RECONFIGURING SYDNEY STREETS

Copenhagen case studies and Sydney adaptations

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Reconfiguring Sydney Streets: Copenhagen case studies and Sydney adaptations

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Søtorvet

Notes on terminology:

Each city uses specific terms for bicycle facilities. In Sydney the terms bicycle path and bicycle lane mean something different depending on where in the street they are located and the degree of separation provided. In Copenhagen they talk primarily of cycle tracks. Sydney has shared paths where pedestrians and cyclists share a footpath. In Copenhagen this facility is prohibited. For consistent comparison all facilities in this document that provide a line of travel for cyclists, aside from shared paths, are termed bicycle lanes.

Contraflow lane: A bicycle lane in the opposite direction to motor traffic on a one-way street.

Designed speed: The speed motorists are likely to drive due to the configuration of the street, regardless of the signposted speed. Motorists tend to drive slower on narrow, enclosed streets and where sight lines are obscured or kept short.

Cross fall: The downward slope of paving to facilitate water flows.

One-way pair: A one-way bicycle lane on each side of the street. In Copenhagen the lane runs between the footpath and parked cars.

Raingarden: A planted area that is lower than the surrounding pavement to capture stormwater and passively irrigate planting.

Split-verge kerb extension: A proposed reconfiguration type for the common Sydney street profile of 12.8m between kerbs with 3.6m verges, to accommodate high amenity bicycle lanes.

Part 1:
Designing for cycling

Reconfiguring Sydney Streets offers planners, designers, decision makers and the interested public hypothetical streetscape designs for selected Sydney streets – a feasible reshaping of the urban environment to put in place bicycle infrastructure, drawing on specific Danish practices in the city of Copenhagen.

This document has two parts. The first presents case studies that show how Copenhagen implements important design principles to provide bicycle infrastructure in different types of streets. Examples include both ideal and compromised solutions. Informed by these case studies, the second part of this document presents examples of particular Sydney streets, hypothetically reconfigured to accommodate bicycles – an application of Danish design principles in the context of Sydney street conditions.

Copenhagen and Sydney are different cities, in urban form, culture and climate. However numerous metropolitan centres in Sydney double or triple the density of inner Copenhagen and the weather in Sydney is arguably more amenable for cycling than in Copenhagen. The two cities have similar street profiles and human vulnerability is universal. This means that successful traffic management techniques need not change radically from city to city. For example, the ordering of street uses based on vulnerability is perhaps the most important principle underpinning Copenhagen's approach. Similarly important and widely applicable principles are the techniques of separation and the minimum bike lane width required so that cyclists of varying ages and abilities can safely overtake.

We know that a large proportion of Sydney car trips are short and suitable for cycling. For example, over 60% of car trips to Bondi Junction, classified a major centre, are under 5km.[1] We also know that many Sydney residents have said they would like to cycle, if safe facilities were available. While we need to appreciate local contexts when adapting Sydney's streets, it is important to recognise the success of tried and tested design principles: cycling has become the majority mode of transport in Copenhagen's city centre.

The hypothetical examples in the second part of this document demonstrate that Sydney, like Copenhagen, can accommodate the bicycle as a widely appealing transport choice by applying design principles to particular streets.

Fredensgade

59%
of people residing in the City of Sydney who do not ride bicycles said they would cycle to work if separated bicycle paths were available.

75% of non-regular cyclists and
73% of potential cyclists
said having separated bicycle lanes and off-road routes would make them cycle more regularly.
(City of Sydney, 2007)

70%
of NSW residents would like to cycle more for everyday transport if cycling was safer and more convenient.
(NSW Government, 2013)

The real differences between cities is political will. In Copenhagen there is consensus across the political spectrum that cycling is good for the city.[2] Ayfer Baykal, Mayor of the Technical and Environmental Administration, describes cycling as a prioritised political tool for creating a more liveable city.[3] Good conditions for cycling are part of the city's official health policy. Australia's adult obesity rate is double that of Denmark,[4] despite having a higher rate of organised sport participation. The reason is 'incidental activity' – cycling and walking – as an integral part of daily life.

The City of Copenhagen, as well as the Danish Government, recognise there are multiple benefits of cycling. Funds to address climate change include an allocation for bicycle infrastructure. Bicycle transport has become integral to urban planning and design, with a focus on separated, direct bicycle lanes and easy transfer to public transport. As a result, even though Danes enjoy some of the highest levels of average wealth in the world, more people in Copenhagen choose this low expense – but quick and convenient – mode of transport than any other. The critical word here is convenient – planned and designed. 88% of cyclists surveyed in Copenhagen said they choose the bicycle because it is quick and convenient,[5] not because they are trying to get healthy or improve the city's air quality – these just happen to be positive side benefits.

In Sydney's congested traffic, a door-to-door trip to work can be slower by public transport or private car than it is by bicycle, yet only 3.4% of trips in the City of Sydney are by bicycle.[6] The City of Copenhagen's municipal area triples the City of Sydney and has a lower residential density. There is a compelling need to investigate how cycling routes, designed to be safe, direct and convenient, could enable more people to make that trip by bicycle. While Copenhagen's high rates of cycling (49% of all trips in the City Copenhagen,[7] which covers triple the municipal area of the City of Sydney, with a lower residential density) may seem far beyond Sydney's reach, we have a clear message that Sydneysiders would like to cycle more. 73% of 'potential' cyclists and 59% of 'non-cyclists' living in the City of Sydney would cycle to work if separated lanes were provided.[8] Even at the state level, according to the NSW government, 70% of residents would like to ride a bike more for everyday transport – if cycling was made safer and more convenient.[9]

Copenhagen's high levels of cycling are a result of planning, design and implementation. However only a few decades ago bicycle infrastructure was not seen as worthwhile by authorities. Danish urbanist Jan Gehl argues that the shift in policy was initiated by a bottom-up groundswell that culminated in public demonstrations during the 1970s.[10] Niels Jensen, veteran transport planner at the City of Copenhagen, explains that the planners and engineers of the time were focused on providing for cars, who argued emphatically that there was no room for bicycle lanes on the streets of

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Copenhagen. A familiar argument in Sydney.

It is hard to imagine that the authorities in Copenhagen once argued against the extensive cycling infrastructure that has transformed access to the city. According to Jensen, it took half a decade for political will to shift in support of cycling, and a further decade for the planning bodies to adjust their thinking and modes of operation. In Sydney, the current groundswell of interest in cycling suggests the city could potentially be on the cusp of a similar shift. To realise this opportunity and facilitate a significant mode share swing to cycling, street reconfiguration approaches are needed to provide a network of separated bicycle lanes.

Bicycle lanes in Copenhagen are predominantly variations on the one-way pair: a one-way lane on either side of the street. Jensen explains that this has been found the most effective model, because it works efficiently with intersections and aligns with vehicular movement, making it easy for all street users to understand and follow.

The City of Sydney has taken a different approach for its recently installed separated bicycle lanes, which operate as bidirectional cycleways, on one side of the street. This type is not commonly used in Copenhagen. Copenhagen's preferred model; the one-way pair, does require more space. In Sydney's narrow streets bidirectional cycleways are an astute piece of infrastructure, designed to slot into streets with 12.8m between kerbs – the most common profile in Sydney. The idea is that by narrowing lanes, the cycleway can be added without compromising footpaths or losing car travel lanes or parking – a seemingly 'no losers' approach. While exhibiting some limitations, the arrival of the bidirectional cycleway on Sydney's streets has provided the fundamental requirement for cycling to become an appealing form of transport – safety. People are using the new facilities and cycling is increasing. Each time a new cycleway opens, more people decide to ride.[11] As the survey's suggest there is unmet demand ready to be released, an evident appetite for an expanded network of separated bicycle lanes.

Over time, Sydney will see various measures trialled in pursuit of a bicycle-friendly city. More bidirectional cycleways will be opened and welcomed. One advantage of the bidirectional cycleway is its potential to be duplicated to create a one-way pair as demand increases.

The challenge remains how to negotiate space in a range of street contexts to provide either the separation, or the calmed traffic conditions that give people the confidence to choose the bicycle as a mode of transport, regardless of their age or gender. This document offers for Sydney streets a design perspective from Copenhagen – a city that has been configuring streets to accommodate bicycles for several decades and is now considered a world leader in bicycle planning.

Standard suburban (S) train

Frederiksborggade

Street profile

Pedestrian	**34%**
Bicycle	**21%**
Car	**45%**

SEPARATED ONE-WAY PAIR
Context: mixed-use street

This configuration is the classic type, termed 'the Copenhagen lane' outside Denmark. Bicycles are separated from motor traffic by a row of parked cars and a buffer zone wide enough for tree planting, bicycle parking and access for parked cars. The bicycle lanes are wide enough for easy overtaking and riding side by side. Since 2010 the inside space of lanes wide enough for two to ride abreast with enough space for a third to overtake have been termed 'conversation lanes', replacing the short-lived reference to the outside space as the 'fast lane'.[12]

The footpath is separated from the bicycle lane by a low kerb and different paving. The Cycling Embassy of Denmark recommends kerb height for bicycle lanes between 50-90mm.[13]

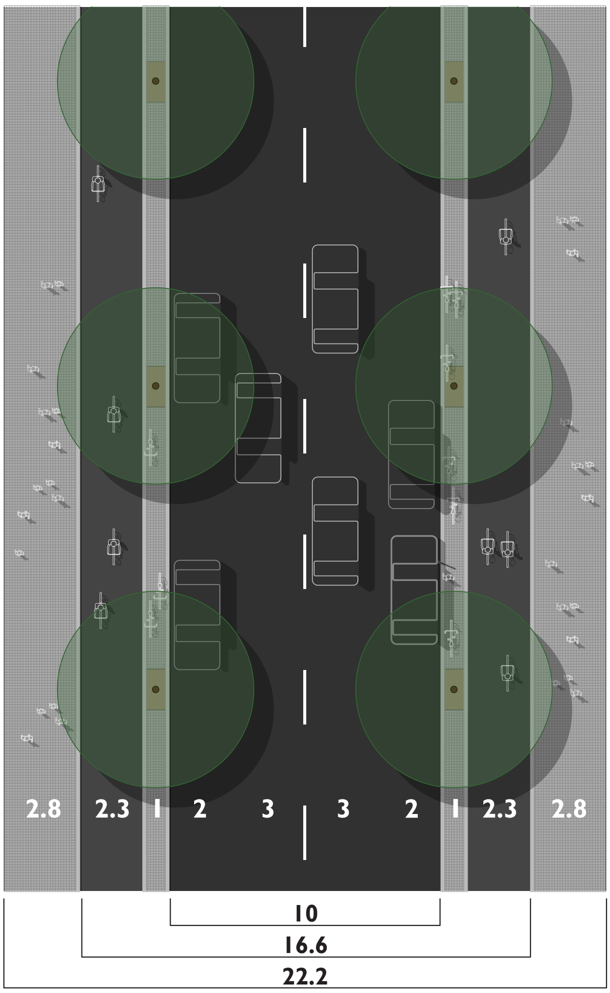
Speed limit
50 km/hr

Separation
Kerb separation to road with 1m buffer zone level with the bicycle lane.

Kerb and material separation to footpath.

The buffer provides enough space for tree planting and bicycle parking.

Parking
Parallel car parking both sides.



Vesterbrogade

Street profile

Pedestrian	**27%**
Bicycle	**23.5%**
Car	**49.5%**

SEPARATED ONE-WAY PAIR

Context: mixed-use street

When separated bicycle lanes were introduced on this street one side of car parking was removed. At a later date, trees have been planted in line with cars on the side of parking that was retained.

The bicycle lanes are two metres wide with no buffer space to parked cars. This omission of buffer space to achieve a wider bicycle lane is increasingly being adopted in Copenhagen in both the widening of existing lanes and construction of new lanes.

Speed Limit

50 km/hr

Separation

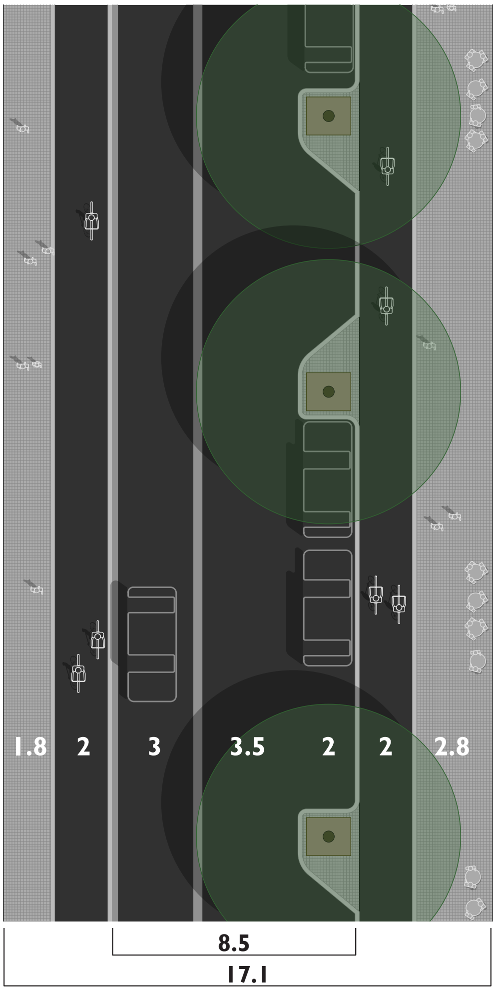
Kerb separation to road with no buffer space to parked cars.

Kerb and material separation to footpath.

Parking

Parallel car parking on one side.

Tree planting in line with parking.



Søndre Fasanvej

Street profile

Pedestrian	**21%**
Bicycle	**21%**
Car	**58%**

SEPARATED ONE-WAY PAIR

Context: street between parklands and zoo

Lanes such as these are used as an interim measure when space or funding make it difficult to install facilities with kerb separation to the road.[14] Between kerbs, each separate road use is marked with paint.

With no buffer space between parked cars and bicycles there is a risk of conflict with opening car doors but much less so than if the bicycle lane was on the driver's side as is the case with common shoulder bicycle lanes in Sydney. There is twice the likelihood of a car door opening on the driver's side than the passenger side; all cars have a driver, but (in NSW) only 50% have a passenger.[15] The higher chance of door opening on the driver's side combined with the risk of cyclists veering into moving traffic in order to evade the door is considered too great a threat. Consequently bicycle lanes are always located between the footpath and cars.

Speed limit

50 km/hr

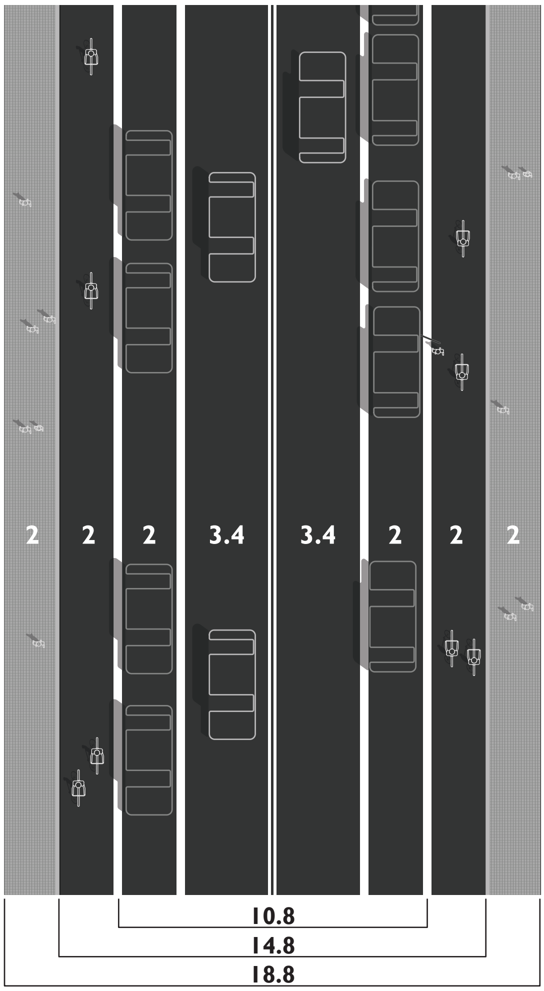
Separation

300mm wide white painted line with no buffer space to parked cars.

Kerb and material separation to footpath.

Parking

Parallel car parking both sides.



Mimersgade

Street profile

Pedestrian	36%
Bicycle	21%
Car	43%

KERBSIDE LINE MARKED ONE-WAY PAIR ON APPROACH TO INTERSECTION

Context: residential street

Most accidents involving bicycles occur at intersections. While streets with low speeds and low traffic volume do not usually have separated facilities in Copenhagen, intersections are often provided with targeted facilities. Mimersgade is one such example.

No parking is permitted on approach to the intersection (70m from stop line at Mimersgade - diagram is indicative) as this space is used to provide 1.7-m kerbside bicycle lanes. These are not grade separated from motor traffic. They are marked by a 300mm white painted line. A 3.5m advanced stop line is used to further increase visibility of bicycles at the intersection.

Between intersections the street operates as mixed traffic conditions.

Speed limit

40 km/hr

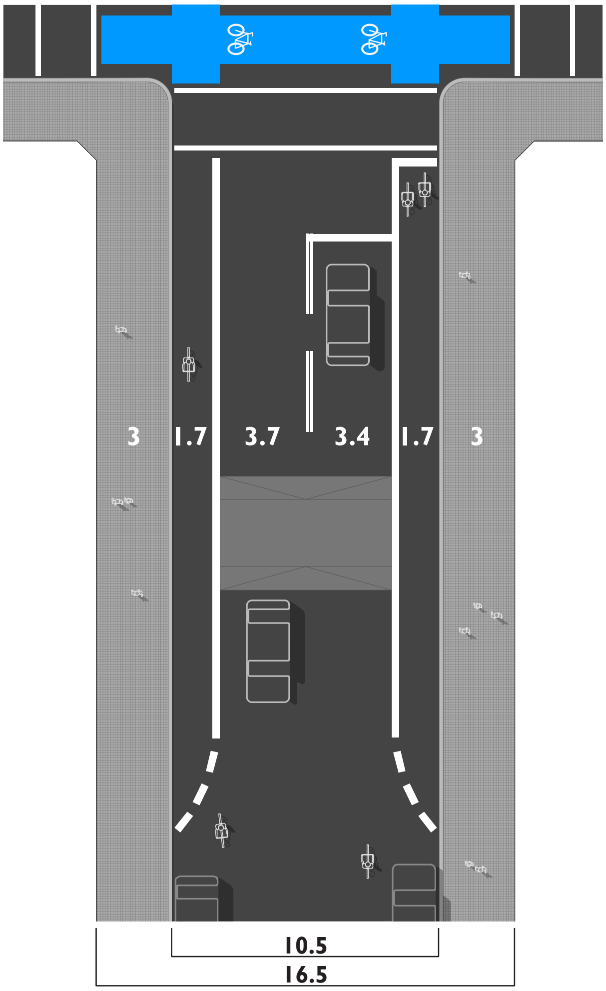
Separation

300mm wide white painted line with no buffer space to travelling vehicles.

Kerb and material separation to footpath.

Parking

Parallel car parking both sides. No parking 70m from intersection where kerbside lanes are present.



Sønder Boulevard

Street profile

Pedestrian	56%
Bicycle	14%
Car	30%

SEPARATED ONE-WAY PAIR

Context: mixed-use street, mostly residential

Before its redesign in 2005 this street was car dominated with a degraded, treeless central median (a century earlier the median was a grand parterre with Elm trees). Six workshops with residents and local business people resulted in its current configuration.

The central median was widened and numerous active and passive uses are catered for. People are free to furnish the space as they wish. Uses that have emerged include formal facilities such as a basketball court and children's play equipment as well as self organised barbecues, seating, garden plots and skating structures.

Speed limit

50 km/hr

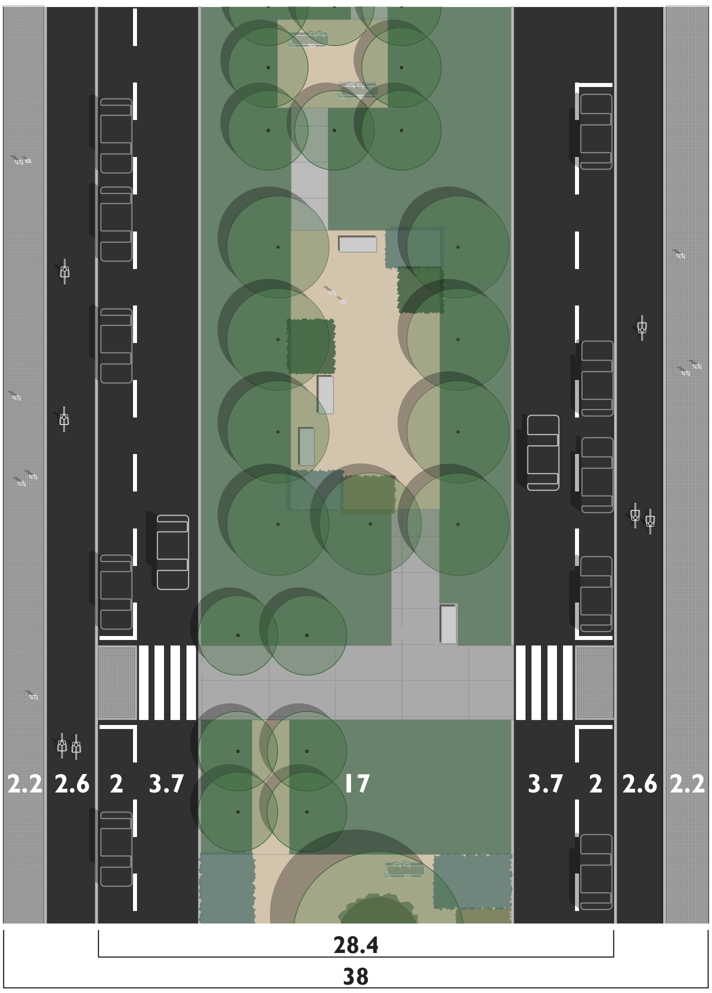
Separation

Kerb separation to road with no buffer space to parked cars.

Kerb and material separation to footpath.

Parking

Parallel car parking both sides.



Niels Ebbesens Vej

Street profile

Pedestrian	**40%**
Car/Bicycle	**60%**

SLOWED MIXED TRAFFIC

Context: mixed-use street, mostly residential

There is generally no need for separated facilities on local, low speed streets. However traffic management configurations can provide a safer and more comfortable environment for bicycles.

In this example parallel parking on both sides has been changed to 90˚parking on one side. The side with parking alternates along the length of the street. This removes long sight lines and straight lanes for vehicles encouraging slower, more careful driving.

Speed limit

30 km/hr

Separation

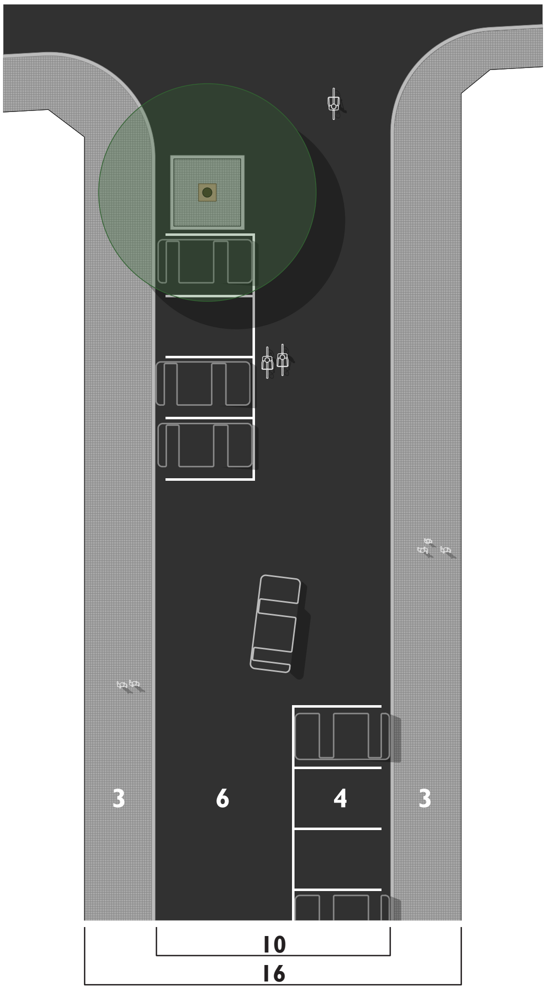
No Separation to vehicles.

Kerb and material separation to footpath.

Parking

90˚car parking, switching street sides at intervals.

Tree planting in line with parking.



Classensgade (main street)

Street profile

Pedestrian	30%
Bicycle	16%
Car	54%

KERBSIDE ONE-WAY PAIR
Context: mixed-use street, mostly residential

The 1.5m bicycle lanes on Classensgade are well below the Danish standard, prohibiting overtaking. The lanes are not grade-separated from the road and there is no buffer zone to shield cyclists from parked cars where a door could open.

While compromised, and a configuration the City is not proud of,[16] an important principle is adhered to: the bike lane is placed between parked cars and the footpath – away from moving traffic. While there remains a risk of conflict with opening car doors, it is considerably less so than if the lane was on the driver's side. Most importantly in the event of conflict with an opening door the risk of the cyclist moving into the path of moving traffic has been eliminated.

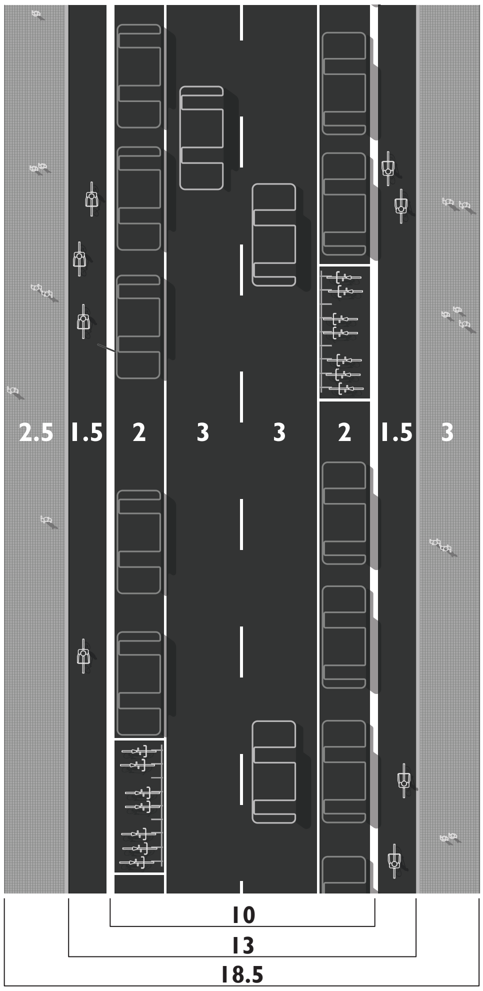
Speed limit
50 km/hr

Separation
300mm wide white painted line with no buffer space to parked cars.

Kerb and material separation to footpath.

Parking
Parallel car parking both sides.

Bicycle parking bays in line with car parking.



Classensgade (side street)

Street profile

Pedestrian	28%
Car/Bicycle	49%
Parking/planting	23%

MIXED TRAFFIC

Context: mixed-use street, mostly residential

All parking and planting has been aligned to the centre of this short street, allowing for mixed traffic lanes with clear visibility between drivers and cyclists. In this condition cars generally do not attempt to overtake cyclists.

Speed limit

50 km/hr - designed speed ensures slower driving.

Separation

No Separation to vehicles.

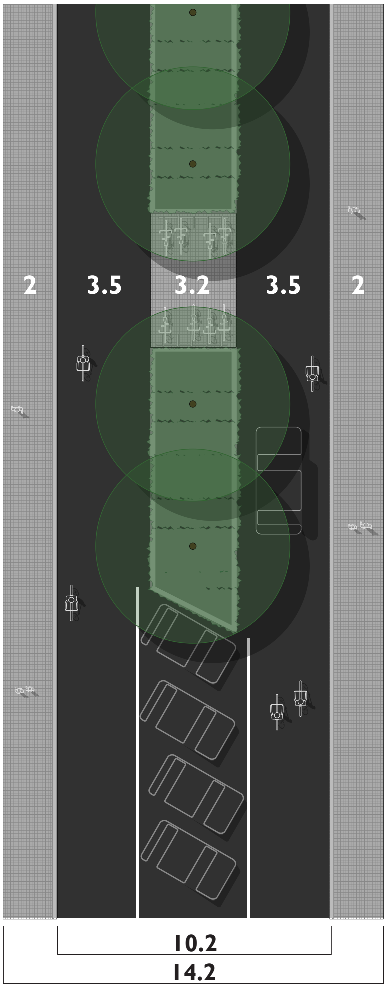
Kerb and material separation to footpath.

Parking

45˚car parking to centre of street.

Bicycle parking bays in line with car parking.

Tree planting in line with parking.



Kristianiagade

Street profile

Pedestrian	**24%**
Bicycle	**11%**
Car	**65%**

SEPARATED / MIXED TRAFFIC COMBINATION

Context: mixed-use street, mostly residential

This street operates in conjunction with the parallel street Østbanegade. They each contain a separated one-way bicycle path in opposite directions.

The 4.4m mixed traffic lane is wider, allowing safe overtaking. While there is space for a painted shoulder lane between parked cars and traffic - the dominant type in Australian cities - a mixed traffic environment with no line marking is considered safer. Painted shoulder lanes between parked and moving cars are not used in Copenhagen.

Speed limit

50 km/hr

Separation

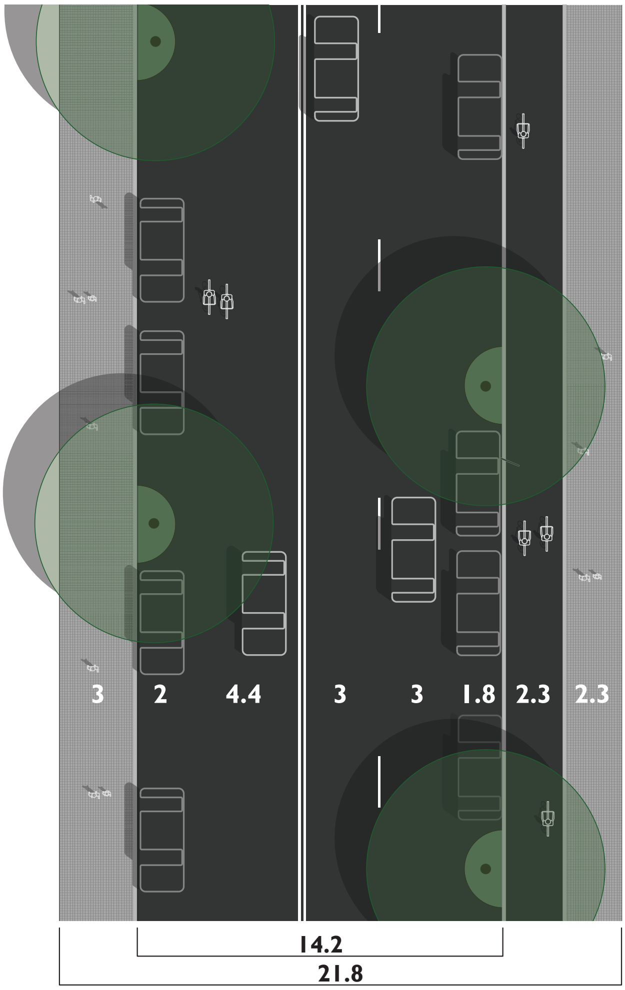
Northbound - Kerb separation to road with no buffer space to parked cars and kerb and material separation to footpath.

Southbound - no separation to vehicles.

Parking

Parallel car parking on both sides.

Tree planting in line with parking.



Randersgade

Street profile

Pedestrian	**30%**
Bicycle	**24%**
Car	**46%**

YIELD STREET WITH KERBSIDE LINE MARKED ONE-WAY PAIR

Context: mixed-use street, mostly residential

Randersgade acts as a 'yield street', meaning cars are required to negotiate a narrow unmarked road whereby one vehicle must yield to the other by pulling aside and allowing them to pass.

Speed humps with bicycle passage are situated before each intersection, slowing cars down for increased safety at intersections.

Speed limit

30 km/hr

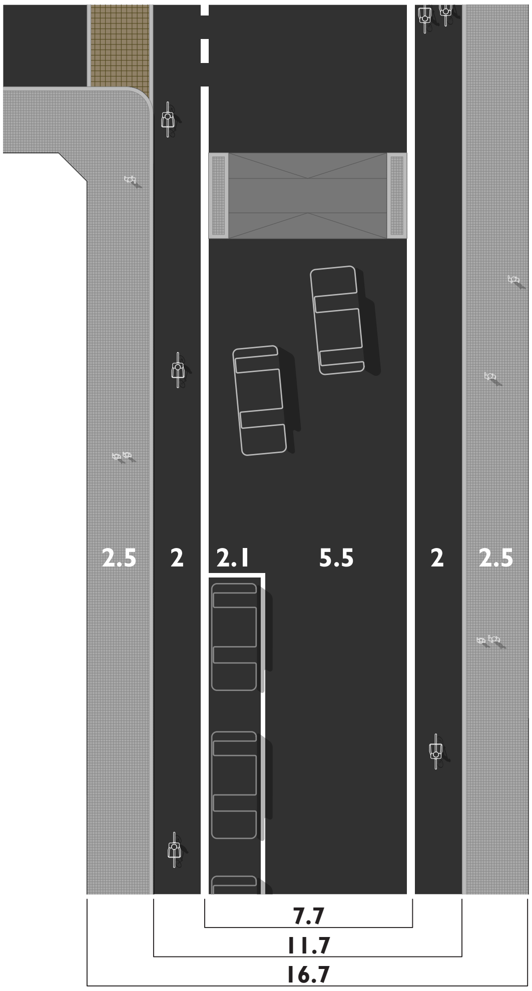
Separation

300mm white painted line with no buffer space to parked cars.

Kerb and material separation to footpath.

Parking

Parallel parking switching sides at intervals.



Dronning Louise Bro
(Queen Louise's Bridge)

Street profile

Pedestrian	40%
Bicycle	33%
Car	27%

SEPARATED ONE-WAY PAIR
Context: bridge connecting city centre with inner city neighbourhood

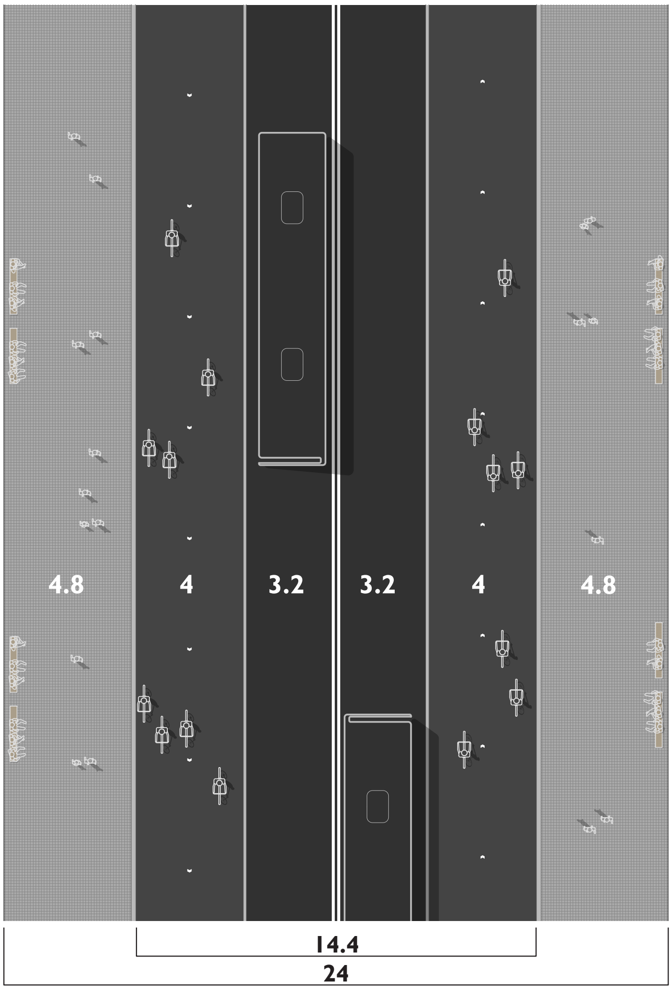
As an important connection to the city centre, this bridge has been reconfigured as a bicycle, pedestrian and bus boulevard. The street leading to this bridge towards the city, Nørrebrogade, was given a similar treatment two years prior. Widening the bicycle paths to 4m each way was a response to bicycle overcrowding at intersections. To achieve this, and increase bus service reliability, car access was reduced. More seating has been provided which, together with less car traffic, has led to the bridge becoming a bustling social space.

Speed limit
40 km/hr

Separation
Kerb separation to road with no buffer space to travelling vehicles.

Kerb and material separation to footpath.

Parking
No parking



Elmegade

Street profile A			Street profile B	
Pedestrian	52%	/	Pedestrian	27%
Bicycle	19%		Bicycle	24%
Car	29%		Car	49%

LINE MARKED CONTRAFLOW LANE/MIXED TRAFFIC COMBINATION

Context: Mixed-use street

Elmegade is a small shopping street with retail shop fronts, cafes and bars. To create a more lively street and cater for the local businesses, a number of temporary changes were made. Car access is one-way with a marked 2.2m contraflow bicycle lane. Most parking has been removed and road space reallocated for outdoor seating and bicycle parking.

After a trial period this arrangement has now been formalised with grade separated contraflow bicycle line and seating areas.

Speed limit

40 km/hr

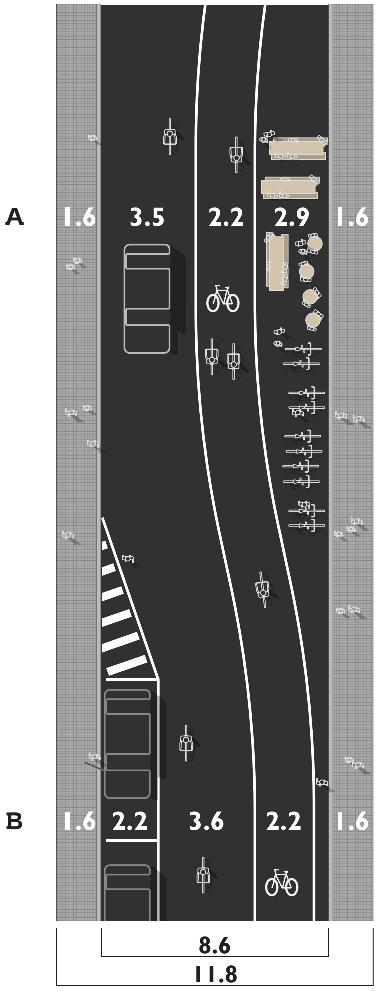
Separation

Double 100mm white painted lines with no buffer space to travelling vehicles.

Kerb and material separation to footpath.

Parking

There is limited parking in dedicated bays intended primarily for deliveries and other local business related purposes.



Østerbrogade / Classensgade

SIGNALISED INTERSECTION
Context: mixed-use intersection

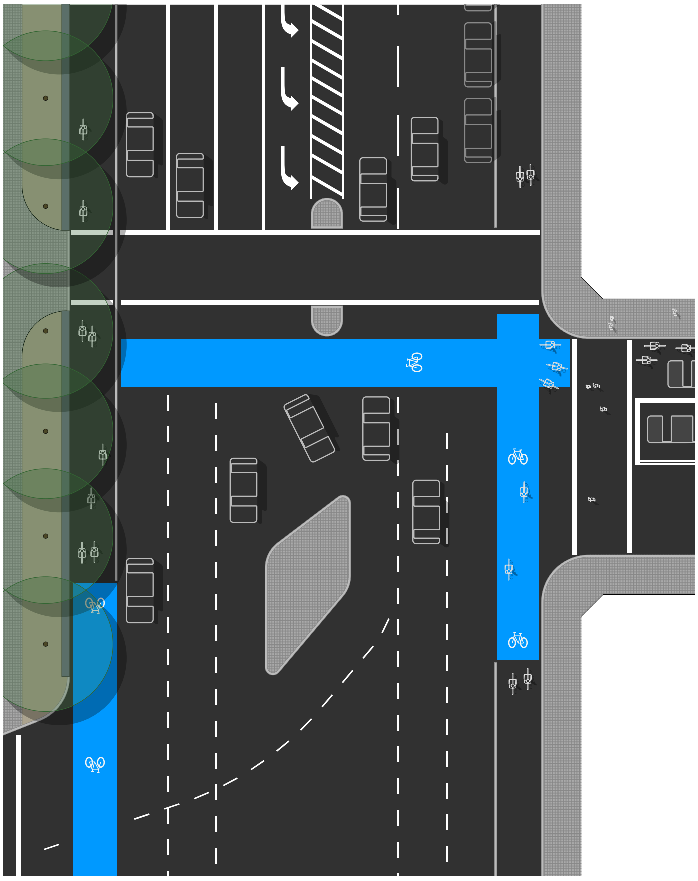
The standard treatment through intersections is a continuation of the bicycle lane with blue paint. Blue paint is only used at crossing situations. This example shows how the blue crossings can work even in large, relatively complex signalised intersections.

Hook turns are made from a space between the blue crossing and the pedestrian crossing of the side street. This technique means bicycles do not merge with and negotiate motor traffic.

Municipalities can seek dispensation from the police to allow cyclists to turn right through red lights at selected intersections. A two year trial period showed this did not lead to more accidents while significantly improving bicycle traffic flow and trip time.[17]

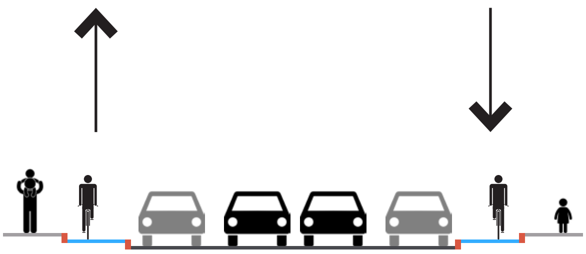
Speed limit
50 km/hr

Separation
Lane width painted blue through intersection.



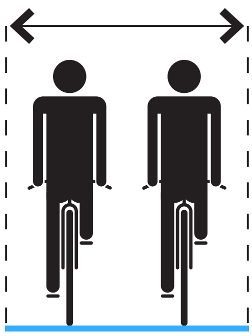
Design Principles for separated bike lanes

One-way pair with bikes between cars and footpath



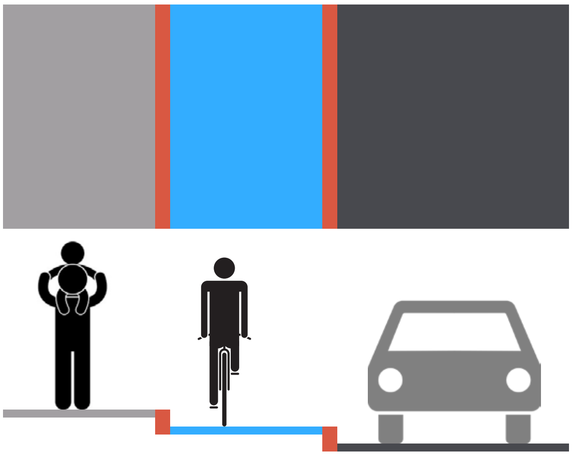
Works most efficiently with intersections and aligns with vehicular movement, easy for all street users to understand and follow.[18]

One-way minimum 1.7m



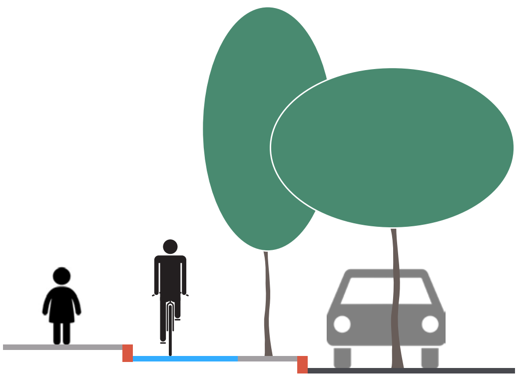
Controlled testing found 1.7m to be the minimum width to allow safe overtaking.[19]

Material difference to footpath and grade separation both sides



Without material and grade separation pedestrians will drift into the bike lane. Cars need clear physical separation from bikes to make cycling appealing.[20]

Integrate planting as traffic calming / separation



Street planting should to be seen to improve pedestrian and cyclist amenity and structure the street according to the other principles.

Part 2:
Reconfiguring Sydney Streets

The case studies from Copenhagen (see pages 8-21) illustrate a number of possibilities for bicycle provision based on design principles that provide safety, efficiency and user legibility. The examples suggest where compromises can be made to fit a particular street context and where principles should be adhered to.

Bicycle lanes in Denmark are separated from motor traffic and located between the footpath and cars. Bicycle lanes are never painted shoulder lanes between parked and moving cars.

While the current standard width of a one-way bicycle lane is 2.2m,[21] the Danish Road Directorate has demonstrated that a lane width of 1.7m is the minimum required for safe overtaking.[22] One case study (see page 14) shows a 1.5m lane – clearly below standard. While this is extremely rare and a condition the City is not pleased with, it shows a compromise where separation from motor traffic is more important than stringently pursuing a particular lane width.

For the proposed reconfigured Sydney streets in the following pages, all the one-way bicycle lanes are at least 1.7m wide.

As yet Sydney does not share an advantage that Copenhagen enjoys – the widespread awareness of bicycles and legal responsibility favouring cyclists and pedestrians – so more care needs to be taken of potential conflict between different street users.

The surface proposed for Sydney's bicycle lanes is asphalt.[23] The Danish Road Directorate states that as a rule asphalt, in a finer aggregate/smoother finish than roads, is the most suitable cycling surface. Segmental paving or concrete slabs, as currently used for some off-road cycleways in Sydney, provide a poorer quality of riding due to regular joints and greater resistance.

It may appear as if Sydney's streets lack the capacity to cater for separated bicycle facilities, at least without compromising other uses. From one perspective this is true – to insert a new space, allocation changes need to be made, at times at the expense of another particular use. However, as the examples here demonstrate, this expense can be marginal and sometimes even beneficial to other uses. Allocating space for bicycles is consistent with government strategies at all levels to increase active travel and decrease car dependence.

The hypothetical examples presented here explore how Danish design principles can be applied in Sydney streets to provide safe and efficient bicycle facilities at a level needed to appeal to a wide range of people. An important consideration is demonstrating how this can be done in an acceptable way – after all we are still 'breaking the ice' in some jurisdictions.

Some common street types in Sydney can accommodate the ideal 'Copenhagen lane' in a relatively cost-effective way without detrimentally affecting traffic flow, parking or footpaths. These streets would be suitable demonstration streets. Other examples show where compromises may require narrowing of motor vehicle lanes or, less commonly, footpaths. In these instances other benefits are sought, such as opportunities for additional street planting, or the fact that walking is safer and more pleasant when the distance between motor traffic and pedestrians is increased – with the use of a bicycle lane.

For some time there has been wide acceptance, globally and in Australian cities, that when traffic volumes are lowered, there are direct increases in the social, environmental and economic quality of streets. This view is underpinned by a substantial body of research, from Donald Appleyard's social studies in the US during the 1970s to Jan Gehl's work in Danish and Australian cities over the last few decades, and in 2013 given official recognition by the Australian federal government.[24] Conversely, there are many shopping streets in Sydney that were once appealing to people who shopped there on foot or by bicycle, until traffic increased to such an extent that the danger, noise and fumes literally drove them away. In economic and social terms, those communities have lost their place of local commerce; businesses can't survive and land values, as well as social interaction, have decreased.

The Sydney streets illustrated on the following pages are real opportunities in real locations. They have been chosen for their type and strategic location. The designs are not intended to be seen as specific proposals for those particular streets, nor has endorsement been sought from the relevant Councils. Instead, the designs offer reconfiguration possibilities that could be applied to any street of similar conditions. Evidence suggests a significant mode share swing to cycling is possible, providing safe and convenient facilities are available. These streets propose a design response to that evidence.

Orpington Street

Street profile

Pedestrian	**20%**
Turf strip	**16%**
Car	**64%**

Current treatment: none
Context: residential street connecting to train station

Orpington Street is characteristic of Federation era streets; Brushbox trees are planted on the street in line with parked cars. The footpath is 1.8m and the strip of grass, without trees, is also 1.8m.

The overall dimensions of this street are consistent with the common street profile in Sydney of 12.8m between kerbs and 3.6m verges.

The opportunity with this type of street lies in the verge dimensions and the location of the existing mature trees.

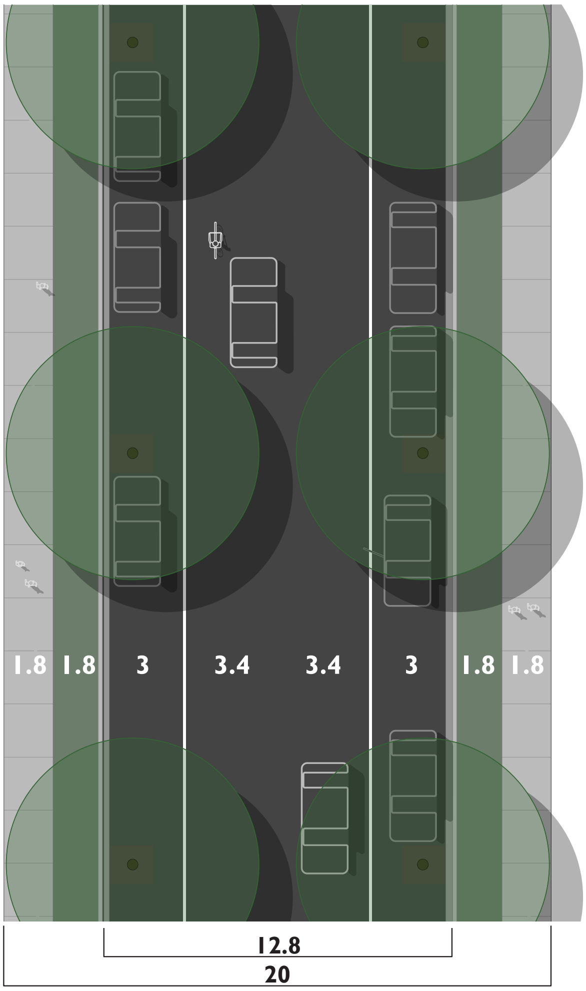
This street is identified as a regional route in the Inner Sydney Regional Bike Plan.

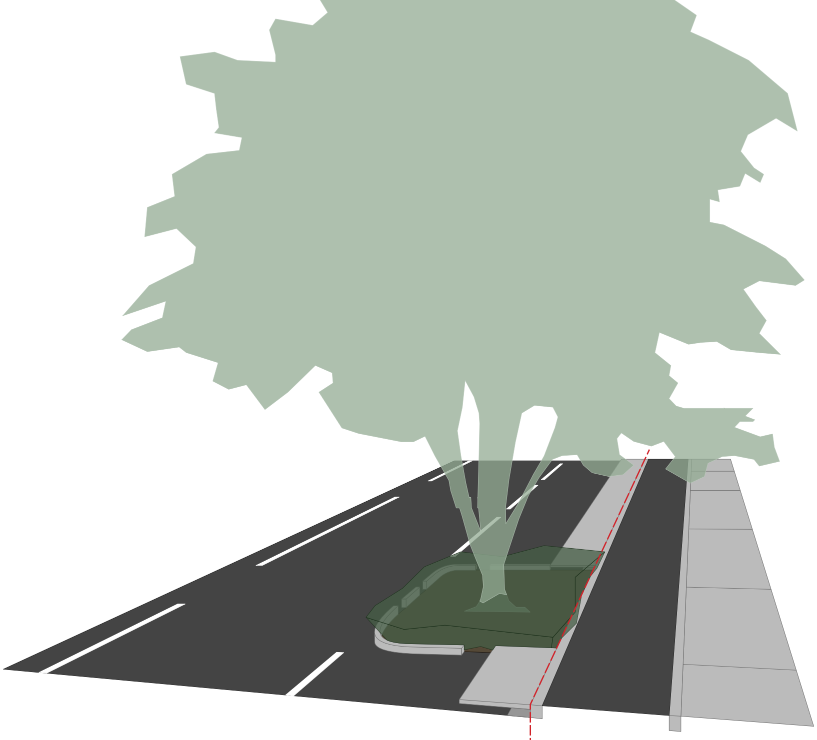
Speed Limit
50 km/hr

Traffic
Two-way motor traffic

Separation
No separation.

Parking
Parallel car parking both sides between street trees.





Orpington Street
Reconfigured

Street profile

Pedestrian	28%
Bicycle	17%
Raingarden	5%
Car	50%

SEPARATED ONE-WAY PAIR; 'SPLIT VERGE/KERB EXTENSION'
Context: residential street connecting to train station

Federation era streets such as this present an opportunity to achieve all the principles of a well designed 'Copenhagen lane' cost-effectively and without restricting other street uses.

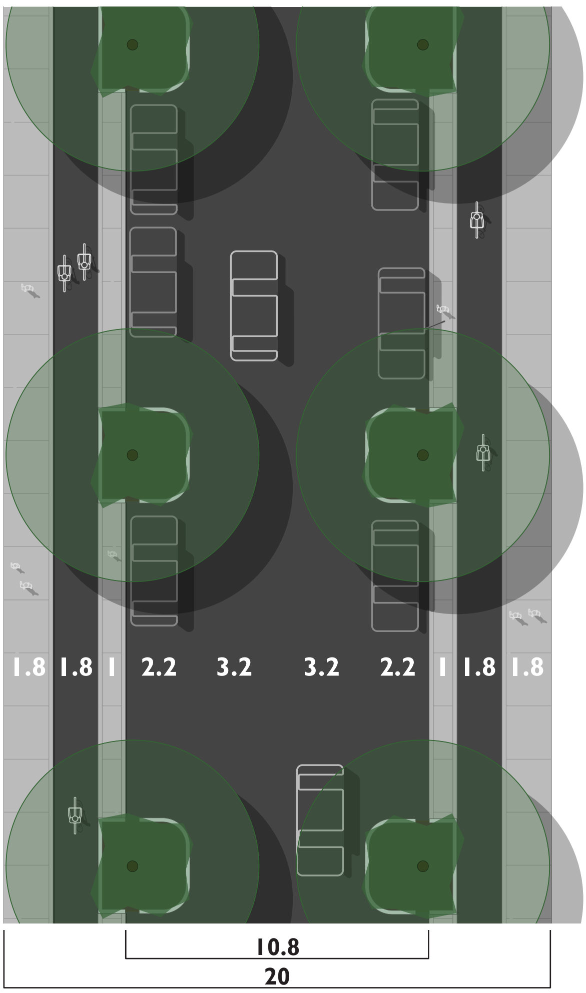
The strip of grass becomes a one-way bicycle lane. Asphalt is laid between the existing footpath and kerb - both retained. The kerb is extended into the road by 1m to provide a buffer zone between parked cars and moving bikes. This can be done without modifying stormwater infrastructure. A raingarden is added to the base of the existing trees.

This reconfiguration type, applicable in many Sydney streets, is termed here as the 'split-verge/kerb extension.'

Separation
Kerb separation to road with 1m buffer space to parked cars.

Low kerb and material separation to footpath. The kerb grade change is highly recommended but not strictly necessary if considered an interim stage.

Parking
Parallel car parking both sides retained. Raingarden added to tree planting.



Frenchmans Road (west)

Street profile

Pedestrian	**20%**
Turf strip	**16%**
Car	**64%**

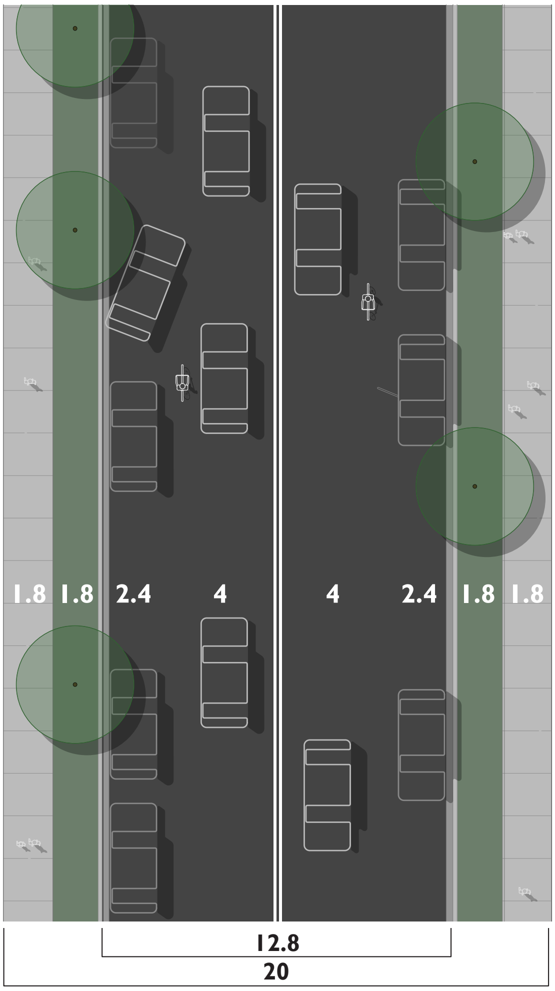
Current treatment: none
Context: residential street

As the most direct connection between two major centres and leading on to a university, high school, primary school and hospital, this street carries a high volume of motor traffic, including buses. It is also an important cycling route. Running along the ridge, it is the only route between these centres that has an acceptable grade for cycling.

The street has the common profile of 12.8m between kerbs and 3.6m verges. The verges are split 1.8m for the footpath and 1.8m for turf and tree planting. Existing trees of various ages and conditions dot the verge.

This street is identified as a regional route in the Inner Sydney Regional Bike Plan.

Speed limit
60 km/hr



Frenchmans Road (west)
Reconfigured

Street profile

Pedestrian	28%
Bicycle	17%
Raingarden	5%
Car	50%

SEPARATED ONE-WAY PAIR; 'SPLIT VERGE/KERB EXTENSION'
Context: residential street

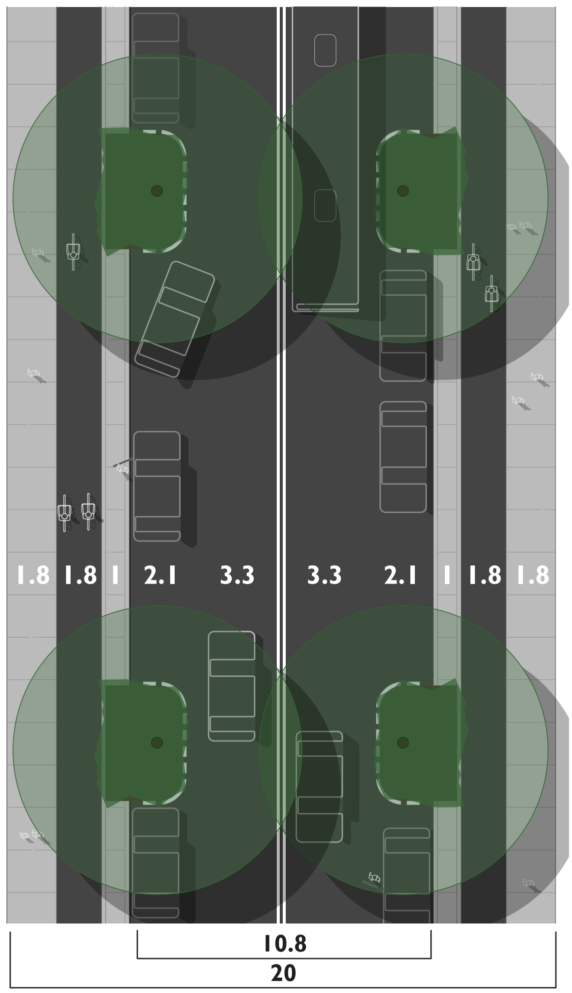
With the common cross file 12.8m between kerbs and 3.6m verges and no clearway restrictions, this street could adopt the 'split-verge/kerb extension.'

Large trees regularly spaced within raingardens would replace the current haphazard arrangement of scattered trees to provide a civic boulevard character.

Separation
Kerb separation to road with 1m buffer space to parked cars.

Low kerb and material separation to footpath. The kerb grade change is highly recommended but not strictly necessary if considered an interim stage.

Parking
Parallel car parking both sides retained. Tree planting with raingardens in line with parked cars.



Frenchmans Road (east)

Street profile

Pedestrian	**36%**
Car	**64%**

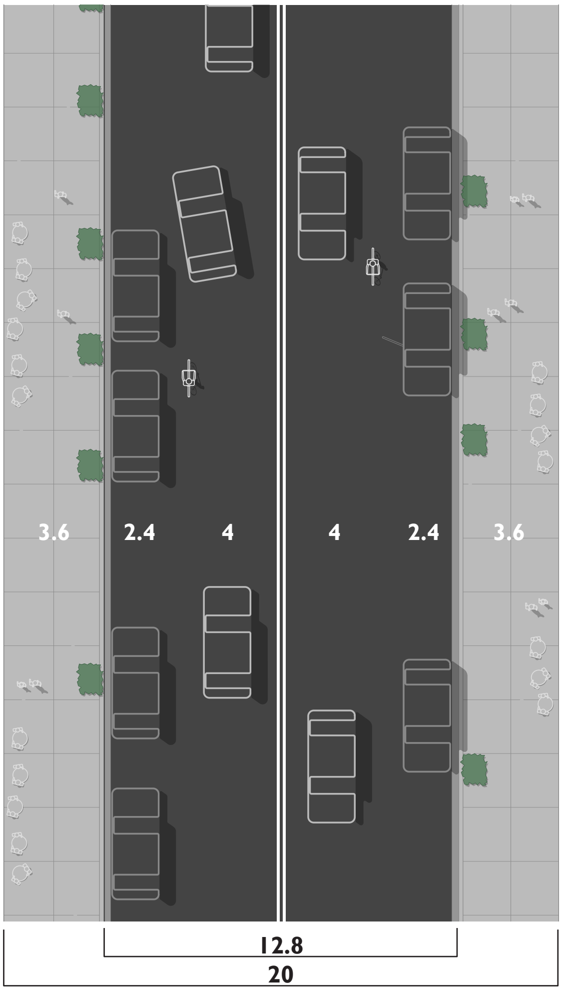
Current treatment: none
Context: mixed-use street

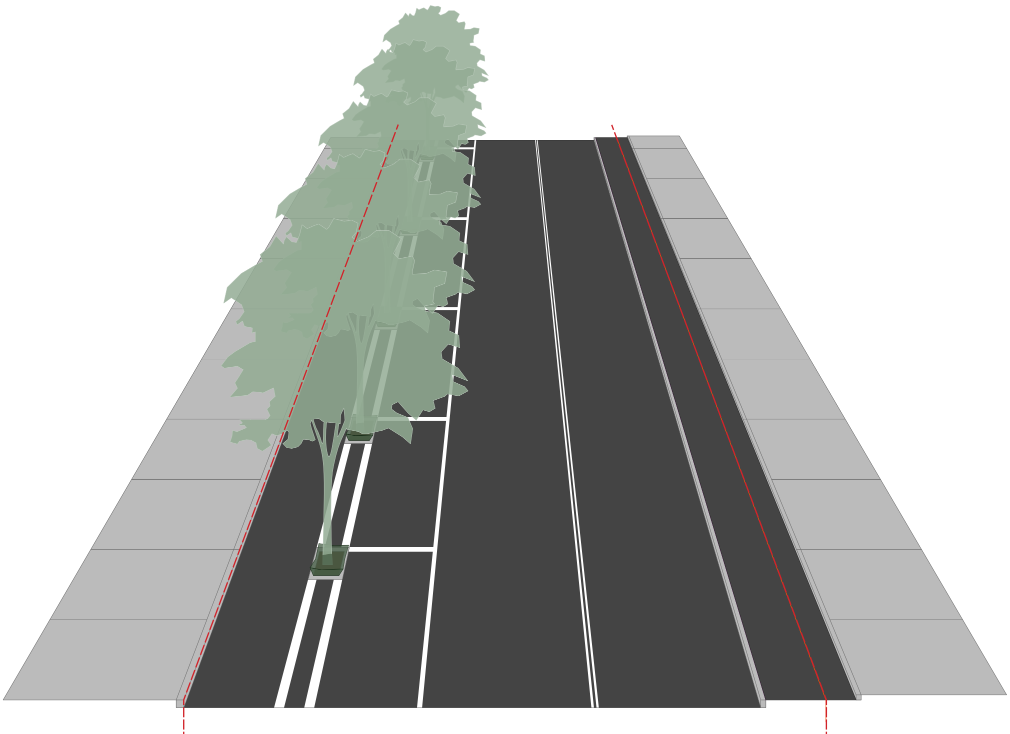
This street carries the same volume as the western segment of Frenchmans Road and is part of the direct connection between two major centres, leading on to a university, high school, primary school and hospital. It maintains the street profile of 12.8m between kerbs and 3.6m verges.

The important difference here from Frenchmans Road (west) is the street activation provided by the shopfronts and cafes with seating occupying a portion of the footpath. Due to spatial constraints, including awnings, shrubs are the only form of street planting.

Speed limit
60 km/hr

Parking
Parallel car parking both sides.





Frenchmans Road (east)
Reconfigured

Street profile

Pedestrian	**36%**
Bicycle	**18%**
Raingarden	**1%**
Car	**45%**

SEPARATED ONE-WAY PAIR COMBINATION
Context: mixed-use street

The constraints of this street suggest an asymmetrical configuration is necessary to achieve a high quality outcome. Pedestrian amenity is of high concern where local businesses are reliant on foot traffic. However research shows that good cycling amenity leads to higher local spending - more than those arriving on foot or by car.[25,2627] One study in Melbourne shows expenditure generated by one parking pace can more than quadruple if replaced with six bike parking spaces.[28]

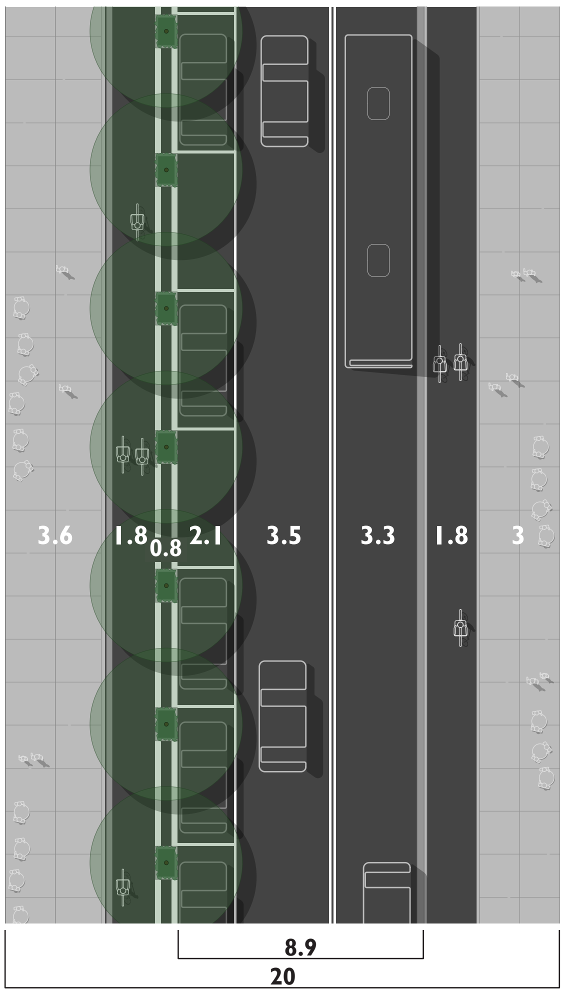
A compromise is reached in which car parking is reduced by 15 spaces on one side along with a 0.6m footpath reduction. The footpath and kerb on the other side is not modified. This allows a 1.8m bicycle lane on each side, with a 0.8m painted buffer to parked cars in which trees can be planted.

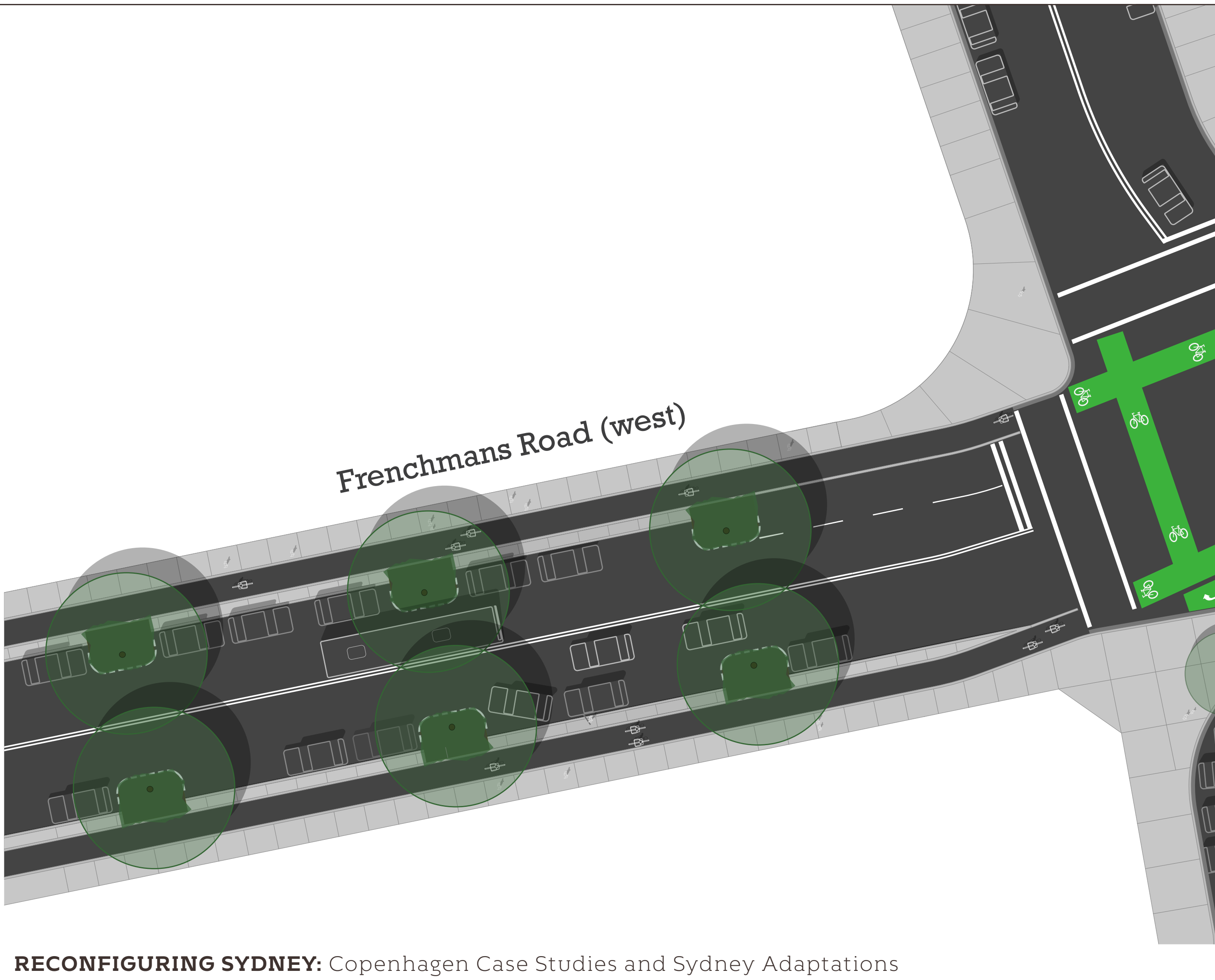
This reconfiguration also provides improved eastbound flow for bus services with no car parking actions.

Separation
Westbound - 0.8m painted buffer space to parked cars with tree planting and existing kerb and material separation to footpath.

Eastbound - Kerb separation only to road and low kerb and material separation to footpath.

Parking
Westbound - Parallel car parking retained.
Eastbound - Parallel car parking removed (15 spaces).




Frenchmans Road (west)

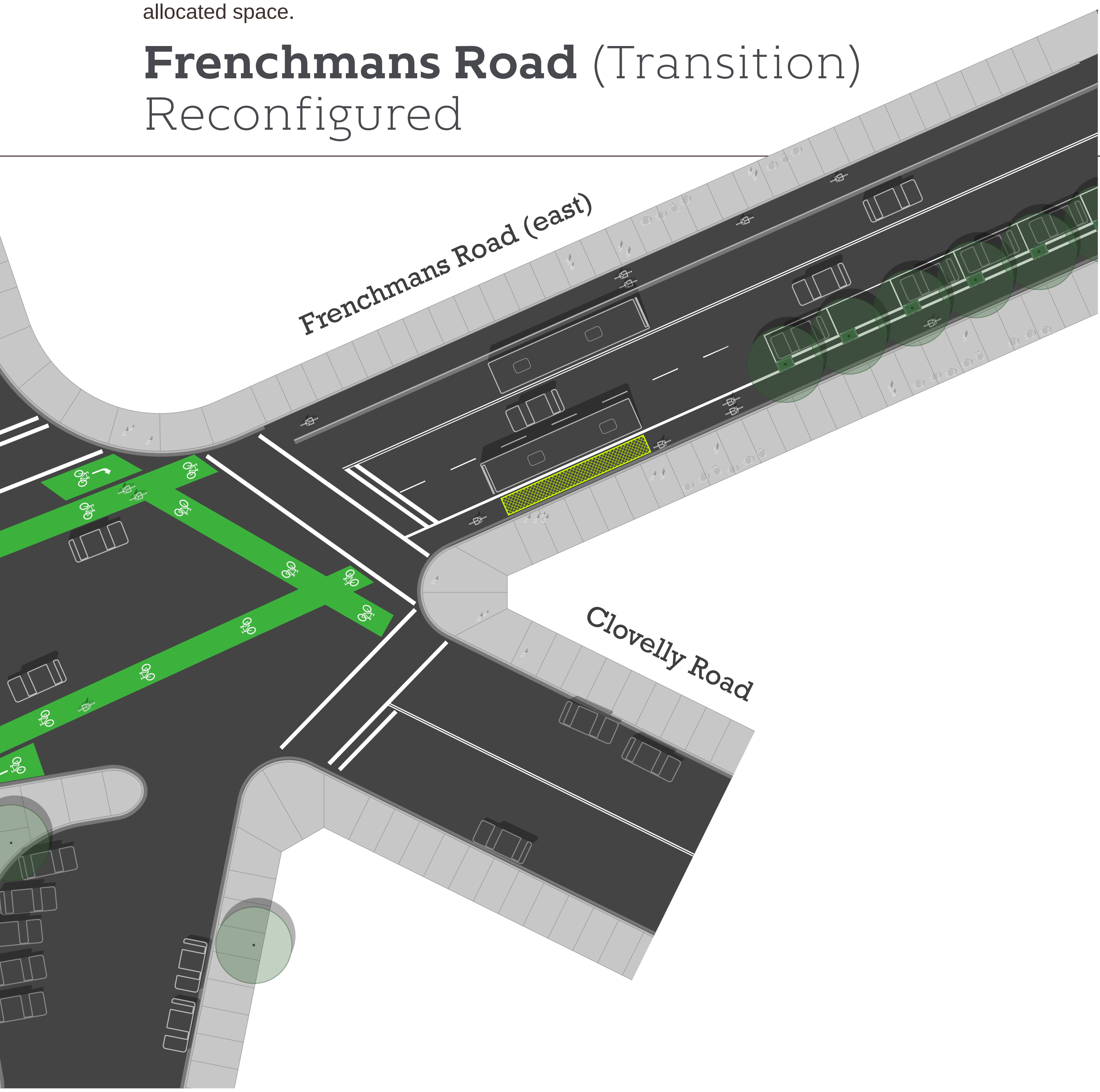
The illustration below shows how the two previous Frenchman Road types transition through an intersection in a logical, easy to understand manner.

Sections of the street can be implemented incrementally over time, depending on available budget and political preference for one type/ section or the other.

A benefit of the one-way pair, as opposed to the bidirectional cycleway on one side, is the transition between a separated and non-separated section of the street. For the one-way pair cyclists ride on the left in both conditions, allowing easy transitions.

For right hand turning, instead of the current common practice of merging with car traffic and turning with cars in the right traffic lane, cyclists slide to the left and wait for the traffic signals to change before making a hook turn from an allocated space.

Frenchmans Road (Transition) Reconfigured



President Avenue

Street profile

Pedestrian	7%
Turf strip	30%
Car	63%

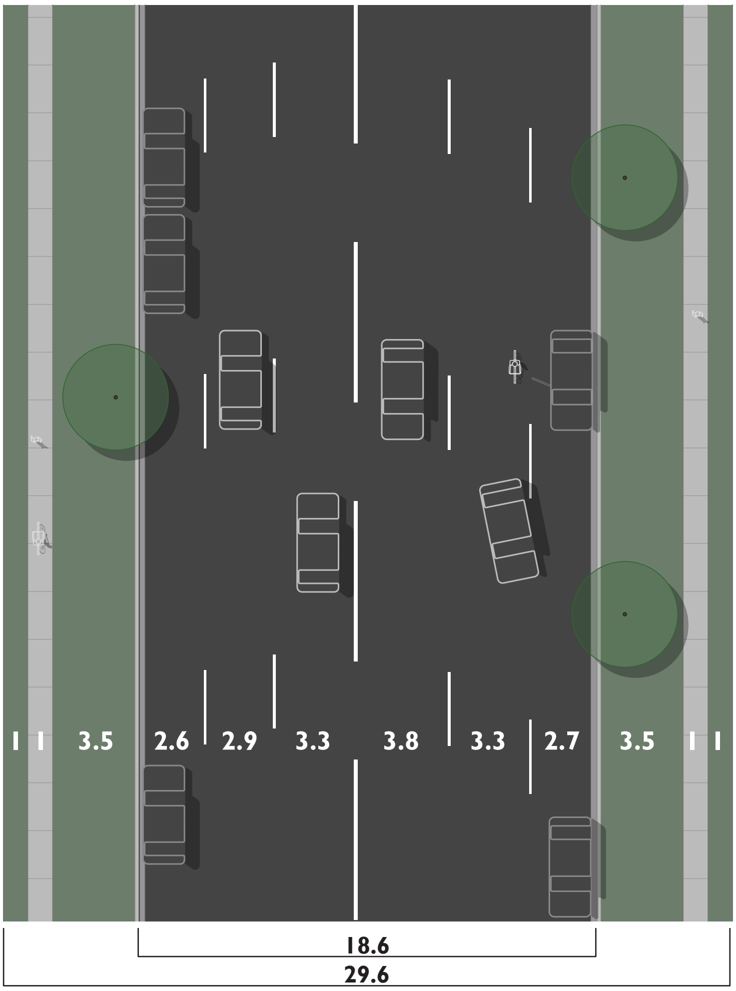
Current treatment: none
Context: residential street leading to a TAFE, high schools, hospital and train station

President Avenue is a wide street both in vehicular and verge space. Two traffic lanes and one lane of parking are provided each way. Kerbside parking demand is low as all apartment housing provides ample off-street parking. In addition side streets provide ample kerbside parking.

The wide verges present generally poor streetscape amenity. The footpath is a narrow 1m and trees vary in age and condition. The verges present compelling opportunities for separated bicycle lanes and improved pedestrian amenity without modifying traffic lanes or placing stress on car parking.

Speed limit

60 km/hr



President Avenue
Reconfigured

Street profile

Pedestrian	**14%**
Bicycle	**14%**
Turf strip	**10%**
Raingarden	**4%**
Car	**58%**

SEPARATED ONE-WAY PAIR

Context: residential street leading to a TAFE, high schools, hospital and train station

The 5.5m verge offers space for a 2m bicycle lane, a widened footpath to 2m and a 1.5m tree-lined buffer to cars. Large street trees are planted in raingardens in line with parked cars. Due to low kerbside parking demand these trees can be spaced more closely than the other examples illustrated. Cross falls on the verge allow for a low kerb between the bicycle lane and footpath.

This model could be considered an ideal Copenhagen style bicycle lane, built without modification to kerbs or stormwater infrastructure as well as significantly increase in tree planting.

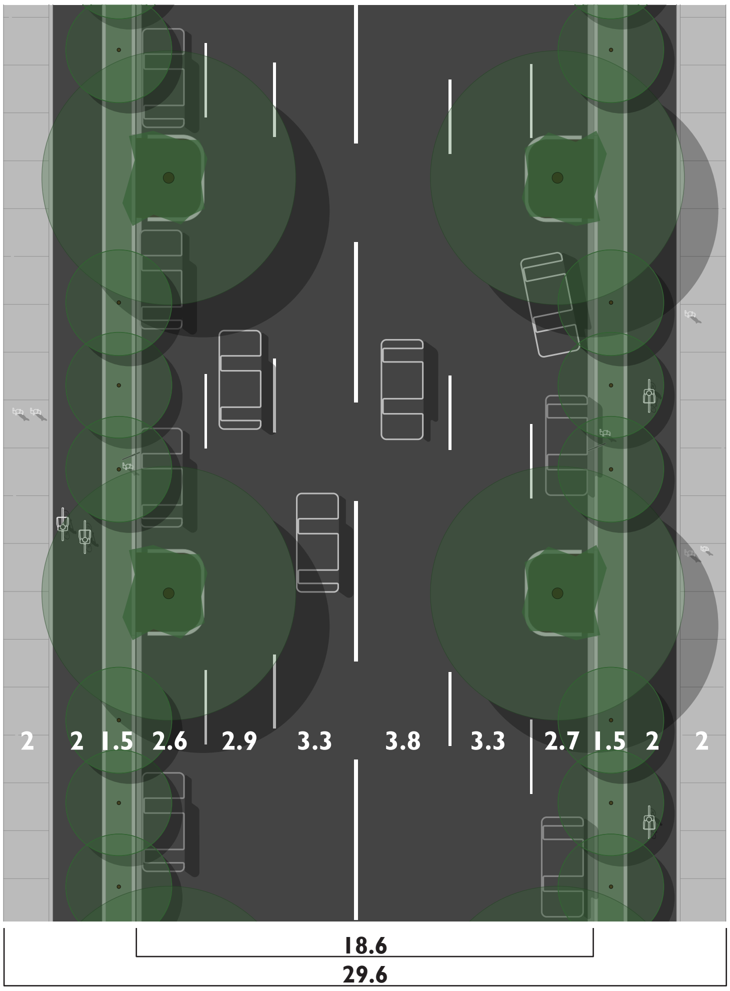
Separation

Kerb separation to road with 1.5m buffer space to parked cars with tree planting.

Low kerb and material separation to footpath.

Parking

Parallel car parking both sides retained. Tree planting/raingardens in line with parked cars.



Old South Head Road

Street profile

Shared path	**36%**
Car	**64%**

Current treatment: shared path - no visible treatment
Context: residential street connecting to metropolitan centre and train station

Old South Head Road is an example of an important route for bicycles under heavily constrained conditions. It has two lanes of motor traffic each way with no on-street parking and suffers from heavy congestion. A number of high frequency bus routes use this street.

There are no suitable alternative routes for bicycles without a significant detour. Bondi Junction is a 'Major Metropolitan Centre' with ongoing high rise residential development. It is more than twice as dense (people/ha) than Inner Copenhagen.[29] It is a significant commercial and retail location and the terminus train station of the Eastern Suburbs Line. Over 60% of car trips to Bondi Junction are under 5km.[30] There are no separated bicycle facilities in or approaching the centre.

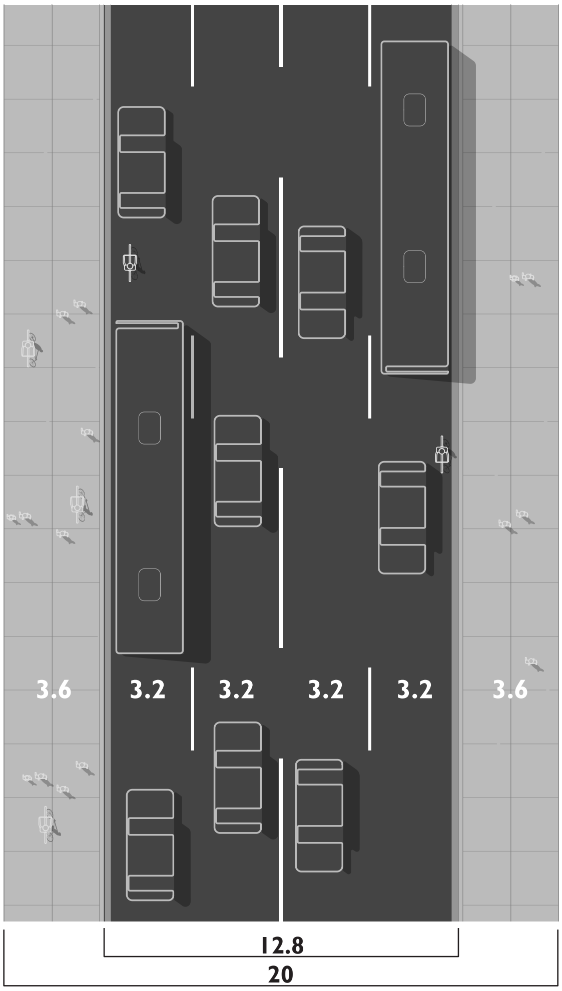
Currently the footpath acts as a shared path, but with high pedestrian use and growing bicycle use there is increasing likelihood of conflict. The level of travel quality for bicycles and pedestrians is poor.

Speed limit

50 km/hr

Parking

No kerbside parking.



Old South Head Road
Reconfigured

Street profile

Pedestrian	19%
Bicycle	17%
Car	64%

SEPARATED ONE-WAY PAIR
Context: residential street connecting to metropolitan centre and train station

Maintaining pedestrian capacity is important but separated bicycle facilities are also important on this route - a compromise must be reached. Ideally 1.7m of the footpath is demarcated for bicycles - the minimum width the Danish Road Directorate has demonstrated is required for safe overtaking. Taking into consideration the particular political difficulty of this street a narrower, below-standard width of 1.2m would be acceptable.

Over time the poles and wires that clutter the footpath would be rationalised or laid underground and lighting hung by catenary between buildings, as is the case in all Copenhagen streets, for a better functional and aesthetic street overall.

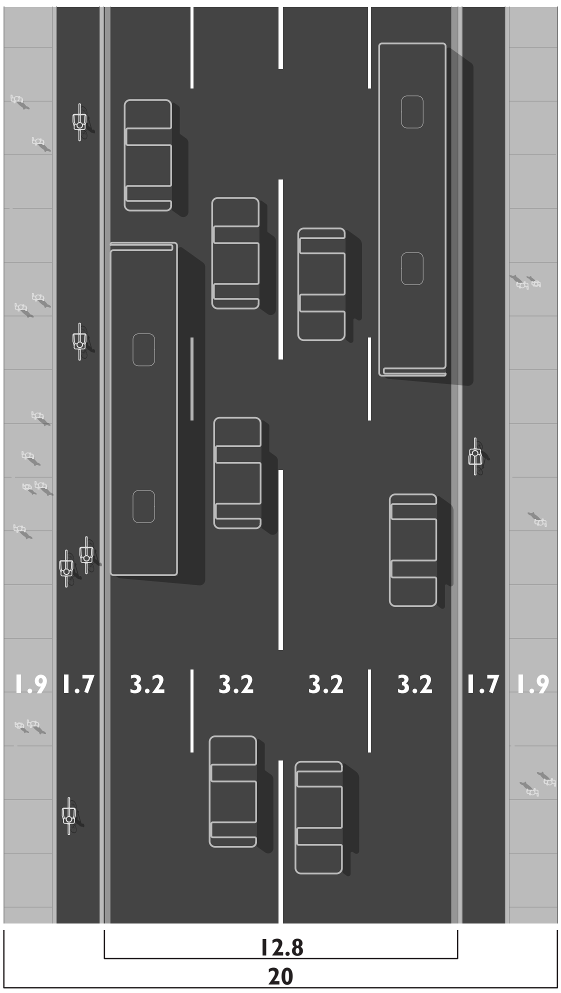
The kerb is retained, flush with the new asphalt bicycle lane. The footpath is upgraded and raised 50mm above the bicycle lane.

Footpath compromises such as this were commonly made in the early stages of bike lane implementation in Copenhagen during the 1980s.

Separation
Existing kerb retained as separation to road with no buffer space.

Low kerb and material separation to footpath.

Parking



Lawson Street

Street profile

Pedestrian	**36%**
Car	**64%**

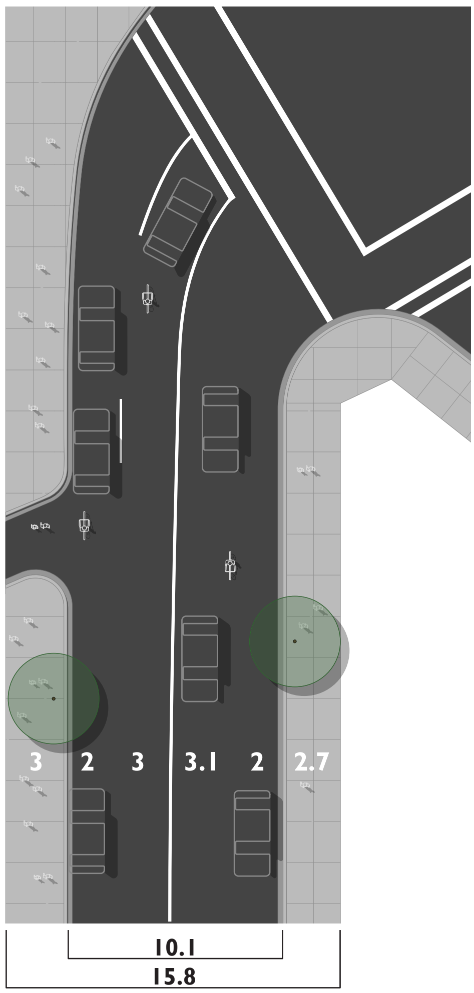
Current treatment: none
Context: mixed-use connection between train station and university

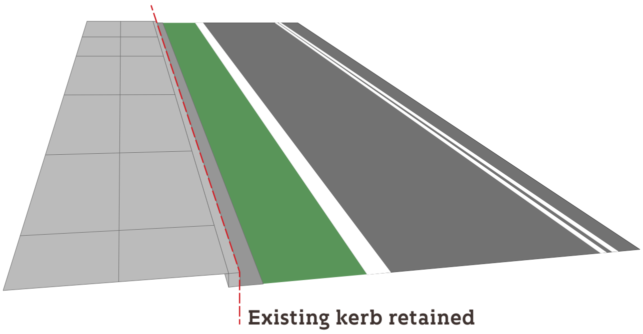
Lawson Street is narrow yet still caters for two-way motor traffic and parallel parking on each side. The inclusion of separated facilities in such a street is not advisable due to relatively low designed speed and taking into consideration what would need to be removed to provide the dedicated space - either all kerbside parking or one side of kerbside parking and conversion to one-way motor traffic.

These conditions are suitable for a mixed condition. However navigating traffic at the intersection can be problematic for bicycles. Research consistently shows that most accidents between bicycles and cars occur at intersections.[31,32]

Speed limit
40 km/hr

Parking
Parallel car parking on both sides.





Lawson Street
Reconfigured

Street profile

Pedestrian	36%
Bicycle	25%
Car	39%

KERBSIDE LINE MARKED ONE-WAY PAIR ON APPROACH TO INTERSECTION
Context: mixed-use connection between train station and university

Mid-block conditions remain the same, but the intersection approach is provided with painted kerbside lanes and an advanced stop line and bike box. This treatment provides bicycles with an unimpeded passage to the intersection and places them in clear sight of motor traffic at a red light.

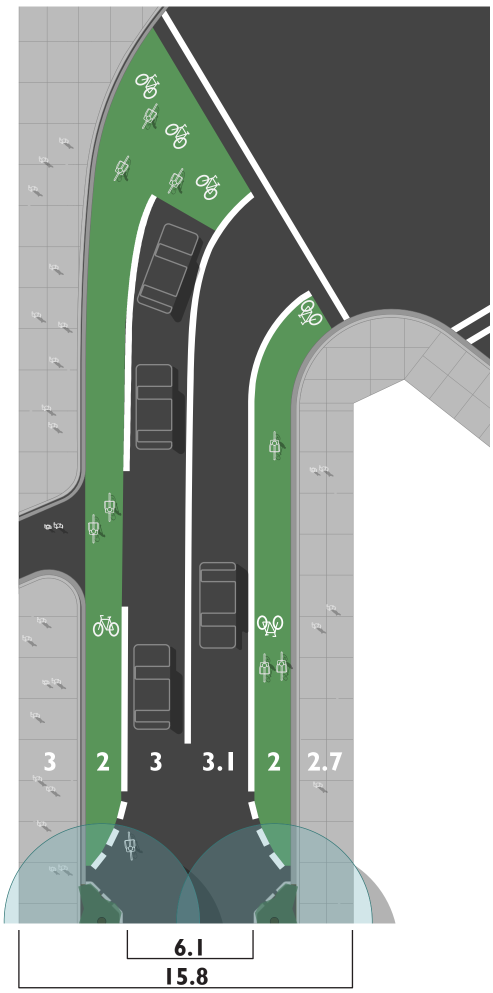
This treatment would require the removal of the left turning motor traffic lane and one car parking space each side of the street. Reducing capacity for motor vehicles on a local street such as this is a highly effective way to provide better bicycle and pedestrian amenity.

Mixed traffic mid-block.

Separation
300mm white painted line with no buffer space to travelling vehicles.

Low kerb separation to footpath.

Parking
Parallel car parking retained on both sides. No parking on approach to intersection where kerb side lanes are present.



Hickson Road

Street profile

Pedestrian	**26%**
Bicycle	**10%**
Median	**10%**
Car	**54%**

Current treatment: line marked shoulder bicycle lane
Context: mixed-use street

Hickson Road is a wide and flat street edging the north-east side of the city centre. It connects the Rocks and Circular Quay with Walsh Bay Arts & Commercial precinct, the emerging Barangaroo precinct and on to Darling Harbour. This segment of the street contains one lane of motor traffic each way, two lanes of car parking each way, a 1.5m line painted shoulder bicycle lane between parked and moving cars, 3.6 and 4m footpaths and a 3m wide median planted with fig trees.

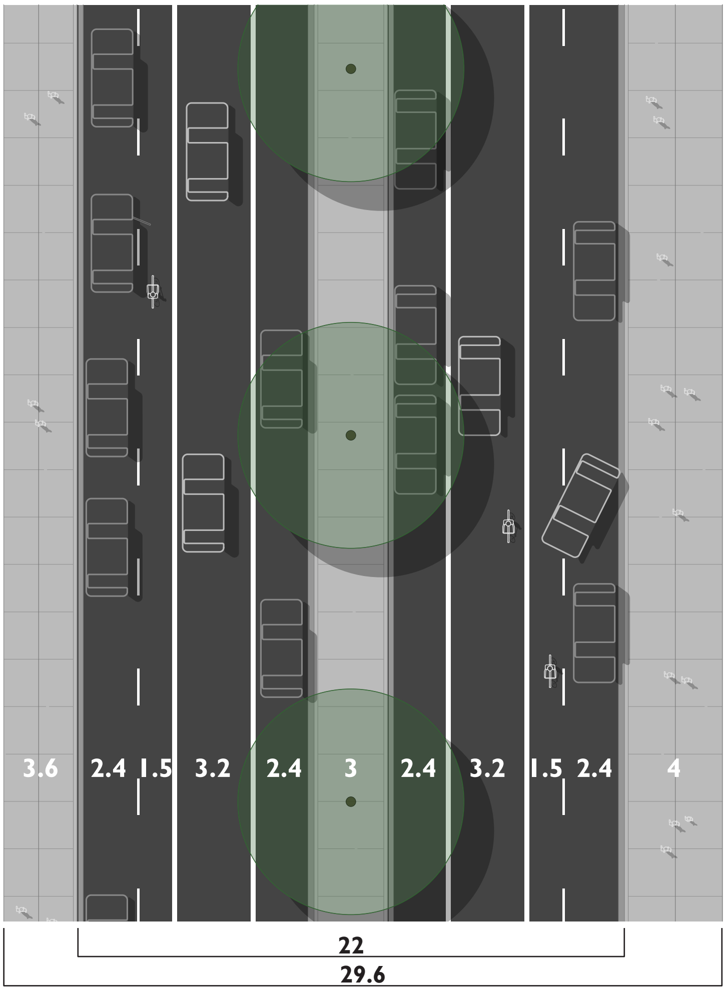
38% of the street cross-profile is car parking - arguably not the most suitable use for a street with such high cultural and historical value.

Type

Shoulder bicycle lane:
150mm painted line and bike logos

Speed limit

50 km/hr



Hickson Road
Reconfigured

Street profile

Pedestrian	37%
Bicycle	17%
Median	10%
Car	36%

SEPARATED ONE-WAY PAIR
Context: mixed-use street

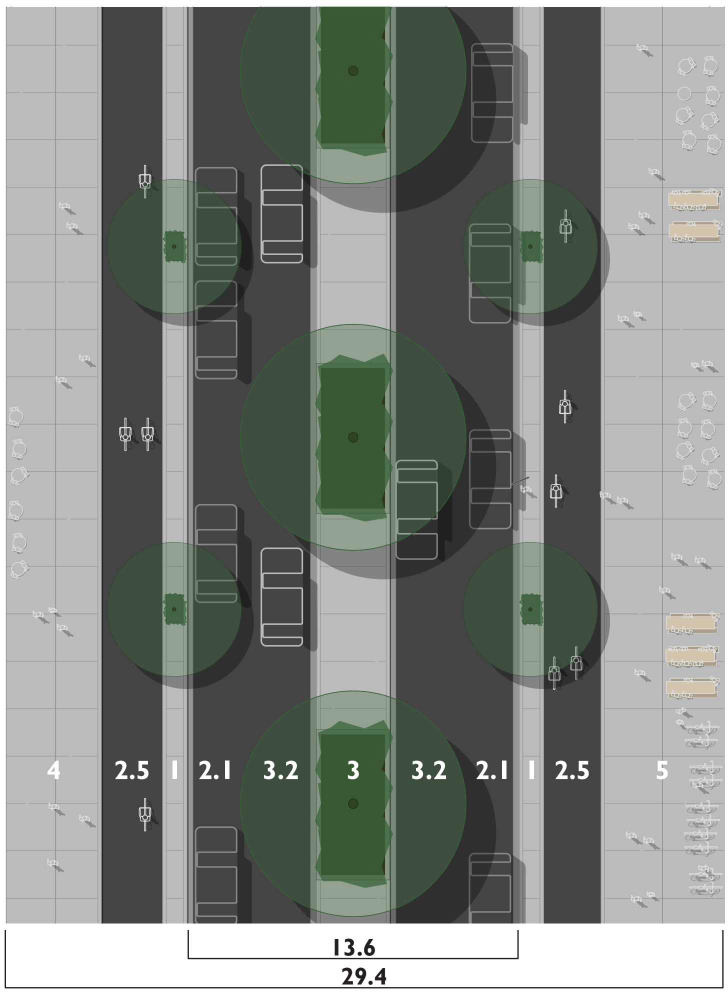
By reducing parking lanes from four to two, ample space becomes available to provide separated bicycle facilities and improved pedestrian amenity.

Motor vehicle lane widths are reduced to provide a 2.5m bicycle lane each way, 1m buffer zones with street trees and wider footpaths. The sunnier side of the street is given a wider footpath for cafe, bar and restaurant spill out space. Motor traffic is now 7.7 and 8.7m from the building facade, further improving pedestrian amenity.

Separation
Kerb separation to road with 1m buffer space with tree planting.

Low kerb and material separation to footpath.

Parking
Parallel parking both sides.



Ridge Street

Street profile

Pedestrian	**36%**
Bicycle	**10%**
Car	**54%**

Current treatment: line marked shoulder bicycle lane
Context: mixed-use street, mainly residential

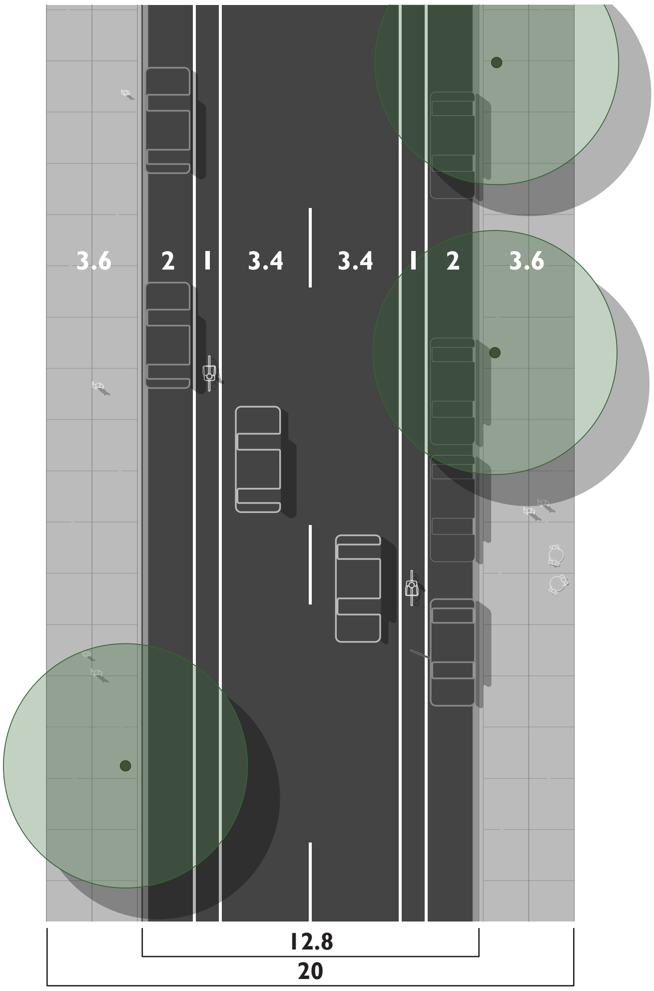
Ridge Street connects to one of the few bicycle and pedestrian bridges across the Bradfield Highway. Four schools are accessed from this street, along with a number of recreational facilities.

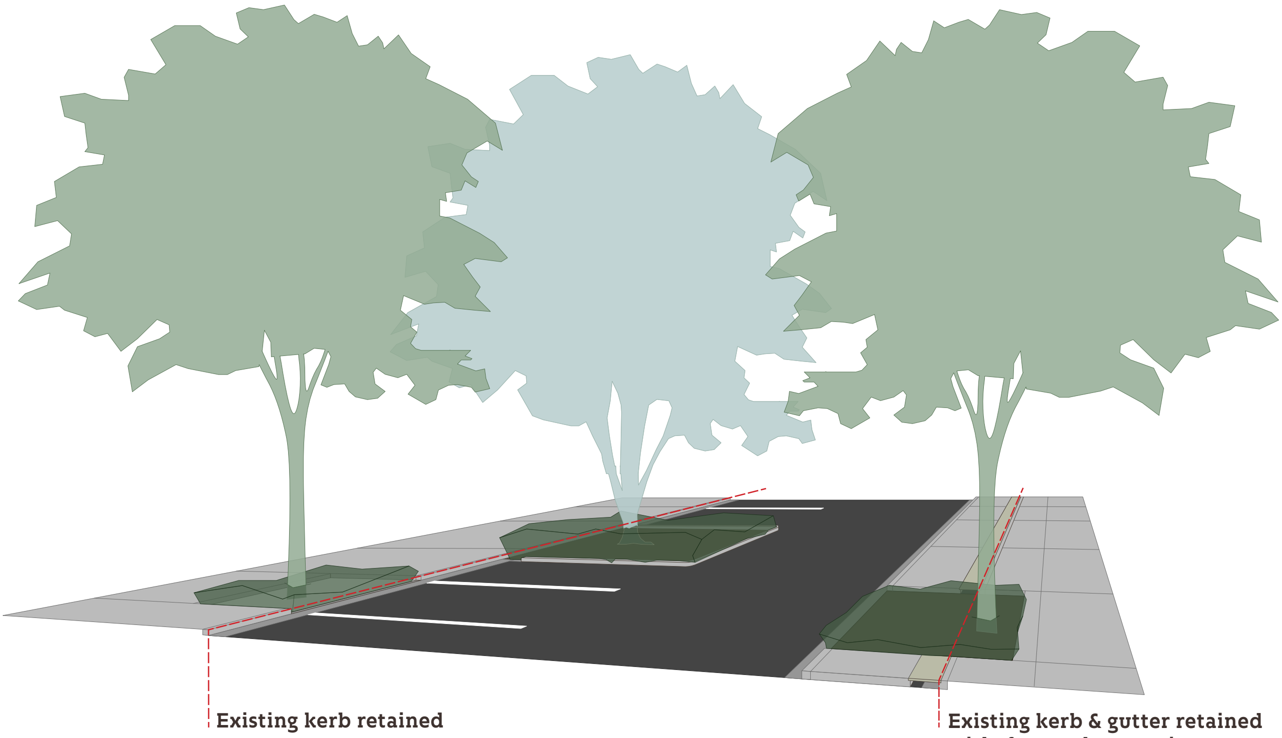
Current provision is a 1m painted shoulder lane between parked cars and travelling cars. An open door of a parked car can occupy more than the entire width of the lane.

Ridge Street carries a relative low volume of traffic.

Type
Shoulder bicycle lane:
150mm painted line 1m from parked cars

Speed limit
50 km/hr
40 km/hr school zone weekdays 8-9am and 2-4pm.





Ridge Street
Reconfigured

Street profile

Pedestrian	44%
Car/Bicycle	51%
Raingardens	5%

SLOWED MIXED TRAFFIC
Context: mixed-use street, mainly residential

With a relative low traffic volume, a mixed traffic condition is suitable for this street. Cars are slowed, making it safer for cyclists. More footpath space and tree planting is provided to enhance life on the street.

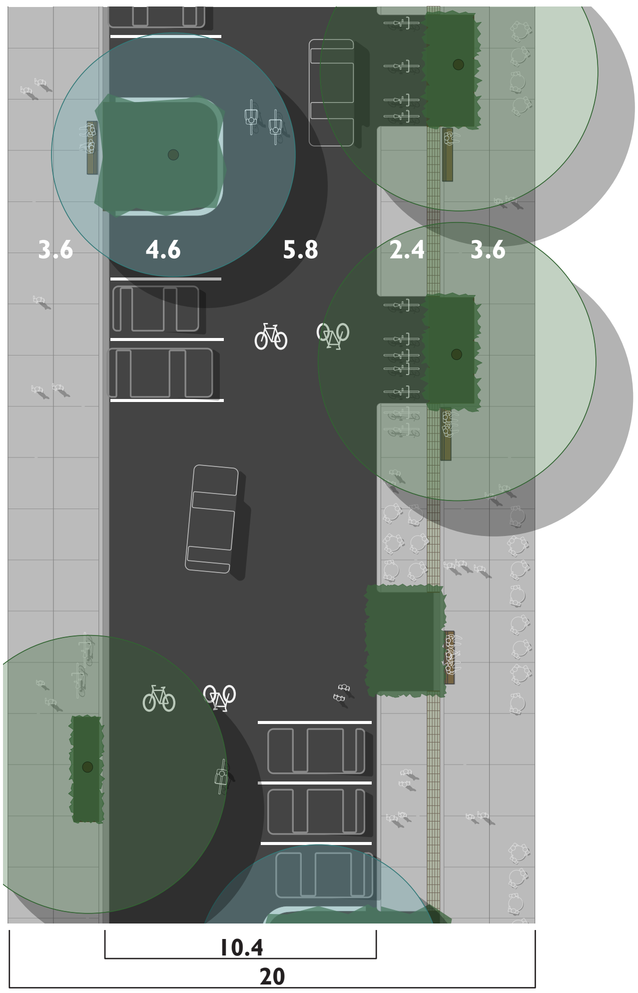
Parallel parking on both sides can be converted to 90˚on one side with little overall loss of spaces. Segments of car parking switch sides of the street at intervals to eliminate long sight lines for vehicles and calm traffic. Large street trees are planted with raingardens in line with parking.

The footpath with the sunny northern aspect, and existing cafes, is widened by 2.4m. This allows more space for outdoor seating, planting, bicycle parking and casual socialising.

Separation
No separation to vehicles.

Kerb and material separation to footpath.

Parking
90˚car parking, switching street sides at intervals. Raingardens with large trees with each segment of car parking.



Pyrmont Bridge

Street profile
Shared **100%**

Current treatment: Shared path
Context: car-free bridge connecting Pyrmont to the city centre

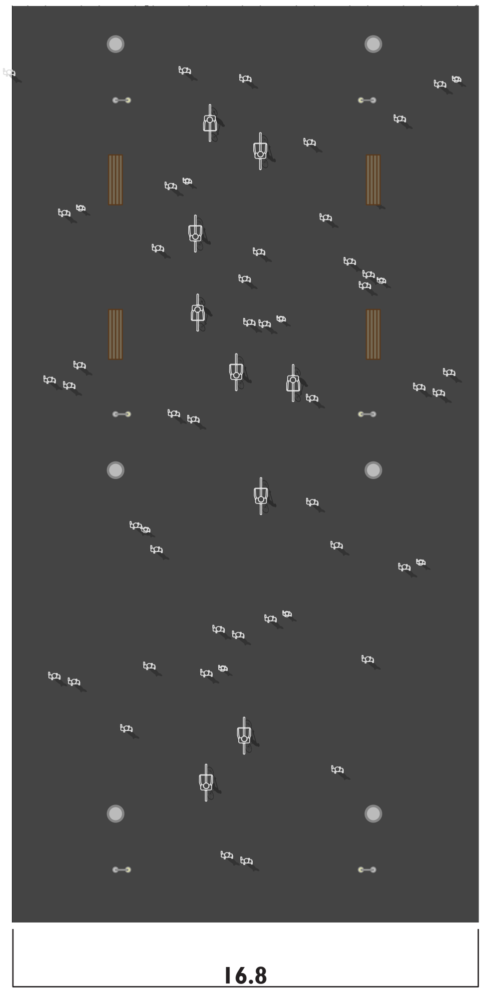
Pyrmont Bridge connects the Pyrmont peninsular to the city centre. For bicycles it is the primary connection to the city from the west. There is no connection north of the bridge and arguably no convenient connection south of the bridge for at least 1km.

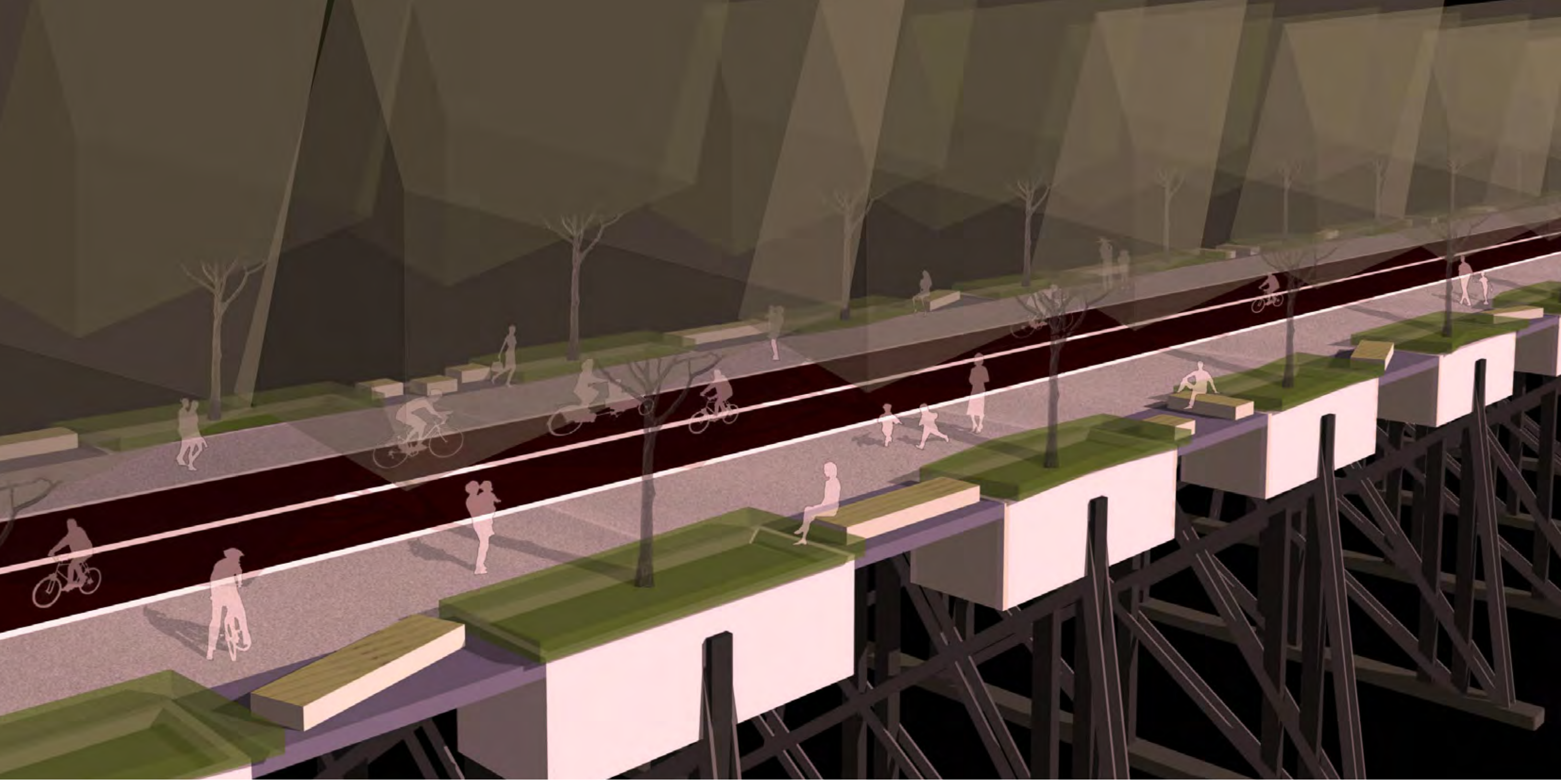
Pyrmont Bridge is constructed of Australian ironbark timber and steel central spans. The swingspan is supported on a base made from concrete and Hawkesbury Sandstone. Yet the surface, the most closely experienced material, is a vast expanse of patchy asphalt. It has been adapted to a number of uses, at one time accommodating four lanes of car traffic, at another a monorail.

Conflict between pedestrians and the increasing number of cyclists crossing the bridge has been highly publicised. Consequently the City of Sydney has stationed officers on a permanent basis during peak hours with the role of managing potential conflict.

Speed limit

10km/hr





Pyrmont Bridge
Reconfigured

Street profile

Pedestrian	**62%**
Bike	**25%**
Raingarden	**13%**

SEPARATED BIDIRECTIONAL CYCLEWAY

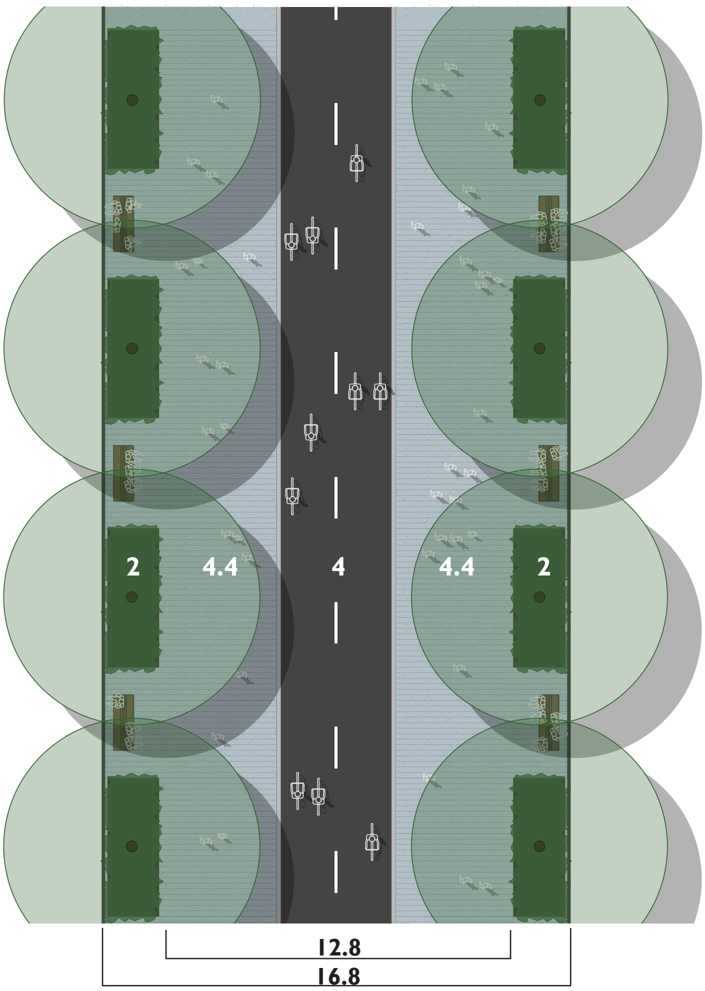
Context: car-free bridge connecting Pyrmont to the city centre

This provocative intervention aims to encourage broader thinking in street and infrastructure design. It proposes a separated facility centred on the bridge with pedestrian promenades on either side. It daringly suggests an 'all-of bridge-approach' where planting boxes are fixed to the underside of the bridge to support large trees at grade with the promenade. These planters frame small protected spaces for people to occupy as they please whether meeting friends, taking a lunch break or just resting and enjoying views of the city and city life.

It takes a view that the bridge, recognised as a National Engineering Landmark, has the potential to be boldly transformed into a beautiful public space that contributes a new layer to the city's identity, as well as a functional piece of transport infrastructure.

Separation

Low kerb and material separation to footpath.



The positive feedback loop

This study has demonstrated how common types of streets in Sydney can be reconfigured to provide safe and appealing bicycle facilities that a wide range of people would feel comfortable using – as is the case in Copenhagen.

Some examples show how space for bicycle facilities can be integrated in a cost effective manner and without significant reductions in capacity for other street uses. Orpington Street (pages 24-25), President Avenue (pages 32-33), Old South Head Road (pages 34-35) and Ridge Street (pages 40-41) are examples. These changes would be warmly welcomed by existing and potential cyclists and, most likely, would be accepted by groups more resistant to bicycle infrastructure. Transformation of these streets would work to instigate a surge in cycling uptake – attracting a wider range and greater number of people choosing to cycle – as has been the case each time the City of Sydney or the State Government has opened a separated cycleway.

Other examples demonstrate more challenging conditions where compromises need to be found. The offered designs provide direction in how to achieve a suitable outcome that aligns with government goals of increasing cycling, walking and public transport, as well as enhancing the liveability of streets in general. Frenchmans Road (East) is an example of reconfiguration that would be more readily implemented once cycling has increased from its current modest levels and there is more support for bicycle infrastructure at the expense of on-street parking (see pages 28-29). The example of Hickson Road in the City of Sydney is one that would be more suitable to implement as an all-of-street upgrade, or financially leveraged in conjunction with a major development such as the neighbouring Barangaroo site (see pages 38-39). Frenchmans Road (East) and Hickson Road represent the next step of street design in which the bicycle is officially acknowledged as a legitimate and desired form of urban transport, with clear state government leadership.

To support people's growing interest in cycling and to meet government goals to increase cycling, we need infrastructure, education and culture change. We know there is a strong desire within the community for the opportunity to replace trips by motor vehicle with trips by bicycle, as long as suitable facilities are provided.

Bicycle infrastructure is paramount: a space where people can ride a bicycle safely and conveniently, whatever their age, gender or aptitude. Providing this space requires reconfiguration of streets that have for many decades focused on provision for the car at the expense of other uses. Such reconfiguration presents challenges, but it is achievable.

By understanding the design principles underpinning built conditions that have fostered widespread cycling in cities such as Copenhagen, and cross-referencing those principles with existing conditions in typical Sydney streets, compelling opportunities can be found. Sydney streets can be readily reconfigured to accommodate bicycles.

Notes

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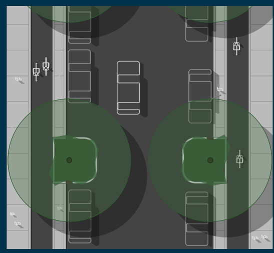


RECONFIGURING **SYDNEY** STREETS

Reconfiguring Sydney Streets: Copenhagen case studies and Sydney adaptations is the work of landscape architect and urban designer Mike Harris.

Using case studies from his extensive research in Denmark, Harris demonstrates how Copenhagen transformed itself from a city of traffic jams to a city of people. Drawing on the Danish design principles that continue to guide their construction of safe bicycle and pedestrian infrastructure, Harris adapts their models to the Australian urban setting.

At a time when the state governments in NSW and Victoria are spending billions on expressways that divide neighbourhoods and pour more and more cars into already choked cities, Reconfiguring Sydney Streets takes a highly practical and cost-effective look at an alternative approach.

Reconfiguring Sydney Streets presents a sample range of typical profiles of streets in Copenhagen and Sydney. With technical expertise, Harris demonstrates how each of the selected Sydney streets could be reconfigured with minimal disruption and cost so that much safer operating space can be provided for the people of all ages who want to travel on foot or by bicycle – journeys which could readily link with public transport. The amenity of the neighbourhood is further improved through street planting, ease of access and the reduction in motor vehicle speeds.

While our cities and our climate are adversely impacted by over-reliance on cars, more and more people are choosing to walk or go by bicycle as a convenient, healthy, cheap and non-polluting way to get around.

Reconfiguring Sydney Streets is a timely study. Its vision and its fund of technical information are invaluable for transport engineers and planners seeking effective strategies to improve access, connectivity and safety for bicycle riders and pedestrians.

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