

Smart Motorways

Interim Advice Note 161/15

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INTERIM ADVICE NOTE 161/15

Smart Motorways (SM)

Summary

This interim advice note (IAN) gives requirements and advice on smart motorways schemes implementing all lane running and controlled motorway. It sets out the design parameters and the associated infrastructure requirements and advice.

Instructions for use

This IAN applies to smart motorways all lane running and smart motorways controlled motorway schemes on the Highways England network. It supplements and amends:

TD 9/93	Highway Link Design
TD 19/06	Requirements for Road Restraint Systems
TD 22/06	Layout of Grade Separated Junctions
TD 27/05	Cross-Sections and Headrooms
TD 45/94	Motorway Incident Detection and Automatic Signalling (MIDAS)
TD 46/05	Motorway Signalling
TA 73/97	Motorway Emergency Telephones
HD 20/05	Detector Loops for Motorways
IAN 143/11	Supplementary Advice and requirements for the Provision for Non-Motorised Users and Accessibility during planning, design, construction and handover of Improvement Schemes
IAN 149/11	Existing Motorway Minimum Requirements

The following documents are not applicable:

- IAN 111/09 Managed Motorways
Implementation Guidance – Hard
shoulder running
- IAN 112/08 Managed Motorways
Implementation Guidance –
Through junction hard shoulder
running

Amendments

The main changes from IAN 161/13 are:

1. Addition of safety baseline and objectives for all lane running (ALR) and controlled motorway (CM)
2. Inclusion of requirements and advice for implementing CM without the permanent or dynamic conversion of the hard shoulder to a running lane
3. Specific requirements for maintenance renewal integration
4. Emphasis on whole life design
5. Clarification regarding the application of through junction running (TJR) on ALR
6. Clarification of diverge and merge design requirements
7. Refinement of refuge area requirements on ALR
8. Requirements if a new junction is added within an SM scheme
9. Definition of a blind spot for CCTV surveillance on ALR
10. Updated lighting requirements
11. Clarification of signing requirements associated with variable speed limits (VSL)
12. Visibility requirement added between upstream variable message sign (VMS) locations and emergency refuge areas (ERA)
13. Tightening of signal spacing and visibility requirements
14. Update to the environmental and drainage requirements

Users of this IAN shall be responsible for identifying and understanding the implications of all changes between IAN 161/13 and IAN161/15.

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1 Introduction

1.1 Purpose and required actions

- 1.1.1 This IAN gives requirements and advice to all those designing smart motorways (SM) all lane running (ALR) and SM controlled motorway (CM) schemes. It sets out the design parameters for ALR and CM and the associated infrastructure requirements and advice. In addition to this IAN, a companion document has been produced entitled SM Concept of Operations. This document provides, at a high level, guidance on the operational elements of SM and complements this IAN, and may be found here:

http://www.dft.gov.uk/ha/standards/tech_info/index.htm

- 1.1.2 This IAN shall be read in conjunction with GD01 Introduction to the Design Manual for Roads and Bridges (DMRB). The requirements given in this IAN shall be adhered to for ALR and CM schemes in England, to be constructed on the strategic road network, unless a departure from standard is approved.
- 1.1.3 Mandatory requirements in this IAN are denoted by the terms 'shall' and also 'must' where there are regulatory requirements. If it is not possible to comply, a departure from standard shall be agreed with Highways England. Existing features that do not comply with mandatory requirements do not require the submission of a departure from standard. The remainder of the IAN contains advice, explanation and guidance.
- 1.1.4 The process for the approval of departures from standard provides an auditable record of the decisions made in providing a non-compliant solution. As required by IAN 149/11 Existing Motorway Minimum Requirements, a design strategy record (DSR) shall be used to capture design decisions and ensures that departures from standard are not considered in isolation. It provides a single auditable record of the design decisions taken in developing a scheme.

A DSR shall be developed as the design progresses to record design constraints and decisions. The DSR shall include supporting evidence that will enable design decisions to be audited. The DSR shall be used to demonstrate that the existing collision record and operational and maintenance performance has been appropriately considered.

The DSR shall also be used to record key decisions made associated with the design and its associated specification for high quality primary resources, the re-use of material generated within the scheme works and the sourcing of secondary materials from other public sector projects.

1.2 Relationship

- 1.2.1 This IAN shall be used in conjunction with the following DMRB requirements and advice documents (RADs) and varies requirements within them:

TD 9/93

Highway Link Design

TD 19/06

Requirements for Road Restraint Systems

TD 22/06	Layout of Grade Separated Junctions
TD 27/05	Cross-Sections and Headrooms
HD 20/05	Detector Loops for Motorways
TD 45/94	Motorway Incident Detection and Automatic Signalling (MIDAS)
TD 46/05	Motorway Signalling
TA 73/97	Motorway Emergency Telephones

These RADs are referred to as “parent DMRB RADs” within this IAN.

1.2.2 This IAN also varies the requirements within the following IANs:

- IAN 143/11 Supplementary Advice and requirements for the Provision for Non-Motorised Users and Accessibility during planning, design, construction and handover of Improvement Schemes
- IAN 149/11 Existing Motorway Minimum Requirements

1.2.3 The requirements and guidance within this IAN supersede or amend paragraphs within the parent DMRB RADs and the IANs referred to above. Where this occurs, the superseded or amended paragraph is noted within the text. If the superseded or amended paragraph is not noted, and there is a difference in requirement between this IAN and the requirements of the equivalent parent DMRB RADs or referenced IAN, the requirements and advice given in this IAN shall take precedence.

1.2.4 The numbering in this IAN generally follows the same numbering in sections 2 to 12 of IAN 161/13 but is prefixed by an additional number 2. For example:

- section 5 in IAN 161/13 is now section 2.5 in IAN 161/15
- paragraph 5.1 in IAN 161/13 is now paragraph 2.5.1 in IAN 161/15 etc.

1.3 Implementation

1.3.1 This IAN replaces IAN 161/13 and should be used forthwith for all ALR and CM schemes provided that, in the opinion of the Overseeing Organisation, this would not result in significant additional expense or delay progress.

1.4 Scope

1.4.1 The SM concept provides a means of facilitating the dynamic control of traffic for congestion and incident management and includes the use of variable mandatory speed limits (VMSL).

1.4.2 The scope of this IAN is to provide requirements and advice for:

- ALR, a SM scheme with the permanent conversion of the hard shoulder to a running lane. This supersedes the dynamic hard shoulder running requirements covered in IAN 111/09 and IAN 112/08
- CM, a SM scheme without the permanent or dynamic conversion of the hard shoulder to a running lane. Sections 2.3, 2.4 and 2.5 do not normally apply to stand alone CM links unless CM is positively referenced in these sections

1.4.3 There are two categories of CM scheme. A category 1 scheme is the use of a signalling and signing layout in accordance with Figure 2.2.2 and is a similar

arrangement to an ALR signalling and signing scheme. A category 2 scheme is the conversion of an existing advisory lane signalling scheme to CM, this generally includes the replacement of lane signalling and 2x12 message signs with a variable message sign (VMS) capable of displaying pictograms, wickets and messages similar to an ALR scheme. A Category 2 scheme would also be in line with Figure 2.2.2 but existing portal gantries may be used to support VMS rather than using a cantilever structure.

- 1.4.4 This IAN has been developed for use on the strategic road network (SRN) managed by Highways England where motorway regulations apply. Use of this IAN on roads in circumstances other than the above shall be subject to approval from the relevant highway authority.
- 1.4.5 This IAN shall only be used where the resulting scheme has no more than 4 lanes on a link in either direction. Advice shall be sought from the Overseeing Organisation if links with more than 4 lanes are being considered. At diverge connector roads, more than 4 lanes may be provided where required for diverge flows but shall be supported by lane signalling – refer to paragraph 2.7.21.
- 1.4.6 Refer to Annex A for a glossary of acronyms and terms.

1.5 Mutual recognition

- 1.5.1 This IAN does not provide product requirements.

2 Smart motorways

2.1 Operational safety

Safety management system (SMS)

- 2.1.1 Schemes shall be implemented with an appropriate level of safety risk management in order to provide road users, road workers and third parties with adequate risk protection (as defined in GD 04 Standard for Safety Risk Assessment on the Strategic Road Network). This shall be in accordance with IAN 139, GD 04 and IAN 69.

Safety baseline and objectives - ALR

- 2.1.2 A generic safety baseline and generic safety objectives have been agreed for ALR schemes. These cover road users and road workers.

- 2.1.3 Road user safety baseline:

Validated STATS19 personal injury collision (PIC) data covering the scheme extent, including merge and diverge connectors shall be used to determine the road user safety baseline. The road user safety baseline used to demonstrate the safety objective has been met, shall be the number (averaged per annum) of all fatal and weighted injury (FWI) casualties and the rate of FWI casualties per billion vehicle miles per annum averaged for the three years prior to the installation of any element of ALR (including motorway incident detection and automatic signalling (MIDAS)) and prior to the start of construction.

FWI is defined as: (number of fatalities) + 0.1 x (number of serious casualties) + 0.01 x (number of slight casualties).

- 2.1.4 Road user safety objective:

An ALR scheme will satisfy the minimum road user safety objective if it is demonstrated for a period of three years after becoming fully operational that:

- the average number of FWI casualties per year is no more than the safety baseline
- the rate of FWI casualties per billion vehicle miles per annum is no more than the safety baseline
- no population of the customer (for example car drivers, pedestrians, large goods vehicle (LGV) drivers and motorcyclists) is disproportionately adversely affected in terms of safety and risk to each population remains tolerable.

Where different forms of SM are proposed on opposing carriageways, for example, CM and ALR, then the demonstration of the road user objective being met should be assessed per link per carriageway.

- 2.1.5 The designer shall determine if additional safety mitigation measures may be justifiably deployed (that are not contained in this IAN) that would provide an improved contribution to Highways England's safety targets. The adoption of any such measures shall be endorsed by the Highways England Project Manager and project safety control review group (PSCRG). The designer shall also liaise with the owner of this IAN, the contact is detailed in section 4.

- 2.1.6 A hazard log based analysis has been undertaken on the generic ALR design and is reported in the “ALR Generic Safety Report” which may be found on the Highways England website:

<http://www.highways.gov.uk/knowledge/projects/smart-motorways-call-off-support/>

- 2.1.7 Road worker safety objective:

There is no numerical objective or target for road worker collisions on ALR schemes and the risk must be managed in accordance with the ‘so far as is reasonably practicable (SFAIRP)’ principle. This is a legal requirement. Highways England’s “Aiming for Zero (AfZ)” strategy shall be applied for further positive action to reduce the risk to road workers during maintenance and operation. One part of the strategy aims to eliminate all fatalities and serious injuries to road workers maintaining Highways England’s road network. Highways England no longer permits live lane crossings on the motorway network and has an overarching ambition of having zero killed or serious injuries on the SRN.

Safety baseline and objectives - CM

- 2.1.8 A generic safety baseline and a generic safety target and objective have been agreed for CM schemes. These cover road users and road workers.

- 2.1.9 Road user safety baseline:

This is the same as for ALR.

- 2.1.10 Road user safety target:

The safety target is the achievement of an improvement in safety equivalent to that normally expected from the implementation of MIDAS queue protection (10%) plus CM (expected to be 15%).

- 2.1.11 The designer shall determine if additional safety mitigation measures may be justifiably deployed (that are not contained in this IAN) that would provide an improved contribution to achieving Highways England’s safety performance indicators. The adoption of any such measures shall be endorsed by the Highways England Project Manager and the PSCRG. The designer shall also liaise with the owner of this IAN, the contact is detailed in section 4.

- 2.1.12 Road worker safety objective:

This is the same as for ALR.

- 2.1.13 The “CM Generic Safety Report” may be found on the Highways England website:

<http://www.highways.gov.uk/knowledge/projects/smart-motorways-call-off-support/>

2.2 Outline design and maintenance requirements

General

2.2.1 Not used.

2.2.2 Permanent conversion of the hard shoulder to a running lane is a key aspect of ALR. The ability to dynamically control mandatory speed limits and lane availability is a key element of both ALR and CM.

The lane referencing used in this IAN is as follows:

Existing motorway	ALR scheme	CM scheme
Hard shoulder	Lane 1	Hard shoulder
Lane 1	Lane 2	Lane 1
Lane 2	Lane 3	Lane 2
Lane 3	Lane 4	Lane 3

Through junction running (ALR only)

2.2.3 On an ALR scheme, the permanent conversion of the hard shoulder on the main line to a running lane also applies intra-junction and is the preferred operational regime, as it offers benefits in terms of a consistent customer experience. However, this shall be assessed on a junction by junction basis (including scheme terminal junctions). TJR for ALR schemes should be provided where this has been determined as the most appropriate layout following analysis of the design year traffic flows (mainline and connector road requirements) and any operational or physical constraints. Proposals for each junction on an ALR scheme (including the terminal junctions/interchanges) shall be endorsed by the PSCRG, Operations technical leadership group (TLG) and Project Board.

2.2.4 Not used.

2.2.5 Not used.

Refuge areas (ALR only)

2.2.6 Refuge areas shall be included in an ALR design, providing a place for customers to stop during an emergency, (see paragraph 2.5.14 for the definition of a refuge area).

2.2.7 Not used.

Generic design

2.2.8 The generic design for ALR is illustrated in Figure 2.2.1. The generic design for CM is illustrated in Figure 2.2.2.

Figure 2.2.1: Generic design for ALR

This diagram is indicative, and is intended to give a general overview of ALR and is not a definitive layout.

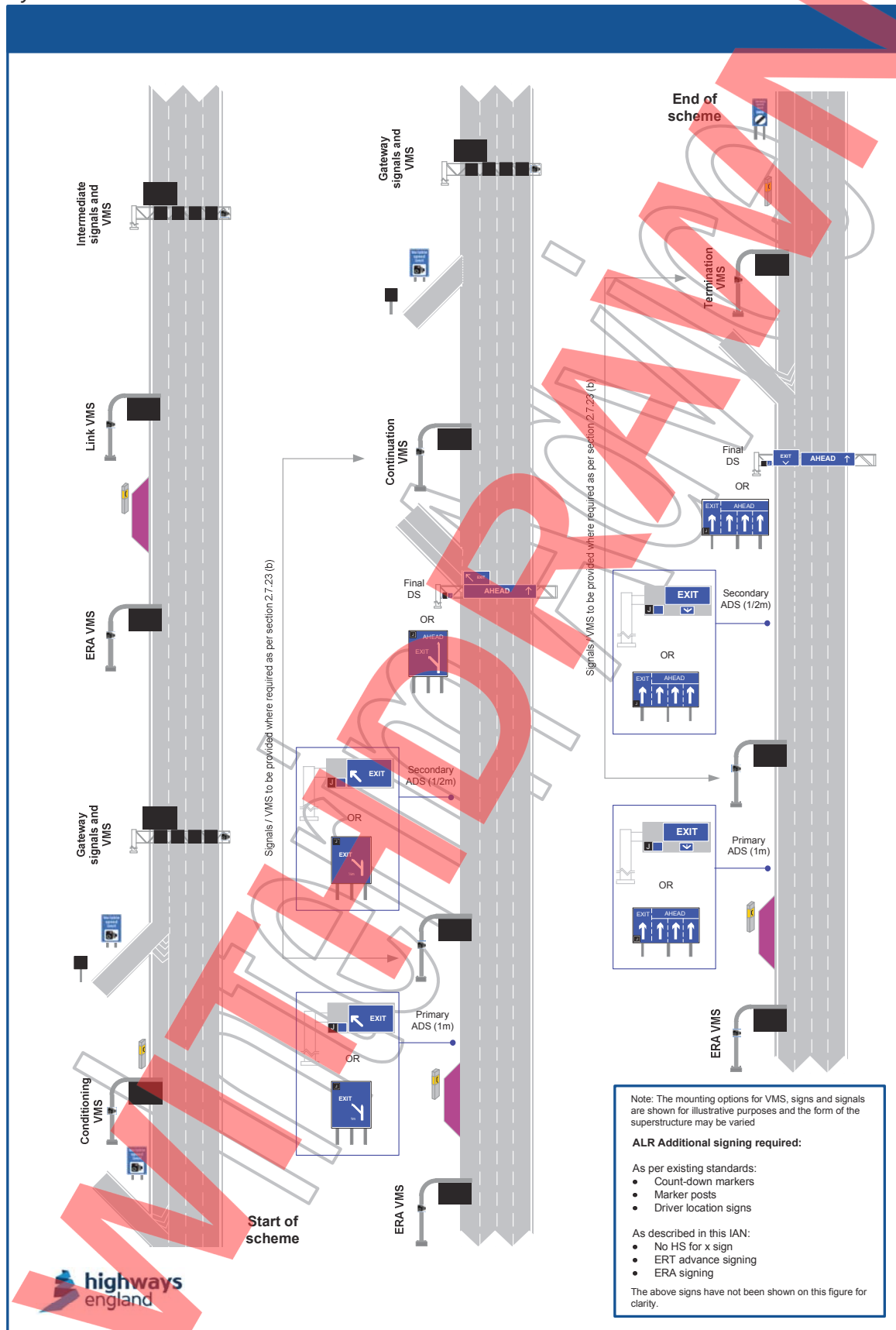
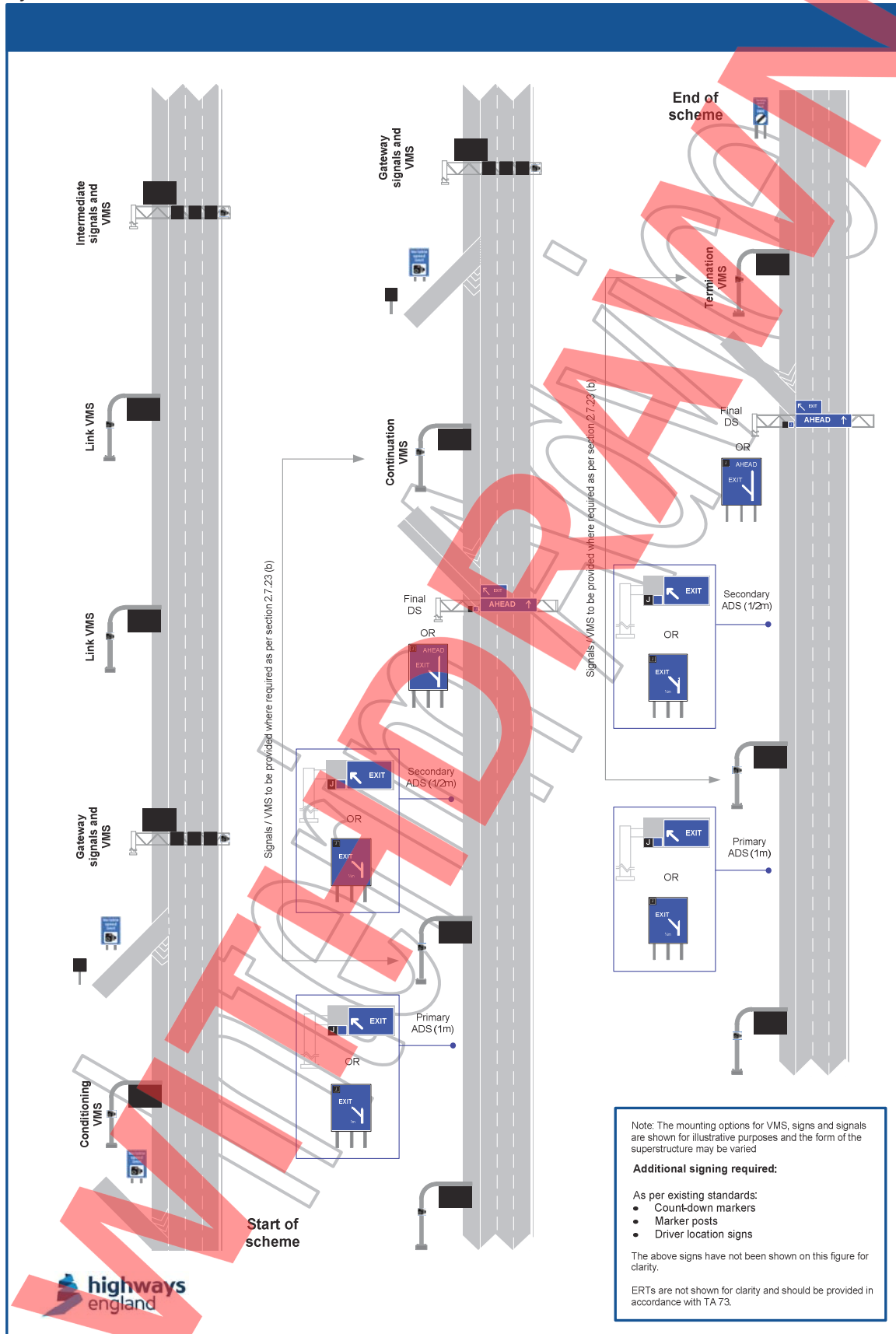


Figure 2.2.2: Generic design for CM

This diagram is indicative, and is intended to give a general overview of CM and is not a definitive layout.



2.2.9 The safe and efficient operation of ALR and CM schemes is dependent on a controlled environment with high availability technology assets to provide:

- compliant customer behaviour
- appropriate and relevant information being delivered to the customer at a timely rate, so as not to cause overload of information, or leave the customer in doubt as to what to do

The infrastructure, technology and procedures put in place enable the network to be managed in a way that provides a level of customer compliance necessary to support the delivery of performance benefits.

Maintenance

2.2.10 A SM scheme must be designed for maintenance (IAN 69) and an appropriate maintenance and repair strategy statement (MRSS) shall be developed. This must place emphasis on the elimination and reduction of maintenance activities and risks.

2.2.11 The Construction (Design and Management) Regulations 2015 impose a statutory duty to reduce health, safety and welfare risks for, amongst other things, the maintenance of completed schemes.

2.2.12 The scheme design must eliminate, reduce or control foreseeable risks that may arise during construction and maintenance and operations so far as is reasonably practicable. Information must be provided on any residual risks to those who will carry out construction or undertake maintenance, operations and de-commissioning.

2.2.13 Not used.

2.2.14 With the permanent conversion of the hard shoulder to a running lane on an ALR link, there is no hard shoulder available for maintenance access or for the setting out of traffic management. All maintenance activities within an ALR scheme shall be carried out in a safe manner and generally should be undertaken from either a designated area for maintenance or from a lane closure under traffic management. To minimise the impact of lane closures on network performance, the scheme should be designed to minimise maintenance activities requiring temporary traffic management (TTM). The majority of routine maintenance is expected to be undertaken outside of peak periods.

Provision shall be made within an ALR design to support the deployment of post-implementation TTM. Fixed taper points (FTP) for TTM shall be identified throughout the length of the scheme (including scheme approaches) in accordance with the taper selection requirements stated in Chapter 8 of the traffic signs manual (TSM) and agreed with Network Delivery and Development (NDD) and the maintenance service provider (MSP). Signs or signals required for the purpose of signing TTM shall be capable of being remotely operated. A risk based assessment in accordance with GD 04 shall be undertaken to inform the design decisions. This provision of remote operated temporary traffic management (ROTTM) signs does not require a departure from standard but the choice of sign used shall be endorsed by the PSCRG and the decision making process included in the DSR. The designer should seek guidance from the Overseeing Organisation regarding the current requirements for the provision and implementation of TTM signing.

The designer shall liaise with the MSP to ensure that where appropriate, provision is made in the design for FTP roadside identification.

Use of ROTTM and FTPs shall be considered for use on CM schemes through a risk based assessment in accordance with GD04, but is not mandated. The decision shall be recorded in the DSR.

Additional information is provided in the SM Concept of Operations; with guidance on one potential solution provided in the document 'Generic Safe Method for Placing TTM on MM-ALR.' and may be found at:

http://www.dft.gov.uk/ha/standards/tech_info/index.htm

Advice from the Overseeing Organisation should be sought regarding the requirements for ROTTM signs, control system and the associated operating procedures. TR2603 and IAN 180 provide further details on ROTTM signs.

- 2.2.15 The guidance and requirements in IAN 182 - Major Schemes: Enabling Handover into Operation and Maintenance shall be followed for SM schemes.
- 2.2.16 The safety report must demonstrate that the road worker safety risks has been reduced to be as low as is reasonably practicable. This shall include all TTM requirements for maintenance access. Detailed agreement shall be reached with NDD/MSP on the approach to maintenance of assets and how this shall be provisioned in the design. This shall be recorded in the DSR and MRSS.
- 2.2.17 Provision of maintenance access on all SM schemes shall be in accordance with major project instruction MPI -11- 062013 Provision of Maintenance Access to Equipment on MM-ALR Schemes.
- 2.2.18 Further details and advice on the provision, siting and design of maintenance hard standings is described in TD 69 'The Location and Layout of Lay-bys and Rest Areas.'

Health and safety file – information to be provided

- 2.2.19 The designer shall provide information for the Health and Safety File to enable any future improvement or change of use of the constructed scheme to be undertaken. This includes the consideration of the design assumptions and the safety objectives of the SM scheme as required under the direction provided by GD 04. This is to ensure that the safety critical elements of the original SM scheme design are not compromised by future improvements or changes in use that were not anticipated as part of the application of this IAN. Documents to be incorporated shall include but not be limited to:

- DSR
- Safety report
- Hazard log report
- MRSS
- Combined operating regime

Whole life design

2.2.20 The designer must ensure that consideration is given to reducing the risk exposure in accordance with IAN 69 whilst increasing the longevity, maintainability and optimising the whole life costs of the assets that are specified. Designers should not limit the specification requirements to solely minimise capital expenditure.

Maintenance renewal integration

2.2.21 SM interventions on the network present opportunities to undertake maintenance renewal activities resulting in an overall cost saving for Highways England and minimising disruption to the customer. The intent is to provide a period of 5 years free of major renewal following completion of the SM works. The residual life of all existing assets retained in a scheme at the opening year of that scheme should be no less than 5 years to avoid significant customer disruption soon after completion of the SM scheme. SM schemes should include the re-surfacing of the pavement within the scheme limits where there is less than 5 years residual life after the opening of the scheme or a change to ALR lane configuration is expected to erode the residual life to less than five years due to revised wheel track positions aligning with existing longitudinal joints. The impact of TTM layouts required for SM construction should also be included in the determination of the residual life assessment of pavement.

2.2.22 Maintenance renewal integration shall be assessed and the proposals shall be documented in the MRSS. Assets identified for maintenance integration shall be supported by a business case and their inclusion in the scheme shall be agreed by both the Highways England Project Manager and Senior User.

2.2.23 The process of maintenance renewal integration should begin as early in the development of the SM scheme as possible. Early engagement of NDD following the entry of a scheme to Highways England's Improvement Programme is essential to allow sufficient time to:

- undertake necessary surveys/data collection
- identify the potential maintenance works
- produce a business case; and
- agree funding in time to incorporate within the integrated design development of the SM scheme

2.2.24 Where existing structures, features or assets are fit for purpose, they should not be replaced for the sole purpose of meeting current Highways England RADs.

2.2.25 Existing structures, features or assets that are not fit for purpose should be replaced. For example, assets that are either unsafe in the context of SM or beyond economic repair or have been identified through the maintenance renewal integration process outlined in paragraph 2.2.23.

2.3 Highway link design

General

2.3.1 This section shall be read in conjunction with TD 9/93 Highway Link Design, and IAN 149/11 Existing Motorway Minimum Requirements.

2.3.2 The following paragraph in IAN 149/11 is superseded:

2.2.2

2.3.3 The following paragraph in IAN 149/11 is amended:

2.4.4

Design speed relaxations

2.3.4 The relaxations below Desirable Minimum for the following may be used in combination:

- stopping sight distance
- horizontal curvature
- vertical crest curves
- absolute minimum for sag curves
- superelevation

as described in TD 9/93 paragraphs 2.8 to 2.13 inclusive, 3.1, 3.2, 3.4 to 3.6 inclusive, 4.9 to 4.12 inclusive and 4.14 to 4.16 inclusive.

This supersedes TD 9/93 paragraph 1.24 and IAN 149/11 paragraph 2.2.2.

Road camber

2.3.5 A minimum distance of 3m in cross section shall be provided between changes in crossfall or superelevation within any given cross-section, the exception is at connector road nosings where two changes in crossfall or superelevation are located on either side of the nose.

This amends IAN 149/11 paragraph 2.4.4, bullet point 4.

2.3.6 Where an adverse camber is to be retained between the new lane 1 and 2, there is no requirement to move the crown line from its existing position to co-locate it with the road marking position. However, if pavement works are being carried out such as re-surfacing or strengthening then consideration should then be given to relocating the crown line or removing the adverse camber. The decision making process shall be recorded in the DSR.

2.4 Layout of grade separated junctions

General

- 2.4.1 This section shall be read in conjunction with TD 22/06 Layout of Grade Separated Junctions and IAN 149/11 Existing Motorway Minimum Requirements. This section increases the scope of relaxations provided in TD 22/06, and gives requirements and guidance for modification of grade separated junctions and interchanges on motorways. Reference should be made to IAN 149/11 section 3, which details the relaxations that may be applied to reduce the footprint of the connector roads.
- 2.4.2 The following paragraphs in IAN149/11 are superseded:
- 3.1.3
 - 3.3.2
 - 3.3.3
 - 3.3.4
 - 3.3.9
 - 3.3.10
 - 3.3.11
 - 4.7.5
- 2.4.3 The following paragraphs and figure in TD22/06 are amended:
- 2.30
 - Figure 2/4.5
 - 4.22
- 2.4.4 The widening of connector roads shall be considered where required and may form part of a SM scheme with the agreement of the Highways England Project Manager. In order to achieve the optimal junction layout on an existing motorway, a balance should be reached between what is required by TD22/06 and what is achievable within the scheme constraints, whether physical (particularly the existing carriageway area) or value for money. This supersedes IAN 149/11 paragraph 3.1.3 and 3.3.11.
- 2.4.5 The layouts provided in TD22/06 apply a consistency across the motorway network, and customers are familiar with these layouts. The provision of a substitute layout that differs from that derived from the use of TD22/06 Figure 2/3 MW and Figure 2/5 MW, as described in paragraphs 2.4.6 and 2.4.7 of this IAN, is an acceptable relaxation. This supersedes IAN 149/11 paragraph 3.3.2 and 3.3.9.

Design of merges

2.4.6 If the indicated layouts from TD 22/06 Figure 2/3 MW are not practicable within the scheme constraints, the layout may be amended by either of the following methods:

- a) the Road Class in TD22/06 Table 4/3 may be relaxed to the 'Rural All-Purpose 120kph' as described in paragraphs 3.4.4 and 3.4.5 of IAN 149/11.

This amends TD22/06 paragraph 4.22.

The layout type and geometric parameter shall be recorded in the DSR.

- b) where constraints exist (physical, environmental, operational or financial) the provision of a substitute layout that differs from that defined in TD22/06 Figure 2/3 MW may be used, and is an acceptable relaxation, with the exception of a merge Layout A, B or D as a substitute for a Layout F or G which shall be endorsed by the PSCRG.

The use of Layout H as a substitute for a Layout F is a permitted relaxation. This amends TD22/06 paragraph 2.30 and Figure 2/4.5.

The layouts derived from TD22/06 Figure 2/3 MW and any substitute layouts proposed shall be recorded in the DSR. The DSR shall also record the constraints on any given layout, justifying the proposal for a substitute layout, and any impacts the proposed layout will have on network performance and safety.

This supersedes IAN 149/11 paragraph 3.3.3 and 3.3.4.

- c) A combination of relaxations as described in paragraphs 2.4.6 a) and b) for the type of layout at the same location requires a departure from standard.
- d) A nose ratio that differs from that defined in TD22/06 Table 4/3 is an acceptable relaxation. A sufficient nose width to accommodate road markings to TSRGD diag 1042 shall be maintained. The DSR shall record the nose ratio, the justification and any impacts the proposed layout will have on network performance. This relaxation may be used in combination with other relaxations listed in paragraph 2.4.6.

Design of diverges

2.4.7 If the indicated layouts from TD 22/06 Figure 2/5 MW are not practicable within the scheme constraints, the layout may be amended by either of the following methods:

- a) The Road Class in TD22/06 Table 4/4 may be relaxed to the 'Rural All-Purpose 120kph' as described in paragraphs 3.4.6 to 3.4.8 of IAN 149/11.

This amends TD 22/06 paragraph 4.22.

The layout type and geometric parameter shall be recorded in the DSR.

- b) The provision of a substitute layout that differs from that defined in TD22/06 Figure 2/5 MW may be used, and is an acceptable relaxation, with the exception of a diverge Layout C, B or A as a substitute for a Layout E and a diverge Layout

A as a substitute for a Layout D. These substitutions shall be endorsed by the PSCRG.

The layouts derived from TD22/06 Figure 2/5 MW and any substitute layouts proposed shall be recorded in the DSR. The DSR shall also record the constraints on any given layout, justifying the proposal for a substitute layout, and any impacts the proposed layout will have on network performance and safety.

This supersedes IAN 149/11 paragraph 3.3.9 and 3.3.10.

- c) A combination of relaxations as described in paragraphs 2.4.7 a) and b) for the type of layout at the same location requires a departure from standard.
- d) A nose ratio that differs from that defined in TD22/06 Table 4/4 is an acceptable relaxation. A sufficient nose width to accommodate road markings to TSRGD diag 1042 shall be maintained. The DSR shall record the nose ratio, the justification and any impacts the proposed layout will have on network performance. This relaxation may be used in combination with other relaxations listed in paragraph 2.4.7.

2.4.8 Not used.

2.4.9 Not used.

Merge over-run

2.4.10 For an ALR scheme paragraph 4.7.5 in IAN 149/11 does not apply, as an ALR scheme does not have a hard shoulder.

2.4.11 Merge connector roads at junctions with TJR shall be assessed to identify an appropriate level of merge over-run provision. The inclusion of over-run provision will not require a departure from standard or aspect not covered by standard to be submitted. Over-run assessment and provision shall be included in the DSR and endorsed by the PSCRG.

2.4.12 At TJR locations, assessment and monitoring of the existing merges shall be carried out (including consultation with the regional control centre (RCC)) where a type A, D or B layout is currently in place and is to be retained.

Where merging issues are identified then a merge over-run should be provided.

The over-run assessment and provision shall be endorsed by the PSCRG and the decision making process recorded in the DSR.

Intra-junction layout

2.4.13 Between the diverge and merge of a junction (intra-junction), ALR schemes may either have through junction running or a lane drop/lane gain arrangement. Paragraph 2.2.3 provides information on the assessment of which layout to use.

New junctions

- 2.4.14 Where a new junction is proposed on a SM, then the design of the junction shall be undertaken to the relevant RADs in the DMRB and not the relaxed requirements in this IAN.

2.5 Cross sections, headroom and roadside features

General

2.5.1 This section shall be read in conjunction with TD 27/05 Cross-Sections and Headrooms and IAN 149/11 Existing Motorway Minimum Requirements.

2.5.2 The following sections in IAN 149/11 are not applicable:

- 4.5.1
- 4.5.2
- 4.6.2
- 4.6.6
- 4.7
- 4.7.1
- 4.7.2
- 4.7.3
- 4.7.4
- 4.7.5
- 4.7.6
- 4.7.7
- 4.8.4

2.5.3 The following sections in IAN 149/11 are superseded:

- 4.6.1
- 4.6.4

The following section in IAN 143/11 is not applicable and as such does not require a departure from standard:

Section 3, 4th paragraph, 2nd sentence *'Where there are no Non-Motorised User issues, such as some motorway widening without impacts on side roads or public rights of way, a Departure from Standard for exemption from HD 42/05 should be applied for.'*

The following sections in TD27/05 are superseded:

- 4.11.13

The following sections of TD19/06 are superseded:

- 3.15
- 3.37

Verges, edge detail and omission of hard shoulder

2.5.4 Where there is no edge restraint, such as a kerb or drainage channel then a nearside 500mm hardstrip and 300mm offside hardstrip shall be provided, as a minimum, for both flexible and rigid pavements. The nearside dimension may be relaxed to 300mm if endorsed by the PSCRG. Where an edge restraint is provided, such as a kerb or drainage channel for example, then there is no requirement for a hard strip. If a drainage channel is provided adjacent to a concrete carriageway then the drainage

channel shall be tied to the carriageway pavement. The omission of a hard shoulder does not require a departure from standard.

Any additional pavement width should be allocated to the provision of a near side hard strip rather than increasing the ALR lane widths in Table 2.5.1.

Where there are existing paved areas in the verge which are 'attractive' for customers to stop, mitigations such as frangible bollards should be considered to deter illegal stops. The mitigations should not prevent emergency stops.

Where ALR is utilised, the requirement to hatch an emergency access width/hard strip does not apply where a hard shoulder has been converted into a running lane and a hardstrip is also provided due to the available cross section. However, where the proposed emergency access/hard strip is between 1.5m and 3m wide, then consideration should be given to hatching the emergency access/hard strip. The decision making process shall be recorded in the DSR, and endorsed at the PSCRG. Where a hard shoulder is present on a merge connector road, this will need to be hatched where the width drops below 3m and the hatching should terminate at the entry datum point. Where a hard shoulder is present on a diverge connector road, this will need to be hatched from the exit datum point to where the width becomes greater than 3m.

- 2.5.5 There shall be no loose stone, or filter drain material within 1000mm of the trafficked edge of the carriageway edge line. Proprietary methods of stabilisation may be used, the decision making process for the method of stabilisation shall be recorded in the DSR.

Traffic lane widths

- 2.5.6 The minimum dimensions for traffic lane widths are given in Table 2.5.1. These dimensions are for converting a 3 lane motorway with a hard shoulder to a 4 lane ALR motorway and shall be measured as per TD 27/05. This supersedes IAN 149/11 paragraph 4.6.1.
- 2.5.7 The hierarchy for increasing lane widths is to allocate additional width to Lane 2, then Lane 3 and finally Lane 4. This supersedes IAN 149/11 paragraph 4.6.4.

Re-locating the lane lines (without resurfacing) may result in the proposed wheel tracks moving over the existing longitudinal joints in the final solution. The impact on the joints in both the surface and the binder course, and mitigations shall be recorded in the DSR. Refer to paragraph 2.2.21 regarding residual life requirements. The longitudinal joints being located within the wheel track does not require a departure from standard. Where lane widths below 3.65m are used the wheel track zones shall be 600mm wide at 2050mm centres, centred in the lane.

Re-locating the lane lines (with resurfacing) shall be in accordance with the requirements of SHW Clause 903.21SR identified in IAN 154/12.

Table 2.5.1: Minimum dimensions for traffic lane widths

Lane 1 (m)	Lane 2 (m)	Lane 3 (m)	Lane 4 (m)
3.65	3.50	3.40	3.20

Central reserves

- 2.5.8 Minimum central reserve widths are as shown in Table 4-1 of IAN 149/11.
- 2.5.9 Reductions in central reserve width shall be applied as described in IAN 149/11 paragraphs 4.4.2 to 4.4.5.
- 2.5.10 If works are undertaken in the central reserve, the use of unbound material as the surface treatment should be avoided, and where it is included the material should be stabilised. The materials used shall be agreed at the PSCRG and the decision making process shall be recorded in the DSR.

Vehicle restraint system (VRS) set back

- 2.5.11 The set back is the lateral distance between the traffic face of a safety barrier and as appropriate:
- nearside: the back of the nearside hardstrip (greater than 600mm) or hard shoulder
 - nearside: the kerb face for roads without a nearside hardstrip (or hardstrip less than 600mm) or hard shoulder
 - nearside: the trafficked edge of the edge line for roads without a hardstrip (or hardstrip less than 600mm), hard shoulder or kerb.
 - offside: the trafficked edge of the edge line or the kerb face where there is no edge line

On the nearside where there is no hard shoulder and the hard strip is less than 600mm wide, then the setback shall be measured from the trafficked edge of the edge line.

The minimum dimensions to be used are given in Table 2.5.2.

Table 2.5.2: Set-back

Location	Desirable minimum set-back value(mm)	Available relaxations at sites described in footnotes
In verges with no adjacent hardstrip or hard shoulder (i.e. < than 600mm width hardstrip)	1200	Note (i), (ii), (iv)
In verges with an adjacent hardstrip or hard shoulder (i.e. >=600mm width hardstrip)	600	Note (iii)
Central reserves	1200	Note (i), (ii), (iv)

Notes

Highways England may, where justified, consider relaxations to set-back as follows:

- relaxation to 600mm for roads of speed limit 50mph or less (including temporary mandatory speed limits)

- ii. relaxation to 600mm at existing roads with physical constraints (e.g. a structure) where it would be difficult to provide the desirable value
- iii. relaxation to 450mm is permitted where it is considered necessary to position the VRS away from the edge of an existing embankment in order to provide support to the foundation
- iv. relaxation to 1000mm is permitted where space is limited for extended lengths

If the reduction in setback creates a forward visibility departure (below the relaxations allowed in section 2.3), then a departure shall also be submitted for the reduction in setback. The application of a relaxation in setback shall be recorded in the DSR.

For the purposes of measurement of set-back, an emergency refuge area (ERA) shall be treated as hard shoulder. This supersedes TD 27/05 paragraph 4.11.13.

Vehicle restraint systems (VRS)

2.5.12 The achievement of the road worker safety objective is expected to be reliant on the reduction of unplanned maintenance activities provided by the provision of the central reserve concrete barrier. A central reserve rigid concrete barrier shall be provided on all ALR schemes in accordance with TD 19/06. Provision of a central reserve rigid concrete barrier shall be considered for CM schemes, but is not mandated. A paved central reserve is the preferred option, but this does not preclude the use of a soft central reserve, or a combination of both. An assessment shall be made of the benefits/disbenefits of both hardened and soft central reserve options to establish the appropriate solution. The chosen construction type for the central reserve shall be endorsed by the PSCRG and recorded in the DSR. Where a paved central reserve is provided it may be desirable to provide a near side hard strip in excess of that described in paragraph 2.5.4 if the cross section is wide enough to support this.

If in an emergency a customer is unable to reach a refuge area, they may consider pulling their vehicle onto the verge. For this reason, although gaps between sections of VRS of less than 20m shall be closed, larger gaps should not be closed.

This supersedes TD 19/06 paragraph 3.15.

At post mounted entry slip signals (ESS) sites, the lack of protection by VRS, or not providing the full lead in length, does not require a departure from standard. Each site shall be assessed and the decision to either provide (including the amount of provision) or not provide a VRS and the decision making process shall be recorded in the DSR. VRS provision requirements at ESS sites applies to both ALR and CM schemes.

2.5.13 Full height anchorages shall only be used at ERA locations where VRS is required and, where there is insufficient room for a 10m full height overlap of VRS. They shall not be used facing oncoming traffic, unless behind another restraint system.

Refuge areas

2.5.14 A refuge area is defined as a place (or facility) where customers may stop in an emergency.

Appropriate refuge areas are:

- a motorway service area
- a hard shoulder on a diverge connector road
- a hard shoulder within a junction (lane drop/lane gain only)

- a bespoke facility, such as an ERA

2.5.15 The following features shall not be considered formal refuge areas:

- maintenance hard standings, unless they meet the requirements presented in paragraphs 2.5.26 to 2.5.47
- verges
- hard shoulders on merge connector roads

2.5.16 Emergency roadside telephones (ERT) on ALR schemes shall be provided at:

- a hard shoulder within a junction (lane drop/lane gain only)
- ERA - see paragraph 2.5.26 to 2.5.47

This amends TA 73/97 paragraph A2.2.

2.5.17 Not used.

2.5.18 Marker posts shall not direct customers to ERTs unless there is a continuous hard shoulder between the marker post and the ERT.

Refuge areas on links between junctions

2.5.19 On links between 'through junction running' junctions at least one refuge area shall be provided, where the distance between the tip of the merge nose of the upstream junction and the tip of the diverge nose of the downstream junction is more than 1.5km. On link lengths greater than 1.5km where refuges are not proposed then this shall be endorsed by the PSCRG and recorded in the DSR.

2.5.20 If the upstream junction is diverge only, this distance shall be measured from the tip of the diverge nose.

Refuges on diverge connector roads

2.5.21 Where a refuge area is provided on a diverge connector road (which may be a hard shoulder), it shall be a suitable length and width of bound surface and shall wherever possible be an existing bound surface that may be safely entered and exited. Where a refuge area is not provided this does not require a departure from standard. The decision to provide (or not) a refuge area on a connector road, and what that provision should be shall be agreed with stakeholders and endorsed at the PSCRG.

The refuge area shall be in the field of view of a pan-tilt-zoom (PTZ) camera with no blind spots as defined in paragraph 2.6.30. The decision making process regarding the location, layout and construction shall be recorded in the DSR. ERTs shall not be provided in refuge areas on diverge connector roads.

Intra-junction refuges

2.5.22 Intra-junctions may be identified as having a refuge area if:

- there is a suitable length and width of hard shoulder, that provides a safe area of refuge, that may be safely entered and exited. The decision making process shall be recorded in the DSR; and

- an ERT is provided next to the above area. The ERT should not be conspicuous from the connector roads so as to discourage pedestrians from crossing the carriageway. The ERT should be located away from the back of diverge nose where customers may overrun onto the hard shoulder.

2.5.23 Where there is no available hard shoulder within a junction, an ERA may be provided if the distance between the decision point at the tip of the diverge nose and the next place of refuge is greater than 2.5km and it satisfies the requirements of paragraphs 2.5.26 to 2.5.47. The ERA should be centrally positioned between the merge and diverge (subject to stopping sight distance (SSD) mitigation requirements) and feature an ERT to discourage pedestrians walking from the ERA. The decision making process shall be recorded in the DSR.

Frequency of refuge areas

2.5.24 Throughout an ALR scheme, refuge areas shall be provided such that a customer never has to drive more than 2.5km from a decision point to a refuge area. A decision point shall either be an ERA or the nose of a diverge slip road. Between ERAs, the distance should be measured between the stopping area within each adjacent refuge area, e.g. not from the end of the tapers. Where a motorway service area (MSA), or refuge area on a diverge slip road has been identified, the distance should be measured to the location where a customer may safely stop within the MSA or on the diverge slip road. When measuring from these locations the distance should be taken from the decision point, i.e. the diverge nose or from the end of the hard shoulder in a junction, to the next safe area of refuge.

On the approach to a junction, the hard shoulder within the junction should not be included in the 2.5km spacing calculation, rather the refuge area on the diverge slip road or the slip road itself (where no refuge area provision is made) should be included in the calculation.

Refuge areas on connector roads that lead directly to another route (i.e. do not lead to a junction where access may be made back to the mainline) should not be included in the 2.5km spacing calculation. Where connector roads in these locations are included in the spacing calculation this shall be endorsed at the PSCRG.

2.5.25 The distance between refuge areas shall not exceed 2.5km.

Emergency refuge areas (ERAs)

2.5.26 ERAs may either be bespoke facilities or converted from an existing facility, for example a wide load bay.

2.5.27 ERAs on gradients greater than 2% or immediately upstream of a gradient greater than 2% should be avoided wherever practicable. Where practicable, ERAs should not be sited on the outside of a right hand curve with a radius of less than the appropriate value for the design speed of the motorway given in Table 3-1 in TD 69/07.

2.5.28 Where ERAs are located on gradients greater than 2% or immediately upstream of a gradient greater than 2%, the designer shall determine that the frequency and presence of refuge areas is appropriate from a safety and network performance perspective. The decision making process shall be endorsed by the PSCRG and recorded in the DSR.

2.5.29 An ERA shall not be located between the secondary advance direction sign (ADS) sign and a diverge connector road. This requirement is to prevent customers confusing the ERA with a diverge connector road. Fixed taper points for TTM shall not be located such that ROTTM signs are positioned in an ERA. Fixed taper points shall also not be located within an ERA footprint.

2.5.30 An ERT shall be provided at each ERA. The ERT should be located next to the mid-point of the main stopping area of the ERA. If a vehicle restraint system is located adjacent to the ERT there is no requirement to provide access as per Figure 3.11 TD19/06, providing the ERT installation is designed for access over the restraint system.

This supersedes TD 19/06 Clause 3.37.

2.5.31 Access to the ERT shall be provided for mobility impaired customers.

2.5.32 Where ERAs and therefore ERTs have to be staggered, then an assessment of the risk of pedestrians crossing the motorway shall be undertaken and detailed in the DSR. Consideration should be given to appropriate mitigation. Where concrete barrier is installed the risk of pedestrians crossing the carriageway is reduced, as the concrete barrier acts as a mitigation removing the need to locate the ERAs and hence ERTs opposite each other. This supersedes TA 73/97 paragraph A2.2.

2.5.33 The design length for an entry taper shall be a minimum of 25m. If an ERA is unoccupied a customer is able to use the stopping area, or potentially even part of the exit taper, to bring the vehicle to a standstill.

2.5.34 The design length for the stopping area shall be 30m. This will provide room for multiple vehicles, in particular to allow an LGV to be recovered by an LGV recovery vehicle.

2.5.35 The design length for the exit taper shall be a minimum of 45m.

2.5.36 The width of an ERA shall be 4.6m.

2.5.37 Where ERAs are located on gradients greater than 2% or immediately upstream of a gradient greater than 2%, then the designer shall determine that the above dimensions are appropriate, and whether any additional mitigation is required. The decision making process shall be endorsed by the PSCRG and recorded in the DSR.

2.5.38 The ERA shall be surfaced in accordance with HD36. The construction type should be the same as that of the adjacent carriageway but a reduced pavement thickness, designed to 5msa, is acceptable. The designer shall consider the operational and safety benefits of providing a concrete surface. Concrete may be used for ERA construction provided sub-base drainage is maintained. This does not constitute a departure from standard but shall be included in the DSR.

2.5.39 Each ERA shall have the following signs:

- “No stopping except in an emergency” (2 no.) Traffic Signs Regulations and General Directions (TSRGD) diag 642.3. The first sign shall be located immediately downstream of the ERT and mounted above the NP 2937 sign. The second sign shall be located at the start of the exit taper and angled to face the centre of the ERA at a 1.5m mounting height.



- NP 2938 “Emergency refuge area” with SOS phone picture (1 no.). This sign (Emergency refuge area and SOS symbol) is authorised for use with a 100mm minimum and 400mm maximum ‘x’ height. Sign NP 2938 shall be located in the verge at the start of the ERA entry taper. Where this is not practicable the sign may be located up to 20m upstream of the start of the entry taper.



- TSRGD diag 2713.1 Advanced SOS phone signing shall be provided ½ and 1 mile or 1/3 and 2/3 mile upstream of each ERT. Where it is difficult to place signs in accordance with the above combinations, then the distances may be varied in accordance with TSRGD Schedule 16, item 6.



- NP 2937 “Driver must use SOS phone and await advice to re-join main carriageway” (1 no.). This sign is authorised for use with a 50mm ‘x’ height only and shall be located immediately downstream of the ERT at a 1.5m mounting height.

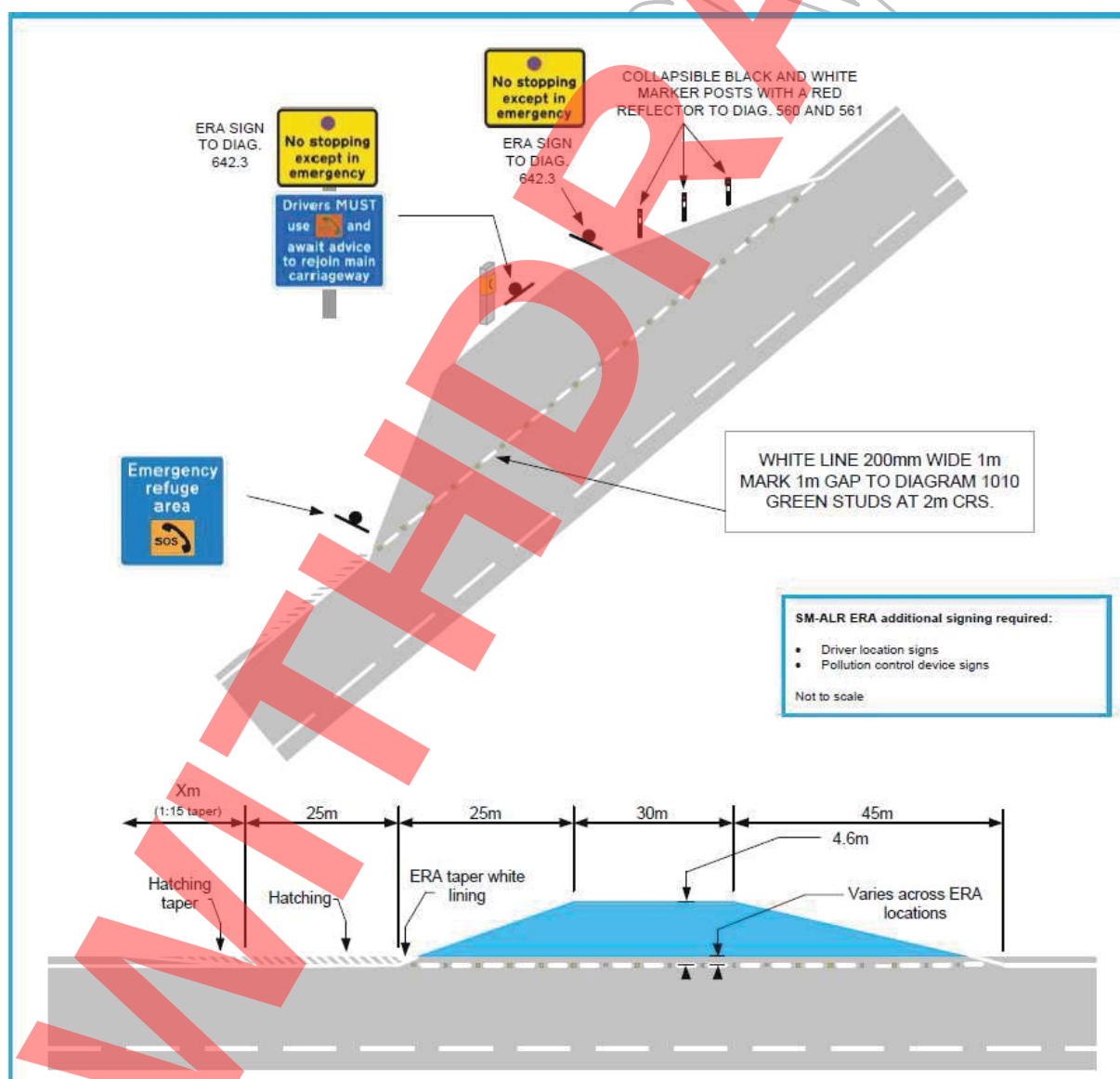


- Three collapsible black and white marker posts with a red reflector to diagrams 560 and 561 shall be provided at each ERA. They shall be evenly spaced on the exit taper in front of the VRS.
- Driver location signs shall be located next to an ERA, co-located with the existing distance marker post. If the distance marker post is not located in the

ERA, then a supplementary driver location sign shall be provided within the ERA. The sign should be clearly visible from the ERT.



Figure 2.5.1 Illustrative drawing of an ERA



2.5.40 No road markings are required within an ERA.

2.5.41 Between the ERA and lane 1, the carriageway markings shall be to diagram 1010 and incorporate green road studs in accordance with Chapter 5 of the TSM. Where a hard strip or hard shoulder width is 1.05m or greater is present in advance of an ERA then the hard shoulder/hard strip shall be hatched out to diagram 1040.5 as shown in Figure 2.5.1.

ERA stopping sight distance (SSD)

2.5.42 Sufficient SSD for customers entering and exiting the ERA shall be required. A one step relaxation below desirable minimum as defined in chapter 2 and Table 3 of TD 9/93 is acceptable and the proposed SSD shall be recorded in the DSR.

2.5.43 The SSD shall be measured from the start of the exit taper, 2.4m back from the traffic edge of the 1010 edge line, to an object height of 1.05m. Entry SSD shall be measured from the centre of lane 1 to a point perpendicular to the ERT, 2.0m back from the traffic edge of the 1010 edge line, to an object height of 1.05m, measured at the midpoint of the full width section of the ERA.

Other ERA requirements

2.5.44 There is no requirement for lighting an ERA.

2.5.45 No monitoring loops or other detection system are required within an ERA. The full extent of each ERA shall be fully included within the field of view of a PTZ closed circuit television (CCTV) camera with no blind spots as defined in paragraph 2.6.30. The associated ERT shall represent a minimum of 10% of screen height.

2.5.46 The designer shall liaise with the MSP to ensure that where appropriate, provision is made in the design to support ERA gritting operations. One potential measure is the provision of an indicator post in advance of the ERA to indicate the point to commence accurate gritting of the ERA.

2.5.47 Refer to paragraph 2.7.23 e) for ERA VMS requirements.

Observation platforms

2.5.48 Where an existing observation platform is present adjacent to an ALR running lane, then this shall be removed. New or reinstated observation platforms should only be provided on an ALR scheme where the Senior User has agreed with a stakeholder request to include a platform. The designer shall risk assess the alternatives and agree these with the relevant stakeholders and the PSCRG. Refer to MPI-32-082014 for further guidance on observation platforms.

Abnormal load bays

2.5.49 Where an existing abnormal load bay is present adjacent to an ALR link, then this shall be closed off with a vehicle restraint system or removed unless provision is made for safe and effective operation following consultation with NDD/Customer Operations (CO) and other relevant stakeholders. When this facility has to be removed an alternative suitable location should be provided on non ALR sections following consultation with NDD/CO and other relevant stakeholders unless it is

agreed that the need for a facility is no longer justified. Abnormal load bay proposals shall be endorsed by the PSCRG.

Other features

- 2.5.50 Where there are existing access and egress arrangements from the main carriageway (e.g. a works depot or turnaround point), early liaison is required with the users of the facility to ensure a safe and operable solution is incorporated in the ALR design.
- 2.5.51 The designer shall assess the potential time for traffic officers to reach live lane incidents taking into account existing turnaround points and junctions. The findings shall be reported to the PSCRG together with any potential interventions that may be necessary to allow traffic officers to meet their incident response targets.

Pavement (Non ERAs)

- 2.5.52 Structural assessment of the hard shoulder shall be carried out before it is used as a running lane following the principles in HD29. A deflectograph survey no more than 3 years old shall be used for the assessment, unless a Traffic Speed Deflectometer survey no more than 3 years old shows all of the data to be within category 1 or category 2 condition and there are no visible signs of structural deterioration such as rutting and longitudinal cracking. A visual inspection of the surface shall also be undertaken, this may be via a high definition video survey.
- 2.5.53 Where hard shoulder widening is required, the new pavement layer thicknesses should be designed in accordance with DMRB Volume 7 HD26 and IAN73. The same pavement layer thicknesses may be used for both bound and unbound materials. Care shall be taken to ensure continuity of sub surface drainage. Equivalent materials should also be used to match those currently in place. Hydraulically bound mixture shall not be placed beside unbound materials, where the continuity of sub surface drainage would be affected.

2.6 Technology

General

- 2.6.1 Roadside technology provided for SM schemes shall have the functionality to enable software to be upgraded, faults to be diagnosed and equipment reset, remotely. Remote fault diagnostics shall allow diagnostics down to a unit or module level to enable the fault to be fixed on the first visit. This will assist in minimising risk exposure to road workers, and traffic management costs, through reducing visits to the roadside.
- 2.6.2 Where existing technology is required to form part of an ALR or CM scheme it shall be compatible with the transmission protocol implemented as part of the scheme. Where this existing equipment is not compatible it shall be upgraded or replaced.

Vehicle detection system

- 2.6.3 This section should be read in conjunction with TD 45/94 and HD 20/05.
- 2.6.4 The following clauses in HD 20/05 are superseded:
- 3.9
 - 3.11
 - 3.12
- 2.6.5 A vehicle detection system shall be provided, to include all running lanes, to support; traffic counting, classification, queue protection and congestion management (VMSL). The detection system shall include 1 mainline counting site per link to be used for counting and classification of vehicles. This site should be aligned across all lanes on both the A and B carriageways. The detector system chosen may require the use of multiple detector types to provide the required system performance. The advice of the Overseeing Organisation may be sought on the detector types and system used.
- 2.6.6 The use of non-loop based detection technologies is desirable on the main line for SM schemes. Loop based detection on connector roads may be more cost-effective.
- 2.6.7 Where non-loop based detection technologies are considered for use, they shall not compromise the required functionality of the vehicle detection system. The technology shall be approved for use for the required application(s) and documented performance capability shall be provided. The detection technology shall be designed and installed in accordance with the manufacturer's instructions.
- 2.6.8 Non-loop technologies may be able to detect traffic on both carriageways from one unit. In this case placement of these detectors should be harmonised across both carriageways in accordance with the spacing requirements to minimise roadside infrastructure. Designers shall refer to the manufacturer's instructions for the optimum mounting height, setback and minimum separation from gantries and structures in locating the detectors to achieve the required performance.
- 2.6.9 Paragraphs 2.6.10 to 2.6.18 apply to inductive loops. They, however, also indicate the level of provision required should an alternative to inductive loops be used. Where there is a conflict between detection location requirements and manufacturer's requirements for non-loop detectors, then the manufacturer's requirements shall take precedence and a departure from standard shall be submitted.

2.6.10 Positioning and spacing are the two steps that are taken sequentially in determining the locations of detector sites for the vehicle detection system. These are defined as follows:

- a) positioning is determining the location of a detector site in relation to a signal; and
- b) spacing is determining the location(s) of detector sites between signals

2.6.11 The objective is to position detectors where they are required to detect traffic queues. Each signal site should have a detector located as close as practicable to that signal so that the signal settings relate as closely as possible to the traffic conditions. This signal is referred to as the 'reference signal' for that detector. Where inductive loops are used, loops should be located 10m upstream of the reference signal. If this is not practicable due to site constraints, as a result of design optimisation, or non-loop based detectors are used, then the detector site shall be provided within 50m upstream to 10m downstream of the reference signal.

2.6.12 Detector sites shall be spaced as follows:

- a) sites between reference signals shall be spaced at regular intervals of 500m +100m/-200m
- b) the overall average detector site spacing for a scheme shall be 500m +50m/-100m

2.6.13 Detectors on diverge connector roads shall be provided. Typically, they should be located 100 metres downstream of the diverge tip of nose, but as a minimum not less than 50 metres downstream of the diverge tip of nose, or if provided, within 10 metres of diverge connector signals.

2.6.14 For diverge connector roads the following requirements should be considered:

- a) that there is sufficient distance from the diverge tip nose to the detector site, such that exiting customers may safely stop without advance warning of a queue that is slightly short of the loop
- (b) that the detector is located at such a distance from the top of the connector (typically at least 100m) that there is sufficient queue to justify setting a 'Queue on slip' message before it triggers; and
- (c) where feasible they are cabled to the same cabinet as the nearest main carriageway detector site

2.6.15 On merge connector roads, the detectors shall be provided at a point downstream of entry slip signals and at a minimum distance of 100 metres upstream from the merge tip of nose. Where feasible they should be cabled to the same cabinet as the nearest main carriageway detector site. Detectors shall not be sited downstream of the final lane gain or merge information signs.

2.6.16 Within motorway to motorway link roads, detectors shall be provided at a minimum distance of 100 metres from the diverge and merge nose tips. Between these two sites the requirements in paragraph 2.6.12 apply.

2.6.17 Where provided, inductive loops shall be located to ensure the maximum loop feeder length does not exceed a measured length of 200m.

- 2.6.18 Detector sites in the vicinity of junctions where ramp metering is to be installed or retained should be positioned in accordance with the guidance in MCH 2470.

Customer compliance

- 2.6.19 Each ALR and CM scheme shall develop a compliance strategy. This will identify any enforcement requirements that need to be included in the scheme. In order to display variable mandatory speed limits a Statutory Instrument must be in place.

Site data

- 2.6.20 Site data shall include the implementation of speed and flow threshold levels (rising and falling) for congestion management algorithms to set appropriate speed limit aspects.
- 2.6.21 Applications for site data changes should be made at least 1 year in advance of the requirement to allow for inclusion in the Software Maintenance Contractor programme.
- 2.6.22 MCH 1596 provides guidance on the procedures to be followed when planning and implementing changes to site data.

Transmission system

- 2.6.23 The existing transmission infrastructure and ducts should be used wherever practicable. The philosophy adopted for the design of the transmission system shall be logged in the DSR.
- 2.6.24 Early liaison shall be carried out with Highways England's telecommunications service provider in order to ensure that the transmission system design meets the requirements of the scheme. The impact of the scheme on access and egress to transmission stations (which require 24/7 access) and other telecommunications assets should be assessed early in the design process to determine the need for re-location or provision of 'off network' access.
- 2.6.25 Not used.

Cabinets

- 2.6.26 With the exception of enforcement cabinets, all cabinets provided for ALR and CM shall meet Highways England requirement specifications. A departure from standard shall be sought if cabinets which do not meet these requirements are to be used. Advice should be sought from the Overseeing Organisation for enforcement cabinet requirements.

Looming in 600 cabinets shall only be provided to support the equipment installed as part of a SM scheme.

Ambient light monitors (ALM)

- 2.6.27 ALMs shall be provided at appropriate intervals to control the brightness levels for the VMS and lane control signals. As a minimum, ALMs should be provided at each gateway and intermediate gantry. ALMs shall be provided on a hinged column adjacent to the gantry site.

CCTV general surveillance

2.6.28 TD 17 and MCH 2530 provide information on CCTV general surveillance. Comprehensive CCTV coverage shall be provided for CM schemes. Comprehensive is defined as the ability of operators to see in excess of 95% of the total scheme area and be able to interpret the images correctly. A 1.75m wide cube target should represent a minimum of 5% of screen height and width. CCTV coverage for CM shall include ERTs. CCTV requirements for ALR schemes shall be provided in accordance with paragraphs 2.6.29, 2.6.30 and 2.6.34.

2.6.29 Pan tilt zoom (PTZ) CCTV coverage of the main carriageway, refuge areas and maintenance hard standings (where provided) shall form part of an ALR scheme.

2.6.30 PTZ CCTV cameras deployed for ALR schemes shall provide full coverage of the mainline carriageway running lanes, with no blind spots. A blind spot exists if a 1.75m wide cube target (or the remaining visible area of this target when obscured) does not represent at least 5% of picture height and width. This will ensure that a stranded car anywhere on the main carriageway should be readily viewed by a camera. This may be achieved by making use of the cameras' pan, tilt and zoom capability.

The coverage shall be such that an operator may interpret correctly the nature of each incident within the designed viewing range at all times of day and night, and in all ambient lighting levels whether the carriageway is lit or not, as they are used to confirm the location of incidents on the main carriageway. To achieve this, at the extreme of the required coverage and maximum zoom, a 1.75m target should represent a minimum of 5% of screen height. There shall be no blind spots (as defined above) in a refuge area. Refer to paragraph 2.5.45 for additional CCTV requirements for ERAs.

The designer shall determine the locations of cameras required for daytime and night time conditions. Camera locations should be agreed with the RCC. The designer shall seek guidance from the Overseeing Organisation regarding the use in unlit areas of enhanced performance cameras ("zero-light" cameras).

2.6.31 The designer shall consider whether existing PTZ CCTV cameras may be used to provide the coverage requirements of ALR or CM as applicable.

2.6.32 The location for the mounting of PTZ CCTV cameras is not stipulated and shall be determined to provide the coverage requirements for ALR or CM (as applicable) whilst taking into account environmental considerations, image stability, and whole life costs including providing suitable maintenance access.

2.6.33 Not used.

2.6.34 CCTV coverage for ALR shall include refuge areas (except at Motorway Service Areas (MSAs)), ERAs/ERTs, and maintenance hard standings (where provided).

2.6.35 Information shall be provided to the operator so that they have confirmation of a camera's reference number and geographic location.

Ramp metering

2.6.36 Refer to MPI-33-082014 for guidance on how to assess Ramp Metering (RM) sites on SM schemes.

2.6.37 Not used.

2.6.38 Not used.

2.6.39 Not used.

Lighting

2.6.40 For SM schemes where the motorway is not currently lit, the designer shall determine if any lighting assessments have been undertaken and whether there has been significant night-time personal injury collisions (PICs). The designer shall discuss with Highways England's Lighting Team and determine if there is any justification to introduce road lighting. Any decision to introduce road lighting shall be endorsed by the Highways England Project Manager, PSCRG and the Highways England Lighting Team.

2.6.41 Existing sections of lit motorway need to be assessed individually in order to ascertain as to whether they should remain lit. Collision risk increases as customers approach a junction. This is due to an increase in lane changing and the time pressures associated with making what is perceived to be an irreversible decision, that is, to exit. On connector roads, collision risk is further increased due to the speed differential between vehicles. Therefore the assessment of schemes should be divided up in to sections as follows.

Starting at the geographical centre of a junction:

- First boundary = end of motorway, nominally the give way line on the gyratory or intersection
- Second boundary = 5 seconds travel time in advance of the give way line
- Third boundary = the maximum length of connector road that may be lit without triggering the need to light the main carriageway
- Fourth boundary = night time sighting location of secondary ADS. Nominally 300m upstream of a secondary ADS
- Fifth boundary = night time sighting location of primary ADS. Nominally 300m upstream of a primary ADS

2.6.42 Lighting shall provide an economically sustainable solution or it is at risk of switch off prior to end of life. Therefore each section shall be assessed in accordance with the core TA 49 principles. For replacement lighting, that is, where new columns are installed at locations where existing lighting is removed, the whole life benefits shall exceed the whole life costs by a factor of at least two. For existing lighting, that is, where the existing lighting columns are utilised, the benefits shall exceed the operating costs. In the case of existing lighting, if the evidence suggests there is no longer a justification for lighting, the IAN167 process will provide the evidence needed to support the conclusion to remove lighting (see paragraph 2.6.43 below).

The primary data source used for the predicted benefits of road lighting (collision savings) shall be the night time collisions over last 5 years. Only collision savings for lighting of 24% on connector roads and 10% on the main carriageway shall be used unless substantive evidence to the contrary is provided. The valuation of night-time

motorway collisions should be taken from the WebTAG document unit 3.4.1. WebTAG is not necessarily updated each year so an inflation figure may be derived by comparing average value of prevention of all injury collisions on motorways in successive years from "Reported Road Casualties Great Britain".

Detailed analysis of collision contributory factors (or absence of contributory factors) is not necessary where the high level initial analysis demonstrates that the case for retaining lighting is substantial. Where detailed analysis is justified, the designer shall exclude collisions where it is clear that lighting has had no significant impact on the probability or severity of a collision. IAN167 provides a list of primary contributory factors to determine which collisions should be excluded from the analysis.

- 2.6.43 Where a significant length of road lighting is to be removed as part of the SM scheme this shall be justified by application of the IAN167 process. IAN167/12 was written to reflect NDD area team governance arrangements for NDD sponsored schemes. It is recognised that a 12 month 'switch off' trial is not normally feasible for a SM scheme due to programme constraints. When applied to SM schemes, the stage 8 requirements shall be amended to ensure lighting removal is endorsed by the PSCRG. The communication strategy to support lighting removal shall not be stand-alone and shall be incorporated in the overall communications for the scheme.

Where the SM scheme is merely reducing the extent of lighting by an amount unlikely to be noticeable by the average customer, then the risk based justification shall be founded on the core principles of IAN167 and recorded in the DSR.

The process for removal of all lighting columns shall be implemented by the scheme. If this is not practicable, feasible or cost-effective, then the lighting should be switched off until such time it may be removed in conjunction with other future works.

- 2.6.44 Where lighting remains justified on some, but not all sections, a route lighting plan shall be developed that strikes a balance between operating the minimum length of lighting and avoiding excessive transitions between lit and unlit sections for the customer.

New lighting (defined as requiring new luminaires and/or columns) shall be designed in accordance with TD34 and shall meet the requirements for cost-effectively minimising customer collision risk while also minimising road worker safety risk.

The design shall provide the minimum light level for the driving task. Target light levels are:

- ME3a (M3) where junction separation is >3km
- ME2 (M2) where junction separation is <3km (or equal to 3km)

Note: no area/section shall be lit as a conflict area

In order to minimise design and installation costs, deviating from the minimum lighting levels, overall uniformity and longitudinal uniformity shall be considered, if it results in use of the existing lighting or lighting columns. Light levels up to 5% below the target light level and/or overall uniformity down to 0.39 and/or longitudinal uniformity down to 0.6 will not require a departure, but shall be recorded in the DSR. Target light levels may be further reduced with the use of high S/P ratio luminaires when re-using existing column locations, but this will require consultation with Professional & Technical Solutions (PTS) lighting specialists and a departure from standard.

The design shall maximise maintenance intervals and minimise maintenance activities.

Where new luminaires are installed, they shall be:

- Remotely controlled and monitored and controlled by a motorway road lighting control system (MORLICS) compatible central management system (CMS) that supports remote diagnostics, dynamic dimming & switch off and energy bill settlement as well as the potential to act as a pseudo-energy meter
- Fitted with a light source that has a predicted life-time in excess of the electrical test interval, thereby reducing the requirement for non-scheduled maintenance visits and facilitating multi-tasking when traffic management is in place for planned maintenance

Liaison with the maintenance service provider is required to identify whether there is an existing CMS system that may be adopted or modified. If a new CMS system is required to support the SM scheme then the PTS Lighting Specialists shall be consulted.

Where new columns are installed, it shall be assessed whether passively safe columns represent a better solution than non-passively safe columns protected by barrier. Both road user and road worker safety shall be assessed for these options using the scheme Hazard Log.

2.6.45 Not used.

2.6.46 Not used.

2.6.47 Not used.

2.6.48 Not used.

2.6.49 Not used.

Power and communications infrastructure

2.6.50 There should not be a presumption that there is a wholesale replacement of technology infrastructure as part of a SM scheme. Wherever practicable, existing power and communications infrastructure should be re-used where these assets have a residual life of 5 years or more after the opening of the scheme.

The designer shall ascertain load requirements for equipment sites and the design of the power distribution network should reflect these requirements. This supersedes Part 1 TA 77/97 Annex A, A6.6 Design - Equipment Loads.

The designer shall undertake a GD 04 assessment to identify if there is a requirement for any distribution network operator (DNO) electricity connections (exit points) to have enhanced security (dual feeds). This will improve the response time for getting the electricity supplies restored in the event of a fault on the DNO electricity network.

2.6.51 Each type of electrical equipment on a gantry shall be capable of being isolated independently from all other electrical circuits. This is to ensure that equipment such as CCTV, control signals, enforcement equipment and VMS units all work normally when sign lighting is switched off for maintenance. The Gantry Main Switch shall isolate all mains voltage powered equipment on the gantry.

2.6.52 Super-span portal gantries shall be capable of being isolated from either carriageway.

- 2.6.53 Where inductive loop detectors are used, cables from the far carriageway shall be routed via cross-motorway ducts where they exist and are proven. Where such ducts do not exist, consideration shall be given to slot cutting across both carriageways in accordance with MCH 1540.

Ducting

- 2.6.54 New cross carriageway ducts should only be installed where they are needed for cabling being installed as part of a SM scheme.

Where existing communications ducts through bridge structures are serviceable and have sufficient capacity for the SM scheme and any other planned technology requirements, there is no requirement to provide replacement or supplementary ducts. Where existing cross carriageway ducts or ducts through structures are not currently air tight they may still be utilised for the SM scheme subject to satisfactorily passing a mandrel test. A departure from standard is not required if the existing communications cross carriageway duct or bridge duct configuration is not a minimum of 4 x100mm ducts. The final ducting solution at each bridge shall be agreed with Highways England's telecommunications service provider and the MSP. Installation of duct brackets attached to underbridge decks or parapets is only permitted after all other options to reuse existing ducts or install new ducts in verges have been discounted and shall be agreed with the Technical Approval Authority.

The installation of cross carriageway ducts via trenching is only permitted if the ducts are being installed as part of a new carriageway construction or full reconstruction.

Security

- 2.6.55 The designer shall consider, in conjunction with the Senior User, the vulnerability of SM schemes to metal theft and the impact this type of theft would have on the integrity of the scheme. Schemes shall undertake a metal theft risk assessment to define and evaluate the risks they face from metal theft.

The risk assessment process should evaluate vulnerability based upon the attractiveness, remoteness, accessibility and removability of metal infrastructure locations. The impact should be assessed based upon the level of disruption, safety, cost and reputational impact that would be realised from thefts at these locations. The vulnerability and impact scores should then be combined to give a metal theft risk score for each metal infrastructure location. Based on the overall risk profile for a scheme, mitigation measures should then be selected and prioritised.

Mitigation measures should be selected and implemented, based upon best practice, in conjunction with the Senior User, to proportionately reduce metal theft risk, with a focus on those locations assessed to be high priority.

Refer to MPI-21-012014 for requirement and guidance for new schemes to perform a metal theft risk assessment. This assessment shall be reported to the PSCRG for endorsement.

Emergency roadside telephone (ERT) requirements for CM

- 2.6.56 ERTs on CM schemes shall be provided in accordance with TA 73.

2.7 Signals and signs

General

- 2.7.1 This section shall be read in conjunction with TD 46/05 Motorway Signalling and IAN 149/11 Existing Motorway Minimum Requirements.
- 2.7.2 Variable message sign (VMS) and direction signs associated with a junction will normally be cantilever and post mounted respectively, however where existing portal gantries are present then the designer shall first assess the feasibility of re-using this existing infrastructure where it has sufficient residual design life.
- 2.7.3 Not used.

Direction signing

- 2.7.4 Direction signs shall be located as described in Figures 5-8 to 5-12 in IAN 149/11, and to the tolerances contained therein. The datum point should be defined as 200m upstream of the start (tip) of the diverge nose for Type E Diverges in accordance with TD 22/06 and used for SM layouts. There is no requirement to provide gantry mounted confirmatory signs (TSRGD diag. 2908, 2908.1 or 2909) or confirmatory signs (TSRGD diag. 2910 & 2910.1), however if these are currently installed they may be retained and their location adjusted (where required) to reflect the changes introduced by the scheme.
- 2.7.5 The amount of information shown on an ADS is dependent on the junction type, complexity of the junction and the destinations signed. In some complex situations ahead signage may be required on the primary and secondary ADS.
- 2.7.6 For direction signing, other than the final direction sign, post mounted signing should be used to minimise the need to implement TTM for maintenance of the sign. Overhead direction signing (e.g. mounted on a cantilever or portal gantry) may be used where operationally it is considered more appropriate to do so. Factors that may influence this are:
- complex junction layout
 - insufficient verge space for verge mounted signs
 - physical site constraints, e.g. the horizontal or vertical alignment of the road would block forward visibility to a verge mounted sign
 - very high traffic flows or high percentage of LGVs leading to the risk of sign obscuration
- 2.7.7 The signing strategy shall be agreed with Highways England, and recorded in the DSR.

Verge signs

- 2.7.8 Countdown markers, marker posts and driver location signs shall be provided in accordance with existing Highways England's RADs unless otherwise stated in this IAN. Existing driver location signs with an x-height of 115mm may be retained on an ALR scheme. New driver location signs installed as part of an ALR scheme may also have an x-height of 115mm.
- 2.7.9 On an ALR scheme, a 'Refuge areas for emergency use only' (NP 2935) sign shall be provided in the verge as close as is practicable to 100m downstream of the entry datum point. This sign is authorised for use with a 100mm minimum and 300mm maximum 'x' height.



- 2.7.10 NP 409 'Variable speed limit' signs must be provided at all gateways to the scheme. On the mainline, link roads, and interchange links, signs should be placed as close as practicable to 250m in advance of the first VMS. On merge connector roads the sign should be located in the nearside verge before the nose taking into account the existing verge infrastructure. At MSA merge connector roads, a sign to NP 409 is desirable. This sign may be omitted where there are physical constraints, for example land availability or poor geometry. The decision making process shall be included in the DSR. Where constraints prohibit the sign being located in the nearside verge then the sign may be located in the offside verge. Only one sign is required at each merge connector location. Only one sign in the verge is required on the mainline. NP 409 sign is shown below and is a non-prescribed sign that has been Nationally Authorised. NP 409 'Variable speed limit' sign has been authorised for use with a 250mm, 200mm, 150mm, 125mm and 100mm 'x' heights.

Where space is limited it is acceptable to co-locate the 'Variable speed limit' sign with the 'No hard shoulder' sign. The total reading time for both signs should not exceed two seconds and the minimum clear visibility distance must be provided. The impact of other signs in front of and behind the co-located signs must also be taken into account.



- 2.7.11 Enforcement camera sign (TSRGD diagram 879) must be provided at each signalling location and should be mounted on the signalling superstructure (where visibility of the sign permits) rather than on a separate post. It is desirable for this sign to be 1500mm in height but shall be a minimum of 1200mm high.



- 2.7.12 A minimum of one non prescribed combined fixed 'Variable Speed Limit ENDS'/national speed limit signs to NP 409.1 must be provided at the exit points from the scheme: on the mainline; link roads; and interchange links and should be placed as close as practicable to the boundaries of the associated Statutory Instrument. On link roads and interchange links, this may be located on either the nearside or offside or both, taking in to account visibility for customers and any requirements for maintenance. A connector road sign should not be located where motorists may mistake the sign as applying to the mainline motorway. There is no requirement for this sign at diverge slip roads that lead to a Local Authority road, roundabout, T junction or MSA as end of motorway regulation signs to Diag. No. 2931/2932 should already be provided. There is a requirement to ensure that signs to Diag. No. 670 or 671 are also provided in addition to the end of motorway regulation sign Diag. No. 2931 for motorway diverge slips or Diag. No. 2932 for exits to MSAs. Signs to Diag. No. 670 or 671 shall be provided in accordance with the following:

- **Motorway diverge slip roads with a national speed limit (NSL) in place after the exit (on a lit road).** End of motorway regulations sign to Diag. No. 2931 shall be accompanied by a Diag. No. 671 NSL repeater sign (min. 450mm diameter) that shall be placed on the first lighting column after the 'End' sign. The sign to Diag. No. 671 may be located on the nearside or offside
- **For motorway diverge slip roads with any other speed limit in place after the exit (lit or unlit).** An 'End' sign to Diag. No. 2931 shall be accompanied by a Diag. No. 670 sign (to correspond with the speed limit after the exit) to be placed adjacent to or after the sign to Diag. No. 2931 and shall be installed on the nearside and offside
- **For motorway diverge slip roads to MSAs or maintenance compounds.** An 'End' sign to Diag. No. 2932 shall be accompanied by a Diag. No. 670 sign (to correspond with the speed limit within the MSA or compound) to be placed adjacent to or after the sign to Diag. No. 2932 and shall be installed on the nearside and offside. Where there are constraints which result in the sign to Diag. No. 670 being placed greater than 100m after the 2932 sign, a repeater sign to Diag. No. 671 (min. 450mm diameter) shall be placed (nearside or offside) between the 'End' sign to Diag. No. 2932 and speed limit signs to Diag. No. 670

If there is a merge the combined fixed 'Variable speed limit ENDS'/national speed limit signs should be placed just before the merge, and as close as practicable to 300m downstream of the termination VMS. If no merge is present at the exit from the scheme, the combined fixed 'Variable speed limit ENDS'/national speed limit signs should be located as near as is practicable to between 200m and 300m upstream of the next advisory signal, if the next advisory signal is more than 1km downstream the signing should be placed between 300m and 800m downstream of the termination VMS. The point at which variable speed limit ends must as far as reasonably

practicable be signed to coincide with the defined point stated within the relevant Statutory Instrument. Only one sign in the verge is required on the mainline. NP 409.1 'Variable speed limit ENDS' sign has been authorised for use with a 250mm, 200mm, 150mm, 125mm and 100mm 'x' heights.



- 2.7.13 An information sign 'No hard shoulder for XX miles' to TSRGD (diag. 820.1) shall be provided on the main line at the downstream end of the intra-junction section entering an ALR scheme and on all merge connector roads providing entry to an ALR link (excluding MSAs). The distance shown shall be measured from the start of the reduction in width/end of the hard shoulder to the point a full width hard shoulder is provided at the end of the ALR scheme. The sign shall be located as close as is practicable and in advance of the start of the reduction in width/end of the hard shoulder.

The sign shall be located where it is sufficiently visible that customers requiring emergency use of the hard shoulder have adequate time to decide to pull over and still come to a stop before the end taper or decide to carry on. Also there is a need for the sign to be sufficiently visible from the hard shoulder so that any customer who does not have enough space to accelerate and merge before the end of the hard shoulder is able to see this information. Readability is dependent on 'x' height and clear visibility distance. Where there is limited verge width (requiring a reduced 'x' height) or limited clear visibility due to a curve, bridge or other obstruction etc, it may be that the sign has to be located in advance of the diagram 1040.5 taper.

If there are space constraints, then it may be acceptable to co-locate the 'no hard shoulder' sign and the 'variable speed limit' signs as described in paragraph 2.7.10.



Where links switch between ALR and non ALR then the distance on the 'no hard shoulder for XX miles' sign should be to the start of the hard shoulder for the downstream non ALR link. At the end of the non ALR link a 'no hard shoulder for XX miles' sign shall be included for the downstream ALR link. A 'no hard shoulder for XX miles' sign is not required intra-junction at non-TJR junctions.

2.7.14 Vehicle separation markings (chevrons) and their associated signs shall not be used on SM schemes.

Control signals

2.7.15 The following sections in IAN 149/11 are amended:

- 5.6.1
- 5.6.3
- 5.6.4

2.7.16 The following sections in IAN 149/11 are superseded:

- 5.2.1 c i)
- 5.5
- 5.6.6

2.7.17 At every signalling site the capability for variable message signing shall be provided unless otherwise directed in paragraph 2.7.20 and 2.7.21. Where carriageway signalling is provided, both this and the VMS capability shall be integrated within one item of equipment, as shown in Figures 2.2.1 and 2.2.2 and shall be located to ensure adequate guidance is provided to customers. For ALR schemes, the midpoint of the carriageway signal/VMS enclosure should be located between the edge of carriageway road marking and the lane 1/lane 2 road marking. For CM schemes, the midpoint of the carriageway signal/VMS enclosure should be located between the edge of carriageway and the hard shoulder/lane 1 road marking. The final choice of carriageway signal/VMS lateral position shall be dictated by the horizontal and vertical alignment of the carriageway and presence of upstream obstructions.

VMS deployed or modified for ALR or CM shall be capable of displaying the following which are relevant to the entire carriageway:

- a) text messages
- b) advisory speed limits
- c) mandatory speed limits
- d) lane control aspects
- e) pictograms

These requirements do not apply to existing strategic message signs.

2.7.18 Lane signals (above each live lane) and VMS shall be provided 300m (+/-100m) downstream of the entry datum point, as shown in Figures 2.2.1 and 2.2.2 at the "Gateway signals and VMS" location. Where there are two successive merges, and the distance between the end of the first merge and the nose of the second merge is insufficient to locate a gateway gantry in accordance with the above, then the gateway gantry at the first merge may be omitted. The decision making process shall be recorded in the DSR.

Lane signals deployed for ALR and CM shall be capable of displaying:

- a) advisory speed limits
- b) mandatory speed limits
- c) lane control aspects

2.7.19 A minimum of two signal sites per link (between the entry and exit datum points) shall be provided. Dependent on the specific link characteristics, the second set of signals (on a link with only two signal sites) may either be above lane or carriageway signals (see paragraph 2.7.21). The selection of signal type for the second site shall be agreed with the PSCRG and recorded in the DSR. Where signal spacing is less than 600m to meet the requirement for two signal sites per link, a departure from standard is not required. The spacing between the signals should be broadly equal and the decision behind the spacing recorded in the DSR. Any other situation where signal spacing is less than 600m shall be endorsed by the PSCRG.

For link lengths between 5km and 6km measured from the gateway signal to the downstream Continuation/Termination VMS at the back of the diverge nose, an assessment is required to decide whether additional "lane signals and VMS" sites should be provided, as shown in Figures 2.2.1 and 2.2.2 at the "intermediate signals and VMS" location. This assessment shall be recorded in the DSR and decision endorsed by the PSCRG.

If the link exceeds 6km then one or more "intermediate signal and VMS" sites shall be provided. The distance between signals as described below shall not be greater than 6km and should be located so that the spacings are broadly equal;

- gateway signal to the downstream Continuation/Termination VMS at the back of the diverge nose
- gateway signal to a downstream intermediate signal
- intermediate signal to the downstream Continuation/Termination VMS at the back of the diverge nose
- intermediate signal to downstream intermediate signal

The assessment described above shall be recorded in the DSR and the decision endorsed by the PSCRG.

2.7.20 Where existing signal portal gantry structures are retained as part of a scheme, a VMS should be provided to replace the advisory lane signals rather than replacing them with mandatory lane signals unless the gantry is a gateway or intermediate gantry.

A VMS shall not be installed on the same structure where ahead signing, exit signing and lane signalling are all co-located.

2.7.21 Elsewhere, above lane signalling is not required, with the exception of:

- a) locations with 5 or more running lanes (e.g. a parallel connector road on the approach to a junction). In these locations, above lane signalling and VMS shall be deployed to meet the spacing and visibility requirements detailed in paragraph 2.7.23. ADS signs shall also be mounted on portal gantries on 5 lane sections.
- b) Where additional signals are required between the secondary ADS and the continuation/termination VMS, then these may take the form of a cantilever VMS, lane signals or VMS on the final ADS gantry in accordance with paragraph 2.7.20.

Paragraphs 2.7.18 to 2.7.21 replace IAN 149/11 paragraph 5.6.1 a) and b).

2.7.22 A VMS shall be provided downstream of the diverge back of nose at a junction or interchange. Taking account of site constraints, the VMS shall be provided as close to

the diverge back of nose as practicable. With the exception of the terminal junction this VMS is defined as a Continuation VMS. At the terminal junction of a scheme this VMS is defined as the Termination VMS. This requirement does not apply to MSAs. MSAs are not considered a junction in terms of the provision of signing and signalling.

At the start of the scheme the first VMS is defined as the conditioning VMS and shall be provided on all approaches to a SM scheme. This may be multiple locations at a motorway to motorway interchange. Only one conditioning signal should be provided per approach when transitioning from advisory signalling.

Where an existing gantry is present over the diverge nose then this may be used for VMS provision, instead of locating the signal downstream of the back of nose. Wherever practicable the VMS should be provided on the existing gantry in a location over the main carriageway that simplifies traffic management requirements for maintenance.

2.7.23 Spacing distances and visibility requirements for control signalling/VMS:

- a) at diverge junctions, carriageway signalling on a VMS shall be located 300m (+/- 100m) upstream of the Primary and Secondary (ADS). If these requirements are not able to be met a departure from standard is not required however the reasons why shall be detailed in the scheme DSR. Where existing portal gantries are present, the designer should first look to reuse this existing infrastructure where suitable, thereby co-locating the control signalling with the Primary, Secondary and Final Direction Signs.
- b) signal spacing and visibility rules shall be maintained on the approach to junctions, and where required, signals shall be installed between the secondary ADS and the continuation/termination VMS.
- c) mandatory control signals shall be spaced between a minimum of 600m and up to a maximum of 1500m apart, subject to the provision of a minimum unobstructed visibility of the signal as described in paragraph i), ii), iii) and iv) below. Signal spacings greater than 1500m require a departure from standard and endorsement by the PSCRG and Operations technical leadership group. Signal gantries shall not be positioned such that they span a ghost island, as this may cause inappropriate signals to be displayed to customers.

Minimum unobstructed visibility requirements:

- i. in advance of the downstream signal for a distance of 350m. This is consistent with minimum sight line to an enhanced motorway indicator (EMI) stated in TA 74/05, A4.3 signal visibility.
- ii. in advance of the downstream signal for a distance of at least $\frac{1}{2}$ of the proposed spacing. Where the distance between signals is less than 800m this requirement does not apply.
- iii. in advance of the downstream signal such that the maximum distance between the upstream signal and the start of visibility of the downstream signal shall not exceed 500m. Where a scheme design proposes non-visibility distances between 500m and 600m this shall be endorsed by the PSCRG and recorded in the scheme DSR; a departure from standard shall be submitted for non-visibility distances in excess of 600m and shall be endorsed by the PSCRG and Operations technical leadership group. A departure from standard will not be accepted for less than 350m forward visibility when there is also an associated departure in excess of 500m for the gap in visibility.
- iv. where the downstream signal is provided by a verge mounted VMS an unobstructed sight line shall be provided for a minimum of 50% of the

VMS sign face (right hand side); where it is provided by a lane signal an unobstructed sight line shall be provided to all of the signal mounted over lane 1 (right hand bend) or lane 4 (left hand bend). The shortest sight line shall be checked:

- from the centre line of the right hand traffic lane on right hand bends
- from the centre line of the left hand traffic lane on left hand bends
- from the centre point of any lane on straights or near straights

This amends IAN 149/11 paragraph 5.6.3.

d) Provision shall also be made to facilitate the use of control signals/VMS for signing TTM. The control signals/VMS shall be positioned upstream of the fixed taper points (FTP) within the tolerances detailed below:

- FTP Final signal/VMS - 300 to 450m from the fixed taper point
- FTP Secondary signal/VMS - 500 to 1500m from the final signal/VMS
- FTP Primary signal/VMS - 500 to 1500m from the secondary signal/VMS

e) For every ERA, a VMS shall be located upstream of the ERA such that a vehicle exiting the ERA is visible from all lanes at a point adjacent to this VMS. This is referred to as the ERA VMS. This enables the message "Slow vehicle leaving refuge area" to be set where required.

f) Visibility requirements for signal sites that are designated as 'live' and 'non-live' enforcement sites shall be met and departures from standard shall not be permitted.

2.7.24 An Intra-Junction VMS with combined signal shall be provided if the distance between the Continuation VMS/Conditioning VMS and the Gateway Signal/VMS following the junction merge, is greater than 1500m. The Intra-Junction VMS should be located as near to the midpoint as possible subject to sight line and buildability constraints. The spacing and visibility requirements described in paragraph 2.7.23 c) of this IAN are also applicable intra-junction, however non-compliances will not require a departure from standard but should be recorded in the DSR and endorsed by the PSCRG. This amends IAN 149/11 paragraph 5.6.4. The spacing and visibility requirements described in paragraph 2.7.23 c) of this IAN are applicable at MSAs.

Strategic variable message signing

2.7.25 Additional strategic VMS will not be required as part of the scheme. However where existing strategic VMS are present they shall be retained or be repositioned. The sequence of sign and signalling installations on the approach to a junction should be strategic VMS, VMS, and then the primary ADS. This sequence is then repeated for the secondary ADS. The spacing between this roadside equipment is to be nominally equalised and shall be no less than 180m. If it is not possible to relocate strategic VMS at the above defined positions, alternative positions shall be agreed with the RCC, national traffic information service (NTIS) and the Senior User, endorsed by the PSCRG and recorded in the DSR. A departure from standard is not required.

- 2.7.26 Where other existing VMS are used to provide a strategic signing capability by the National Traffic Operations Centre for strategic traffic management or customer information messages, the scheme shall agree with the scheme Senior User and Customer Operations, the level of strategic signing capability which shall be retained for each link, and how this should be provided.
- 2.7.27 Where there are currently no VMS used to provide a strategic signing capability on a link, the scheme is not required to provide this capability.
- 2.7.28 VMS whose primary function is strategic signing shall be prioritised for strategic use within the message hierarchy.

Entry slip signals (ESS)

- 2.7.29 ESS shall be provided at all junctions.
- 2.7.30 ESS shall be located at the last decision point before accessing the motorway, normally the start of the slip road, such that customers still have the option not to join the motorway (during a motorway closure) when viewing the signal(s). Multiple directions of entry to a slip road may require additional signals to provide adequate forward visibility.
- 2.7.31 If there is one or more existing ESS, capable of displaying advisory aspects and suitably located to provide adequate forward visibility, they may be retained provided the first signal downstream of the merge is visible from the entry datum point.
- 2.7.32 Existing ESS shall be upgraded to ESS capable of displaying the ESS equivalent aspects detailed in paragraph 2.7.18 if the first signal downstream of the merge is not visible from the entry datum point. Where existing ESS are being upgraded the existing infrastructure should be re-used where possible.
- 2.7.33 If existing ESS are not suitably located at the start of the slip or there are no existing ESS then a single mandatory ESS shall be installed at the start of the slip road, located to provide adequate visibility for approaching traffic. If adequate visibility is not achieved with one signal, additional signals shall be provided as necessary.

Paragraphs 2.7.29 to 2.7.33 supersede IAN 149/11 paragraph 5.6.6.

- 2.7.34 At motorway service areas (MSAs), existing ESS may be retained if the first signal downstream of the merge is visible from the entry datum point; otherwise they should be replaced with a single ESS capable of displaying the aspects detailed in paragraph 2.7.18.

Where ESS are not currently installed (at MSAs) they shall only be provided if:

- a) the first signal downstream of the merge is not visible from the entry datum point; or
- b) the ESS is able to be located such that customers still have the option not to join the motorway (during a motorway closure) when viewing the signal.

VMS/signalling requirements on free flow links

2.7.35 Where a SM scheme intersects with an existing or planned SM scheme at a motorway to motorway interchange with free flow links between the schemes, the designer shall seek guidance from the Overseeing Organisation to determine the VMS/signalling requirements.

Road markings

2.7.36 Road marking material for lane markings on ALR schemes shall be designed to maximise the dry retro-reflectivity. The designer shall give consideration to the use of long life road studs and road markings.

2.8 Traffic modelling and economics

- 2.8.1 As ALR schemes involve the conversion of the hard shoulder to a permanent controlled running lane, unlike previous hard shoulder running (HSR) schemes which made dynamic use of the hard shoulder, the traffic modelling needs to be undertaken using conventional techniques. Refer to IAN 164 for the requirements and guidance on the economic assessment of ALR schemes designed to IAN 161/15.

Refer to IAN 160 for guidance on the economic appraisal of CM schemes designed to IAN 161/15.

- 2.8.2 As a result, the guidance included in the relevant parts of WebTAG, DMRB and appropriate IAN documents will apply, as in the case of conventional schemes for Highways England.

2.9 Structures

- 2.9.1 Highway structures i.e. overbridges, underbridges, retaining walls etc along the length of the SM scheme should be reviewed and any features that would not meet the requirements of the SM scheme should be identified. This should be based on a review of existing data, including completed structural assessment and inspection reports, and should consider the condition of the structures and any safety related defects. Any additional assessment work which is considered necessary shall be agreed with the Highways England Project Manager. This should be undertaken at the earliest opportunity.
- 2.9.2 In the initial review particular focus shall be placed on those structures which may restrict the operation of the SM scheme i.e. geometric and headroom constraints over hard shoulders and verges at overbridges and any current loading restriction on structures (underbridges or retaining walls) supporting the motorway. Headrooms shall be checked on site, and compared to TD27 'Cross-Sections and Headrooms' requirements.
- 2.9.3 Where structural assessments are required, these shall be in accordance with the principles set out in BD 95 'Treatment of Existing Structures on Highway Widening Schemes', although it should be noted that a SM scheme is not a widening scheme. Reference shall also be made to BD101 The Structural Review and Assessment Process. They shall be subject to technical approval procedures.

Retention of existing gantries

- 2.9.4 Any existing gantries modified, repositioned or reused as part of a SM scheme shall be subject to a detailed special inspection (with testing where appropriate) and structural assessment. Attention is drawn to the need to consider wind and vehicle buffeting loading and fatigue effects in the assessment. A geotechnical assessment will also be required where the loadings on existing foundations increase significantly. This needs to be carried out early in the design process, so as to establish the need for gantry strengthening works and the extent of refurbishment works required. The residual life of the structures shall be agreed with the Technical Approval Authority and be no less than 15 years from scheme opening. Inspections and assessments shall address welds between critical structural members. Where agreed with the Highways England Project Manager, critical welds should be tested.

New gantries

- 2.9.5 A risk assessment shall be undertaken to determine the requirement for provision of a permanent means of access to the gantry structure for inspection and maintenance in accordance with MPI – 39 'Gantry Access - Assessment of Risk for the provision of fixed access'. If a permanent means of access to a gantry structure is provided, then consideration shall also be given to the need for any additional access infrastructure requirements to the gantry location. This additional infrastructure shall enable the MSP to safely access the gantry location and also reduce disruption to customers wherever practicable. A gantry support in the central reserve shall not be provided as this would increase maintenance activities in the central reserve. Where the carriageways split, creating a wide central reserve, then a gantry support may be provided in the central reserve where it becomes impractical to span both carriageways and the central reserve. The decision to locate a gantry in such a location and the assessment of the required span shall be included in the DSR.
- 2.9.6 Not used.

2.9.7 Gantries sited or re-sited on bridges or viaducts require detailed consideration of the structural effects and interactions.

2.9.8 The design life of gantries shall be in accordance with BD 51.

Piers, parapets and gantries

2.9.9 IAN 91 and IAN 97 deal respectively with the identification and assessment of piers and parapets that are not compliant with current Highways England's RADs. They enable such sites to be classified as high, medium, low, or negligible risk advocating the following principles for mitigation:

High-Risk: high-priority upgrade/strengthening required in SM scheme

Medium-Risk: upgrade at next suitable major maintenance scheme or include in the SM scheme if works would be required within 5 years after the opening of the SM scheme – refer to paragraph 2.2.21.

Low-Risk: upgrade at next suitable major maintenance scheme or include in the SM scheme if works would be required within 5 years after the opening of the SM scheme – refer to paragraph 2.2.21.

Negligible-Risk: upgrading not required (monitor only)

2.9.10 Not used.

2.9.11 Not used.

2.9.12 For existing bridge piers on SM links the risk of vehicle impact shall be assessed using IAN 91.

2.9.13 Existing gantry legs should be reviewed in accordance with Clause 1.4 of BD 48/93 for the risks associated with potential vehicular impact protection. For existing gantries: BD 48/93 clause 1.4 provides the following advice:

“Sign and signal gantries and pipe bridges need not be assessed for impact loading using analytical methods. However, each structure should be individually assessed to ensure that it is adequately protected by a vehicle restraint system which has a containment level equal to or greater than an open sided box beam.”

2.9.14 Consequently, in accordance with current guidance, gantry legs protected by vehicle restraint systems of N2 containment class (or equivalent) are acceptable for assessment purposes. Where gantry legs are not provided with this minimum level of protection, the level of risk is never higher than low (based on comparison with IAN 91 risk ranking levels for low-use footbridges), and upgrading would not normally be required.

2.9.15 For bridge parapet sites on SM links the risk of vehicle impact shall be assessed using IAN 97.

2.9.16 Where sites are assessed as high-risk (e.g., Group 1A piers, parapets requiring upgrading to H4A level of containment, parapets with containment level less than minimum requirement for pedestrians), the risk should be mitigated by upgrading work carried out as a matter of priority before or during the SM scheme. The upgrading work shall be discussed and agreed with the Highways England Project Manager. The upgrading work shall be subject to Technical Approval.

- 2.9.17 Where sites are assessed as medium-risk or low-risk (e.g., Group 1B and Group 2 piers, substandard gantry leg protection, parapets requiring N1/N2 or H2 level of containment), the risk should be mitigated by upgrading work carried out as part of a planned maintenance scheme undertaken either before or after the SM scheme (unless works would be required within 5 years of the opening of the SM scheme in which case these works should form part of the SM scheme). The upgrading work shall be discussed and agreed with the Highways England Project Manager. The upgrading work shall be subject to Technical Approval.

Railway/third party infrastructure considerations

- 2.9.18 Bridges and structures belonging to Railway Infrastructure Owning Authorities or third party owners may be affected by SM proposals. Any potential changes to such bridges and structures (e.g. structural modifications, replacement of protective barriers, reduced setbacks etc.), should be discussed and agreed with the Railway Infrastructure Owning Authority or with the third party and should be reported to the Highways England Project Manager, and may be subject to their approval procedures. Liaison with such parties shall be started at the earliest opportunity.

2.10 Environment

General

2.10.1 This IAN shall be read in conjunction with relevant environmental advice and requirements within the Design Manual for Roads and Bridges and all relevant IANs and MPIs.

2.10.2 SM schemes share constraints and considerations with other projects types. However, SM schemes need to consider the influence of moving traffic closer to potential receptors. In addition, appropriate strategies need to be put in place to ensure that baseline data collection, assessment and design work contribute to speeding up scheme delivery.

Environmental baseline and objectives

2.10.3 The Road investment strategy (RIS) sets out what UK Government requires from Highways England. This includes specific measures and requirements to meet the challenge of “delivering better environmental outcomes”. Generic environmental objectives are set for the SRN and these apply equally to SM schemes.

2.10.4 The RIS shall be reviewed and the contribution of individual projects to delivering better environmental outcomes shall be submitted to the Highways England Project Manager for approval as early in the project life cycle as possible. These shall be reviewed and revised at key design stages intervals as the project progresses.

Environmental design

2.10.5 A scheme specific environmental scoping report is required to be carried out. This shall clearly justify and describe why topics need to be assessed with respect to the likelihood of significant effects.

2.10.6 In order to provide enhanced cost certainty and reduce design iterations, early consideration of design solutions and environmental requirements is essential, and should be subject to review and refinement through the project lifecycle.

Drainage and water quality

2.10.7 Refer to section 2.11.

2.11 Drainage and water quality

2.11.1 Assessments and design shall be undertaken in line with the advice and requirements within the DMRB, IANs and MPIs, however it is important to highlight the environmental assessment and drainage design philosophies for SM schemes. Additional design provisions are required to mitigate the risk of the additional paved areas that arise from SM schemes.

2.11.2 The designer shall undertake their own assessments to include any site specific variations and identify areas where the requirements are not able to be met. This shall be agreed with the Overseeing Organisation.

2.11.3 Where existing motorways are modified or converted to SM and there is additional paved area e.g. the provision of ERAs or as a result of paving the central reserve, the following additional design provisions shall be made:

- The intention is that there is no need for any additional outfalls and that existing outfalls continue to discharge at existing established rates. However, wherever there is an opportunity within the constraints of the project to provide 'betterment' on existing outfall rates then this should be evaluated in relation to the existing localised flood risk.
- Design for a 1:5 year return period (inclusive of 20% to allow for climate change) for any additional water arising as a result of the additional paved area only.
- Flow attenuation measures may also be needed to ensure the discharge at the outfall is not worsened. Where pavement area increases are required, flow attenuation shall be provided to ensure existing discharge rates are not increased. The design shall be assessed in accordance with the National Planning Policy Framework.
- Appropriate spillage control measures shall also be included in the ERA design. Requirements are set out in HD33 Surface and Sub-Surface Drainage Systems for Highways.
- Flow width: ALR schemes convert the current hard shoulder into permanent lane 1 and create a managed environment where operational regimes may provide mitigation for different types of event. Where it is seen as a potential risk that the flow width will ingress onto lane 1 (including the road markings at the back edge of lane 1) during a rainfall event of less than 1:5 year event, an assessment should be made of how often this may occur and whether these events may reasonably be managed. The flow of water parallel to the carriageway edge should not exceed an allowable width. When checked for a 1 in 5 year storm the maximum verge side flow width, inclusive of hardstrips where present, shall not encroach more than 200mm (at 2.5% crossfall) into lane 1. Where the crossfall is greater than 2.5% then the depth of water lying on the carriageway shall not exceed 5mm. This supersedes HD 33/06 para 6.3, bullet 3.
- Keep surface and sub-surface waters separate in design process and encourage permeable solutions.

2.11.4 Chamber access covers in the carriageway shall be eliminated wherever practicable. Where it is not practicable to re-align an existing drainage network or provide side access chambers to locate their access covers in the verge, the following hierarchy of

requirements shall be followed (where 1 is the preferred solution and 3 is the least desirable solution):

1. Plate over access cover points of existing chambers that are not essential for safe and efficient drainage maintenance operations. The existing chamber shall also be 'piped through' (pipework installed to complete the pipe run through the redundant chamber) and backfilled or removed and backfilled as appropriate. The plating should be flush with the bottom of the sub-base layer wherever possible. Those chambers that are of a catch-pit type shall be benched out.
2. Re-locate access covers from the running lanes to the hardstrip, and rotate the cover and frame so that the gap between the trafficked side of the cover's frame and running lane is maximised.
3. Where access covers cannot be practicably plated over or re-located from the running lanes, the cover and frame shall be rotated to maximise the distance of the cover's frame from the wheel tracks and the bedding of the cover and frames shall be constructed in accordance with the guidance provided in HA 104/09. It is a departure from standard to have an access cover located in a running lane.

2.11.5 All access covers in the carriageway (including hard strip) shall conform with advice in HA 104/09 paragraph 3.3 on higher category covers and frames, and provide the necessary skid resistance requirements. Chamber covers and frames shall be secured to ensure that they are not dislodged by a vehicle. All proposals for chambers in a carriageway, including plating over, shall be endorsed by the PSCRG and the decision process recorded in the DSR. Access covers should be avoided in highway conflict points of merges and diverges.

2.11.6 Plating shall be recorded in the drainage database (HADDMS), including details of the depth of the plating.

2.11.7 Where any re-alignment is undertaken or chambers in the verge introduced – the connecting piping shall be the same diameter to that of the main drain and there shall be an invert to invert connection that will enable a CCTV crawler camera to be driven into the buried chamber and look left and right.

2.11.8 Where a SM scheme includes major junction improvement works then guidance shall be sought from the Overseeing Organisation.

2.12 Earthwork and retaining structures

2.12.1 ALR utilises the full carriageway by converting the hard shoulder to a running lane, it is not a widening scheme. The design process for ALR and CM shall be set out in the normal way using HD 22 'Managing geotechnical risk' mandatory geotechnical certification process. Early liaison with Highways England shall be undertaken to determine the appropriate reporting strategy.

2.12.2 The condition of the existing earthwork asset along the length of scheme, not just at the proposed new structures, should be assessed in accordance with HD41 'Maintenance of Highway Geotechnical Assets'. Those earthworks identified with defects should be reviewed and the current mitigation strategy assessed in light of the proposed operational regime.

- **Class 1A, 1B & 1C** high priority earthwork defects whose current remediation is to close the existing hard shoulder should be re-assessed in consultation with NDD, prior to any agreement to include them within the scope of the scheme. Remaining defects should be addressed at the next appropriate maintenance period (unless works would be required within 5 years of the opening of the SM scheme in which case these works should form part of the SM scheme).
- **Class 1D, 2A & 2B** areas of risk should have an agreed monitoring regime in place during the works and mitigation plans approved for implementation.
- **Class 3A, 3B & 3C** low risk areas where previous defects have been repaired or which are unlikely to develop into a defect should be subject only to routine inspections.

2.12.3 This and the following clause give the key design and environmental issues that need to be addressed when finalising the selection and development of a detailed design solution for a site specific earth retaining requirement, considering selection criteria and treatment options. These requirements are in addition to the requirements given in HA43. It provides a hierarchy of potential options, taking into consideration sometimes conflicting engineering and environmental objectives.

2.12.4 The key design hierarchy selection should consider, at all stages, the impact of the loss of significant amounts of tree and shrub cover in the short and medium term, particularly where this may be located adjacent to sensitive receptors. Further, in consultation with Highways England, consideration should be given to the value of vegetation cover against the context of environmental assumptions and commitments given in the environmental assessment report (EAR) and specifically in terms of its function and practicality of replacement.

- **Is sufficient space available to create a slope re-grading or granular earthwork modification system?**

If yes then consider the following: would the construction of a slope realignment solution require the loss of significant amounts of vegetation as stated above? If 'yes' then consider another system, see below; if 'no' then proceed with the design solution, accommodating opportunities for reinstatement including tree and shrub planting.

If no then consider next stage in the design solution selection system.

- **Is sufficient space available for some form of green faced geotechnical retention system?**

If **yes** then consider the following: would the construction of the green faced retention system (also taking into consideration temporary construction land take requirements) require the loss of significant amounts of vegetation as stated above? If 'yes' then consider another system, see below; if 'no' then proceed with the design solution.

If **no** then consider next stage in the design solution selection system.

- **Are there space and/or geotechnical restrictions where some form of near vertical treatment may be required?**

If the retention of significant amounts of vegetation cover governs and geotechnical considerations permit, then utilise stable exposed rock cutting faces or retaining wall and geotechnical solutions to achieve earthwork stability, but accommodate a facility for a standardised, aesthetically appropriate surface treatment.

The process set out in HA43 includes a variety of geotechnical solutions, including soil nailing, reinforced soil, crib wall, gabion, blockwork, gravity in-situ concrete and piling solutions to meet the specific design constraints. From an environmental perspective, piled solutions generally require a smaller overall footprint than other solutions, hence minimising impacts on the adjacent soft estate.

3 Withdrawal conditions

This IAN will be withdrawn when the requirements and advice have been migrated into the Design Manual for Roads and Bridges.

4 Contacts

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5 Normative references

The following documents, in whole or in part, are normative references for this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GD 01 - Introduction to the Design Manual for Roads and Bridges (DMRB 0.1.2)

GD 04 - Standard for Safety Risk Assessment on the Strategic Road Network (DMRB 0.2.3)

TD/TA

TD 9/93 - Highway Link Design (DMRB 6.1.1).

TD 17 - Criteria for the Provision of Closed Circuit Television on Motorways (DMRB 9.3.1)

TD 19/06 - Requirements for Road Restraint Systems (DMRB 2.2.8)

TD 22/06 - Layout of Grade Separated Junctions (DMRB 6.2.1)

TD 27/05 - Cross-Sections and Headrooms (DMRB 6.1.2)

TD 34 - Design of Road Lighting for the Strategic Motorway and All Purpose Trunk Road Network (DMRB 8.3.3)

TD 45/94 - Motorway Incident Detection and Automatic Signalling (MIDAS) (DMRB 9.1.2)

TD 46/05 - Motorway Signalling (DMRB 9.1.1)

TA 49 - Appraisal of New & Replacement Lighting on the Strategic Motorway & All Purpose Trunk Road Network (DMRB 8.3.1)

TD 69 - The Location and Layout of Lay-bys and Rest Areas (DMRB 6.3.3)

TA 73/97 - Motorway Emergency Telephones (DMRB 9.4.2)

TA 74/05 - Motorway Signalling (DMRB 9.4.3)

TA 77/97 – Motorways (DMRB 9.5.1)

Interim Advice Notes (IAN)

IAN 69 - Design for Maintenance

IAN 73 - Design of Pavement Foundations

IAN 91 - Interim Advice on the Identification of 'Particularly At Risk' Supports

IAN 97 - Assessment and Upgrading of Existing Vehicle Parapets

IAN 111/09 - Managed Motorways implementation guidance - Hard shoulder running

IAN 112/08 - Managed Motorway Implementation Guidance - Through Junction Hard Shoulder Running [PR 100/08]

IAN 139 - Managed Motorways Project Safety Risk Work Instructions

IAN 143/11 - Supplementary Advice and requirements for the Provision for Non-Motorised Users and Accessibility during planning, design, construction and handover of Improvement Schemes

IAN 149/11 - Existing Motorway Minimum Requirements

IAN 154/12 - Revision of SHW Clause 903, Clause 921 and Clause 942

IAN 160 - Appraisal of Technology Schemes

IAN 164 - Managed Motorways - All Lane Running – Economic Assessment

IAN 167/12 Rev 1 - Guidance for the Removal of Road Lighting

IAN 180 - Guidance for the selection of remote controlled temporary traffic management signs for use on the Highways Agency trunk road and motorway network

IAN 182 - Major Schemes: Enabling Handover into Operation and Maintenance

HD/HA

HD 20/05 - Detector Loops for Motorways (DMRB 9.3.1)

HD 22 - Managing Geotechnical Risk (DMRB 4.1.2)

HD 26 - Pavement Design (DMRB 7.2.3)

HD 29 - Data for pavement assessment (DMRB 7.3.2)

HD 33/06 - Surface and Sub-surface Drainage Systems for Highways (DMRB 4.2.3).

HD 36/06 - Surfacing materials for new and maintenance construction

HD 41 - Maintenance of Highway Geotechnical Assets (DMRB 4.1.3)

HD 42/05 - Non-motorised Users Audit (DMRB 5.2.5)

HA 43 - Geotechnical Considerations and Techniques for Widening Highway Earthworks (DMRB 4.1.7)

HA 104/09 - Chamber Tops and Gully Tops for Road Drainage and Services: Installation and Maintenance (DMRB 4.2.5)

BD

BD 48/93 - The Assessment and Strengthening of Highway Bridge Supports (DMRB 3.4.7)

BD 51 - Portal and Cantilever Sign/Signal Gantries (DMRB 2.2.4)

BD 95 - Treatment of Existing Structures on Highway Widening Schemes (DMRB 1.2.3)

BD101 - The Structural Review and Assessment Process

GDs, TDs, BDs, HDs, HAs, TAs and IANs may be found:

http://www.standardsforhighways.co.uk/ha/standards/tech_info/index.htm

MCH

MCH 1540 - Specification for the Installation of Detector Loops on Motorways and All-Purpose Trunk Roads

MCH 1596 - HATMS Site Data Change Procedure

MCH 2470 - Ramp Metering Technical Design Guidelines

MCHs may be found:

<https://www.gov.uk/traffic-systems-and-signing-plans-registry-how-to-access-documents>

Other

ALR Generic Safety Report

<http://www.highways.gov.uk/knowledge/projects/smart-motorways-call-off-support/>

CM Generic Safety Report

<http://www.highways.gov.uk/knowledge/projects/smart-motorways-call-off-support/>

Transport Analysis Guidance (WebTAG)

<https://www.gov.uk/transport-analysis-guidance-webtag>

Traffic Signs Regulations and General Directions (TSRGD)

<http://www.legislation.gov.uk/ukSI/2002/3113/contents/made>

Traffic Signs Manual (TSM)

<https://www.gov.uk/government/publications/traffic-signs-manual>

Construction Design and Management Regulations 2015

<http://www.legislation.gov.uk/ukSI/2015/51/contents/made>

TR2603 - Technical Specification for Remote Controlled Temporary Traffic Management Signs for use on the Highways Agency Strategic Road Network

<https://www.gov.uk/traffic-systems-and-signing-plans-registry-how-to-access-documents>

Road Investment Strategy

<https://www.gov.uk/government/collections/road-investment-strategy>

6 Informative References

Smart Motorways - Concept of Operations

http://www.dft.gov.uk/ha/standards/tech_info/index.htm

MPI - 39 - 032015 Gantry Access - Assessment of Risk for the provision of fixed access

MPI - 33 - 082014 Guidance on treatment of Ramp Metering sites within Smart Motorways Schemes

MPI - 32 - 082014 Provision of Observation Platforms

MPI - 21 - 012014 Requirement and guidance for new schemes to perform a metal theft risk assessment

MPI -11 - 062013 Provision of Maintenance Access to Equipment on MM-ALR Schemes

MPIs are available from the Overseeing Organisation

MCH 2530 - Technical Requirements for the HA CCTV System

<https://www.gov.uk/traffic-systems-and-signing-plans-registry-how-to-access-documents>

Highways England Major Projects MP project control framework (PCF)

Documentation and guidance is available from the Overseeing Organisation

Generic Safe Method for placing TTM on MM-ALR:

http://www.dft.gov.uk/ha/standards/tech_info/index.htm

Annex A: Glossary of acronyms and terms

Acronym/Term	Description
ADS	Advance direction sign
ALM	Ambient light monitor
ALR	All lane running
CCTV	Closed circuit television
CM	Controlled motorway
CO	Customer Operations
DMRB	Design manual for roads and bridges
DSR	Design strategy record
EAR	Environmental assessment report
EMI	Enhanced motorway indicator
ERA	Emergency refuge area
ERT	Emergency roadside telephone
ESS	Entry slip signal
FWI	Fatal and weighted injury
HSR	Hard shoulder running
IAN	Interim advice note
Kph	Kilometres per hour
LGV	Large goods vehicle
MIDAS	Motorway incident detection and automatic signalling
MORLICS	Motorway road lighting control system
MP	Major Projects
MPI	Major Projects instruction
MSA	Motorway service area
MSP	Maintenance service provider
NDD	Network Delivery and Development
PIC	Personal injury collision
PCF	Project control framework
PSCRG	Project safety control review group
PTS	Professional & Technical Solutions
PTZ	Pan-tilt-zoom
RADs	Requirement and advice documents
RCC	Regional control centre
SFAIRP	So far as is reasonably practicable
RIS	Road investment strategy
SM	Smart motorways
SMS	Safety management system
SSD	Stopping sight distance
TSM	Traffic signs manual
TSRGD	Traffic Signs Regulations and General Directions
VMS	Variable message sign
VMSL	Variable mandatory speed limits
VRS	Vehicle restraint system

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