Sustrans Design Manual

Handbook for cycle-friendly design

April 2014

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Foreword

For at least two generations, planning for transport in the UK has primarily focused on the car. The unintended consequence of this has been to suppress walking and cycling, and often public transport use, across all sectors of society.

This imbalance has resulted in a transport sector that accounts for a quarter of UK carbon emissions and that relies extensively on ever more expensive oil.

By shifting from motorised transport to cleaner, healthier travel, particularly for shorter journeys, we can make a significant contribution towards tackling these issues. This would be good for both public health and the liveability of our communities, and save billions of pounds in health and environmental costs.

Evidence from the Sustainable Travel Demonstration Towns shows that there is enormous potential for changing people's travel behaviour. Nine out of ten short journeys could be made by foot, bike and public transport.

The key to success is to ensure that our streets and public spaces are suitable for people of all ages and all abilities to get around without a car. We need to focus on those not yet walking and cycling as well as those that already are.

Achieving this requires the integration of high quality infrastructure with complementary behaviour change measures. Unfortunately much of the transport infrastructure in the UK was designed and built on the assumption that almost everyone had access to a car, so people do not consider walking or getting on their bike or a bus.

The design and development of high quality infrastructure to support healthy cleaner travel requires engineers and planners to have a good understanding of, and access to, current design guidance and examples of best practice, including the latest innovative and experimental schemes.

There is a wealth of material already available from various sources. This guidance from Sustrans aims to offer broad advice on key issues around highway design, with a particular emphasis on cycling. It also provides a single point of access to this further guidance.

The guidance will be further developed in the coming months and years to include more on walking and will be regularly updated with new examples. It will be underpinned by better training for transport professionals.

We fully support Sustrans in their ambition to ensure that all of us involved in the development and design of transport infrastructure and public space do all that we can to enable travel to be both healthier and better for the environment.

Geoff French
President, Institution of Civil Engineers

Jim Steer
President, Chartered Institute of Logistics and Transport

Nick Richardson
Chair, Transport Planning Society

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About Sustrans

Sustrans makes smarter travel choices possible, desirable and inevitable. We're a leading UK charity enabling people to travel by foot, bike or public transport for more of the journeys we make every day. We work with families, communities, policy-makers and partner organisations so that people are able to choose healthier, cleaner and cheaper journeys, with better places and spaces to move through and live in.

It's time we all began making smarter travel choices. Make your move and support Sustrans today.

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Introduction

Brighton

Oxford

Bristol

Cambridge

Photo : LB Camden

London

This document is part of a suite of technical design guidance on active travel being developed by Sustrans. There is much useful material already available from a range of organisations, and this guidance from Sustrans aims to provide detailed technical advice on key issues around on and off highway cycle infrastructure whilst signposting users to this developing library of further resources.

The Sustrans guidance library will be largely web based and will be regularly updated with new examples including the latest innovative and experimental schemes.

The full guidance will be structured to comprise:

- handbook for cycle friendly design
- main technical guidance document on designing for cycling, divided into chapters
- more detailed guidance on selected topics, both technical and relating to strategies, monitoring etc
- technical case studies
- media resources, including a photo library and training materials
- frequently asked questions

This handbook contains a concise illustrated compendium of technical guidance relating to cycling: it can stand alone as a 'tool box' of ideas but also links to a library of relevant on line resources. It is very visual but contains the essential technical details, and was inspired by earlier guidance produced by the City of Edinburgh Council.

This element of the guidance is available in printed format as it is intended for widespread use as a readily available digest of the key elements of design guidance, which can be used on-site by planners and engineers.

Detailed content relating to walking design and infrastructure will be added in the coming months.

It is intended that this document be reviewed following publication of the revised Traffic Signs, Regulations and General Directions in 2015, so feedback on the content is invited, and should be made to *designandconstruction@sustrans.org.uk*

The structure of this guidance is illustrated in the contents page, and broadly follows the following sequence:

- a summary of the key principles and processes for a user-focused design
- wider considerations of urban design and other measures to improve the general highway design for cyclists and pedestrians
- on-carriageway provision for cyclists on links and junctions
- cycle provision off the carriageway, whether cycle tracks alongside the road or traffic free routes away from the road, including crossings
- routes in rural areas
- associated design issues including cycle parking, signing, integration with public transport and the design of new developments
- the maintenance and management of routes

Understanding user needs 1

Top 10 tips for user-focused design for cycling

1. **Cyclists are important:** designs should send the message that cyclists are at least as important users of the highway network as motor traffic, with cyclists being given an advantage in terms of directness and priority where possible;

2. **User experience:** cycle the route yourself, at various times of the day / week, and make sure you consult with potential cycle users and existing users throughout the design process;

3. **Target user:** design should be attractive and comfortable for the less confident cyclist – a sensible 12 year old or novice adult who is trained to National Standards / Bikeability Level 2 – but should aim to provide for the more confident cyclist as well. Where more confident cyclists choose not to use any facilities provided their needs should also be addressed with separate provision where appropriate; they should not be compromised by the design;

4. **Design in line with cycle training:** on-highway design should reinforce how people are taught to cycle in National Standards / Bikeability Level 2, in particular primary and secondary road positioning;

5. **Cycles are vehicles:** take account of their space requirements, manoeuvrability and speed in all infrastructure, not just specific cycle facilities;

6. **Cycles are muscle powered:** aim to minimise energy loss through stopping, hills and sharp corners; cyclists should never be required to dismount on cycle routes;

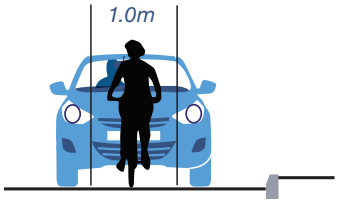
7. **Make space for cyclists:** where segregation of traffic is appropriate this should be achieved through reallocation of road space – taking space from the footway should be the last resort;

8. **Tame traffic:** the speed and volume of motor traffic, the proportion of large vehicles, and opportunities to reduce these, will influence the type of provision appropriate and whether specific cycle facilities may be necessary;

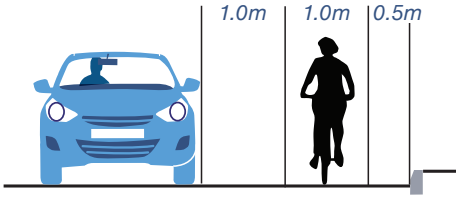
9. **Continuity and quality of standards:** consistent high quality provision (including signage) along a route and at both ends of the trip is essential, with route design following the 5 Core Principles of Coherence, Directness, Safety, Comfort and Attractiveness. Difficult engineering solutions should be addressed early on to avoid gaps being left. The design should aim to minimise maintenance requirements and costs, and take account of who is responsible for that. Ensure the design of the route enables it to be used effectively in the dark and in poor weather;

10. **Behaviour of other users:** take account of the real world behaviour of all users – including how pedestrians and drivers may interact with cyclists and vice versa.

Primary and secondary riding positions



Primary
(centre of lane)



Secondary
(0.5-1m from kerb)

The primary road position is that of the general flow of traffic (i.e. in the centre of the lane). **The secondary road position** is roughly 1 metre to the left of the traffic flow and not less than 0.5 metres to the edge of the road

Cyclist riding in primary road position, Derby

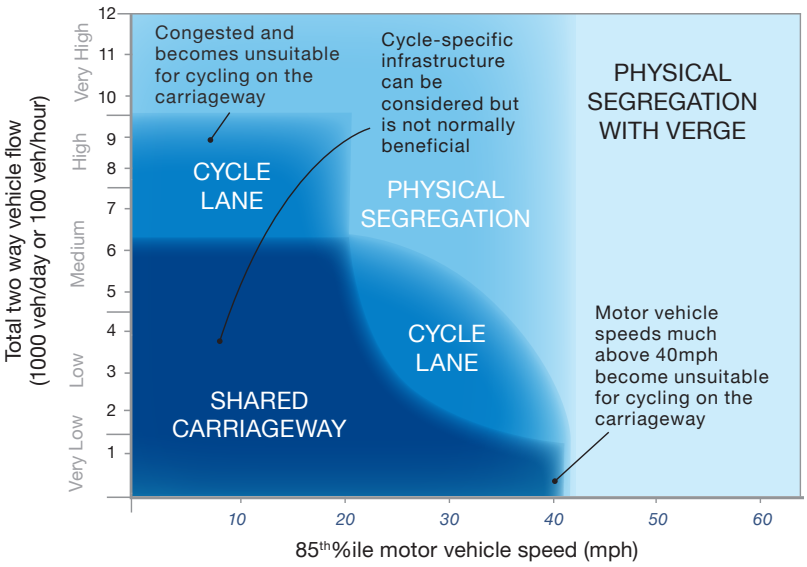
Cyclist riding in secondary road position, Cambridge

Understanding user needs 2

Provision on links

This figure illustrates how traffic volume and speed may influence the decision on the need to segregate cyclists from other traffic, and demonstrates how restraint of traffic speeds and volumes may be used to create satisfactory conditions to encourage new and novice cyclists to use the carriageway. The threshold values are intended to reflect the needs of the key target user as described above.

Main cycle routes (see Network Planning) will generally justify a higher level of service than other cycle routes and so may have lower thresholds at which segregation is provided and greater widths.



Shared space, Bristol

20mph, Bristol

Photo: Jon Toy

Cycle lane, Cambridge

Hybrid cycle track, Brighton

Cycle track with verge, Guildford

Core principles for routes used by cyclists

Coherence

- link all potential origins and destinations
- be continuous and recognisable
- offer consistent standard of protection throughout
- be properly signed
- include well located cycle parking

Directness

- be based on desire lines
- result in minimal detours or delays
- provide a positive advantage in terms of directness and priority over motor traffic

Safety

- be safe and perceived as safe
- provide personal security
- limit conflict between cyclists and pedestrians and other vehicles

Comfort

- be smooth, non-slip, well maintained, drained and free of debris
- have sufficient width for the level of use
- have easy gradients
- be designed to avoid complicated manoeuvres
- enable cyclists to maintain momentum
- minimise impacts of noise, spray and headlight dazzle from other traffic

Attractiveness

- be attractive and interesting
- integrate with and complement their surroundings
- contribute to good urban design
- enhance personal security
- be well maintained

Adaptability

Where substantial increases in cycling are expected, consideration should also be given to the adaptability of infrastructure to accommodate large increases in use

Understanding user needs 3

Design speeds

Key design parameters for cycle tracks will normally reflect the expected design speed of the route. A design speed of 12mph is appropriate for a local access route, or for a main route where there is likely to be significant interaction with pedestrians. For other main routes, designers should aim to provide a higher design speed of 20mph.

Widths required by cyclists

The space required by cyclists in motion needs to take account of :

- 'dynamic width' of the cyclist
- clearance when passing fixed objects
- distance from other traffic (both cyclists and passing motor vehicles)

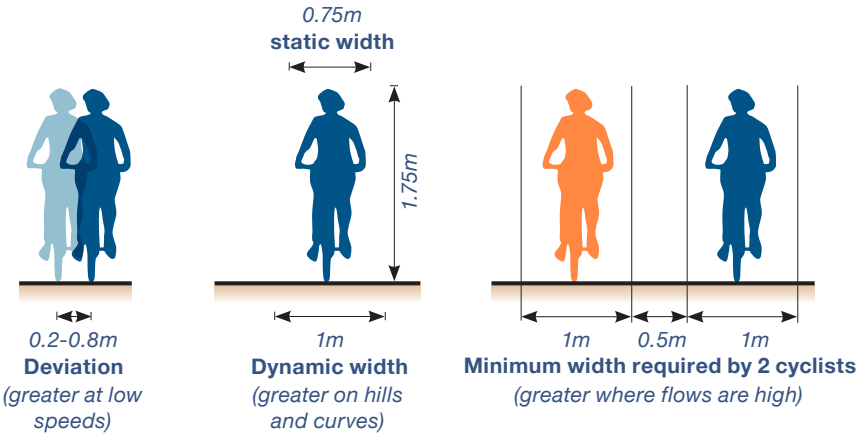


Table H.1 **Overtaking by motor vehicles**	
Minimum passing distance	
20mph	1m
30mph	1.5 m
Total width required for overtaking cyclist in secondary riding position (see figure below)	
Car passing at 20 mph	4.3m
Car passing at 30 mph	4.8m
Bus/HGV passing at 20 mph	5.1m
Bus/HGV passing at 30 mph	5.6m

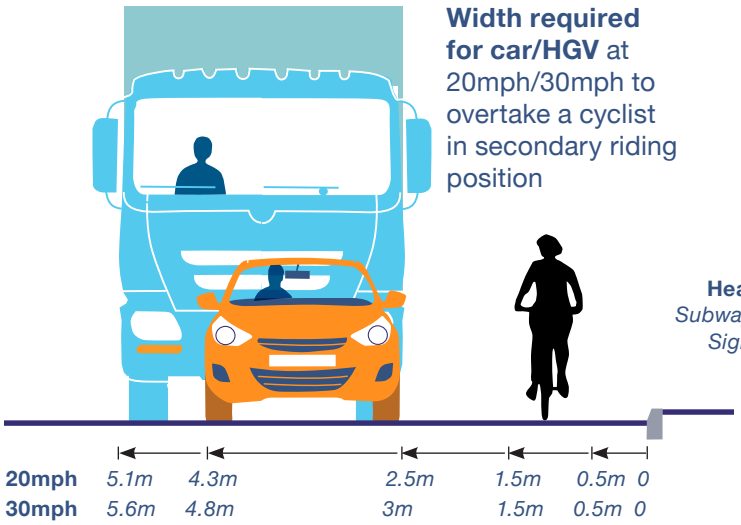
Table H.2 **Additional clearances to maintain effective widths for cyclists** (see figure below)

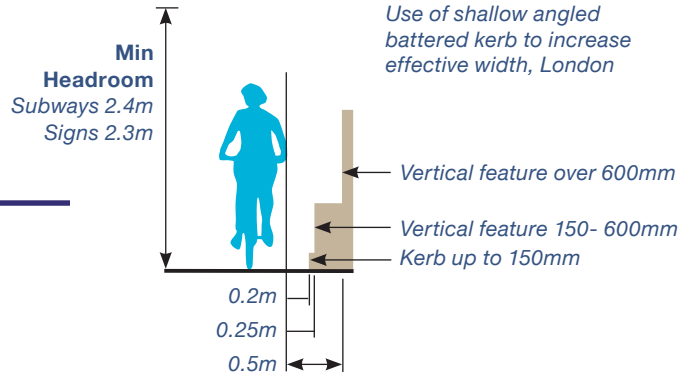
Type of edge constraint	**Additional width required (mm)**
Flush or near-flush surface (including shallow angled battered kerbs - see photo below)	Nil
Kerb up to 150 mm high	Add 200
Vertical feature from 150 to 600 mm high	Add 250
Vertical feature above 600 mm high	Add 500

Table H.3 **Calculation of minimum width required:** minimum width = a+b+c+d

a	dynamic width
b	minimum passing distance from other users (Table H.1)
c	clearance for edge constraints (Table H.2)
d	additional width for high cycle/pedestrian volumes, steep gradients, curves

Source : LTN 2/08 & LTN 1/12





Use of shallow angled battered kerb to increase effective width, London

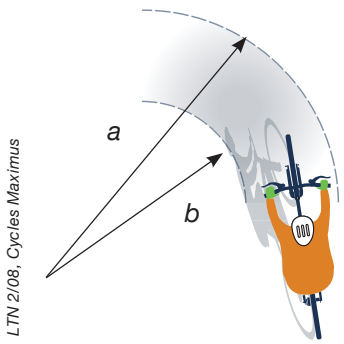
Not to scale

Understanding user needs 4

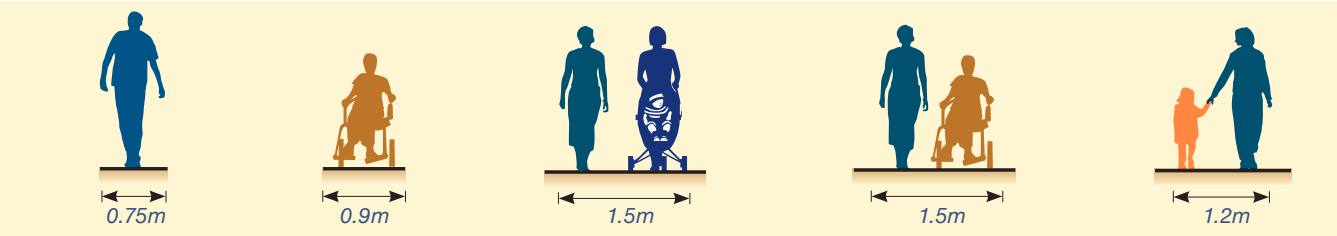
Table H.4 **Cycle parking and manoeuvring at low speeds**: minimum dimensions

	Overall width (mm)	Overall length (mm)	Minimum turning circle (mm)	
			Outer radius (a)	Inner radius (b)
Conventional bicycle	700	1800	1650	850
Tandem	700	2400	3150	2250
Bicycle and trailer	800	2700	2650	1500
Cargo trike	1200	2600	2300	100

Note: a wide range of adapted bikes are used for disability cycling: their design requirements will generally fall within the ranges in this table



Typical minimum widths required by pedestrians and wheelchair users



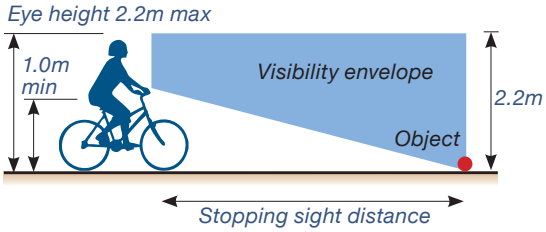
Visibility

Table H.5 **Link design parameters** - traffic free

Type of cycle route	Design speed	Min. stopping sight distance (1)	Sight distance in motion (2)	Min. radius of curve
Commuter route	20 mph	25 m	80 m	25 m
Local access route	12 mph	15 m	50 m	15 m

1. *Add 50% for unsealed surfaces*
2. *Sight distance in motion is the distance a cyclist needs to see ahead when riding in order to feel safe and comfortable*

Forward visibility envelope



Visibility at junctions

Recommended X distances for cyclists are:

- 4m preferred
- 2m recommended
- 1m where geometry is tight

If these visibility requirements cannot be achieved the alternative is to use the full range of markings and signs available to make clear the need for cyclists to slow down and give way.

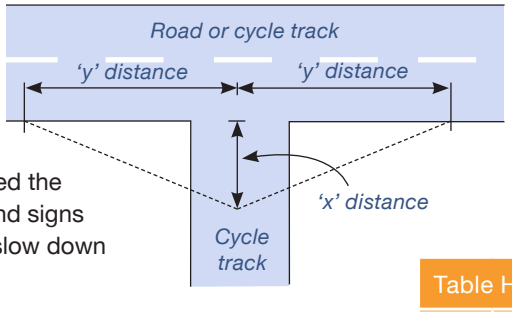


Table H.6 **Visibility at junctions**

85%ile speed (kph)	20	25	30	40	45	50	60	70	85	100	120
'y' distance (m) on road	14	18	23	33	39	45	59	120	160	215	295

Source: Manual for Streets TD 42/95

Table H.7 **Gradients**

3%	Preferred maximum
5%	Normal maximum – up to 100m
7%	Limiting gradient – up to 30m
>7%	For short lengths

In hilly areas, many roads have steeper gradients but can still make acceptable cycle routes

Network planning

Characteristics of an urban network

In urban areas the cycle network will comprise the highway network, modified where necessary, together with traffic free routes which offer more direct journeys, overcome barriers or offer attractive routes. The aim should be to develop a basic cycle network around a 'mesh width' of no more than 250m, so that an alternative route is never more than 250m away. Within this network more strategic main routes would be identified for prioritisation of investment and promotion. The network should be:

- safe, convenient, continuous and attractive to encourage new cyclists
- useful for all manner of routine journeys for local people and existing cyclists
- memorable such that occasional users are persuaded to cycle more

Developing a network

The degree of sophistication of the process will depend on the size of the urban area under consideration. All or some of the following stages may be required:

- identify main trip attractors (residential, employment, retail, education, transport, health, visitor attractions, proposed developments etc)
- assess demand (existing and potential cyclists)
- identify desire lines
- review existing routes, cycle parking, constraints and options for improvements and other proposed transport schemes
- engage with stakeholders (throughout process)
- develop a prioritised costed network development plan
- marketing / public engagement strategy
- monitor and review

Development of a network should generally begin from the urban centre, working outwards. The network may be organised around a hierarchy of routes:

- main routes
- secondary routes
- access routes

Filtered permeability, Bristol

Secure cycle parking, Cambridge

Access through pedestrianised street, Lancaster

Examples of **elements of a network**

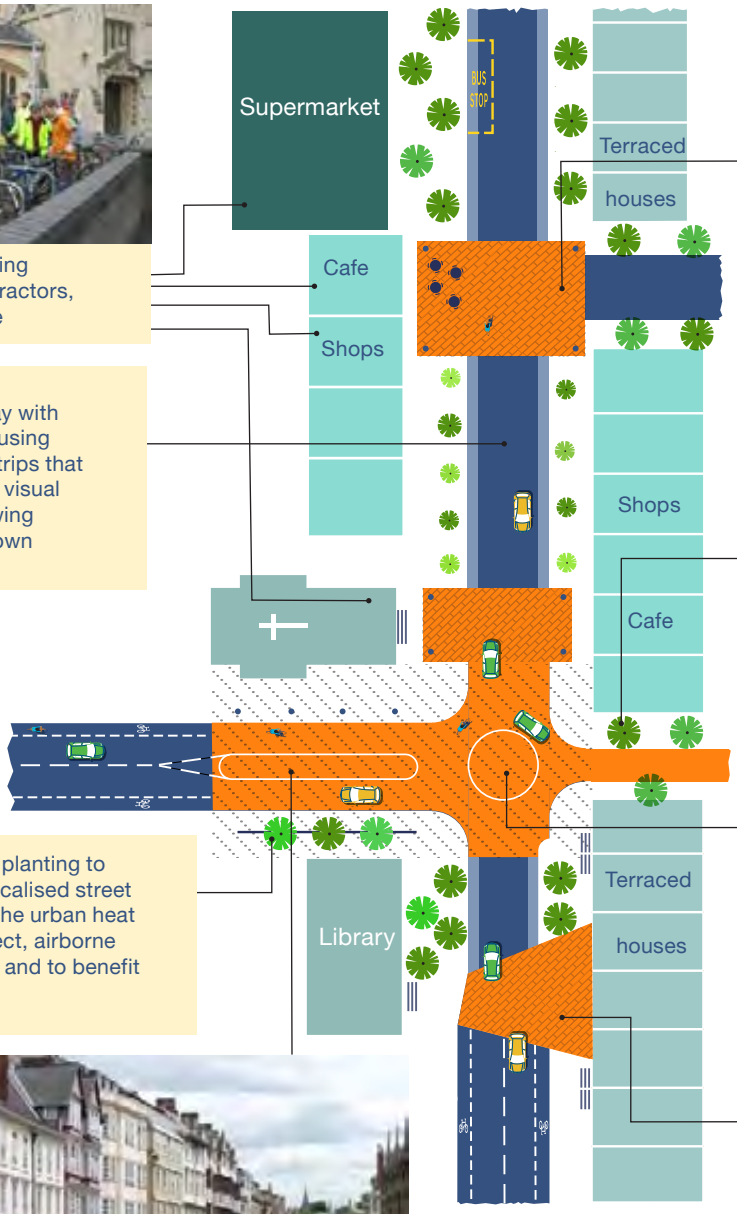
- providing **good access** to and through town centres and other local centres - this commonly requires mixed priority streets
- **direct connections** to public transport hubs and other trip generators
- **filtered permeability** - traffic cells, access for cyclists through road closures and vehicle restricted areas, contraflow facilities, exemption from restricted turns, cycle bridges across rivers and railways, short-cuts through parks
- **area-wide 20mph limits** and zones and other means to reduce traffic speed and volume
- giving a high priority to **cycle friendly junctions** at the design stage
- **cycle lanes and advanced stop lines** to enable cyclists to avoid queuing traffic
- cycle tracks alongside **rivers** and **canals** and on **disused railways**
- **maximising route opportunities** to and through new developments
- **secure and convenient cycle parking** at both trip ends

Streets and roads 1
Street design

Many urban streets are not wide enough to provide separate cycle facilities or have frontage activity that makes such provision impractical. Design for such environments needs to think beyond standard highway design, defining a slow speed highway environment where cycles, pedestrians and motorised traffic can safely integrate. A good street design can help create a bespoke solution that suits the local surrounding buildings and activities. This page illustrates a set of ideas from which the designer may choose to suit the context. Involving the community in local street design is strongly recommended as it enables the scheme to reflect the needs and aspirations of people living or working in the area.

Cycle parking outside attractors, Cambridge

Distinctively paved junction highlighted by vertical elements, giving space for outdoor cafe seating, Edinburgh



Not to scale

6m wide carriageway with narrowing using drainage strips that reduce the visual width, slowing vehicles down

Filtered permeability delivered by key traffic free route highlighted by distinctive vertical elements

Informal roundabout helps control speeds at junction, London

Attractive planting to combat localised street flooding, the urban heat island effect, airborne pollutants and to benefit wildlife

Flush central reserve helps reduce carriageway width (allowing occasional over-run by larger vehicles) and allows comfortable pedestrian crossings at more locations, Oxford

Widened crossing in front of library creates a distinctive gateway feature into the scheme and addresses pedestrian desire lines, Poynton

Streets and roads 2
Speed reduction: street design

Designers should aim to create streets that control vehicle speeds by their physical geometry, visual appearance and provision for pedestrians, cyclists and frontage activity rather than relying on signs and vertical or horizontal traffic calming measures. Such an approach can facilitate the introduction of 20mph speed limits.

Traffic calming using trees, Bristol

The range of traffic calming measures available includes:

- physical features
- changes in priority
- street dimensions
- reduced visibility
- psychology and perception

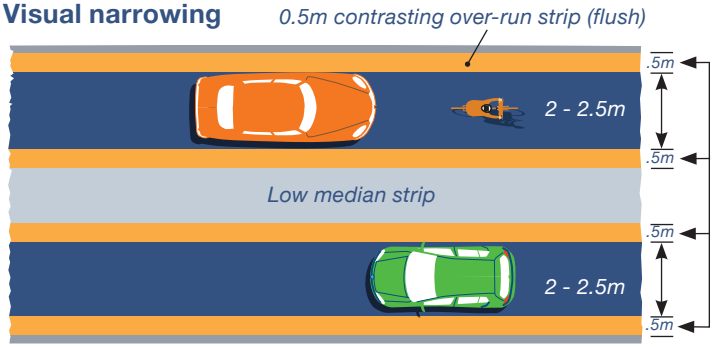
This page illustrates a number of examples of how street design can reduce speeds.

Guidance on achieving appropriate traffic speeds is contained in Manual for Streets. Examples of particular approaches include:

- shared space
- home zones
- community led street design
- mixed priority streets
- Cycle Streets

Some local authorities have developed design palettes for the design of streets with 20mph speed limits.

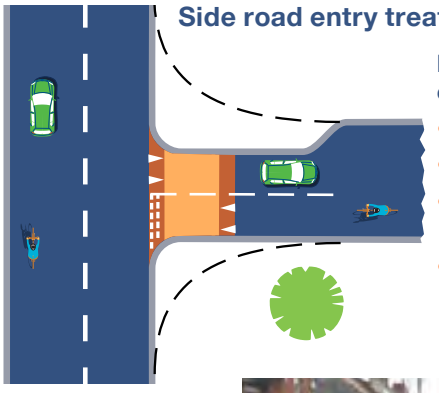
Visual narrowing



Visual narrowing, Poynton

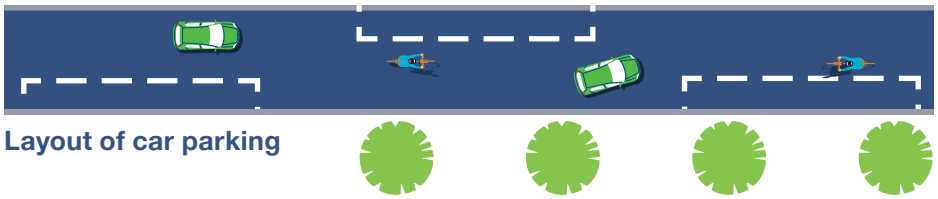
Entry treatment, London

Side road entry treatment



Measures to consider:

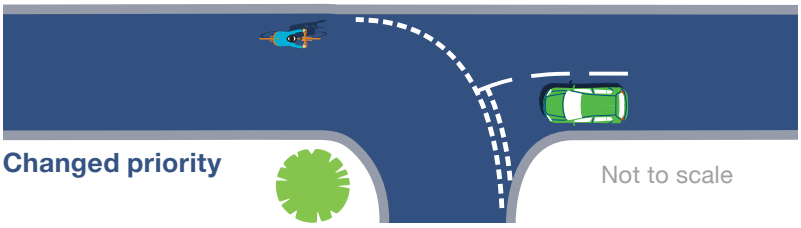
- reduced width
- tight radii
- raised crossing
- contrasting surface



Layout of car parking

Staggered parking, Wokingham

Changed priority, London



Changed priority

Not to scale

Streets and roads 3

Speed reduction: physical traffic calming

This page illustrates the most common forms of conventional vertical and horizontal traffic calming measures, and how they can be designed to take account of cyclists.

Raised junction, Haringey

Sinusoidal road hump, Edinburgh

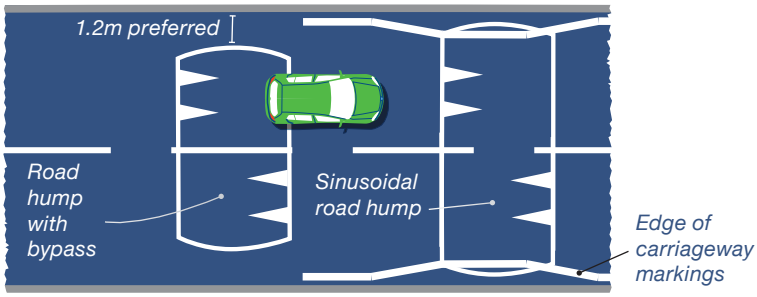
Speed cushions, Nottingham

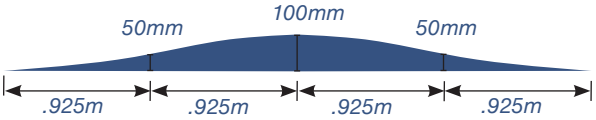
Pinch point, Shrewsbury

Central island, London

Vertical features

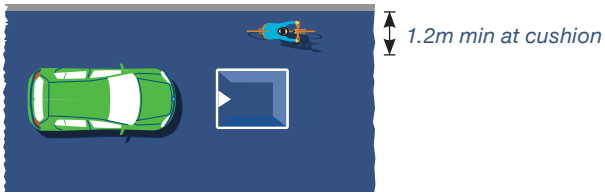
Road humps



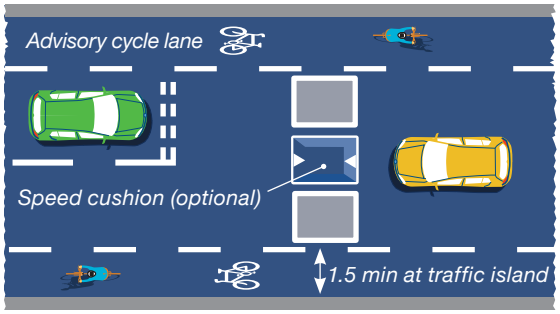


Sinusoidal road hump cross section
(preferred geometry for vertical dimension)

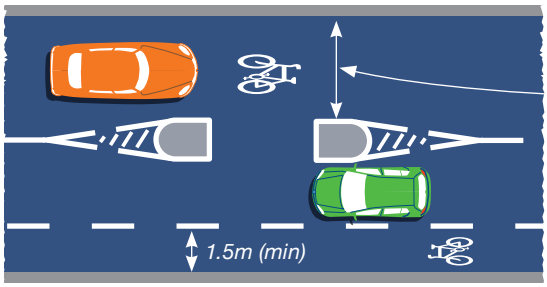
Speed cushion



Horizontal features



Priority system - pinch point



Central island

Recommended width depends on speed, but avoid gaps of 3.1 - 3.9m. Where pinch point cannot be removed consider marking large cycle symbol centrally. Where a cycle lane is provided it should be continued through the pinch point with a width of at least 1.5m

Not to scale

Streets and roads 4

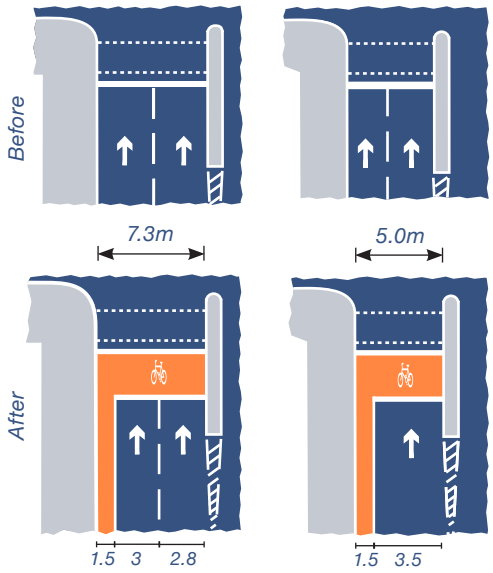
Reallocation of road space

A fundamental aspect of the provision of cycling facilities is the reallocation of carriageway from motor vehicles to cycling. This can be seen in the majority of figures within this document. The provision of cycle tracks in urban areas at the expense of the footway is not encouraged (it tends to be unpopular with pedestrians and cyclists), particularly where there are high pedestrian flows, although there are some limited situations where this may be necessary. Reallocation of road space makes an important statement about the relative priority of different transport users, as it not only promotes cycling but can act as a restraint on motor traffic, which is an important aspect of transport and planning policy in congested urban areas. Typically this will involve one or more of the following:

- filtered permeability
- removal of a traffic lane
- conversion of traffic lanes to bus lanes
- reduced width of traffic lanes
- removal of centre line
- reduction in traffic speeds
- introduction of weight limits
- removal of car parking
- reallocation of time at signals
- shared space

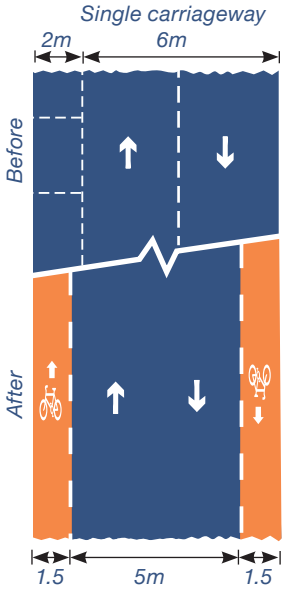
The drawings on this page illustrate a number of options where traffic lanes have been removed or narrowed to accommodate provision for cyclists.

Advanced stop lines
with feeder lanes



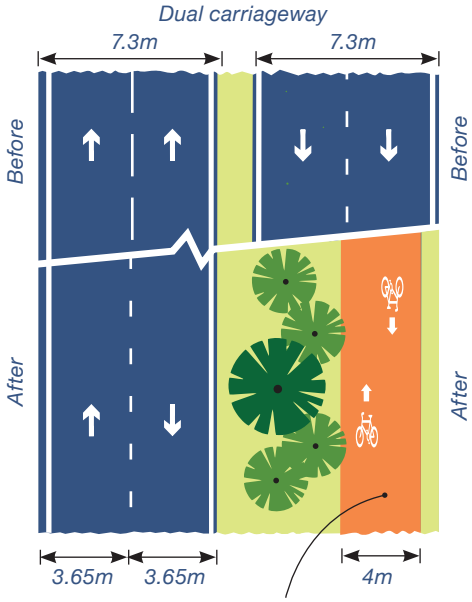
Advanced stop line with feeder lane, London

Narrowing of
traffic lanes



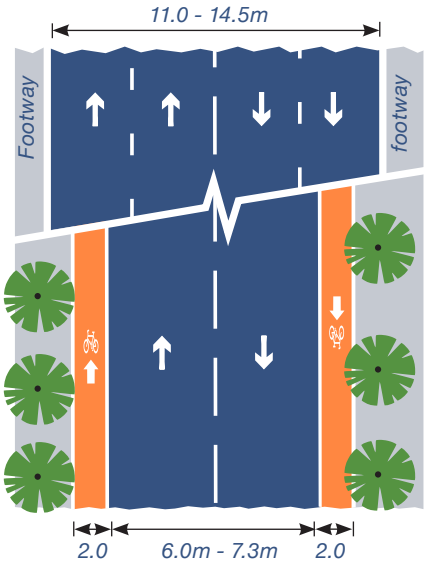
Remove centre line for widths below 5.5m

Removal of traffic lane
to provide cycle track



Segregated two-way cycle track

Removal of traffic lanes
to provide cycle lanes



Narrowing of traffic lanes/ removal of centre line, Cambridge

Removal of traffic lane to provide cycle track, Bristol

Removal of traffic lanes to provide cycle lanes, Hull

Not to scale

Streets and roads 5

Quiet streets and Cycle Streets

Where a designated cycle route uses a low speed quiet street (e.g. residential road, town centre back street or road through a park) it should typically:

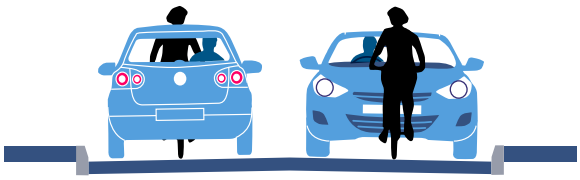
- provide a convenient and direct route between key destinations
- give cyclists priority on the road itself and also right of way at junctions
- carry no more than 3,000 motor vehicles per day

Design elements may include:

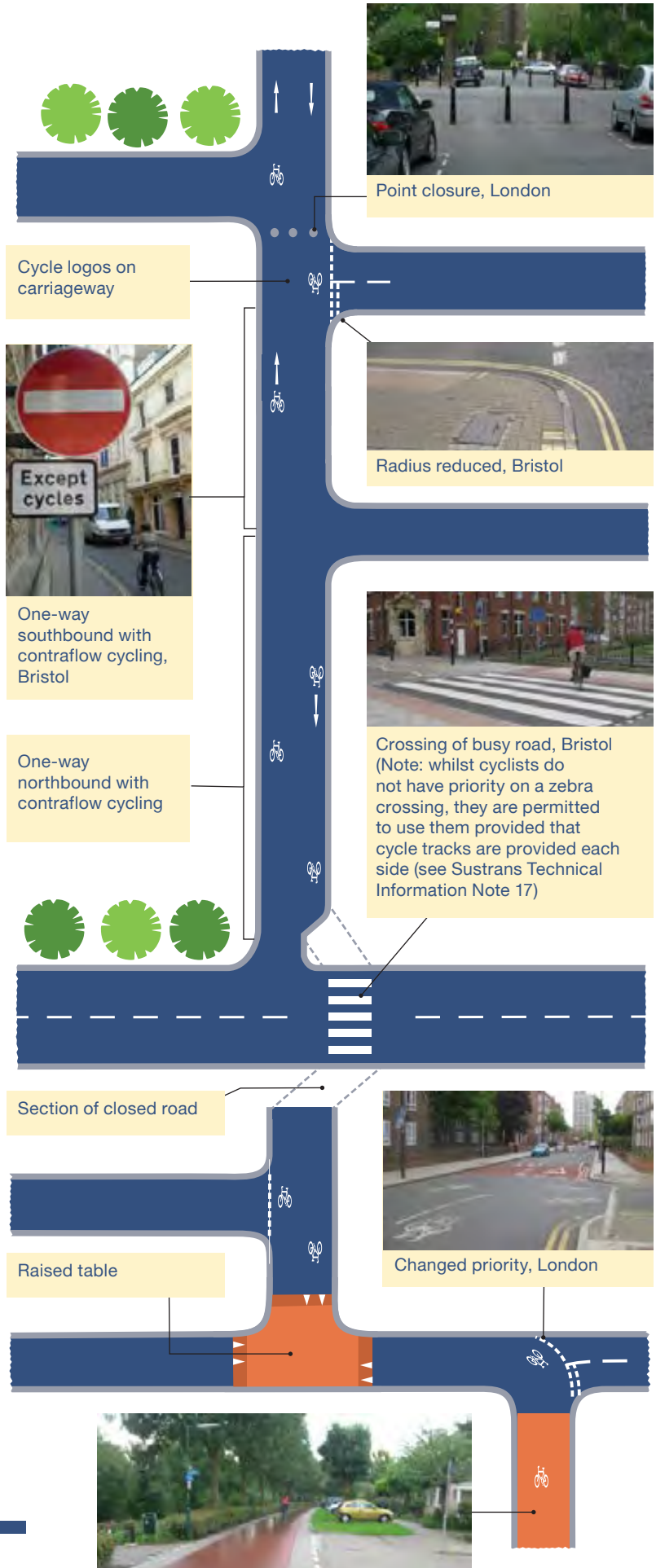
- 20mph speed limits
- changed priorities
- one-way with contraflow cycling
- psychological and physical traffic calming
- point closures with cycle gaps
- banned turns with exemption for cyclists
- cycle priority at road crossings
- surface markings

In certain situations sections of the route may be designated a Cycle Street (see Sustrans Technical Information Note 32). This is a street designed to be a main cycle route which is open to motor traffic, in which case:

- the street design should encourage cyclists to assume priority with drivers of motor vehicles behaving as 'guests'
- it should carry at least 1,000 cyclists per day, including forecast cycle growth
- cyclists should potentially outnumber motor vehicles
- the design should provide cyclists with a level of service comparable to that provided by a high quality traffic free route
- the length over which a car has to follow a cyclist should be limited to 400m



Cars are 'guests' on Cycle Streets



Point closure, London

Cycle logos on carriageway

Radius reduced, Bristol

One-way southbound with contraflow cycling, Bristol

One-way northbound with contraflow cycling

Crossing of busy road, Bristol (Note: whilst cyclists do not have priority on a zebra crossing, they are permitted to use them provided that cycle tracks are provided each side (see Sustrans Technical Information Note 17)

Section of closed road

Raised table

Changed priority, London

Surface treatment (Cycle Street), The Netherlands

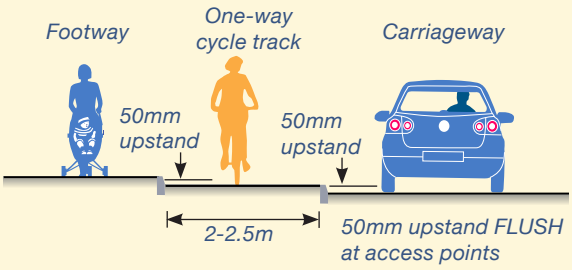
Not to scale

Streets and roads 6

Innovative cycle facilities : details

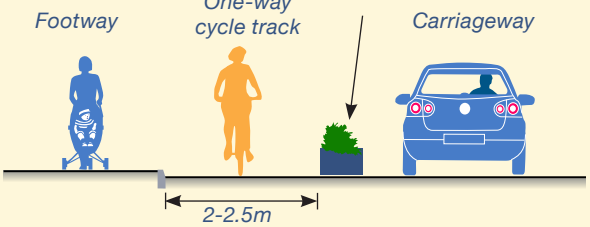
This page provides basic details of a number of innovative measures to assist cyclists on links and at junctions that have recently been implemented in the UK, most of which are featured elsewhere in this handbook. More information on these and other future innovative schemes, including links to design details, is available from the Inspiring Infrastructure section of Sustrans' website.

Hybrid cycle track detail *(e.g. Brighton)*



Light segregation detail *(e.g. Camden)*

Intermittent segregation 2.5m to 10m spacing
- *planters*
- *armadillos*
- *wands*



Benefits : low cost; easily widened

Hybrid cycle track, Brighton

Photo: LB Camden

Planters and armadillos, Camden

Armadillo

Photo: TRL Ltd

Wands

Bus stop bypass, Brighton

Early start for cycles

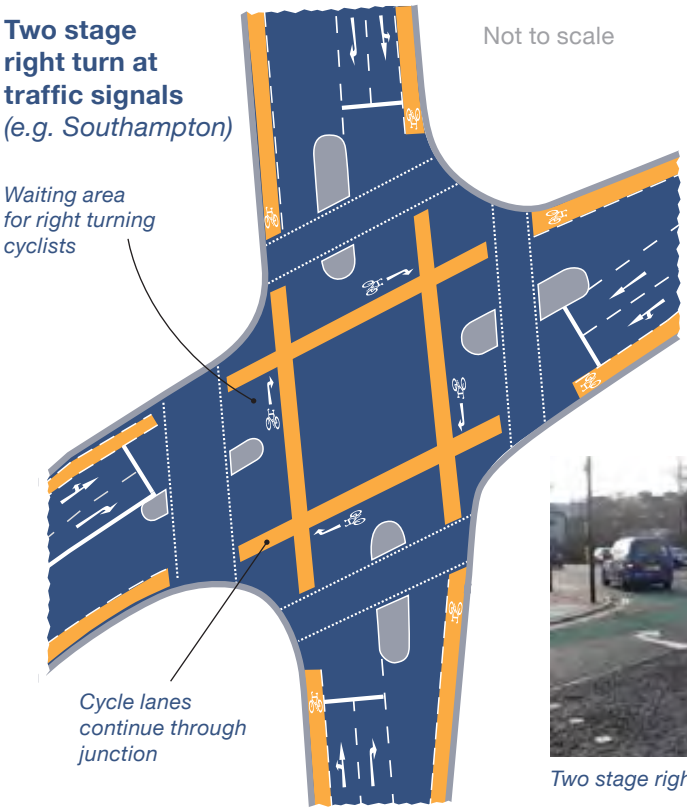
Green cycle pre-signal gives 5 seconds head start for cyclists, Examples in Brighton, York and Cambridge (requires authorisation)

Small aspect, low level signal heads for cyclists, London (requires authorisation)

Photo: TfL

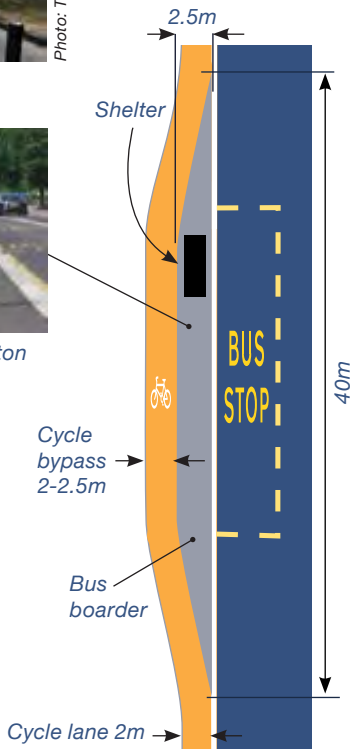
Two stage right turn at traffic signals *(e.g. Southampton)*

Not to scale



Two stage right turn, Southampton

Bus stop bypass typical detail *(e.g. Brighton)*



Streets and roads 7

Carriageway and lane widths

Illustration of the sizes of vehicle various lane widths can accommodate at low speeds (HGV, coach and car illustrated)

(Cardiff Cycle Design Guide)

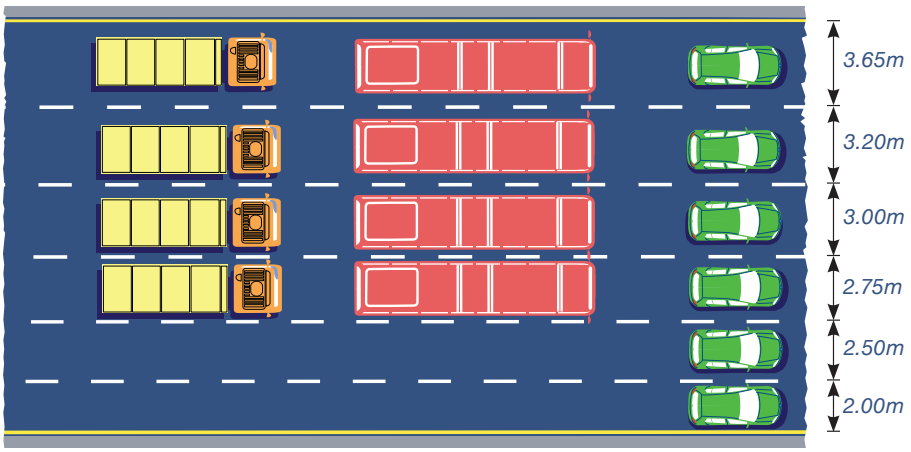
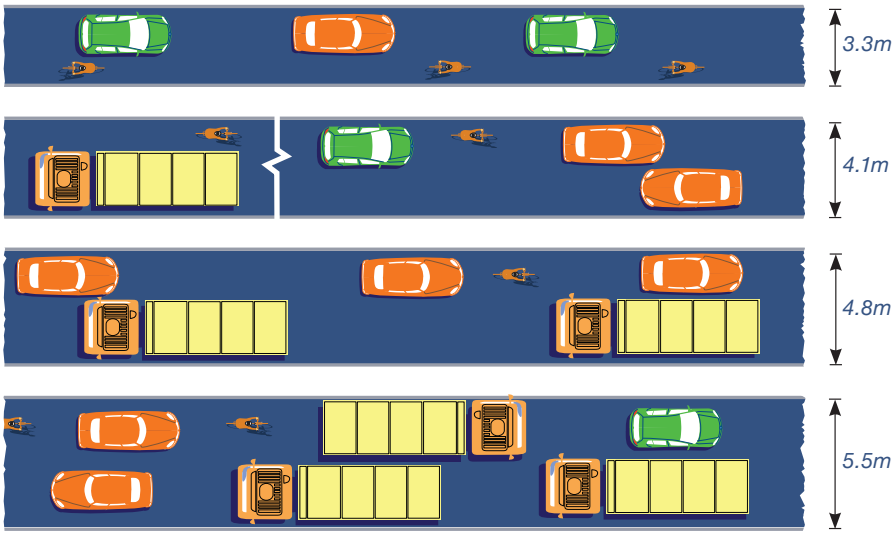


Illustration of what various effective carriage widths can accommodate at low speeds and low flow. They are not necessarily recommendations and are narrower than the widths required for overtaking in Table H.1 (note: emergency vehicle access generally requires width of 3.5m)

(adapted from Manual for Streets)



Minimum widths for one-way cycle lanes

1.5m on nearside approach to Advanced Stop Line (ASL) (1.2m absolute minimum)

1.5m where speed limit is 30mph

2.0m where speed limit is 30mph and cycle flow high

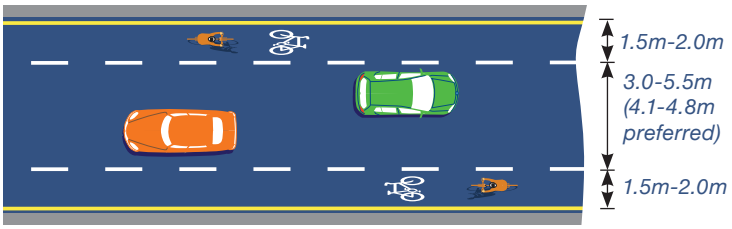
2.0m (or 1.5m + 0.5m margin) on busy roads or speed limit 40mph

2.0m ASL approach lane between traffic lanes

2.0-2.5m for hybrid cycle tracks and light segregation, dependent on level of use

Hybrid cycle track, Brighton

Centre line removal, Cambridge



Example of advisory cycle lane layout with centre line removed
(Cardiff Cycle Design Guide)

Waiting restrictions may be appropriate

Not to scale

Streets and roads 8

Traffic calming and contra-flow cycling

Note: for traffic calming details see **streets and roads 3**

Use of cycle symbols and arrows at intervals, Brighton

Contraflow cycling in one-way street with no cycle lane

Car parking

Speed cushions can be advantageous to cyclists and bus operators if carefully designed

Point narrowing: avoid widths between 3.1 and 3.9m, Hounslow

Cycle gate or "No Entry Except Cycles" sign, Bristol

Removal of centre line to provide cycle lanes, Islington

Protected entry for cyclists

Flat topped humps should be constructed along pedestrian desire lines

Transition must be flush

Humps to be of sinusoidal profile

Provide cycle bypass at narrowing to single lane, min 1.5m width, Bristol

Provision of cycle bypass ramped up to footway level reduces maintenance but requires additional drainage, Lambeth

Contraflow cycle lane 2m preferred 1.5m minimum, Leighton Linslade

Not to scale

Streets and roads 9

Cycle lanes and traffic signals

Parking/loading bay. Avoid echelon (nose in) parking

Dividing strip 0.5m min (1m preferred)

Cycle lane width retained where right turn lane provided. Reduce traffic lane width as necessary

Cycle lane width min 1.5m (30mph limit) or 2m (40mph limit)

Cycle lane should normally be mandatory (solid line). Advisory cycle lanes (broken lines) are required where vehicles may need to enter them

Reduced radius on corner, subject to tracking path for large vehicles, and possible side road entry treatment

Advisory cycle lane with 0.5m increased width and coloured surfacing across side road, London

Central feeder lane to be min 2m width, with coloured surfacing, Shrewsbury

Cycle lane continued across junction with 0.5m increased width, London

Nearside ASL feeder lane min 1.5m width (absolute min. 1.2m)

Coloured surface in ASL box and up to 30m on approach to signals recommended

Advanced stop line (ASL) to assist cyclists. ASL box normally 5m deep, up to 7.5m with authorisation

Cycle track with separate stage at traffic signals

Radius at cycle track junction 2m minimum (4m preferred)

Preferred length of feeder lane to be as long as normal peak period traffic queues

Pre-signal to give cyclists 5 seconds start (requires authorisation), Brighton

Hybrid cycle track to join carriageway as mandatory cycle lane on approach to signals

Hybrid cycle track returns cyclists to carriageway at side road, with tight corner radii and raised crossing, Brighton, or crosses side road as advisory cycle lane, York

Hybrid cycle track (one way) with kerb segregation from both carriageway and footway, or 'light segregation'. Preferred min 2m. For details see Streets and Roads 6, Brighton

Photo: Jon Toy

Not to scale

Streets and roads 10

Shared roads, buses and traffic signals

Widened footway

Paved edge strip to narrow carriageway (see Streets and roads 2)

Central margin strip and informal crossing point to assist pedestrians, Poynton

Bus lane widths

- 4.5m recommended
- 4m preferred minimum
- 3m absolute minimum
- 3.2m to 3.9m to be avoided

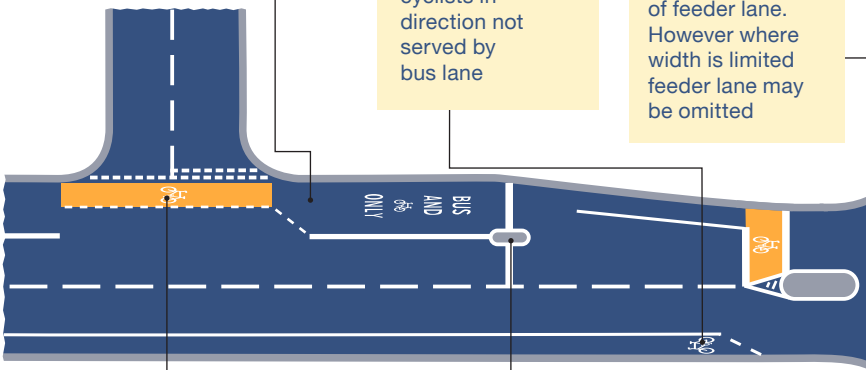
Car parking bay inset into widened footway, Stonehouse

Photo: Brighton and Hove Council

Cycle bypass at traffic signals, Brighton

Provision for cyclists in direction not served by bus lane

Presumption in favour of provision of feeder lane. However where width is limited feeder lane may be omitted



Cycle lane through junction

Advisory cycle lane provides continuity at break in bus lane, Brighton

Bus pre-signal with permanent green for cyclists (requires authorisation), Cambridge

Photo: Brighton and Hove Council

Cycle bypass at bus stop, Brighton

Cycle lane past car parking, Glasgow

Exit taper 1:5 min

Parking/loading

Dividing strip 0.5m (1m preferred)

Entry taper 1:10 min

Road closure "except cycles", Brighton

Right turn pocket for cyclists, 1.5m min width (refuge optional where width allows), Shrewsbury

Not to scale

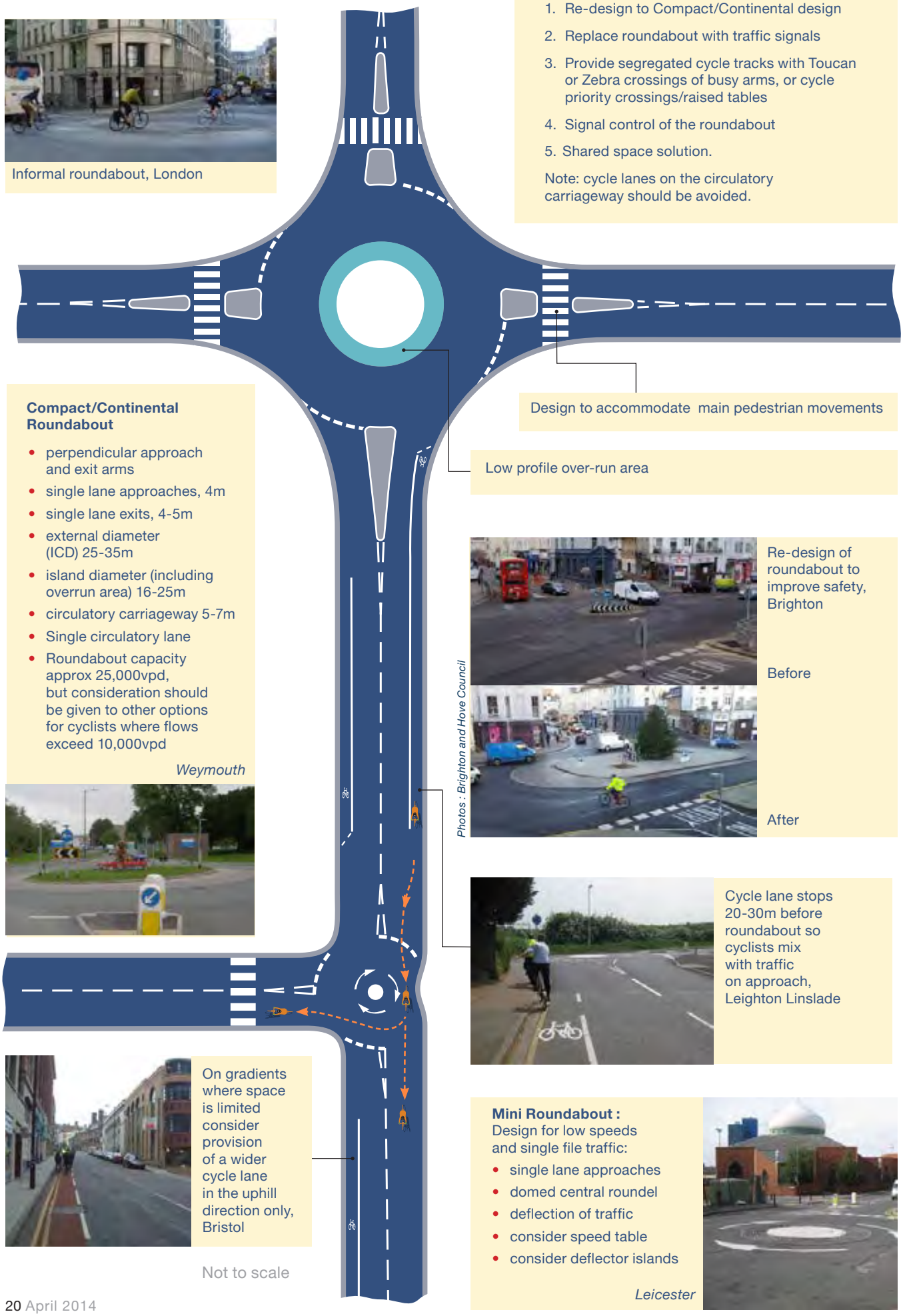
Streets and roads 11
Roundabouts

Informal roundabout, London

Large conventional roundabouts pose problems for cyclists. Options to consider are:

1. Re-design to Compact/Continental design
2. Replace roundabout with traffic signals
3. Provide segregated cycle tracks with Toucan or Zebra crossings of busy arms, or cycle priority crossings/raised tables
4. Signal control of the roundabout
5. Shared space solution.

Note: cycle lanes on the circulatory carriageway should be avoided.



Design to accommodate main pedestrian movements

Low profile over-run area

Compact/Continental Roundabout

- perpendicular approach and exit arms
- single lane approaches, 4m
- single lane exits, 4-5m
- external diameter (ICD) 25-35m
- island diameter (including overrun area) 16-25m
- circulatory carriageway 5-7m
- Single circulatory lane
- Roundabout capacity approx 25,000vpd, but consideration should be given to other options for cyclists where flows exceed 10,000vpd

Weymouth

Re-design of roundabout to improve safety, Brighton

Before

After

Photos : Brighton and Hove Council

Cycle lane stops 20-30m before roundabout so cyclists mix with traffic on approach, Leighton Linslade

On gradients where space is limited consider provision of a wider cycle lane in the uphill direction only, Bristol

Not to scale

Mini Roundabout :
Design for low speeds and single file traffic:

- single lane approaches
- domed central roundel
- deflection of traffic
- consider speed table
- consider deflector islands

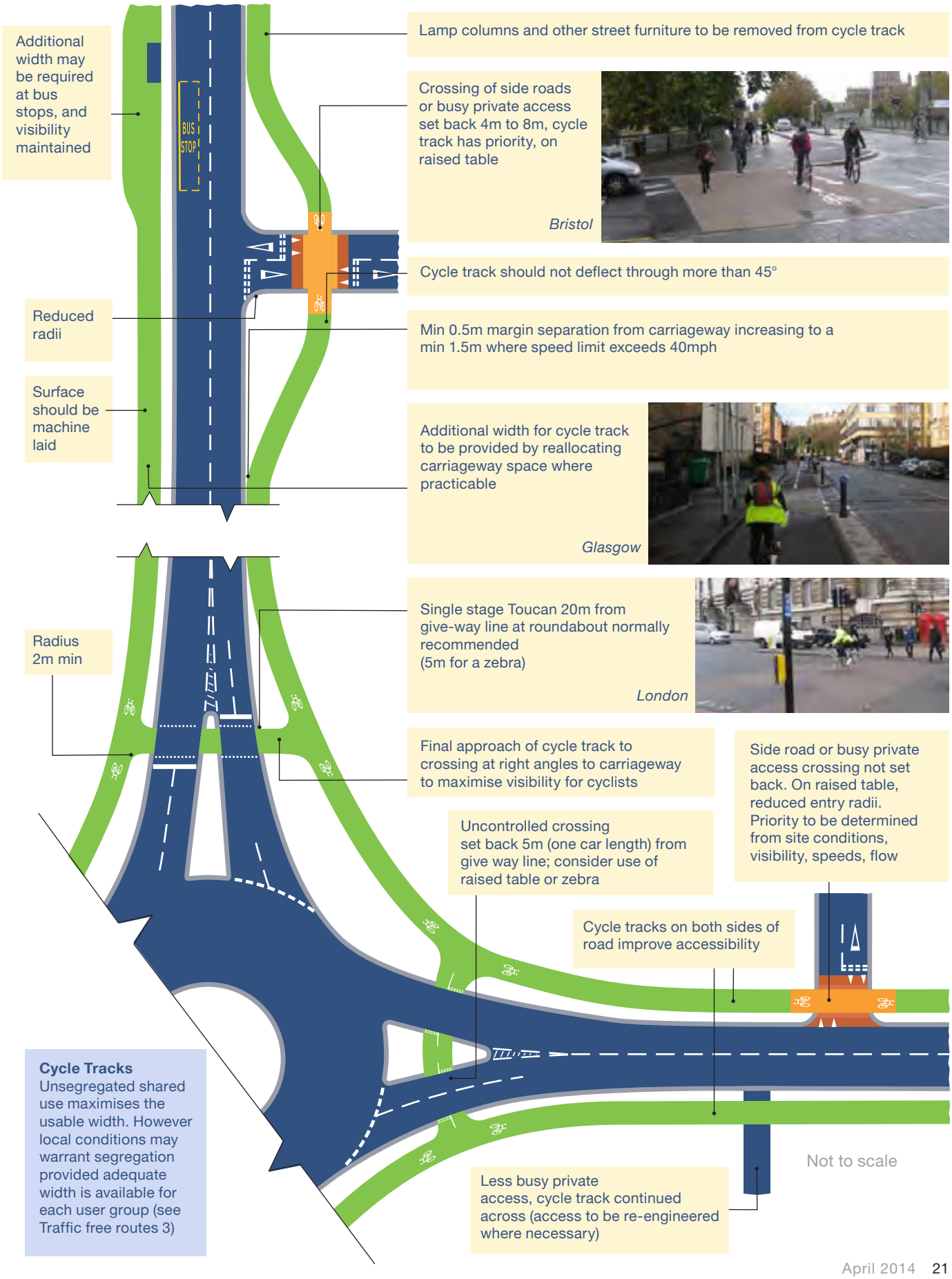
Leicester

Streets and roads 12

Cycle tracks alongside carriageway

Key design requirements:

- minimise number of side road crossings
- provide for all movements at all junctions
- cycle track continuity to avoid crossing and recrossing road
- aim to provide cycle tracks on both sides of the road

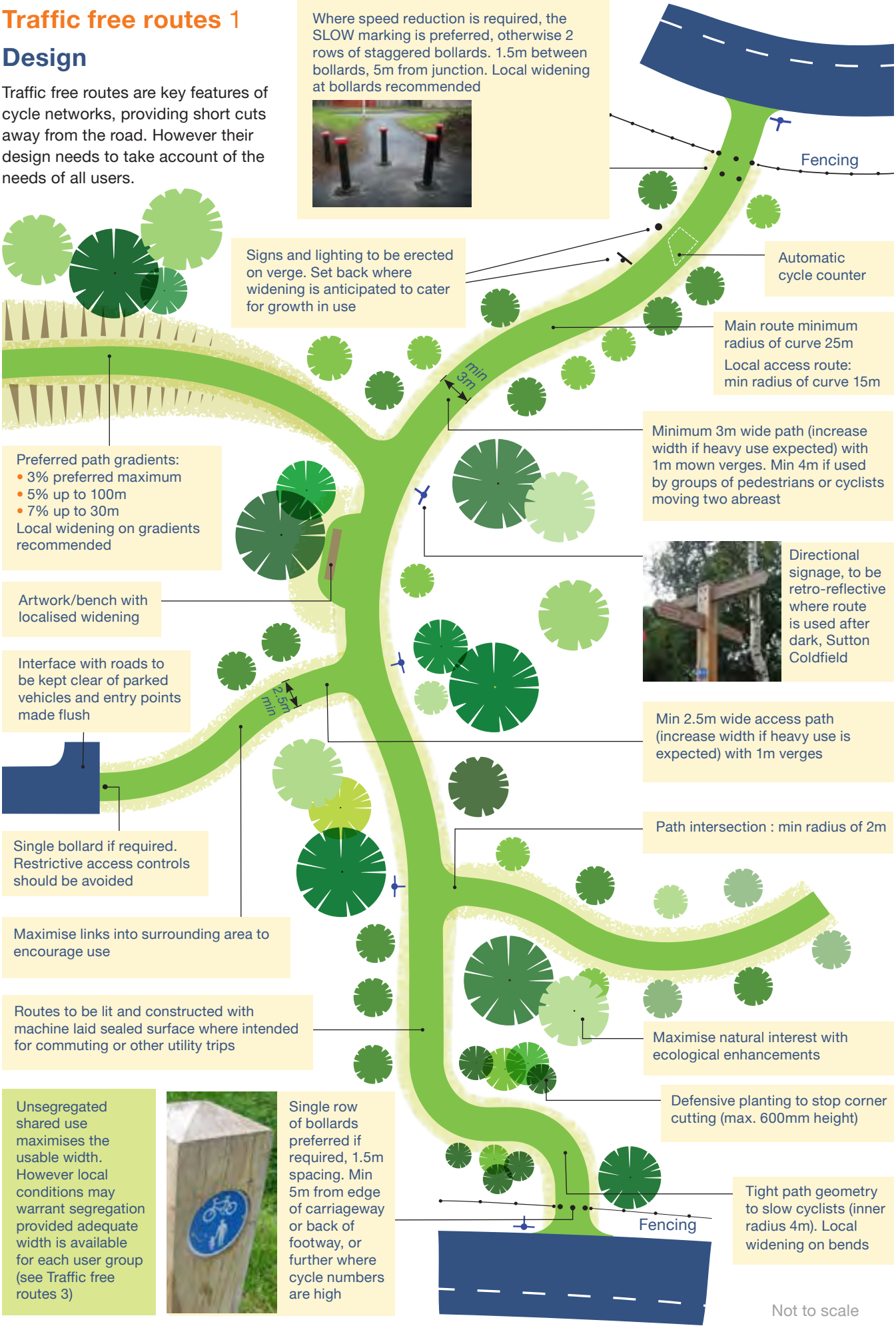


Traffic free routes 1

Design

Traffic free routes are key features of cycle networks, providing short cuts away from the road. However their design needs to take account of the needs of all users.

Where speed reduction is required, the SLOW marking is preferred, otherwise 2 rows of staggered bollards. 1.5m between bollards, 5m from junction. Local widening at bollards recommended



Signs and lighting to be erected on verge. Set back where widening is anticipated to cater for growth in use

Automatic cycle counter

Main route minimum radius of curve 25m

Local access route: min radius of curve 15m

Minimum 3m wide path (increase width if heavy use expected) with 1m mown verges. Min 4m if used by groups of pedestrians or cyclists moving two abreast

Preferred path gradients:
- 3% preferred maximum
- 5% up to 100m
- 7% up to 30m

Local widening on gradients recommended

Directional signage, to be retro-reflective where route is used after dark, Sutton Coldfield

Artwork/bench with localised widening

Interface with roads to be kept clear of parked vehicles and entry points made flush

Min 2.5m wide access path (increase width if heavy use is expected) with 1m verges

Path intersection : min radius of 2m

Single bollard if required. Restrictive access controls should be avoided

Maximise links into surrounding area to encourage use

Routes to be lit and constructed with machine laid sealed surface where intended for commuting or other utility trips

Maximise natural interest with ecological enhancements

Defensive planting to stop corner cutting (max. 600mm height)

Unsegregated shared use maximises the usable width. However local conditions may warrant segregation provided adequate width is available for each user group (see Traffic free routes 3)

Single row of bollards preferred if required, 1.5m spacing. Min 5m from edge of carriageway or back of footway, or further where cycle numbers are high

Tight path geometry to slow cyclists (inner radius 4m). Local widening on bends

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Traffic free routes 2

Path construction

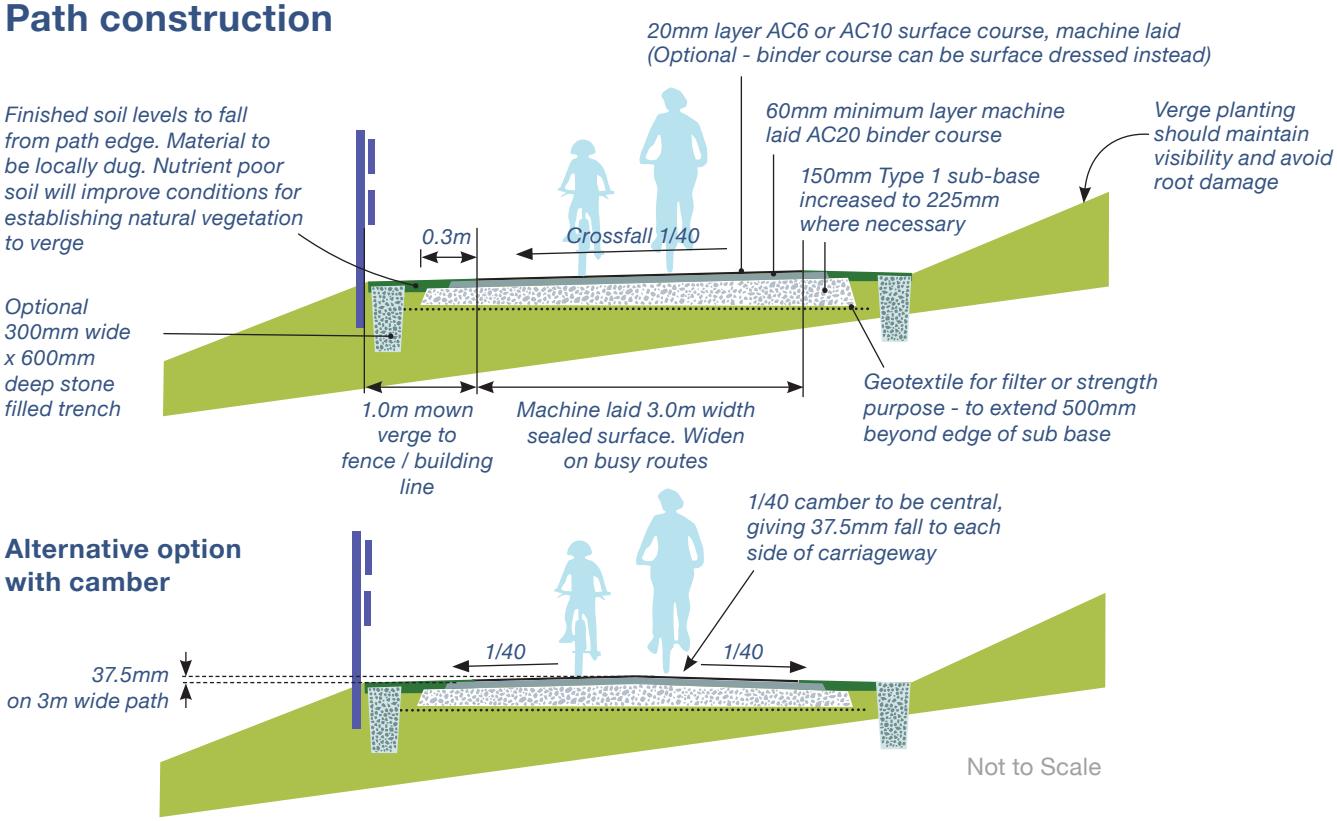


Table H.8 **Path construction requirements,** unsegregated shared use		
Nature of route	**Min. effective path width** (see Note 1)	**Type of surface**
Urban traffic free	3.0m on all main cycle routes, secondary cycle routes, major access paths and school links; wider on curves and steep gradients. Where high usage is expected, or significant demand to ride two abreast, a width of 4m is preferred and segregation between cyclists and pedestrians considered. 2.5m possible on access routes and links with low use	Sealed surface imperative Surface dressed top to bitumen base course may be appropriate
Urban fringe / semi rural traffic free	3.0m on all main cycle routes, major access paths and school links 2.5m possible on lesser secondary cycle routes and access links	Sealed surface imperative Surface dressed top to bitumen base course may be appropriate
Rural traffic free	2.5m on all main routes, major access paths and school links 2.0m possible on lesser routes and links	Sealed surface required on any route within 5km of urban area or 2km of village environment Sealed surface required on routes linking villages where school traffic or other utility trips will benefit. Surface dressed top to bitumen base course may be appropriate Use of unsealed surface requires a rigid maintenance plan Use of unsealed surface not recommended on paths: • with gradient steeper than 1 in 20 • shared with equestrians • where significant run off expected

1. *Refer to Table H.2 for additional width required for various edge constraints*
2. *Minimum acceptable verge width is 0.5m, 1.0m preferred*
3. *Greater width required where route is used by horses*
4. *For widths on segregated routes see Table H.9*

Traffic free routes 3

Segregation of cyclists and pedestrians

In Sustrans' experience there are significant advantages with unsegregated paths where the width is shared by all users, particularly on traffic free routes away from the road. Unsegregated routes maximise usable width and minimise maintenance requirements and sign/line clutter. Effective segregation will benefit all users but requires significant additional width to provide the same level of service. Each situation must be considered on a case by case basis, and careful consideration must be given to the factors listed below.

DfT advice in LTN 1/12 encourages designers to think through their decisions rather than start from a default position of implementing any particular feature.

Unsegregated shared use, London

Whether to segregate

Segregation can take the form of a white line, either painted or in the form of a tactile delineator, or physical separation such as a kerb (standard or tapered), barrier or verge. Effective segregation requires sufficient width to be provided for each user group; segregation where insufficient width is provided is largely ineffective.

Developing the design of a shared use path, including decisions on segregation, should include early consultation with relevant interested parties such as those representing people with disabilities, walkers and cyclists.

Factors to consider when deciding whether to segregate include:

- width available
- level of use
- type of use (e.g. journey purpose)
- variability of use
- use by groups
- use by vulnerable pedestrians
- gradients
- land take, drainage, maintenance

Shared use routes alongside the carriageway are more likely to justify segregation between cyclists and pedestrians, in which case there are particular advantages in providing one-way cycle tracks on each side of the road.

Segregated shared use routes may require use of tactile paving.

Widths

Width requirements for unsegregated paths are given in *Table H.8*.

Where segregation is provided, the requirements for users indicate the following two-way widths:

Table H.9 **Widths**	**Cyclists**	**Pedestrians**	**Total**
Preferred width	3.5m	3.5m	7m
Acceptable minimum	2.5m	2m	4.5m
Absolute minimum for short lengths	2m	1.5m	3.5m

The effect of edge constraints is given in *Table H.2*. Segregated cycle tracks of 2.5m or more in width should normally include centre lines.

Segregation by tactile setts, Bristol

Segregation by grass verge, Loughborough

One way hybrid cycle tracks on both sides of carriageway, Brighton

Management

Following the introduction of a shared use path it is advisable to monitor its performance; this will enable any concerns to be identified early on and suitable mitigating measures implemented if required.

On unsegregated paths consideration should be given to the erection of courtesy signs such as "cyclists give way to pedestrians" or "share with care".

Rural areas

Roads and villages

Rural cycle networks serve local utility and leisure cycling trips and commonly use the existing highway where, although traffic flows may be low, the national speed limit applies. Villages provide a focus of attractions in rural networks and must be served, although they are also where motor traffic movements are concentrated.

Villages

Important elements to consider to reduce the impact of traffic and improve the conditions in the village for cyclists and pedestrians are to:

- identify and strengthen entry points to village
- emphasise location of village centre to traffic
- create visual features at junctions and key locations
- encourage slower speeds: reduce visual width of carriageway, remove centre lines, reduce signing, lower speed limits, emphasise pedestrian desire lines and crossing locations.

Outside villages

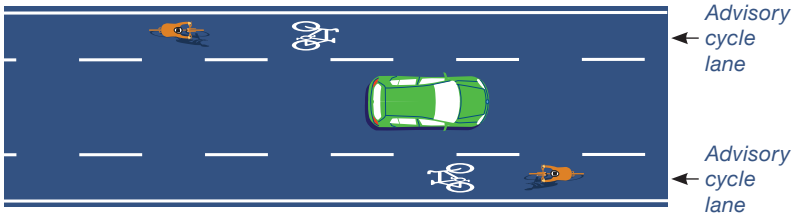
Fewer options are available to make roads outside of villages more friendly for cyclists and pedestrians, where speeds are higher and traffic movement is the main function. In many cases cyclists may need to use parallel routes on quieter roads or traffic free paths. Where changes are made to the road, these must be sensitive to the nature of the rural environment. Measures to consider include:

- Quiet Lane designation, or similar
- 20mph limits
- area wide 40mph limits
- access restrictions/closures
- road narrowings
- changed priorities
- surface treatments
- removal of centre lines and other signs and lines
- selective warning signs (including vehicle activated)

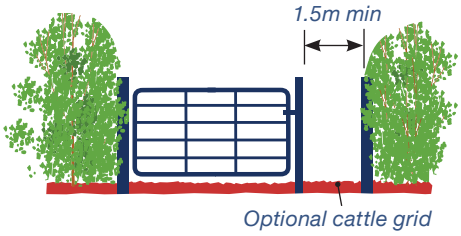
Photo: Devon CC

Rural 20mph speed limit, Devon

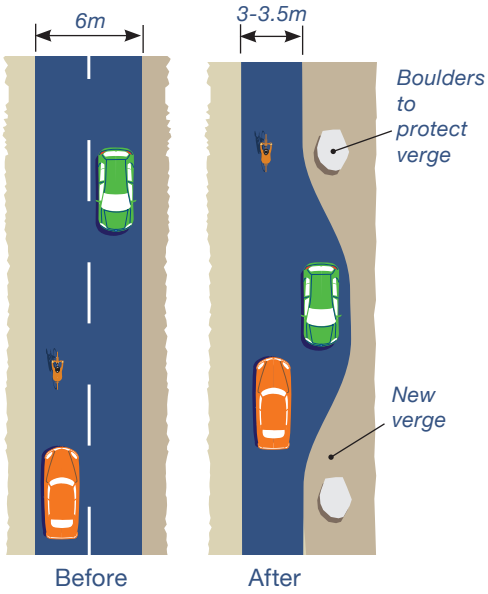
Removal of centre lines (see *Streets and roads 7*)



Typical gated road closure

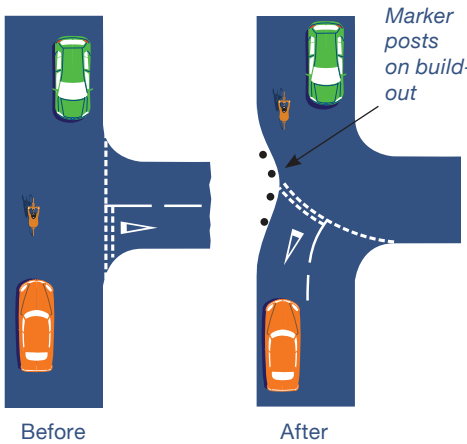


Conversion of two-way road to single track road with passing places (low flow, 20mph limit)



Road reduced to single track, Devon

Changed priorities



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Crossings 1 : General

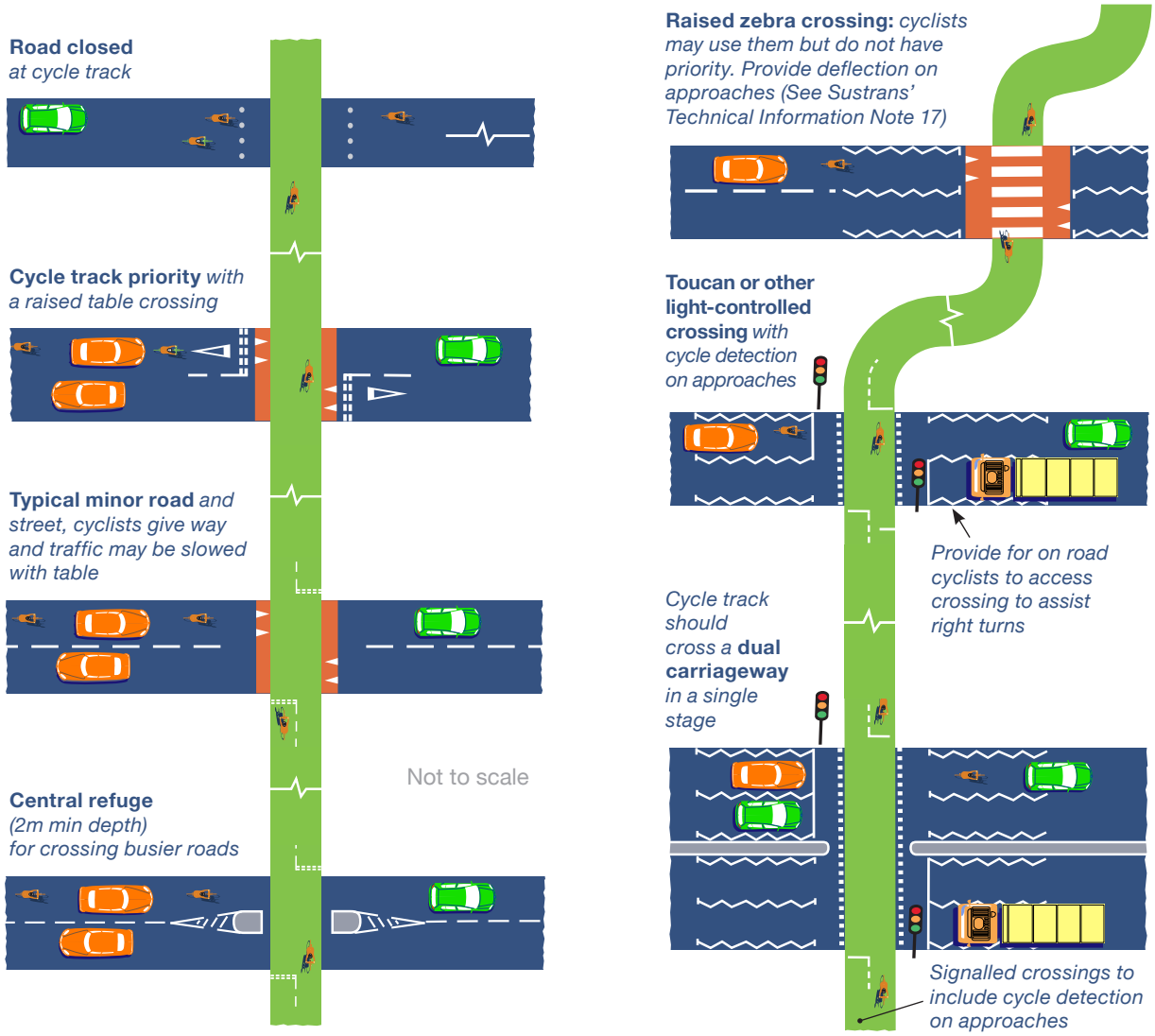


Table H.10 **Choice of crossing type**

85th percentile speed	Traffic flow (two way daily)	Type of crossing
< 30 mph	< 2,000	Cyclists have priority at side road - raised crossing
< 30 mph	< 4,000	Cyclists have priority mid-link - raised crossing
< 50 mph	< 6,000	Cyclists give way to road traffic (no refuge)
<35mph	< 8,000	Zebra crossing shared with cyclists
< 50 mph	< 8,000	Cyclists give way to road traffic plus central refuge - urban
< 60mph	< 10,000	Cyclists give way to road traffic plus central stage refuge - rural
< 50 mph	> 8,000	Signal controlled including Toucans
> 50 mph	> 8,000	Grade separated crossing - urban
> 60 mph	> 10,000	Grade separated crossing - rural

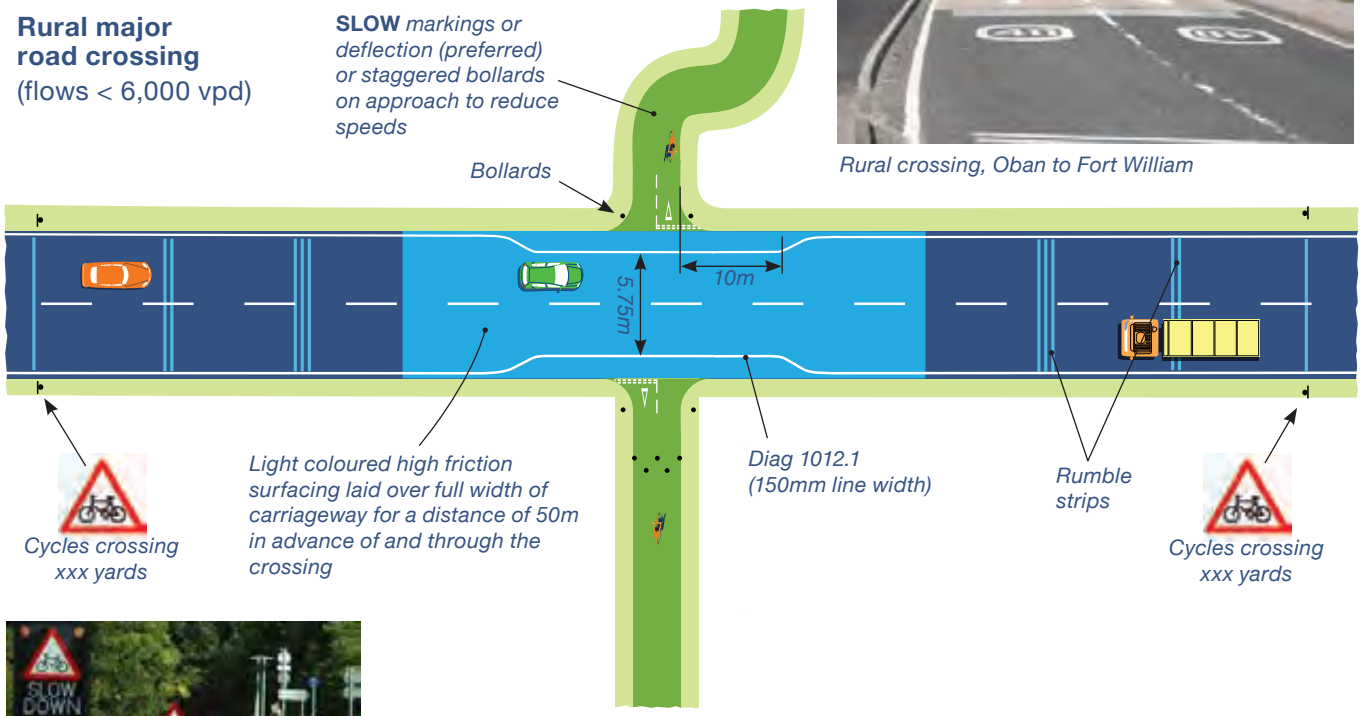
Notes : 1. Table provides guidance on appropriate crossing type, but individual locations should be assessed on a case-by-case basis.
2. Main cycle routes justify a higher level of service than other routes and so are likely to have greater priority at crossings and junctions.

Crossings 2 : Rural

On single two lane carriageways where the national speed limit of 60mph applies, the designs below should be considered. If necessary additional measures to reduce vehicle speeds should be implemented including one or more of contrasting colour, high skid resistant surfacing, rumble strips, visual narrowing. Consider use of detector loops in cycle track to activate additional warning signs for drivers.

Rural crossing, Oban to Fort William

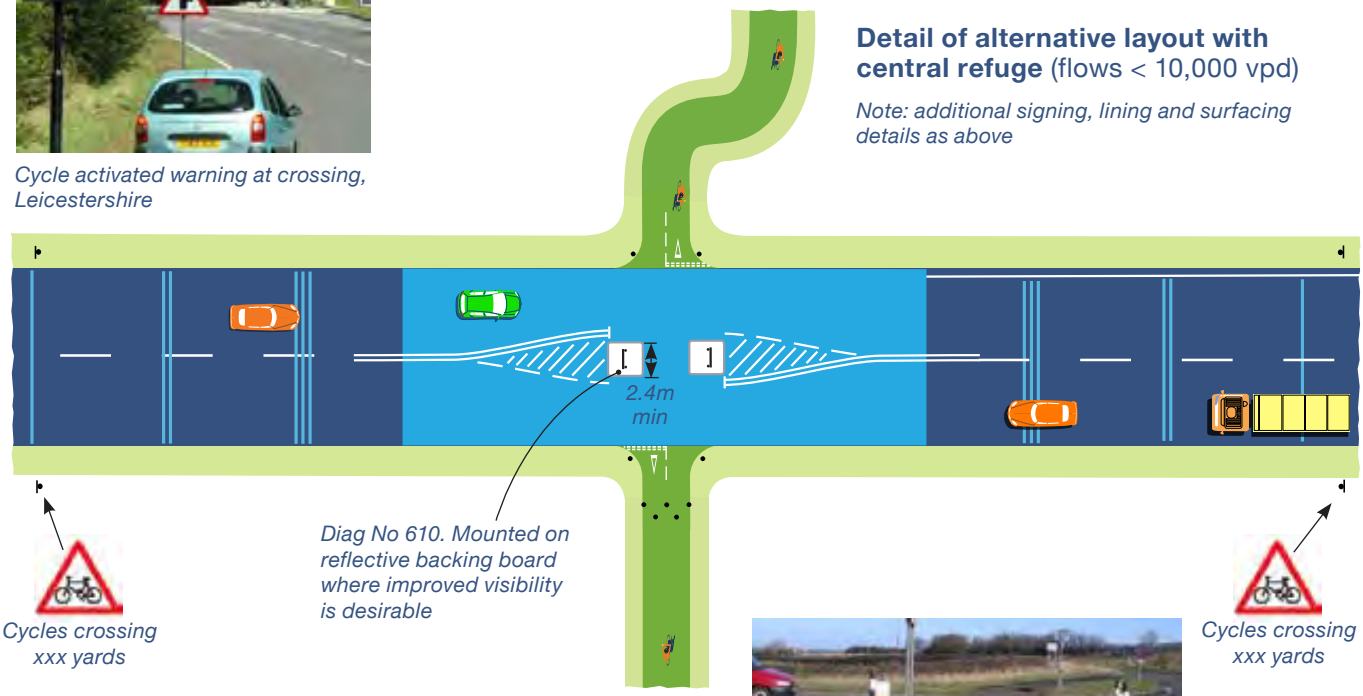
Rural major road crossing (flows < 6,000 vpd)



Cycle activated warning at crossing, Leicestershire

Detail of alternative layout with central refuge (flows < 10,000 vpd)

Note: additional signing, lining and surfacing details as above



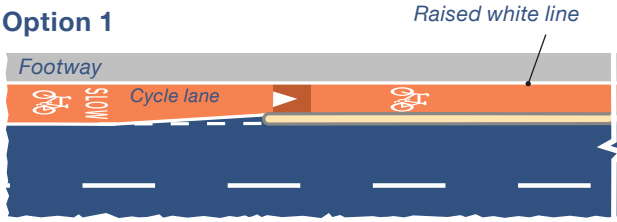
Not to scale

Central refuge, Berwick to Tynemouth

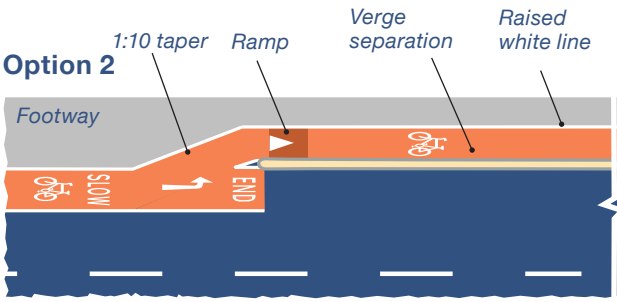
Interface with carriageway

Leaving carriageway

Option 1

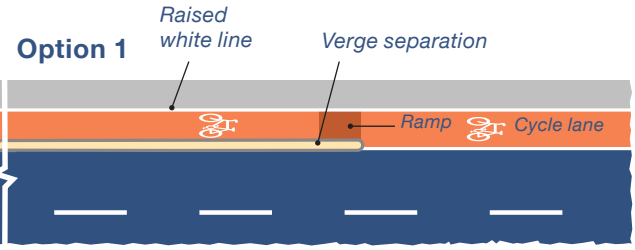


Option 2

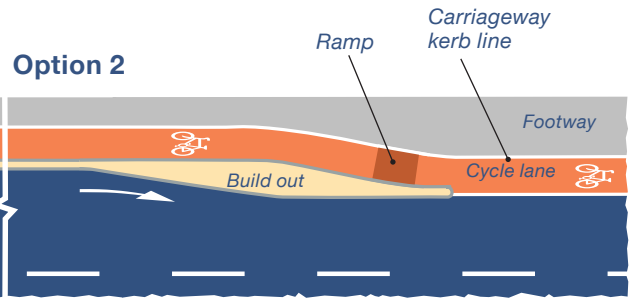


Joining carriageway

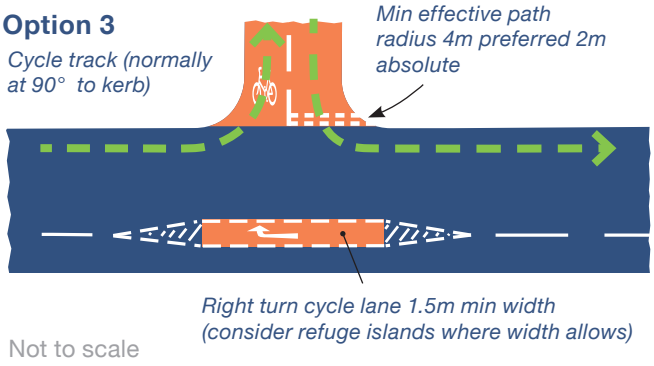
Option 1



Option 2



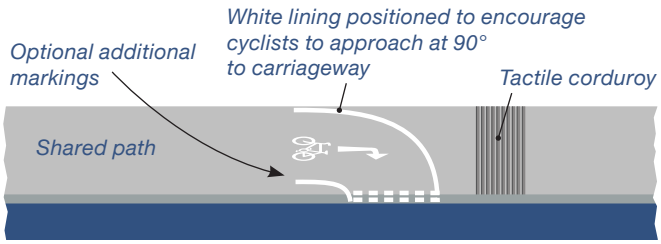
Option 3



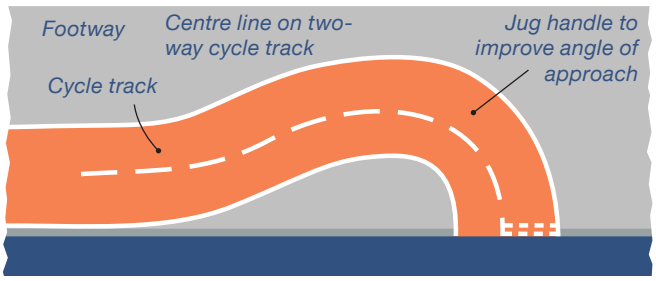
Not to scale

Crossing carriageway

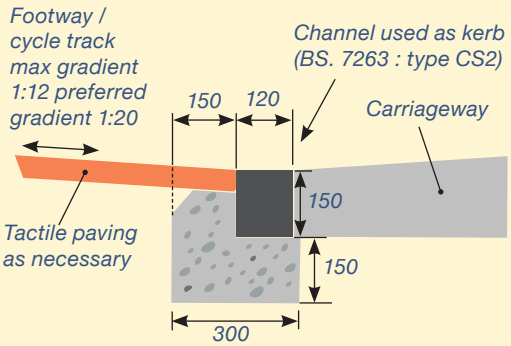
Option 1 (shared use with pedestrians)



Option 2 (segregation from pedestrians)



Flush kerb detail



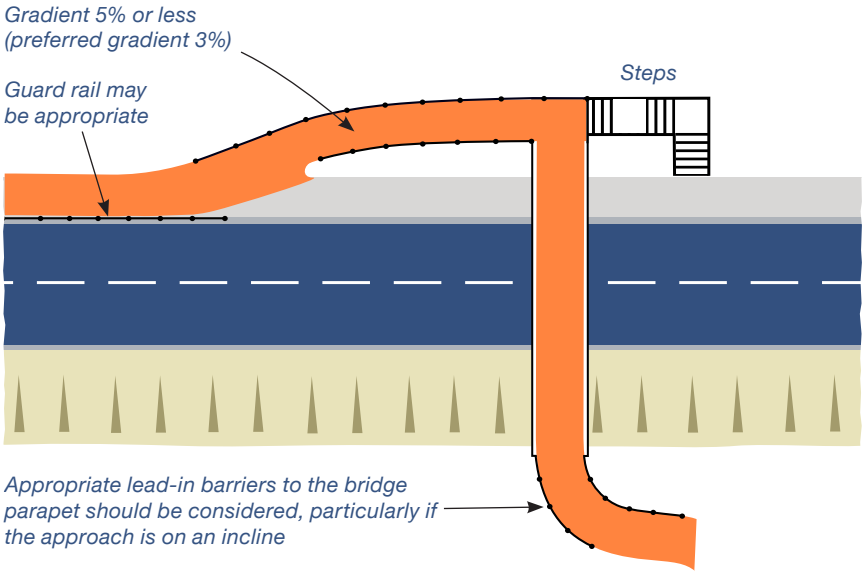
Notes

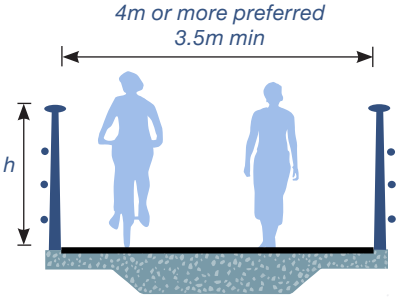
1. All kerb transitions must be flush (±6mm)
2. Where cycle access may be obstructed by parking, consider use of a build-out, waiting restrictions, white line or 'keep clear' markings
3. Where a cycle route leaves a shared path to join/cross the carriageway, signing should initially be kept to a minimum. If necessary, direction signing can subsequently be reinforced by:
   - white lining
   - arrow (1059) and cycle symbol (1057)
   - Cyclists Rejoin Carriageway (966)
4. End of Route (965) and Cyclists Dismount (966 variant) NOT recommended
5. Additional drainage likely to be required at transitions

Bridges and other structures

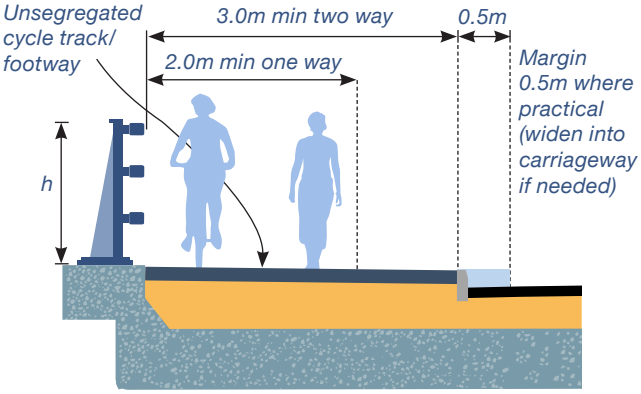
Bridges

Sub-standard parapets on cycle route, Bristol





Not to scale

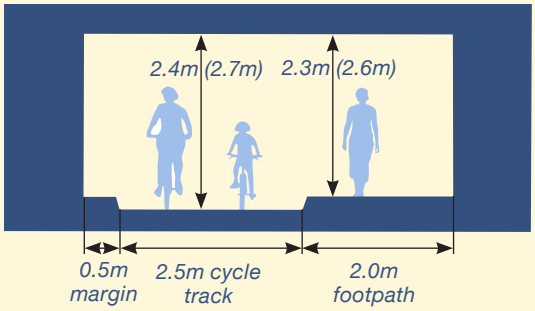


Parapet height *(h)*

- *1.4m preferred for cyclists, but many existing bridges operate well with lower heights*
- *1.8m for equestrian use (mounted)*
- *effective width of bridge reduced by 500mm at each parapet*
- *for advice on substandard parapet heights, refer to Sustrans Technical Information Note 30*

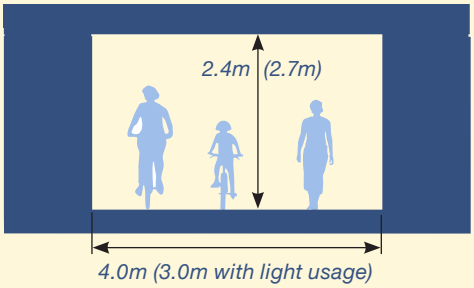
Subways

Typical Section (Segregated)



- *dimensions shown are minimum recommended for new subways*
- *dimensions in brackets apply to subway lengths> 23m*
- *many existing subways operate well with lower headrooms and appropriate warning signs*
- *headroom of 3.7m required for equestrians (mounted)*
- *a greater width or walls receding towards the top increases natural light*

Typical Section (Unsegregated)



A bridge with sub-standard headroom on cycle route, Nottingham

Destination signage

More detailed guidance on destination signage and guidance on regulatory and warning signage is provided in Sustrans' Technical information Note 5.

Comprehensive destination signing plays a key role in the development of safe and attractive places to cycle. Signs are an essential part of any cycle route and great care must be taken when considering their design and placement. They must provide clear, reliable information and at the same time must be appropriate and sensitive to their environment. A balance must be struck between sufficient signage and the visual clutter and maintenance liability that signing can cause. Surface markings may provide a useful alternative to post mounted signs.

Cycle specific route signing serves several purposes:

- routes for cyclists may differ from those for motor traffic
- gives cyclists good directions
- improves cyclist safety and comfort
- raises awareness of cyclists amongst other road users
- promotes cycle routes to other road users (particularly where times are used)

Direction signing should make the route legible and reflect cyclists' behaviour, and include:

- direction
- destination(s)
- distance (or time)

Non-standard signs may be appropriate in certain situations:

- to fit in with a sensitive environment
- use of map type signs to assist legibility
- signing alternative routes, e.g. where main route is unlit or may flood
- Use of temporary signs to maintain continuity is a good short-term measure until permanent signs are put up.

All signing should be:

- high quality
- coherent
- consistent
- frequent
- well maintained
- appropriate

Tip: maximise use of lamp columns and other existing surfaces for mounting signs to avoid clutter

Avoid: Cyclists Dismount or End of Route signs

Lancaster

Leighton Linslade

Colchester

Exeter

Lancaster

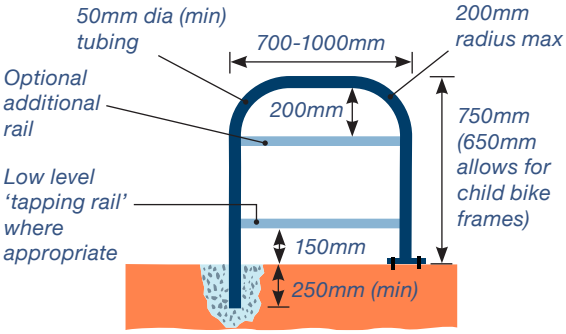
Bristol

Aylesbury

Cycle parking

Cycle parking is an essential element of a cycle network. It should cater for all destinations and be sited close to building entrances where it can be observed by passers by and the building occupier. The preferred type of public cycle parking is the Sheffield stand, in conjunction with shelters where bikes are left for long periods. Care should be taken when siting cycle parking to avoid obstructions to pedestrians including those with visual impairments.

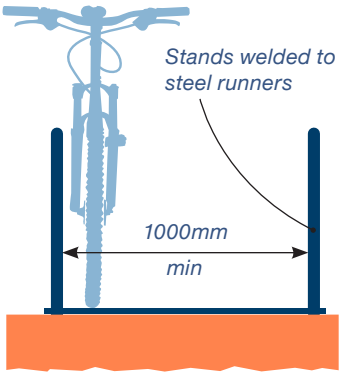
Sheffield stands



Option 1: *Stand embedded into the ground (preferred)*

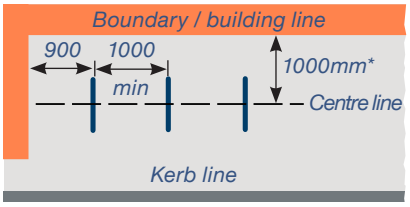
Option 2: *Stand bolted to the ground*

'Toast rack' of Sheffield stands



Layouts

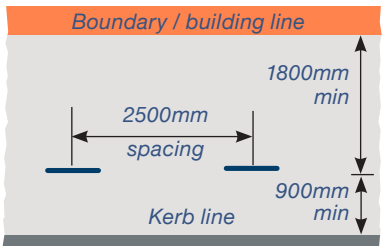
Perpendicular

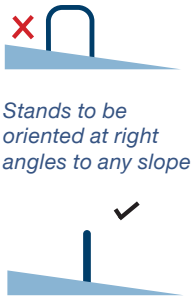


**If no pedestrian access required, otherwise 2500min*

Visitor parking, Cambridge

Along kerb





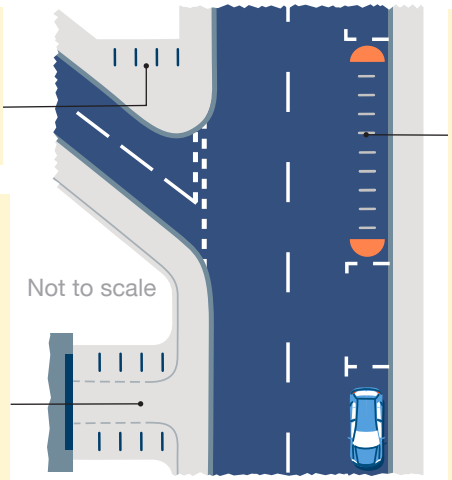
Stands to be oriented at right angles to any slope

Parking alongside kerb, London

Siting details

Footway: cycle parking on the footway should be located where it is unlikely to cause obstruction to pedestrians

Off-street: cycle parking should be in prominent locations near entrances to major attractions. Appropriate standards for cycle parking should be imposed on new developments



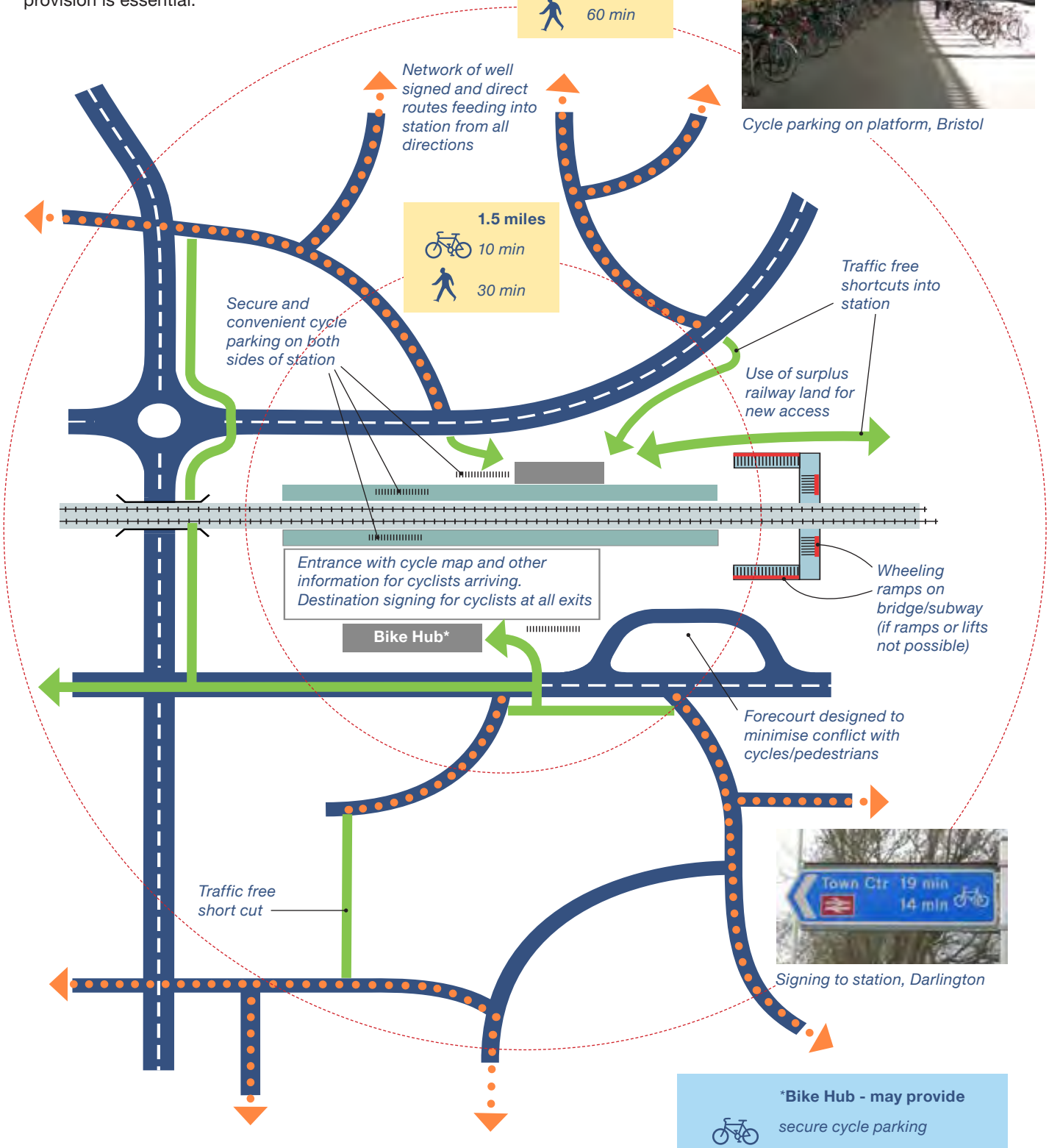
On carriageway: road space can be given over to cycle parking, for example by removal of car parking bays. The cycle stands should be protected from encroachment by motor vehicles. Care should be taken when siting on-carriageway cycle parking opposite (nose to kerb) echelon parking bays

Brighton

Cycle/rail integration

Urban and rural railway stations may have a commuter catchment by bike of at least 5 miles radius. Railways present linear barriers to cycle permeability so high quality cycle crossing provision is essential.

Cycle parking on platform, Bristol



Signing to station, Darlington

*Bike Hub - may provide

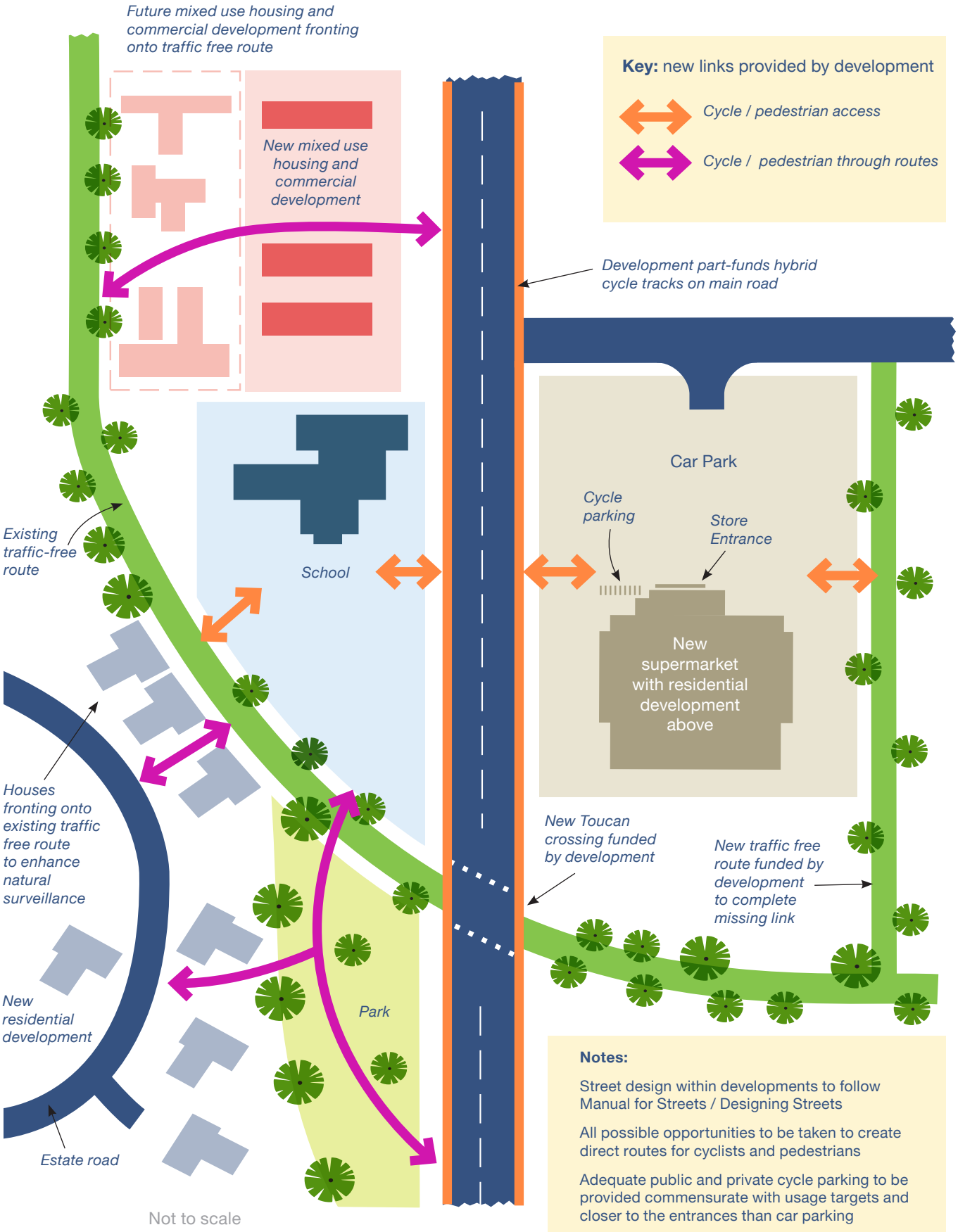
- secure cycle parking
- luggage storage
- maintenance facility
- sales
- bike hire

Note: Station forecourt design to prioritise pedestrian, cycle and bus passenger movements over taxis and private cars

Not to scale

Development planning

New developments present opportunities to improve the permeability of the development plot and to adjust building lines that previously constrained the cycle network around the pre-existing frontages.



Notes:

Street design within developments to follow Manual for Streets / Designing Streets

All possible opportunities to be taken to create direct routes for cyclists and pedestrians

Adequate public and private cycle parking to be provided commensurate with usage targets and closer to the entrances than car parking

Maintenance and management

Provide for cyclists at roadworks

Design complexity causes maintenance liability

Repair damaged surface

Facility ineffective due to poor maintenance

Tactile surfaces increase complexity and maintenance liability

Inadequate drainage

Mowing of grass verge required

Regular sign inspection and maintenance required

Overall principles:

- a route that is kept in good condition will be more popular than one allowed to deteriorate
- having invested in the route's construction it is important that it remains attractive to users
- design should minimise maintenance liabilities and consider whole life cost of scheme
- maintenance should be considered as part of the route development process long before work to build it starts
- a high standard of design will mean less maintenance in the future. For example a path surfaced with tarmac will have a long life and require little maintenance
- secure funding for maintenance at project development stage

On road routes:

- pre-plan cycle network enhancements as part of network management programme
- prioritise maintenance of 1.5m to 2m nearest to kerb
- repair loose drain covers and potholes
- clear drainage channels and gullies
- sweep debris
- repair worn markings / coloured surfacing
- accommodate cyclists at roadworks
- include in winter maintenance
- repair / replace damaged / lost signs

Traffic free routes:

- repair surface damage
- clear drainage channels and culverts
- sweep debris
- mow verges / remove edge creep
- cut encroaching trees and other vegetation
- repair / replace damaged / lost signs
- maintain lighting, furniture, structures
- use of local volunteers to assist
- develop signing and management plan to encourage considerate behaviour on shared paths
- winter maintenance, including snow cleaning
- develop a wider habitat management plan to enhance the biodiversity value of the route

Maintenance policies to include:

- prioritise cycle routes
- conduct frequent inspections
- inspect routes on a bike
- use local volunteers to assist with inspections and minor maintenance
- publicise fault reporting hotline
- quick response to problems
- regular programmed maintenance
- roadworks to accommodate safe and convenient movement of cyclists
- use temporary direction signing as short term measure where new signs are needed

References

This section includes a range of useful UK reference documents.
Links to all of these are provided from Sustrans' website.

Key references:

Cycling Infrastructure Design, LTN 2/08, DfT 2008

Manual for Streets DfT, Communities & Local Government 2007

Manual for Streets 2, CIHT 2010

Guidelines for Providing for Journeys on Foot, CIHT 2000

Shared Use Routes for Pedestrians and Cyclists, LTN 1/12, DfT 2012

Cardiff Cycle Design Guide, Cardiff Council, 2011

Inclusive Mobility: A Guide to Best Practice on Access to Pedestrian and Transport Infrastructure, DfT 2002

London Cycling Design Standards, TfL 2005

Cycling England: Design Checklist, 2010

Infrastructure Toolkit for Cycling Towns, Cycling England, 2009

Cycling by Design, Transport Scotland, 2010

Designing Streets, The Scottish Government, 2010

Other DfT guidance:

Shared Space, LTN 1/11, DfT 2011

Traffic Management & Streetscape, LTN 1/08, DfT 2008

Mixed Priority Routes: Practitioners' Guide, LTN 3/08, DfT 2008

Guidance on the Use of Tactile Paving Surfaces, DfT 1998

The Assessment of Pedestrian Crossings, LTN 1/95, DfT 1995

The Design of Pedestrian Crossings, LTN 2/95, DfT 1995

Traffic Signs Regulations and General Directions, HMSO 2002

Traffic Signs (Amendment) (No2) Regulations and General Directions, HMSO 2011

CPR1035, Traffic Management Techniques for Cyclists, TRL 2011

Traffic Advisory Leaflets (various)

Sustrans:

The Merits of Segregated and Non-Segregated Traffic-Free Paths, Phil Jones Associates, Sustrans 2011

A Guide to Controlling Access on Paths, Sustrans 2012

Sustrans' Technical Information Notes (TINs)

TIN05: Cycle Network Signing, 2013

TIN07: Aggregates for Path Construction, 2011

TIN08: Cycle Path Surface Options, 2012

TIN11: Trees, 2012

TIN12: Side Road Crossings, 2011

TIN14: Gaining permission for works that might be affected by coastal or river flooding, 2011

TIN16: Cycle & Pedestrian Routes within Car Parks, 2011

TIN17: Cyclists' Use of Zebra Crossings, 2011

TIN18: Toucan Crossings, 2011

TIN19: Segregation of Shared Use Routes, 2014

TIN23: Road Safety Audits, 2011

TIN24: Manual for Streets 2: Digested Read, 2011

TIN27: National Cycle Network Signing and Route Branding, 2012

TIN28: Horses on the National Cycle Network, 2011

TIN29: Lighting of Cycle Paths, 2012

TIN30: Parapet Heights on Cycle Routes, 2012

TIN31: Obstacles in the Carriageway, 2012

TIN32: Cycle Streets, 2014

Sustrans' Ecology Notes:

Ecology Note 01: Hedge Management, 2011

Ecology Note 02: Grass Verge Management, 2011

Ecology Note 03: Himalayan Balsam, 2011

Ecology Note 04: Japanese Knotweed, 2011

Ecology Note 05: Ragwort, 2011

Ecology Note 06: Ecology in the Planning System, 2011

Trunk Roads : Design Manual for Roads and Bridges:

Provision for Non-Motorised Users, TA91/05, Highways Agency

Geometric Design of Pedestrian, Cycle and Equestrian Routes, TA90/05, Highways Agency

Non-Motorised User Audits, HD42/05, Highways Agency

Subways for Pedestrians and Cyclists Layout and Dimensions, TD36/93, Highways Agency

Footway Design, HD39/01, Highways Agency

Design Criteria for Footbridges, BD 29/04, Highways Agency

Coloured Surfacing In Road Layout (Excluding Traffic Calming), TA 81/99, Highways Agency

Other

Guidance for Towpath Design, Canal and River Trust 2012

Notes on Good Practice Common in Europe, Cycling England, 2005

Transport in the Urban Environment, CIHT 1997

Guidelines for Cycle Audit and Cycle Review, CIHT 1998

The State of our Streets, Living Streets 2012

Sustrans has over 30 years' experience of designing public space to encourage more travel by sustainable modes of transport, and we know that encouraging more people to change their travel behaviour means making their journeys attractive, convenient and safe, whether they share the road with traffic or use separate paths.

We work with local authorities and councils UK-wide to deliver value for money solutions to increase travel by foot, bike and public transport by people of all ages and abilities. We also provide training to support transport and other professionals to deliver more sustainable travel choice.

Technical Design training

Our accredited Better by Design courses are intended for those involved in the development and design of highway schemes that will be used by cyclists.

Our one-day courses include:

- **essential skills:** principles of designing for cyclists in a highway environment; the practical issues of implementation and how to overcome these
- **design processes:** procedures involved in the development of cycle infrastructure, including audits, legislation, regulations and equalities
- **design practice:** practical issues to be tackled when applying design guidance to develop high quality infrastructure for cycling on links, junctions and crossings

Course attendees will receive a certificate of Continued Professional Development (CPD), and this course is endorsed for CPD by CIHT.

Smarter Travel Choices training

Our Smarter Travel Choices courses are intended for health, transport and other professionals involved in the promotion of active and sustainable travel.

Course modules include:

- benefits of sustainable travel
- how to write, monitor and update a travel plan
- how to deliver activities which effectively promote active and sustainable travel
- how to deliver personalised travel advice
- community engagement and involving residents in transport decision making

For full details of our services, visit www.sustrans.org.uk/our-services, and for training details visit www.sustrans.org.uk/training

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