vehicles, depending on the design).
- May require increased width, flexible design or special equipment to maintain. Regular street maintenance vehicles may not fit into the space defined by the buffer and the bike lane.
- Reduce opportunities for faster riders to overtake slower ones.
- Increase interaction between bike riders and pedestrians crossing to and from their cars.

Increase in Riders

"Copenhagen-style" lane on Swanston Street, Melbourne (VicRoads 2007):

- 80% of riders enjoyed the increased separation from vehicles and felt safer.
- 45% of riders ride more often as a result of the treatment.

Cycle tracks in Copenhagen (Jensen et al.):

- 18-20% increase in cycling traffic

Kerbside running bike lane on Grand Avenue, New York City:

- 29% increase in ridership.

Facility Type	Cost ($AUD)
Bike Lanes (Green Paint, Vibraline)	$50/m
Kerbside Running Bike Lanes (Green Paint, Candlesticks, Vibraline)	**$70-150/m**
Copenhagen-Style Bike Lanes	$280/m
Cycle Track (Grade Separated)	$500/m

* Information obtained from City of Melbourne.

Portland design allows sufficient space for maintenance vehicles.

Changed Risk Profile

Cycling treatments, like any change to the transportation system, alter the "risk profile" for road users. Kerbside running bike lanes improve the risk profile for bike riders compared to traditional bike lanes or no treatment at all. Studies of traditional European cycle track designs showed that the added buffer between bike riders and moving traffic resulted in a noticeable decrease in crashes in which vehicles struck bike riders from behind or bike riders turning left (right in Australia). Moving the bicycle lane from the driver's side of the parking lane to the passenger's side also resulted in fewer instances of riders hitting open car doors[5].

However, traditional designs also experienced an increase in the number of rider-rider crashes, crashes with right- and left-turning vehicles, and crashes between bike riders and pedestrians and exiting bus passengers[5]. Initial "Copenhagen-style" lane treatments in Melbourne found problems with pedestrians walking in the bike lane, turning vehicles blocking bike lanes at intersections and pedestrians having difficulty crossing the road"[1].

Improvement in Design

Since these studies, modern European and North American designs have introduced several features that reduce these risks - most noticeably at intersections and pedestrian interfaces. Some of these are described in the table below. Initial figures from New York's kerbside running bike lane on Grand Street show a 27% reduction in injuries to all street users. (Note: a more expensive separated bike lane treatment - the signal protected bike path on 9th Avenue - has seen a 56% reduction in injuries to all street users[6]). The City of Minneapolis initially implemented a kerbside running bike lane without a buffer between the bike and parking lanes. Although they recorded no bicycle-related crashes in the year following installation (12 such crashes were recorded in the 4 years prior)[7] they have since installed a 0.6m buffer zone.

As with all new treatments, time and a wider application allows road users to adjust to the new environment and solve many of the initial problems brought about by unfamiliarity.

Risk	Design Mitigation
Visibility of bike riders at intersections	Parking restrictions prior to the intersection. Creation of "mixing zones" where bike riders integrate with motor vehicle traffic prior to the intersection, especially left turning vehicles. Advance signal phase for bike riders.
Pedestrians crossing the bike lane	Bike lane painted green to differentiate it from other roadway and footpath features.
Motor vehicle passengers alighting from parked vehicle	A buffer is provided that is sufficiently wide to allow bicycles to pass an open car door on the passenger's side and allow room for passengers to disembark or unload.
Rider hitting passenger door	A buffer is provided that is sufficiently wide to allow bicycles to pass an open car door on the passenger's side.
Driver parking on or across the buffer and rendering it ineffective	The buffer is marked distinctly different from the remainder of the road surface and a number of vertical features including profile marking and flexible traffic poles provide clues as to where to park. Additional features such as planter boxes placed at the back of the parking space have been applied in Vancouver to provide some physical restriction whilst not impacting drainage or being a significant cost burden.

Consistency of Implementation

Kerbside running bike lanes are one tool in a designer's kit. Whilst it is desirable to provide consistent treatments wherever possible, variations in facility design may be used to account for fiscal, jurisdictional, and political constraints and changing traffic conditions that can materialize even along a single corridor.

A roadway designer must adapt their treatment to the prevailing conditions, e.g. right turns can be treated with shared through/right-turn lanes, exclusive turn lanes, two-way turn lanes, or hook turns. Similarly, on-road bicycle facilities must adapt to the adjacent land use, traffic volume, expected ridership, fiscal constraints, or jurisdictional boundaries.

> "Well designed kerbside running bike lanes reduce injuries to all road users."

Bicycle facilities can be assembled using a variety of treatments and, as for the right-turn treatment example above, the variety of treatments does not violate road user expectations given they are all familiar. What is important is that they are appropriately implemented for the prevailing conditions and provide smooth transitions between facility types. When facilities are newly introduced - additional effort should be made to build familiarity for all road users.

Design

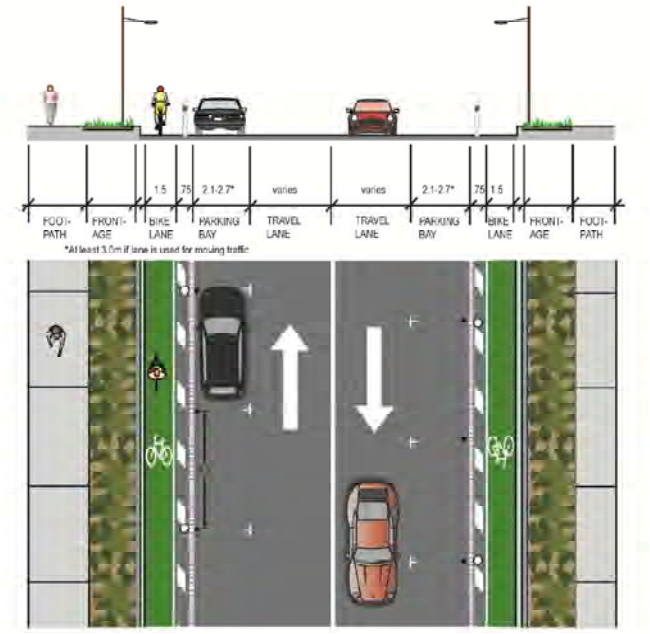
There is support for separated bike lanes in Victorian and Australian road design guidelines. VicRoads Draft Cycle Notes (No. 21) supports increased separation by "swapping the bicycle lane with the parking lane so that bike riders travel to the left of parked cars". The Austroads Guide to Road Design Part 3: Geometric Design also supports separated bike lanes which "generally provide a higher level of service for cyclists and have been shown to promote increased patronage on cycling routes".

Cross-Section

The cross-section of a kerbside running bike lane includes the following components:

Bike Lane

Used to define the space for bike riders, the bike lane should be a minimum of 1.5 metres wide. Because the buffer is ride-able, the bike lane can be narrower than some other forms of separated bike lanes (e.g. "Copenhagen-style" bike lanes). Wider bike lanes should be provided where higher bicycle volumes or design speeds are expected or where there is a need for bike riders to pass one another. The bike lane should be marked with the standard bicycle pavement logo and preferably painted a distinctive colour to enhance its visibility to all road users.



Albert Street – Typical Cross-Section.

Buffer Zone

The buffer zone provides separation between the bike lane and parking lane. It should be marked with chevrons to distinguish it as a no-parking area and be wide enough to allow car doors to open without obstructing the bike lane – an absolute minimum of 0.6 m and a desirable minimum of 0.9 m will allow bike riders to comfortably pass within the bike lane (car door widths typically range from 0.9 to 1.0 metres). Motorists are provided parking guidance through profile line marking (vibra-line) as well as flexible traffic poles and/or other features.

Buffer zones provide separation between the bike lane and the parking lane.

Parking Lane

Typically 2.1 – 2.7 metres wide, parking can be allowed at all times or restricted to off-peak times to allow a second travel lane. In the latter case, additional width to at least 3.0 m is preferable to accommodate moving traffic. Parking restrictions can be signed to help keep the bike lane clear of mis-parked vehicles.

Signage used to define the parking lane in New York City

Traffic Lane(s)

The inside traffic lane is generally unchanged, although depending on the available right-of-way it may need to be narrowed. This should be considered based on the function and volume of the roadway.

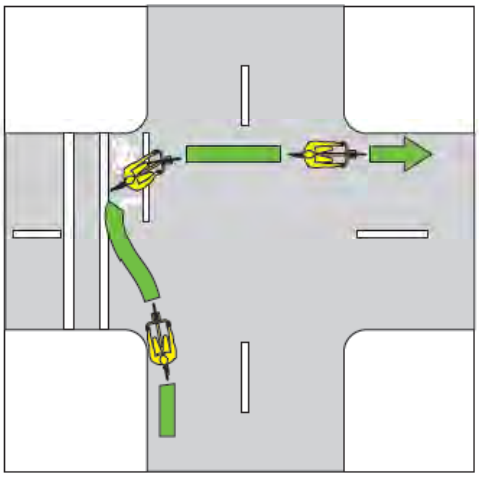
Kerbside Running Bike Lane Cross-Section Dimensions.

City	Bike Lane	Buffer	Parking Lane	Travel Lane
Melbourne	1.5 m	0.75 m	2.3 m	Up to 4.0 m
New York City	1.5 – 1.8 m	0.9 m	2.4 – 2.7 m	3.0 – 3.35 m
Portland	2.1 m	0.9 m	2.4 m	3.6 m
Minneapolis	1.8 m	0.6 m	-	-
Seattle (Proposed)	1.8 m	0.6 m	2.4 m	3.35 m
Copenhagen (cycle track design)	2.0 m	0.6 m	-	-
London Cycling Design Standards	1.5 m (min)	1.0 m	-	-

Intersections

Right Turning Bikes

In Australia bike riders can perform hook turns to turn right at any intersection unless explicitly prohibited[8]. This maneuver can be supported by bike boxes at intersections with high turn demands.



Example of a hook right turn.

Driveways

The bike lane should continue past driveways to highlight that bike riders have the right-of-way. At unsignalised intersections, the lane should continue through the intersection using "broken" (intermittent) lines or some other form of marking (e.g. New York uses a series of sharrows). This provides a dedicated path for riders but alerts them that they do not have exclusive right-of-way and should use caution in crossing.

Sight lines on the approaches to all intersections should be kept clear of obstruction (including vehicle parking) so that bike riders and motorists can see one another.

Vehicles Turning Left

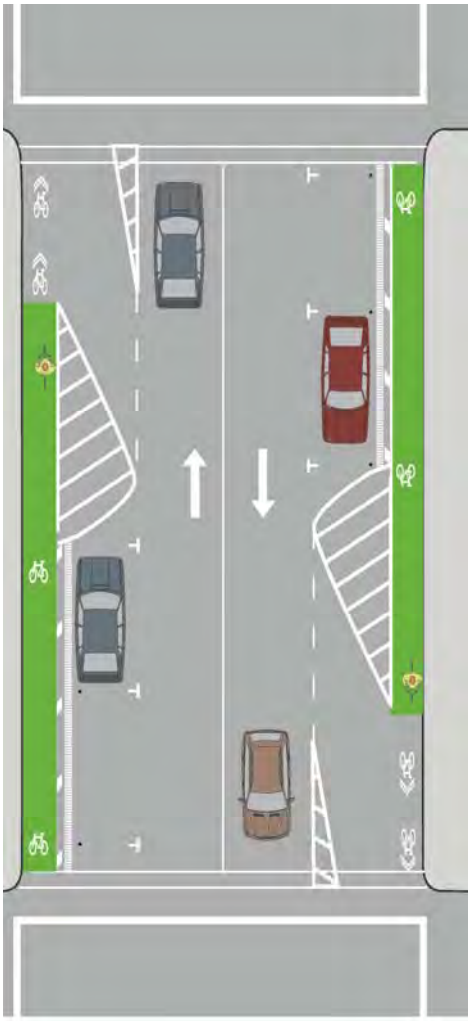
The increased crash risk of traditional European designs at intersections encouraged a number of design features to be introduced into recent designs. In all cases on-street parking should be restricted prior to the intersection to improve sight lines between vehicle drivers and bike riders.

Option 1 – Mixing Zone

The bike lane is truncated, and parking restricted at least 15m (typically 25m) prior to the intersection to create a mixing zone that is a shared space for turning vehicles and through-traveling bike riders. Mixing zones should include pavement markings such as sharrows and a yield line as well as signs to highlight the presence and priority of bike riders. This treatment results in a loss of parking – approximately 3 – 4 spaces per intersection.

Option 2 – Bike Lane Transition

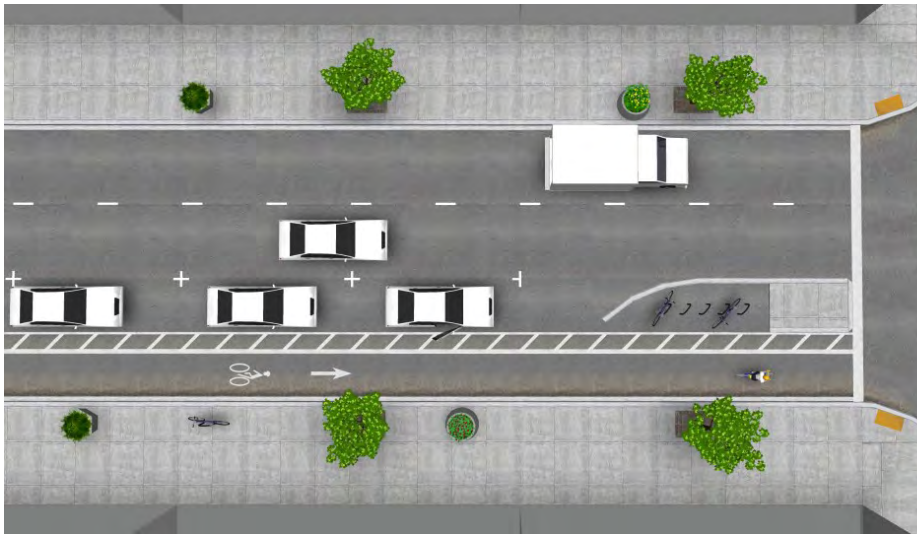
An alternative treatment is to restrict parking to create a turn lane as well as truncate the kerbside running bike lane and transition it to a standard bike lane (with standard bike lane positioning with respect to turn lanes) in advance of the intersection. This treatment also results in a loss of on-street parking.



Example of mixing zone treatment.

Option 3 – Separated Treatment

Another alternative maintains the separation between bike riders and moving traffic. Parking should still be restricted at least 15m prior to the intersection and the space used to create a left-turn lane or an area for planting, bicycle parking, etc. The protected bike lane is continued to the intersection with marking such as sharrows used to provide guidance and priority to cyclists through the intersection. Additional protection can be introduced through advanced or protected signal phasing (i.e. separate to left-turning vehicles), introducing a bike box in advance of a set-back vehicle stop line, coloured pavement markings, and warning signs.



Separated intersection treatment in North America (NACTO Guidelines)

Pedestrian Interaction

The additional separation between pedestrians and traffic can make for a more pleasant walking environment. However, pedestrian misuse of the bike lane as a footpath and pedestrians crossings increase the risk of a pedestrian crash.

Greater definition of the space as a bicycle route is achieved by painting the bike lane a distinctive colour. Dedicated crossing points are provided as appropriate for pedestrians to cross to the buffer. High-quality sidewalks will also discourage encroachment into the bike lane by pedestrians.

Summary

Kerbside running bike lanes are an effective tool in a designer's kit, particularly on roads with higher motor vehicle traffic volumes or speeds. They provide a more comfortable environment for bike riders compared to traditional bike lanes by using a buffer area and a permanent or time-restricted parking lane to separate riders from moving vehicle traffic. The buffer uses painted markings and other cost-effective separators such as profile line marking and flexible traffic poles to allow car doors to open without obstructing the bike lane and to allow passengers to alight from parked vehicles and unload.

They are also more cost-effective and practical than other separated bike lane facilities such as "Copenhagen-style" bike lanes that are more expensive to construct, require a larger cross-section, and impact existing drainage patterns.

The risks of traditional kerbside designs, in particular at intersections and with pedestrians, are addressed through a number of design enhancements introduced as part of recent Australian and North American applications. These include parking restrictions prior to intersections, introduction of a "mixing zone" where left-turning vehicles and bike riders share space, providing positive guidance to riders through the intersection, and painting the bike lane a distinctive colour along its length to distinguish it to riders, pedestrians, and alighting vehicle passengers.

References

1. VicRoads (2008). Cycle Notes No. 21. *Providing Increased Separation for On-Road Bicycle Lanes.*

2. Austroads (2009) Guide to Road Design Part 3: Geometric Design – Section 4.8.5, Separated Bicycle Lanes

3. Landis et al. (2005) *Sidepath Facility Selection and Design.* Tallahassee: Florida Department of Transportation.

4. Transport for London. *London Cycling Design Standards.* Chapter 4: Links – Cycle Lanes, Cycle Tracks and Other Cycle Facilities.

5. Jensen et al. [no date]. *Road Safety and Perceived Risk of Cycle Facilities in Copenhagen.* Copenhagen, Denmark.

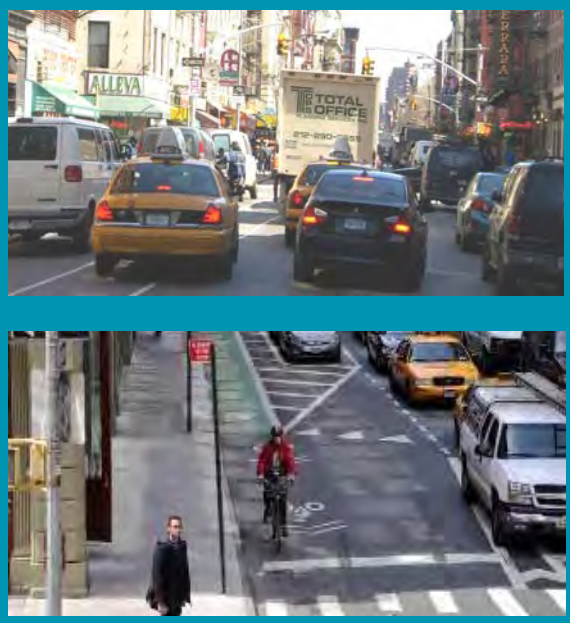
6. Association of Pedestrian and Bicycle Professionals (APBP). *Cycle Tracks: Concept and Design Practices.* Presentation: 17th February 2010.

7. Department of Public Works (2010). *Hennepin Avenue and 1st Avenue Two-Way Conversion Evaluation Report.* Minneapolis, United States.

8. Road Safety Rules 2009. Minister for Roads and Ports, 26 August 2009.

Case Study: Grand Street, New York City

New York City introduced kerbside running bike lanes to Grand Street to provide greater protection for bike riders and better define roadway space for all users. The treatment has resulted in a 29% increase in bike riders along this route and after the first year of operation, Grand Avenue has recorded a 27% reduction in injuries to all street users.



Grand Street – before and after

Design Innovation

Mixing Zones are used to increase the visibility of riders at intersections. Shared lane markings or sharrows define a path for riders through the intersection, and distinctive green paint used along the length of the facility enhances definition to riders and pedestrians.