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9. Carriageways

9.1. Vision

9.1.1. If we are to achieve world-class roads and streets appropriate surfacing specification is essential for providing durable, safe, comfortable and legible road layouts. Selecting the right materials is key to creating a backdrop that will sustain all the activities within the streetscape. Materials should be selected based on their:

- Long-term durability
- Safety performance
- Legibility
- Relationship to the surrounding urban character and overall appearance of the streetscape
- Visual performance characteristics
- Cost to implement
- Whole life cost (maintenance)
- Asset accessibility

9.1.2. Asphalt, and in special circumstances, coloured surfacing and natural stone setts are recommended for carriageway surfaces.

9.1.3. Surface construction must be detailed to accommodate the loads and foreseeable uses acting upon it, and to ensure long-term durability and maintenance of the materials. Surfaces should be smooth, firm and non-slip in all weather conditions with gradients that are both comfortable to walk on and sufficient for free draining of surface water.

9.1.4. We have an internal procedure to review new products proposed for the TLRN and approval should be sought from the SRG and Technical Approvals team at the design stage.

9.2. Carriageway materials

Asphalt surfacing for carriageways

9.2.1. Asphalt is the standard surface material for all carriageways and should be applied in most cases. Asphalt has a high deformation resistance and can be repaired relatively quickly and inexpensively. It can be designed to meet the needs of the expected use. Variable aggregate gradings are acceptable on the TLRN. Aggregate properties such as shape and size, and resistance to crushing or polishing, should be selected based on site conditions. All asphalt surfacing should comply with BS EN 13108 Bituminous mixtures standards.

Maintenance

9.2.2. Resurfacing regimes should be based on an understanding of the existing surface composition and condition of the carriageway. Contractors are encouraged to
recycle materials where practicable and use the following resurfacing techniques as appropriate:

**Innovative surface materials**

9.2.3. There is continual innovation within the industry of materials science, improving the performance and cost effectiveness of surfacing through more efficient laying techniques and new technologies. While the materials palette is strictly defined on the TLRN to ensure quality and consistency, advances in material technologies will be considered on an ad hoc basis to trial new finishes and test the resilience of the product on a limited stretch of road.

**Additional information**

British Standard:

BS 594987 Recommendations for the laying of the various asphalts

**Granite setts for carriageways**

9.2.4. A sett is a dressed block or stone, 50-300mm in length and 75mm or more in depth. Setts are used to aid in the creation of a high quality surface finish to help emphasise greater pedestrian priority. Setts may be considered in exceptional circumstances where looking to:

- Provide a high quality low speed environment, for example, for shared space schemes, where vehicle traffic is especially low
- Communicate a traffic calmed space with visually related carriageway and footway surfaces
- Improve material durability for footway surfaces which are subject to regular vehicle overrun
- Reflect the historic character of an area

**Design considerations**

9.2.5. The installation of setts should be considered for:

- Inset on-carriageway bays and on-footway loading or parking bays and in front of pubs
- The flat surface of raised tables on side road entry treatments, but not on the ramp
- Footway crossovers
- Traffic islands, central median strips or within central reservations that are not flush and do not have regular vehicle overrun

9.2.6. Only in exceptional locations where vehicles are known to mount the kerb, can a band of five 100x100mm setts be installed on the footway, running parallel to the kerb. These may be considered where:
• The area has special historic or civic significance and requires a high quality surface finish
• There is no capacity to provide designated loading bays, but where informal loading is known to take place with a high number of retail units fronting on to the street
• Footways are narrow such that installing bollards would overly impinge on footway space
• There is insufficient depth to structurally reinforce paving slabs

9.2.7. When considering the use of setts it is important to anticipate loading requirements. The specified material and subbase must be designed to withstand expected loading, traffic volume and ground conditions. Where setts terminate and meet tarmac, it is important to specify a robust edge containment detail.

Materials

9.2.8. Setts on the TLRN should be composed of natural stone: granite or Yorkstone, to match the surrounding footways and complement the character of the built environment.

9.2.9. Granite setts are recommended for footways and low speed carriageway settings on side roads or minor roads which do not serve as a bus route.

9.2.10. Yorkstone setts are permitted where vehicle overrun is infrequent, such as adjacent to the kerb edge or on footway crossovers.

Preferred sizes

9.2.11. Generally 200x100mm units are preferred on the TLRN, with depths selected based on the load bearing requirements (150mm depth recommended as a baseline). Other bespoke dimensions may be permitted upon approval by the SRG; note that for design durability the length of the sett is preferred to be no more than twice the width of the unit and the thickness no less than half the width.

9.2.12. Herringbone pattern is the preferred way to lay block paving as the interlocking pattern makes it more resilient to turning movements.

Maintenance

9.2.13. Maintenance of setts is more costly and time consuming than asphalt. Using a mixed palette of colours can help mask dirt, discolouration and marks.

• Prone to failure on heavily trafficked routes
• Prone to being poorly reinstated after maintenance/underground servicing

Additional information

British Standards:

BS EN 1341 provides guidance on the breaking load for setts
BS 7533 Part 12 provides sub-structure advice for pedestrian areas
Figure 9.0: Sett paving patterns in on footway loading bay
Coloured surfacing

9.2.14. Coloured surfacing includes any surfacing that changes the appearance of the conventional asphalt wearing course. The use of coloured surfacing should be justified on a site-by-site basis and approved by the SRG.

9.2.15. Coloured surfacing may be considered where it is providing a safety or operational benefit to specified users and should only be implemented when other remedial measures have been deemed inappropriate. The aim is to reduce the use of coloured surfacing to cut capital and maintenance costs and improve the appearance outcome where surface repairs are required.

**Use across London**

9.2.16. There is variable support for use of coloured surfacing across the London boroughs. The use of conspicuous colours, especially in areas with high heritage and conservation value has been challenged based on concerns about their visual impact. However, some partially sighted pedestrians use colour differentials to help them identify the interface between footway and cycle tracks or carriageways. Therefore where there is an identified risk of conflict between various users, as they are not separated by physical means or by signal control, the use of coloured surfacing may be recommended.

**Design considerations**

9.2.17. Design teams are encouraged to carefully consider the use of coloured surfacing treatments as they should only be applied to manage areas of conflict by emphasising user priority.

9.2.18. Coloured surfaces have no legal status as they do not constitute a formal road marking or sign, however, they can be used to supplement road signs and markings and discourage vehicle encroachment.

9.2.19. It should not be applied at locations with a high density of utilities or where one or several utility companies have a high rate of attendance and trenching as the reinstatement of this type of surface still shows as a trench. Colour does not show up well at night under headlights or in wet conditions.

**Application**

9.2.20. There are several materials that can be used to achieve a coloured surface on the carriageway including: coloured asphalt, resin-bound aggregate and a surface dressing. The specification of coloured surface, skid resistance and method of application is to be in accordance with Clause 924 of the Highway Agency's Specification for Highway Works.
9.2.21. Please speak to one of our technical specialists when considering the use of a coloured surface. The table below provides a range of colours commonly used on the road network:

<table>
<thead>
<tr>
<th>Colour</th>
<th>Example</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Venetian’ red</td>
<td><img src="image" alt="Venetian red example" /></td>
<td>To supplement road markings and aid bus lane compliance. We no longer apply red surfacing to bus lanes, however, some boroughs still do require this.</td>
</tr>
<tr>
<td>BS381C – colour 445</td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘Deep chrome’ green</td>
<td><img src="image" alt="Deep chrome green example" /></td>
<td>To reinforce stop line compliance for motor vehicles or used to delineate cycle lanes which do not have physical segregation.</td>
</tr>
<tr>
<td>BS381C – colour 267</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycle Superhighway</td>
<td><img src="image" alt="Cycle Superhighway example" /></td>
<td>To delineate cycle Superhighway lanes which do not have physical segregation.</td>
</tr>
<tr>
<td>RAL5015 blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural buff – to match Yorkstone paving</td>
<td><img src="image" alt="Natural buff example" /></td>
<td>To visually reinforce crossing locations, a change in traffic management, or align the colour of an off-carriageway facility to other elements in the streetscape.</td>
</tr>
<tr>
<td>Grey – to match granite or concrete streetscape elements</td>
<td><img src="image" alt="Grey example" /></td>
<td>To visually reinforce crossing locations, a change in traffic management, or align the colour of an off-carriageway facility to other elements in the streetscape.</td>
</tr>
</tbody>
</table>

**Maintenance**

9.2.22. Some types of coloured surfacing fade rapidly in heavily trafficked locations (after 6-12 months) and may need to be reapplied regularly. Maintenance regimes should match the original colour pigmentation by selecting the same coloured product and binder. Bespoke treatments are more difficult to maintain, especially where underground servicing is required.
9.2.23. Where maintenance or highway works are required, the colour surface should be laid to provide a consistent finish across the carriageway and should not be applied as a patchwork. Good quality repair work requires the whole surface to be laid again as patchwork repairs are unsightly.

**Research**

9.2.24. Research is being undertaken into the use of unbounded coloured surfacing at junctions. This is expected to conclude that there is a positive safety impact on driver behaviour by using colour on cycle facilities at crossings.

### 9.3. Road markings

9.3.1. Road markings provide traffic signing information and look to enhance the safety and legibility of the road space for all road users. Road markings are applied to the carriageway surface as lines, symbols or words, and in some instances will be marked on the kerb and footway, or temporarily at roadworks.

9.3.2. Road markings are classified as:
- Regulatory – enforceable traffic management markings
- Warning and informatory – markings that increase awareness of likely hazards
- Directional – location and route guidance

9.3.3. Statutory requirements and detailed guidance on the design of road markings for the public highway are provided in the TSRGD 2002 and 2015.

**Design approach**

9.3.4. Design teams should adopt a consistent approach across the TLRN to:
- Ensure safety
- Provide sufficient information to promote good lane discipline
- Encourage traffic regulation compliance and enable efficient enforcement

**Minimising clutter**

9.3.5. Design teams should adopt an approach of minimising clutter and ensure every road marking is carefully considered in conjunction with the character and function of the street, as well as the placement of adjacent traffic signs. As decluttering is one of our prime objectives, the removal of any unnecessary road markings will help to reduce visual clutter and maintenance costs, and in most cases will contribute towards improved legibility. The following considerations should be made to rationalise road markings:
- Road markings which include words (for example, ‘keep clear’/’look left’) should be assessed to see if they are needed
Yellow boxed areas can look unsightly and consideration should be given to removal where legal enforcement is not necessary.

To help facilitate a traffic calming effect, reduced road markings can help in some locations, such as the removal of carriageway centrelines (Centreline removal trial, TfL 2014).

Victoria Embankment: ‘Keep clear’ markings have been used instead of a yellow box.

Marking dimensions

9.3.6. Many markings are fully dimensioned in the TSRGD and TSM. These documents are the main resource for prescribing standard road markings.

9.3.7. Markings should be provided to a maximum thickness of 6mm where pedestrian activity might be expected. Any higher and the marking could pose a trip hazard or adversely impact on drainage.

9.3.8. The size and width of the marking should relate to the speed of the road environment. On the TLRN, we will adopt a signing approach which applies narrower line widths on lower speed road types as detailed below: 50mm line markings may be used in conservation areas or where vehicle speeds are 20mph or lower. Line widths of 100mm should be applied where vehicles speeds exceed 30mph.

9.3.9. Where a cycle lane is delineated on-carriageway, a 50mm-wide kerb edge line should be considered to minimise the impact of the road marking impinging on comfortable cycling space.

Materials

9.3.10. Expert advice should always be sought before prescribing the road marking material as a range of products are available with widely differing performance characteristics.

9.3.11. Road markings are available as:

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Streetscape Guidance

Part D – Physical design and materials

- **Paint** – best restricted to roads with lower traffic flows as the markings are more prone to wear
- **Thermoplastics** – being phased out across the TLRN and should especially be avoided on concrete blocks and natural stone
- **Preformed markings** – preferred where complex shapes and symbols are required
- **Cold plastic** – can be used to mark pedestrian crossings, bus lanes and other common road markings. If applied well it can last between four to eight years
- **Setts** – where setts are used on a side road entry treatment, red setts are permitted to designate the red route but are not a requirement; conventional markings may be used.

**Performance**

9.3.12. Most road markings that have a regulatory function are required to incorporate a retroreflecting material such as glass beads that better reflect vehicle headlights (TSM chapter 5, table 23-1). We recommend that road markings achieve the following specifications:
- Maintain night-time performance even when wet for enhanced safety
- Skid resistant, particularly when markings are applied to larger areas of the carriageway
- Road markings must not hinder a carriageway from draining properly

9.3.13. Hard-wearing materials should be prioritised on roads with high traffic flows.

**Line colours**

9.3.14. All markings and colours should be in accordance with the regulations, British Standards (BS EN 1790 and BS EN 1871) and our Design Standards for Signal Schemes in London.

9.3.15. The colours white, red and yellow lines are prescribed for road marking materials on the TLRN. Black road marking materials may also be introduced where existing markings need to be temporarily obscured. Black road markings have been used to change an advisory cycle lane as a temporary measure.

9.3.16. Coloured resin aggregates for larger areas of carriageway such as bus lanes or for demarcating cycle infrastructure are not formal road markings, but aim to improve the compliance of regulatory road marking signage.

**Road studs**

- Retroreflective road studs may be used to supplement longitudinal road markings, particularly effective for areas with low lighting levels
- Metal road studs should be avoided as they can cause problems for two-wheeled vehicles

**Removal**

9.3.17. It is important that all the material used to define the road marking is removed where new marking arrangements are proposed. Ghost images of old markings...
are unsightly, detract from the streetscape and can have an impact upon legibility and road safety.

9.3.18. The majority of road marking materials should be removed by mechanical means, using sand blasting techniques without damaging the road surface.

**Trials – centreline removal**

9.3.19. Our aspiration for a safer network, reinforced through good design, has been put forward in a recent study which challenges conventional assumptions into the application of centrelines (Centreline removal trial, 2014). The study looks at the impact of removing centrelines on traffic speeds, across three Outer London routes scheduled for resurfacing. Initial results suggest a consistent decrease in vehicle speeds as a result of the interventions. We will continue to monitor collision data at these sites and use this evidence to determine the long-term applicability of centreline removal for encouraging lower speed driving environments.

**Maintenance**

9.3.20. Regulatory markings must be maintained adequately to provide good visual contrast and ensure good effective enforcement. To ensure this:

- Road markings should be regularly reviewed to ensure good legibility and definition
- Maintenance requirements are dependent on traffic flows, the material used and the position of the marking on the road surface, and so will not be the same for all types of street
- During routine maintenance when road markings are often re-marked it is important to ensure the new surface is accurately applied over the old material so that the edges of the markings remain crisp and of the desired width
- The excessive build up of thermoplastic can lead to the ponding of surface water and should be avoided
<table>
<thead>
<tr>
<th>Investigating the impact of centreline removal on traffic speeds across three sites in London</th>
<th>Centreline removal trial London, UK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opportunity</strong></td>
<td>The Mayor’s ‘Better Streets’ initiative challenged TfL to justify any road marking.</td>
</tr>
<tr>
<td><strong>Benefits</strong></td>
<td>The investigation showed that at all three sites there was a statistically significant reduction in traffic speed; drivers were more cautious due to the loss of perceived safety a centreline provides. Collision data will be tracked at these sites for the next three years to ascertain the long-term effects of centreline removal.</td>
</tr>
<tr>
<td><strong>Implementation</strong></td>
<td>A study was conducted at three sites across London to judge the effect of removing centrelines on traffic speeds and accidents.</td>
</tr>
<tr>
<td><strong>Applying in London</strong></td>
<td>While it is not suitable to remove markings at all locations, it is desirable to remove clutter where possible.</td>
</tr>
</tbody>
</table>

**Key functions:**

[Insert key function icons]
## Increasing road safety through technology and design

### Smart Highways

**Oss, Netherlands**

### Opportunity

Road markings made with photoluminescent paint have been trialled on a stretch of the N329 road in the Netherlands.

### Benefits

Glow-in-the-dark lines show up better in fog than conventional reflectors or cat’s eyes. They also save electricity compared to street lighting.

### Implementation

This is one of five concepts developed as part of Studio Roosegaarde’s Smart Highways project, which aims to improve road users’ experiences through technology and innovations.

### Applying in London

Would depend on DfT approval and other factors.

### Key functions:

#### Additional information

**Statutory instruments:**

- Traffic Signal Regulations and General Directions (TSRGD) 2002 and 2015: Section 4 and Schedule 6

**British Standards:**

- BS EN 1790 for preformed markings
- BS EN 1871 for directly laid materials

**Department for Transport:**

- Traffic Signs Manual, Chapter 5: Road Markings, 2003
- Traffic Advisory Leaflet 01/13: Reducing sign clutter, 2013

**Transport for London:**

- Centreline removal trial, 2014
9.4. Cycle infrastructure

9.4.1. The London Cycling Design Standards (2014) (LCDS) provides comprehensive advice that all designers of cycling infrastructure should refer to. It uses the Cycling Level of Service (CLoS) methodology as a measure for the quality of provision for cyclists on any street or route.

9.4.2. Streetscape Guidance identifies the palette of materials appropriate for the different types of cycling infrastructure identified in the LCDS and reinforces the importance of a holistic approach to street design, to maintain the quality and continuity of the streetscape character.

Design considerations

**Network planning**

9.4.3. The network for cycling comprises signed cycle routes and any other street or space that cyclists may legally use. In general, a higher level of service for cyclists should be achieved on signed routes and on any street where motor traffic speeds and volumes have been calmed, such as where 20mph limits apply.

9.4.4. New and improved cycling facilities should be planned coherently to provide for anticipated increase in cycling demand, to address risks to cycle safety and allow coherent, direct and comfortable access to local destinations. All route proposals should include a maintenance plan to ensure cycle routes remain free of debris and in a good riding condition.

9.4.5. We acknowledge the significance of 20mph speed limits for enhancing the quality of the cycling environment and will continue to review sections of the road network with a view to broadening the 20mph designation.
Cycling interventions

9.4.6. Proposals for cycling should reflect the place function of a street within a wider area – the street’s character and the uses and activities that take place within it – rather than be determined solely by the movement of other vehicles.

9.4.7. Cycling facilities should enhance the area through which a route passes and design teams should consider the cycling experience along the full length of the route to provide a consistently attractive setting for cycling and walking. Measures should be light touch and not adversely impact on streetscape quality with additional unnecessary clutter.

9.4.8. The degree of separation required for cyclists should be based on an assessment of the existing conditions, on proposals for improvement of the area and on addressing key safety, capacity and accessibility issues. Higher levels of service for cyclists can be achieved through designing for lower traffic speeds and through greater separation from motor vehicles, while avoiding conflict with pedestrians.

9.4.9. A street may be part of a proposed new or improved cycle route, or may have existing or proposed cycle routes crossing it. In both cases, the level of service offered at junctions and crossing points is a key determinant of the overall quality of provision for cyclists.

- Cycle infrastructure need not be heavily engineered or costly but should be consistent and aligned to the uses and dimensions of the street environment
- Streetscape Guidance encourages designers to consider the impact of cycle infrastructure on the pedestrian environment as well as the visual quality of the streetscape. This includes being mindful of any facility that proposes additional street clutter, the creation of small fragmented areas of space, or overly complicated arrangements to the detriment of other users
- Designs should avoid making cosmetic alterations for the sake of change and should be rooted in an evidence-based design approach
- Trials of temporary layouts to assess impacts of changes to road space allocation should be considered as a step-change towards long-term infrastructure provision

Designating space for cyclists

9.4.10. Formal cycle infrastructure consists of: cycle lanes (regulatory road markings on carriageway), cycle tracks (generally, provision dedicated to cyclists off the carriageway) or areas shared with pedestrians.

9.4.11. Cycle tracks are usually away from the carriageway or separated from it by a verge or height difference. A Section 65 Notice (Highways Act, 1980) can be used to convert a footway into a cycle track and prioritise cycling. Appropriate signing should be incorporated including TSRGD diagram 955 and associated cycle symbol marking (diagram 1057).

9.4.12. LCDS describes different kinds of provision for cyclists in terms of the ‘degree of separation’ they offer from motor vehicles on-carriageway or from pedestrians off-carriageway. With the highest degree of separation first, the on-carriageway options are:

Full separation on links
• **Segregated lane/track**: Cycle lane or track separated by a continuous or near-continuous physical upstand along links (usually verges or kerbed segregating islands)

• **Stepped tracks**: Vertically separated cycle tracks at an intermediate level between the footway and main carriageway, with or without a buffer

**Dedicated cycle lanes**

• **Light segregated lane**: A facility separated and protected by intermittently placed objects generally alongside formal, mandatory cycle lane markings. (Note that no light segregation product has been approved for use across the TLRN, so any proposal should be brought to the attention of the SRG to ensure that the product satisfies streetscape requirements and does not pose a maintenance liability)

• **Mandatory cycle lane**: A marked lane for exclusive use of cyclists during the advertised hours of operation. It is an offence for other vehicles to enter, unless they are exempted. Separate parking restrictions are needed to be fully effective

**Shared lanes**

• **Shared bus lane**: Cyclists may use the full width of the bus lane during and beyond its hours of operation. Applies to all near-side, with-flow bus lanes, and should extend to contraflow and off-side types

• **Advisory cycle lane**: An area intended for, but not legally restricted to, cyclists’ use. Other vehicles are permitted to enter or cross it

**Integrated with other users**

• **Cycle street**: A street where cyclists have assumed priority in a speed restricted area, variously marked with or without formal cycle lanes or indicative areas for cycling

• **Mixed traffic**: A street or space without cycle lanes or tracks, often including cycle symbols on carriageway. Motorised traffic is either absent or at low volumes and speeds. May include space shared between all users

9.4.13. Footways and footpaths may be designated as shared between pedestrians and cyclists. Degrees of separation between cyclists and pedestrians by the carriageway are:

• **Separated footway ('segregated shared use')**: A footway divided between users by painted line markings or a low, raised delineator, often punctuated by fully shared areas. Marked with a sign to diagram 957 of TSRGD

• **Shared use footway or area ('unsegregated shared use')**: A footway fully shared between users and marked with sign to diagram 956 of TSRGD. May exist in a limited area, usually to allow cyclists to make a crossing movement and/or transfer from on- to off-carriageway provision

9.4.14. However, as a general principle, there is a presumption that footways are to be used only by pedestrians. These two options should therefore only be used in exceptional circumstances – for example, where the footway is wide and
pedestrian flows sufficiently low, or where motor traffic conditions justify off-
carriageway provision and cycle tracks are not suitable or viable.

9.4.15. See LCDS for further description and guidance on the application of each of these
cycle infrastructure types.

Materials

Surface materials

9.4.16. The visual impact of materials associated with cycle infrastructure should be
carefully considered. Layouts which are overly complex will not only impact on the
visual quality of the streetscape, but will likely lead to ambiguous layouts which
reduce the legibility of the scheme design for all road users.

9.4.17. The material palette should be simple to minimise issues of maintenance and
ensure consistency across the network. Asphalt is the standard surfacing material
for cycle infrastructure on the TLRN and may take the form of either:

- Asphalt concrete – typically a 6mm asphalt aggregate is recommended to
  provide a smooth finish
- Proprietary asphalt – thin surface course systems (TSCS) may be considered
  in special areas

9.4.18. In selecting a type of asphalt, consideration should be given to the permeability of
the surface and the extent to which more porous open-graded mixes are
incorporated as part of a sustainable drainage strategy.

9.4.19. Natural stone for prolonged stretches of cycle routes should be avoided as skid
resistance can be low. Anti-skid surfacing for cycle routes is acceptable for use on
the TLRN but should be laid longitudinally to avoid ridges. Resin-bound aggregate
may be considered for footway areas which operate as a shared use area.
Unbound surfaces such as gravel or hoggin are not recommended for major cycle
routes as they can deteriorate quickly and provide a low quality of riding surface.

Signage

9.4.20. Signage should be designed to minimise visual clutter and be combined with
existing street furniture, such as lamp columns, and only used at decision points
and sparingly as route repeater signs. The sign reverse should match the
surrounding street furniture colour: black-backed in central London and town
centres, grey on arterial routes.

9.4.21. The height of the signage should provide adequate head clearance: 2.4 metres as
a minimum. Where cycle tracks or shared use areas are provided the appropriate
signing must be erected with consideration to minimising clutter.

Road markings

9.4.22. TSRGD standards should be applied to ensure consistency for all road markings
across the road network. Use of the cycle symbol diagram 1057 should be pre-
formed; hand-formed symbols invariably have a poor appearance. The cycle
symbol should be used to support other road markings: at the start of cycle lanes;
across junctions; and within Advanced Stop Lines (ASLs); or may be used in
isolation as part of a signed route.

9.4.23. Bespoke cycle symbol treatments such as engraved or inlaided natural stone may
be appropriate in conservation areas; approval should be sought from the SRG for
TLRN cycle routes.
### Road marking and placement standards

<table>
<thead>
<tr>
<th>Infrastructure type</th>
<th>Road marking</th>
<th>Recommended width</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mandatory cycle lane</strong></td>
<td>A solid white line in reflective thermoplastic with cycle symbol diagram 1057</td>
<td>2.0 metres</td>
</tr>
<tr>
<td></td>
<td>Lanes of 1.5-2 metres may be acceptable provided that the adjacent traffic lane does not have fast-moving traffic and a high proportion of HGVs and is not less than 3.2 metres wide. The recommended minimum is 1.5 metres for a short lead-in lane to the waiting area for cyclists at an ASL. Site specific physical and traffic conditions may dictate that a 1.2-1.5 metre lead-in is preferable to no lead-in.</td>
<td></td>
</tr>
<tr>
<td><strong>Advisory cycle lane</strong></td>
<td>A broken white line (diagram 1004) in reflective thermoplastic with sign (diagram 967)</td>
<td></td>
</tr>
<tr>
<td><strong>Cycle Superhighways</strong></td>
<td>Diagram 1057 cycle symbol centred above Cycle Superhighway project symbol</td>
<td></td>
</tr>
</tbody>
</table>

### Coloured surfacing and cycling

9.4.24. Coloured surfacing is not a formal traffic sign and should be kept to a minimum on the TLRN for aesthetic and maintenance reasons (refer to Carriageway surfacing for colour surfacing table). It should only be considered for the following situations:

- On mandatory cycle lanes where there is an issue of motor vehicle compliance
- On Cycle Superhighway routes that do not have physical segregation
- Across junctions where there is a risk of left hook, opposing turn or ‘side-swipe’ conflict
- For ASL reservoirs where there is an issue of motor vehicle stop line compliance
- The provision of highly conspicuous surfacing can detract from the aesthetics of the streetscape and may not be appropriate in special or conservation areas
- Where coloured surfacing is to be applied, a veneer coat should be laid on to the wearing course

### Kerbs

- Low kerbs of between 50-100mm may be considered for the cycling and footway surface interface
- The delineation for segregated cycle lanes needs to be carefully detailed with an edge strip that provides good visual definition between carriageways and footways
- Where cycle provision is at footway level, a raised delineator strip (to diagram 1049.1 of TSRGD) with integrated drainage may be used
Streetscape Guidance  Part D – Physical design and materials

- Kerb heights should be carefully detailed to maximise the effective width of the cycle facility by allowing cyclists to travel closer to the kerb, reducing the likelihood of a cyclist catching their pedals on the upstand
- Bull-nose, battered (45 degree) or half-battered kerbs may be used adjacent to any cycle facility
- Where cycle tracks or shared use areas are provided, flush dropped kerbs must be provided at entry and exit points from the carriageway

Drainage
- Cycle infrastructure should be free-draining to ensure effective widths for cycling and skid resistance properties are maintained across the facility
- Gully locations and levels need to be carefully detailed and the type of grating needs to be considered to best provide for cyclists, refer to Keeping London dry for further information
- Gully gratings should be perpendicular to the direction of cyclists’ travel to avoid wheels becoming caught in the grating
- Side entry gullies may be appropriate where the cycle facility is narrow and the crossfall gradient low

Maintenance
- Signs and road markings are important for safety and route legibility. All signing should be regularly monitored to ensure that surface markings are maintained and signs appropriately positioned
- Planting adjacent to cycle lanes and tracks should be maintained regularly to ensure cyclists do not have to leave the facility to avoid overhanging vegetation
- Surface defects can cause significant risks for cyclists and a regime to maintain high quality surfacing is essential for all designated routes
- Maintenance regimes should be aligned to our hierarchy of designated cycle routes, to ensure that the level of maintenance matches the extent of use
Segregated/Shared Route Side Road Entry Treatment - Set Back Less Than Five Meters

Figure 9.0: Segregated route on footway

**Detail AA - Scale 1:20**

- 100mm Asphalt
- 300mm Asphalt
- 150mm Kerb

**Detail BB - Scale 1:100**

- Raised Delineator Strip
- Concrete Edging Strip Flags
- Footway

**Detail CC - Scale 1:20**

- 150mm Diameter 1040.1
- 6mm
- 60mm
- Paving

Cycle Track Fall Carriageway Surfacing

(W)150 x (H)30mm Kerb
A ‘protected intersection’ designed to eliminate bike-car conflicts

<table>
<thead>
<tr>
<th>Protected junction temporary trial Portland, USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opportunity</td>
</tr>
<tr>
<td>Right turns at junctions can be dangerous for less confident and inexperienced cyclists.</td>
</tr>
<tr>
<td>Benefits</td>
</tr>
<tr>
<td>This reinterpretation of a Dutch cycle-friendly junction provides a phased and safe way to make a right turn. The introduction of kerbs within the junction reduces the crossing distance and offers a refuge to cyclists while they wait to complete their turn.</td>
</tr>
<tr>
<td>Implementation</td>
</tr>
<tr>
<td>Junctions that avoid merging cyclists and drivers have proven safer for both.</td>
</tr>
<tr>
<td>Applying in London</td>
</tr>
<tr>
<td>This Dutch inspired concept is being studied to determine its suitability for the London context. The hope is that the design will provide an increased sense of safety and comfort for cyclists, especially at busy junctions.</td>
</tr>
<tr>
<td>Key functions:</td>
</tr>
</tbody>
</table>

Image courtesy of Nick Falbo

Additional information

British Standards:
- BS 594987:2010, Asphalt for roads and other paved areas
- BS EN 13108 Bituminous mixtures. Material specifications (BSI, 2010)

Transport for London:
- London Cycling Design Standards, 2014
9.5. **Bus lanes**

9.5.1. Bus lanes are provided on many red routes to increase journey time reliability for certain types of vehicles and encourage the use of sustainable transport modes. They are usually located at the kerbside to serve bus stops.

9.5.2. Standard bus lanes only allow for buses, taxis, motorcycles and bicycles to use the lane during designated times. In some locations, heavy goods vehicles may also use the bus lane and will be marked accordingly.

**Design considerations**

9.5.3. In determining the practicability and feasibility of implementing a bus lane within the existing built environment, consideration should be given to:
- The volume of potential bus users
- The carriageway width
- The overall capacity of the carriageway
- The proximity of street trees to the carriageway

**Start and end points**

9.5.4. When determining the precise position of the start and end points, coordination of regulatory signs with other street furniture should be considered. Minor bus lane amendments may involve moving the start and finish by a few metres to enable existing street furniture to be used to locate regulatory signing, and minimise clutter.

**Designing for cyclists**

9.5.5. There should be a general presumption that cycles are allowed to use bus lanes. The recommended minimum width for a bus lane shared with cyclists is 4.5 metres. A narrow bus lane of 3-3.2 metres may be provided in constrained scenarios but this does not allow for overtaking within the lane between buses and cycles. Bus lanes of 4-4.5 metres can be acceptable, depending on site specific conditions (risk associated with bus or cycle crossing into adjacent lane when overtaking). See LCDS for further details.

9.5.6. Only where there is safety concern in the planning of a contra-flow, or a with-flow offside bus lane, should exclusion of cyclists be considered. Even in these instances, a comparison should be made with the relative risks that cyclists might face on alternative routes.

**Road markings and signage**

9.5.7. Bus lanes are only enforceable where signage and road markings comply with the TSRGD. Design teams should therefore consider how to minimise the physical and visual impact by avoiding the unnecessary introduction of additional signposts.
- Signs must be consistent, clear and unobstructed along the route
• It should be noted that signs for the start of the bus lane and the repeaters after side roads, can be too large for standard strength lamp columns and higher strength columns may be required

• Venetian red (BS381C – colour 1434) surfacing has been shown to aid bus lane compliance; however, it adversely impacts on the streetscape visually and requires additional maintenance. It should therefore only be used where there is a proven need to improve compliance

• A pigmented thin surface course system is preferred for coloured bus lanes, unless site conditions or location demand an alternative approach

Contact

9.5.8. Advice on the design and layout of bus lanes should be sought from our Bus Priority Team.

Additional information

Statutory instruments:
Traffic Signal Regulations and General Directions (TSRGD) 2002 and 2015

Department for Transport:
Design Manual for Roads and Bridges
Local Transport Note 1/97: Keeping buses moving
Traffic Signs Manual, Chapter 3: Regulatory Signs
Traffic Signs Manual, Chapter 5: Road Markings

9.6. Median strips/central reservations

9.6.1. Median strips have traditionally been used on high speed arterial routes to separate traffic flows and provide safety and operational benefits on the approach to junctions. These centrally located islands, usually consisting of a raised kerb edge and paved surface, are also found on numerous inner city roads with four lanes or more.

9.6.2. Historically most median strips would have contained guardrails but now with lower traffic speeds being introduced and a change in design philosophy for inner urban areas, many of these guardrails have been removed to improve conditions for pedestrians and cyclists.
Benefits

- The use of median strips within high street environments is becoming an increasingly attractive design approach for reducing the severance created by having a wide carriageway
- Median strips can help to facilitate safer and more convenient informal pedestrian crossing movements by effectively acting as an extended pedestrian refuge
- Reducing the carriageway width can help to reduce vehicle speeds, reduce crossing distances and create an environment more conducive to informal pedestrian crossing and social vibrancy
- Median strips provide the opportunity to declutter the footway by locating street furniture on the median itself
- Kerbside activities such as loading or parking can also be integrated within wider median strips, while ensuring sightlines are maintained

Layout

Median strip design standards

<table>
<thead>
<tr>
<th>Median strip width</th>
<th>Suitable functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2 metres – absolute minimum</td>
<td>Pedestrian refuge space for a straight across single phase formal crossing or informal crossing</td>
</tr>
<tr>
<td>1.5 metres – preferred minimum</td>
<td>More comfortable pedestrian refuge space for a straight across single phase crossing</td>
</tr>
<tr>
<td>3.0 metres</td>
<td>Sufficient space to accommodate a staggered crossing facility</td>
</tr>
<tr>
<td></td>
<td>Minimum width to consider cycle parking</td>
</tr>
<tr>
<td></td>
<td>Minimum width to consider tree planting</td>
</tr>
<tr>
<td></td>
<td>Minimum width to consider central loading or parking bay</td>
</tr>
<tr>
<td>4.0 metres</td>
<td>Minimum width to consider a pedestrian refuge space for a straight across two phase crossing</td>
</tr>
</tbody>
</table>
9.6.3. This example shows how a narrow median (less than 1.2 metres) is widened at a controlled crossing to provide an acceptable refuge width.

**Design considerations**

9.6.4. Designs which have numerous short sections of median strip and open carriageway can detract from the quality and legibility of the street environment, and reduce the visual coherence of the median as a whole.

9.6.5. Layouts which significantly vary the width of the median strip should be avoided as this can create pinch points on the carriageway, pockets of ineffective space and visual clutter.

9.6.6. Medians may be introduced asymmetrically within the overall street layout, such that a single lane in one direction may be separated from two lanes in another direction, for example. This can be used to help support contraflow bus lane and contraflow cycle lane designs.

9.6.7. The road geometry on the approach to the median should be detailed so that minimal use of road hatching markings are required to reduce visual clutter and maximise useable road space. Indeed hatchings are not required at all.

9.6.8. The decision to include a median strip should consider the impact on cyclist comfort, as narrowing of the carriageway will likely be required. Poorly positioned or overly wide median strips can create pinch points on the carriageway which impact on cycle comfort and safety. Designers should consider whether the median strip is to be designed to allow cyclists to overtake; in which case the edge should be flush with the carriageway, but the profile of the median strip could be domed.

**Street furniture**

- Care should be taken when locating furniture on the central median as it can impede crossing movements and reduce pedestrian visibility for oncoming traffic.
Standard streetscape principles apply so that the median strip does not become overly cluttered and detract from the view of the other side of the street and the surrounding architecture.

9.6.9. Street furniture on a median strip should be located a minimum 450mm from either kerb edge; 600mm for cycle parking stands.

9.6.10. Street furniture should be located a minimum 1.0 metre away from adjacent objects in long profile along the length of the median strip; 1.2 metres for cycle parking stands, to allow for adequate pedestrian permeability across the median.

9.6.11. For speed limits of 40mph or more, the type of street furniture used on the median should be carefully considered. Furniture such as cycle parking will likely not be appropriate.

- Low-level ‘keep left’ bollards can be used at the start of the median strip and should be clearly positioned 450mm from the kerb edge
- Relocating lighting columns on the median strip can help to reduce clutter on the footway; however, this is a non-standard arrangement on the TLRN and requires SRG approval. Designers should recognise the aesthetic impact of locating light columns in the centre of the road, and the safety implications in terms of lighting distribution, glare and providing sufficient footway lighting
- Planting on median strips can have maintenance implications which may require lane closures. Consult an arboriculturist to discuss viable planting options
- Cycle parking placed on the median strip can help to reduce clutter on the footways, but care should be taken as traffic conditions may make it difficult for cyclists to cross to the parking and to rejoin the carriageway afterwards. It may also increase the distance to their destination such that they choose to ‘fly park’ on the footway instead
- Seating is rarely a practical solution on a central median and unlikely to provide a comfortable resting environment, unless the median strip is sufficiently wide

**Construction**

**Surface materials**

- Surface materials for the median strip should be consistently applied along the length of the median and the tone and colour should resemble the surrounding footways
- The median strip surface materials do not need to match the actual materials used for the footway, however, a higher quality of finish and consistent aesthetic can be achieved when the materials do match
Streetscape Guidance Part D – Physical design and materials

- Where a raised kerb is provided, no tactile paving delineation is required, except at designated formal crossing points with a dropped flush kerb
- Where vehicle overrun is anticipated or parking and loading bays incorporated as part of the median, small unit paving should be applied in the form of setts. Alternatively, these areas may be surfaced in asphalt with a kerb edge to delineate the median strip and appropriate edge restraint construction detailing for either side of the kerb

**Kerbs**
- The kerb material and width should be consistent along the length of the median to provide clear delineation from the carriageway surface
- The kerb edge restraint detailing is vitally important and should be able to withstand impacts from vehicle overrun
- The kerb height for the median strip should be carefully considered and respond to the character and use of the street. The height is important to delineate the median from the carriageway and support the functional requirements of the median strip at specific locations
- Where inspection covers intersect the line of the median strip it may be necessary to detail the kerb edge around the cover. The preference, however, would be to accommodate the inspection cover on the median strip itself by moving the access point where practicable
- Quadrant kerbs for the corner of medians should match the kerb widths to provide a clean aesthetic

### 9.6.12. Technical detail: Kerb cuts and paving layout for median strip

<table>
<thead>
<tr>
<th>Kerb height</th>
<th>Median strip application</th>
</tr>
</thead>
<tbody>
<tr>
<td>125mm-150mm</td>
<td>Standard upstand height for where vehicle speeds are 40mph or greater</td>
</tr>
<tr>
<td></td>
<td>Standard upstand height for central refuge at controlled crossing points and designated uncontrolled crossing points</td>
</tr>
<tr>
<td>60mm-125mm</td>
<td>Standard kerb upstand range for where vehicle speeds are 30mph or less</td>
</tr>
<tr>
<td>Flush-6mm</td>
<td>Adjacent to centrally located cycle parking provision to allow convenient access for cyclists</td>
</tr>
<tr>
<td>60mm</td>
<td>For shared surface schemes</td>
</tr>
<tr>
<td></td>
<td>For centrally located parking and loading bay access</td>
</tr>
<tr>
<td>Flush-6mm</td>
<td>Dropped kerb at formal crossings</td>
</tr>
</tbody>
</table>

**Additional information**

The Highways Agency:

- Design Manual for Roads and Bridges, Volume 6, Section 2: TD 42/95 Geometric Design of Major/Minor Priority Junctions, 1995

Department for Transport:

- Traffic Signs Manual (2003), Chapter 5: Road Markings