HIGHWAYS AGENCY

Safe roads, reliable journeys, informed travellers

Managed Motorways
All lanes running
Interim Advice Note 161/12



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INTERIM ADVICE NOTE 161/12

Managed Motorways
All lanes running (MM-ALR)

Summary
This document gives requirements and guidance on managed motorway schemes implementing all lanes running. It sets out the design parameters and the associated infrastructure and technology requirements.

Instructions for Use
This document applies to managed motorway all lanes running schemes on the Highways Agency 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 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

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IAN Contents

Table of contents

1 Introduction 1
Purpose 1
Scope 1
Lane referencing 3
Safety management system 3
Hazard risk scoring 3
Design strategy record (DSR) 4
Departures from standard 4
2 Outline design and operational safety requirements 5
General 5
Outline design 6
Maintenance 7
3 Highway link design 9
General 9
Design speed relaxations 9
Road camber 9
4 Layout of grade separated junctions 10
General 10
Design of merges 10
Design of diverges 11
Layout within a junction 11
5 Cross sections and headroom 12
General 12
Verges, edge detail and omission of hard shoulder 12
Traffic lane widths 12
Central reserves 13
Vehicle Restraint System (VRS) set back 13
Vehicle Restraint Systems (VRS) 14
Refuge areas 14
Refuge areas on links between junctions 15
Refuges on exit slip/link slip roads 15
Refuges within a junction 16
Frequency of refuge areas 16
Emergency refuge areas (ERAs) 16
Stopping sight distance 19
Other issues 19
6 Technology 20
General 20
Vehicle detection system 20
Road user compliance 21
Site data 21
Transmission system 22
Cabinets 22
Ambient light monitors (ALM) 22
CCTV general surveillance 22
Ramp metering 23
Lighting 23
Power and communications infrastructure 25
Security 25

SUPERSEDED
Superseded by IAN 161/12 Amended

IAN Contents

Downloaded from https://www.standardsforhighways.co.uk on 12-Nov-2026, IAN 161/12, published: Mar-2012

7 Signals and signs 26
General 26
Direction signing 26
Verge signs 27
Control signals 28
Strategic variable message signing 30
Entry slip signals 31
8 Traffic modelling 32
9 Structures 33
Retention of existing gantries 33
New gantries 33
Piers, parapets and gantries 34
Railway/third party infrastructure considerations 35
10 Environmental assessment 36
Screening 36
Scoping 36
Assessment of effects 37
Environmental reporting 37
Environmental design 37
Environmental appraisal 37
11 Drainage design philosophy 38
12 Earthwork and retaining structures design philosophy 39
13 Contact 41
14 Glossary of acronyms and terms 42
15 Normative and Informative References 43
16 Checklists 46

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1 Introduction

Purpose

1.1 This Interim Advice Note (IAN 161/12) gives requirements and advice to all those designing Managed Motorway - All lanes running (MM-ALR) schemes. It sets out the design parameters for MM-ALR and the associated infrastructure and technology requirements. In addition to this IAN, a companion document has been produced entitled MM-ALR Concept of Operations. This document provides, at a high level, guidance on the operational elements of MM-ALR and complements this Interim Advice Note.

1.2 It must be read in conjunction with GD01/08 Introduction to the Design Manual for Roads and Bridges (DMRB). The requirements given in this Interim Advice Note must be adhered to for MM-ALR schemes in England, to be constructed on the strategic road network, unless a departure from standard is approved.

1.3 Mandatory sections of this document are contained in boxes. If it is not possible to comply, a departure from standard must be agreed with the Highways Agency, unless an alternative process is identified within the black box text. The remainder of the document contains advice, explanation and guidance.

Scope

1.4 The managed motorways approach is a means of facilitating the dynamic control of traffic for congestion and incident management. To date, this approach has included hard shoulder running as a key feature. This allowed controlled use of the hard shoulder during times of heavy congestion or during incident management. The objective of this document is to introduce permanent conversion of the hard shoulder to a running lane, whilst retaining the ability to dynamically control traffic. This approach is defined as MM-ALR and the scope of this document is therefore limited to this type of intervention. If a scheme does not include this, then it is outside the scope of this document. Hard shoulder running guidance is covered in a separate document.

1.5 This document must only be used where the resulting scheme has no more than 4 lanes in either direction on the main line. Advice must be sought from the Highways Agency if more than 4 lanes is being considered.

1.6 The implementation of an MM-ALR scheme does not include the bringing forward of planned major maintenance, unless agreed by the Highways Agency.

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1.7 Where current structures or features (e.g. road restraint systems, drainage) are fit for purpose, they must not be replaced for the sole purpose of meeting current standards. Other improvements, funded by the scheme, should only be considered if what is there now is not appropriate for continued use (for example, either unsafe in the context of MM-ALR or beyond economic repair). The asset management decision making process therefore follows a logical process:

1. the true condition of the asset is established to determine if it is fit for purpose
2. if the asset is deemed fit for purpose, then it is reasonable for it to be retained
3. if it is deemed not fit for purpose then there is another decision about removal or replacement

This decision should be taken in the normal way to justify renewal/upgrading, including referring to the relevant assessment standards.

1.8 IAN 161/12 must be used in conjunction with the following DMRB standards 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 standards are referred to as “parent DMRB standards” within this document.

1.9 IAN 161/12 also varies the requirements within the following Interim Advice Note:

- IAN 149/11 Existing Motorway Minimum Requirements

1.10 The requirements and guidance within this document supersede or amend paragraphs within the parent DMRB documents and the IAN 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 document and the requirements of the equivalent parent DMRB standard or referenced IAN, the requirements and advice given in this IAN must take precedence.

1.11 This document has been developed for use on trunk roads managed by the Highways Agency where motorway regulations apply. Use of this document on roads in circumstances other than the above must be subject to approval from the relevant highway authority.

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Lane referencing

1.12 The lane referencing used in this document is as follows:

Existing motorway	MM-ALR scheme
Hard Shoulder	Lane 1
Lane 1	Lane 2
Lane 2	Lane 3
Lane 3	Lane 4

Where a hard shoulder is retained as part of MM-ALR e.g. intra-junction where through junction running (TJR) is not proposed, the lane referencing system intra-junction will remain the same as a D3M motorway.

Safety management system

1.13 Schemes must be implemented with an appropriate level of safety risk management in order to provide road users, road workers (including Traffic Officers) and third parties with adequate risk protection. Project safety risk management must be controlled by deploying an appropriate safety management system, so determining the activities that make up the safety management system is important for all projects.

1.14 Application of this document is based on the Agency's approach to safety risk and safety risk governance in fulfilling the requirement for safety risk assessment and management as appropriate for the type of project. This is achieved through the use of an appropriate safety management system. For MM-ALR schemes this must be in accordance with IAN 139/11 Managed Motorways Project Safety Risk Work Instructions (and the forthcoming standard, "*Safety Risk Management on the Strategic Road Network*").

Hazard risk scoring

1.15 The managed motorway design described in this document does not involve the opening, closing and operation of the hard shoulder for congestion management. Therefore all hazards associated with this must not be included in the hazard log for safety risk management. The features of MM-ALR, most notably the permanent conversion of the hard shoulder to a running lane, affect the safety risk associated with other hazards which must be taken into account in the hazard assessment.

1.16 Knowledge and experience of the safety performance of managed motorway schemes has been gained, in particular in relation to the M42 Managed Motorway pilot scheme. The "M42 Managed Motorway Monitoring and Evaluation Three Year Safety Review" indicates that overall the frequency of personal injury accidents has reduced by more than half, and that there has been an associated reduction in casualty severity.

1.17 A hazard log based analysis has been undertaken on the generic design outlined in this IAN and reported in the "MM-ALR Generic Safety Report", which can be found on the Highways Agency website:

http://www.highways.gov.uk/knowledge_compendium/3D162938610C4AEF8C2E39B84A7627F3.aspx

Using the relevant results from the M42 Managed Motorways pilot, the MM-ALR design requirements detailed in this IAN are predicted to meet the road user safety objective.

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Design strategy record (DSR)

1.18 The departures from standard process provides an auditable record of the decisions made in providing a non-compliant solution. Use of this IAN and IAN 149/11 will eliminate the need for many of the departures from standard previously required for managed motorway schemes. As required by IAN 149/11, a DSR must be used to capture all the significant 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.

1.19 A DSR must be developed as the design progresses, to demonstrate and record strategic and design constraints and decisions, with supporting evidence, in an auditable manner.

1.20 The DSR must be used to demonstrate that the existing accident record and operational and maintenance performance has been considered.

1.21 More information about the DSR process and a worked example can be found on the Highways Agency website:

http://www.highways.gov.uk/knowledge_compendium/assets/documents/Portfolio/Existing_Motorway_Minimum_Requirements_-_Worked_Example.pdf

Departures from standard

1.22 Not withstanding the requirements given in this document, in some circumstances departures from standards will still be required. Existing features not to standard do not require the submission of a departure from standard.

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2 Outline design and operational safety requirements

General

2.1 The Highways Agency's published aims are "safe roads, reliable journeys and informed travellers". A key element in achieving these aims is the implementation of managed motorways.

2.2 Permanent conversion of the hard shoulder to a running lane, along with the ability to dynamically control mandatory speed limits is a key aspect of MM-ALR as detailed in this IAN. This removes the complex operating procedures related to opening and closing the hard shoulder and brings associated capital and operational cost savings.

2.3 The permanent conversion of the hard shoulder on the main line to a running lane also applies intra-junction. However, this does not preclude the provision of a lane-drop/ lane-gain junction arrangement where this is fully justified on the grounds of safety, operational performance or cost.

2.4 For many junctions where the majority of traffic continues along the mainline carriageway, then the provision of an additional lane intra-junction is likely to be the optimum solution. However there may be situations where the cost may be prohibitive, for example due to the need to replace or modify bridges. Conversely, if a junction has very high diverge and merge flows then providing an additional lane through the junction may have dis-benefits, as it is likely to cause flow breakdown.

2.5 In all cases, an assessment must be undertaken based on design year traffic flows and the economic viability of providing the additional lane intra-junction. If the results of the assessment are marginal then the preference must be to provide the additional capacity through the junction by permanent conversion of the hard shoulder. If a lane-drop, lane-gain junction arrangement is to be adopted, the assessment must be included in the DSR and be endorsed by the Roads Programme Steering Group, following acceptance by the PSCRG.

2.6 Refuge areas must be included in the design, providing a place for vehicles to stop in emergency or breakdown, (see paragraph 5.14 for the definition of what constitutes a refuge area).

2.7 Provision of infrastructure to inform drivers of mandatory speed limits and lane availability has been rationalised to improve value for money. Compared to hard shoulder running, increased spacing of information and incorporation of verge mounted signing and signalling, rather than portal gantries, contribute to capital and operational cost savings.

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Outline design

2.8 The generic outline design for MM-ALR is illustrated in figure 2-1 below:

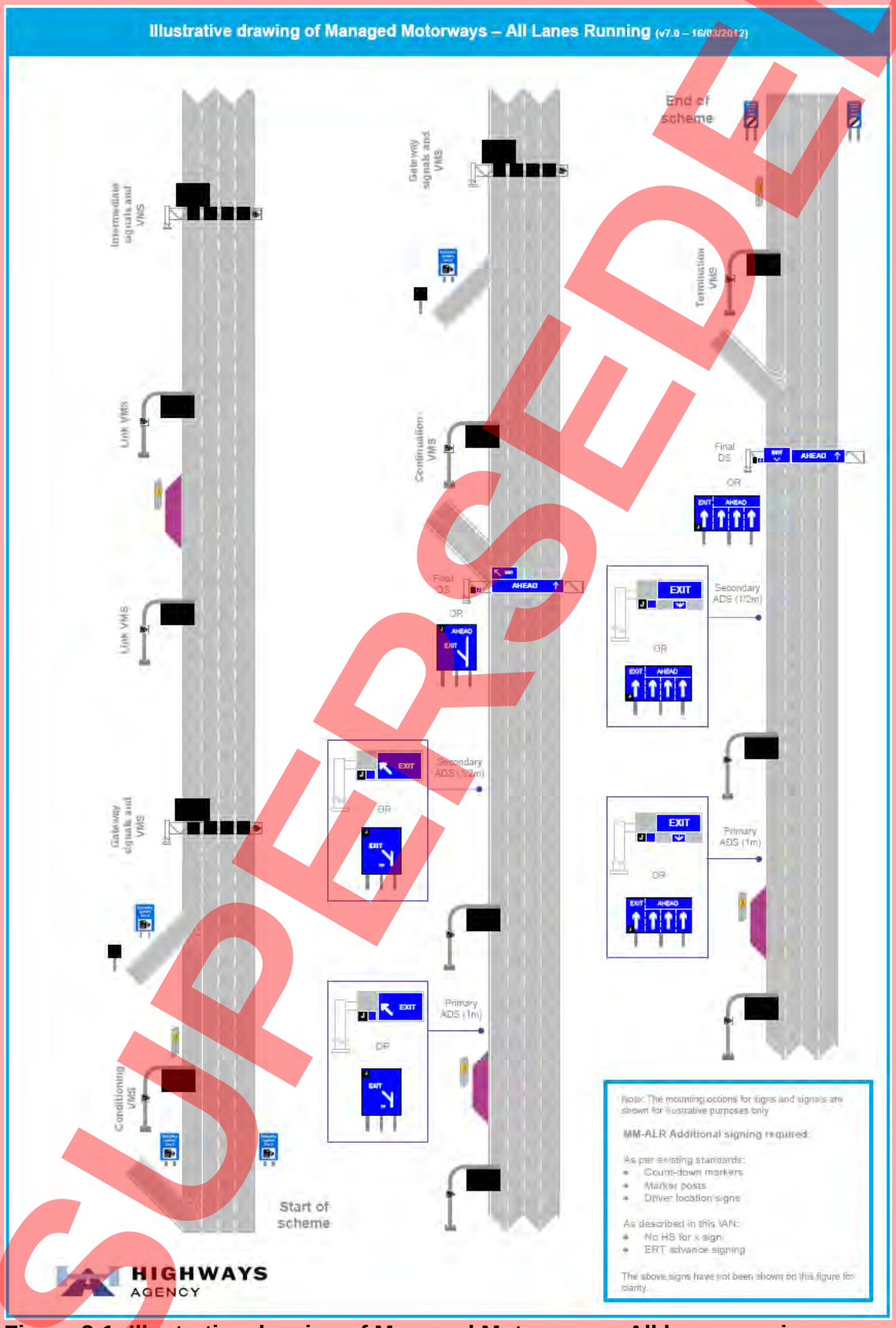


Figure 2-1: Illustrative drawing of Managed Motorways – All lanes running

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2.9 The efficient operation of MM-ALR schemes is dependent on:

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

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

Maintenance

2.10 A MM-ALR scheme must be designed for maintenance (IAN 69) and an appropriate maintenance and repair strategy be developed. This must place emphasis on the elimination and reduction of maintenance activities and risks.

2.11 The Construction (Design and Management) Regulations 2007 impose a statutory duty to reduce health, safety and welfare risks for, amongst other things, the maintenance of completed schemes.

2.12 The scheme design must eliminate hazards and reduce risk exposure to road workers and traffic officers so far as is reasonably practicable. Information must be provided on any residual risks to those that will carry out construction or undertake maintenance and operations.

2.13 The Asset Maintenance and Operational Requirements (AMOR) and The Technology Management & Maintenance Manual (TMMM) set out the Agency's requirements in relation to the carrying out of maintenance and operational activities on the network. The Traffic Officer Manual will detail any changes in procedures required for operating MM-ALR.

2.14 With the permanent conversion of the hard shoulder to a running lane, there will be no hard shoulder available for maintenance access or for the setting out of traffic management. All maintenance activities within a MM-ALR scheme must be carried out in a safe manner and are generally expected to 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 majority of maintenance is expected to be undertaken outside of peak periods.

2.15 Eliminating the dynamic hard shoulder from the design removes the requirement for a hard shoulder monitoring system supported by fixed CCTV cameras, significantly reducing the number of CCTV cameras required within a managed motorways scheme. The increased spacing between consecutive signal locations and the switch from lane specific to predominantly verge mounted provision further reduces the levels of technology infrastructure which must be tested, inspected, and maintained. This results in an overall reduction in the maintenance requirements of MM-ALR, as compared to previous managed motorway designs.

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2.16 The design philosophy and maintenance and repair strategy must demonstrate that the maintenance requirements have been reduced so far as is reasonably practicable. This must include all temporary traffic management requirements for maintenance access. This is of particular importance for signals and their associated controllers, where there is a need to access lane signals in lanes 3 and 4, and the roadside controller at the same time. Detailed agreement must be reached with all relevant parties on the approach to maintenance of equipment and how this must be provisioned in the design. This must be recorded in the DSR.

2.17 Any request for the inclusion of access and/or maintenance hard standings must include a costed justification, including safety risk assessment and be submitted to the scheme Project Safety Control Review Group (PSCRG) for review and will be considered on the grounds of operational safety and whole-life cost. Following agreement by the PSCRG, this information must be submitted to the scheme Senior User for agreement and the relevant information included in the scheme Safety Report and DSR.

2.18 Further details and advice on the provision, siting and design of maintenance hard standings is described in TD 69/07 The Location and Layout of Lay-bys and Rest Areas.

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3 Highway link design

General

3.1 This section shall be read in conjunction with TD 9/93 (DMRB 6.1) Highway Link Design, and IAN 149/11 Existing Motorway Minimum Requirements.

3.2 The following paragraph in IAN 149 is superseded:
2.2.2

3.3 The following paragraph in IAN 149 is amended:
2.4.4

Design speed relaxations

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, and
- superelevation

as described in TD 9 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 paragraph 1.24 and IAN 149 paragraph 2.2.2.

Road camber

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

This amends IAN 149 paragraph 2.4.4, bullet point 4.

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4 Layout of grade separated junctions

General

4.1 This section is to be read in conjunction with TD 22/06 (DMRB 6.2.1) Layout of Grade Separated Junctions and IAN 149/11 Existing Motorway Minimum Requirements. This section increases the scope of relaxations provided in TD 22, and gives requirements and guidance for modification of grade separated junctions and interchanges on motorways. Reference should be made to IAN 149 section 3, which details the relaxations that can be applied to reduce the footprint of the slip roads.

4.2 The following paragraphs in IAN149 are superseded:

3.1.3
3.3.2
3.3.3
3.3.4
3.3.9
3.3.10
3.3.11

4.3 The following paragraphs and figure in TD22 are amended:

2.30
figure 2/4.5
4.22

4.4 The upgrading of slip road layouts, where widening would be required, does not normally form part of the implementation of a MM-ALR scheme unless agreed with the Highways Agency. In order to achieve the optimal junction layout on an existing motorway, a balance should be reached between what is required by TD 22 and what is achievable within the scheme constraints, whether physical (particularly the existing carriageway area) or value for money. This supersedes IAN 149 paragraph 3.1.3 and 3.3.11.

4.5 The layouts provided in TD 22 apply a consistency across the motorway network, and road users are familiar with the standard layouts. The provision of a substitute layout that differs from that derived from the use of TD 22 figure 2/3 MW and figure 2/5 MW, as described in paragraphs 4.6 and 4.7 of this IAN, is an acceptable relaxation. This supersedes IAN 149 paragraph 3.3.2 and 3.3.9.

Design of merges

4.6 If the appropriate layout cannot be provided in full within the scheme constraints, the layout may be amended by either of the following methods:

a) The Road Class in TD 22 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. This amends TD 22 paragraph 4.22. The DSR must record the Road Class adopted for each geometric parameter this relaxation has been applied to.

b) Where constraints exist (physical, environmental, operational, or financial) the provision of a substitute layout that differs from that defined in TD 22 figure 2/3 MW may be used, and is an acceptable relaxation, with the exception of a merge Layout B or A as a substitute for a Layout F or G, for which a departure from

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standard must be submitted. The layouts derived from TD 22 figure 2/3 MW and any substitute layouts proposed must be recorded in the DSR. The DSR must 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.

c) No departure is required for the use of Layout H as a substitute for a Layout F. This amends TD22 paragraph 2.30 and figure 2/4.5.

This supersedes IAN 149 paragraph 3.3.3, and 3.3.4.

Design of diverges

4.7 If the appropriate layout cannot be provided in full within the scheme constraints, the layout may be amended by either of the following methods:

a) the Road Class in TD 22 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. This amends TD 22 paragraph 4.22. The DSR must record the Road Class adopted for each geometric parameter this relaxation has been applied to.

b) the provision of a substitute layout that differs from that defined in TD 22 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 or a diverge Layout A as a substitute for a Layout D, for which a departure from standard must be submitted. The layouts derived from TD 22 figure 2/3 MW and any substitute layouts proposed must be recorded in the DSR. The DSR must 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 paragraph 3.3.9 and 3.3.10.

4.8 At junctions where a lane gain arrangement is not provided, a review (including site survey if necessary) of the existing layout must be carried out, to assess whether drivers currently have difficulty merging. An assessment must also be undertaken of the proposed layout to determine if an HGV can achieve a safe merging speed, at the tip of the merge nose. If this can not be achieved, due to gradient, radius of the slip or other factors, then an appropriate length merge overrun area must be provided. Where redundant carriageway exists, this should be retained as an overrun area. Where the survey or assessment identifies site specific issues, then additional mitigation must be considered. The findings and decision making process regarding overruns must be detailed in the DSR and endorsed by the PSRCG.

4.9 Paragraph 4.7.5 in IAN 149 does not apply as a MM-ALR does not have a hard shoulder.

Layout within a junction

4.10 Between the merge and diverge of a junction, MM-ALR schemes may either have through junction running (i.e. four permanent running lanes within the junction, which is the preferred layout) or a lane drop/lane gain arrangement. Paragraphs 2.3 to 2.5 provide information on the assessment of which layout to use.

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5 Cross sections and headroom

General

5.1 This section shall be read in conjunction with TD 27/05 (DMRB 6.1.2) Cross-Sections and Headrooms and IAN 149/11 Existing Motorway Minimum Requirements.

5.2 The following sections in IAN 149 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

5.3 The following sections in IAN 149 are superseded:

4.6.1
4.6.4

The following sections in TD27 are superseded:

4.11.13

The following sections of TD19 are superseded:

3.15

Verges, edge detail and omission of hard shoulder

5.4 MM-ALR utilises the full carriageway by permanently converting the hard shoulder to a running lane. Where there is no edge restraint, such as a kerb or drainage channel, then a hardstrip must be provided that is sufficient to maintain the structural integrity of the edge of carriageway. The omission of a hard shoulder does not require a departure from standard.

5.5 There must be no loose stone, or filter drain material within 1000mm of the trafficked edge of the carriageway edge line.

Traffic lane widths

5.6 The minimum dimensions for traffic lane widths are given in table 5-1. These dimensions are for converting a 3 lane motorway with a hard shoulder to a 4 lane MM-ALR motorway and must be measured as per TD 27. This supersedes IAN 149 paragraph 4.6.1.

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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 paragraph 4.6.4.

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

Table 5-1: Minimum dimensions for traffic lane widths

Central reserves

5.8 Minimum central reserve widths are as shown in table 4-1 of IAN 149.

5.9 Reductions in central reserve width must be applied as described in IAN 149 paragraphs 4.4.2 to 4.4.5.

5.10 If works are undertaken in the central reserve, and unbound material is to be used as the surface treatment, then a departure from standard must be submitted.

Vehicle Restraint System (VRS) set back

5.11 The set-back is the lateral distance between the traffic face of a safety barrier and as appropriate:

i nearside: the back of the nearside hardstrip (greater than 600mm) or hard shoulder
ii nearside: the kerb face for roads without a nearside hardstrip (or hardstrip less than 600mm) or hard shoulder
iii nearside: the trafficked edge of the edge line for roads without a hardstrip (or hardstrip less than 600mm), hard shoulder or kerb.
iv 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 must be measured from the trafficked edge of the edge line.

The minimum dimensions to be used are given in table 5-2.

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)
In verges with an adjacent hardstrip or hard shoulder (i.e. >=600mm width hardstrip)	600	Note (iii)
Central reserves	1200	Note (i), (ii)

Table 5-2: Set-back

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Notes

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

i. 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 will be 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.

If the reduction in setback creates a forward visibility departure, or there is a coincident horizontal geometry departure, then a departure must also be submitted for the reduction in setback. The application of a relaxation in setback must be recorded in the DSR.

This supersedes TD 27 paragraph 4.11.13.

Vehicle Restraint Systems (VRS)

5.12 If in an emergency a road user is unable to reach a refuge area, they may consider pulling their vehicle onto the verge. For this reason, although gaps of less than 20m must be closed, larger gaps should not be closed where the verge is able to sustain occasional vehicular use and does not contain hazards to vehicle, or their occupants.

This supersedes TD 19 paragraph 3.15.

5.13 Full height anchorages must 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 must not be used facing oncoming traffic, unless behind another restraint system.

Refuge areas

5.14 A refuge area is defined as a place (or facility) where drivers can stop in an emergency.

Appropriate refuge areas are:

- a motorway service area
- a hard shoulder on an exit slip/link road
- a hard shoulder within a junction (lane drop/lane gain only)
- a bespoke facility, such as an emergency refuge area (ERA)

5.15 The following features must not be considered formal refuge areas:

- maintenance hard standings, unless they meet the requirements presented in paragraphs 5.26 to 5.43
- verge
- hard shoulders on entry slip roads

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5.16 Emergency roadside telephones (ERT) must only be provided at:

- a hard shoulder within a junction (lane drop/lane gain only)
- an emergency refuge area (ERA) - see paragraph 5.26 to 5.43

This amends TA 73 paragraph A2.2.

5.17 A person who has left a broken-down vehicle must be able to reach a refuge without the need to walk on the carriageway. Therefore an assessment must be made of locations where the verge is discontinuous and the refuges located to eliminate the need to walk on the carriageway. If this cannot be achieved, it must be recorded in the DSR along with any proposed mitigations endorsed by the PSCRG.

5.18 Marker posts must direct users to ERTs such that their exposure to risk is minimised. The following hierarchy can be used to determine marker post direction:

- that the road user is not directed where they would need to walk on the carriageway to get to the ERT.
- if ERTs are visible from their location they are directed to the nearest visible ERT irrespective of whether it is upstream or downstream of their location.
- if ERTs are not visible from their location they are directed to the upstream ERT within a link.

Refuge areas on links between junctions

5.19 On links between ''through junction running' junctions at least one refuge area must be provided on each carriageway, if 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 that 1.5km.

5.20 If the upstream junction is diverge only, this distance must be measured from the tip of the diverge nose. If the downstream junction is merge only, this distance must be measured from the tip of the merge nose.

Refuges on exit slip/link slip roads

5.21 The refuge, which may be a hard shoulder, must be a suitable length and width of bound surface and will wherever possible be an existing made surface that provides a safe area of refuge and can be safely entered and exited. The refuge area must be viewed by a PTZ camera. The decision making process regarding the location, layout and construction must be recorded in the DSR. No additional ERTs are to be provided on exit slip/link roads.

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Refuges within a junction

5.22 The area within a junction may be considered a refuge area if:

- there is a suitable length and width of hard shoulder, that provides a safe area of refuge, that can be safely entered and exited. The decision making process must be recorded in the DSR.
- an ERT is provided next to the above area. The ERT should not be conspicuous from the slip roads.

5.23 Where there is no available hard shoulder within a junction, an ERA may be provided if the distance between the tip of the diverge nose and the tip of the merge nose is more than 1.5km and it satisfies the requirements of paragraphs 5.26 to 5.45. The ERA must be centrally positioned between the merge and diverge (subject to SSD mitigation requirements) and feature an ERT to discourage pedestrians walking from the ERA. The decision making process must be recorded in the DSR.

Frequency of refuge areas

5.24 Throughout a MM-ALR scheme, refuge areas must be provided such that a driver is never more than 2.5km from a refuge. The distance should be measured between the stopping area within each adjacent refuge area, e.g. not from the end of the tapers.

5.25 The 2.5km distance may be extended where it can be justified on safety, cost and operational grounds, and endorsed by the PSCRG. This must be recorded in the DSR.

Emergency refuge areas (ERAs)

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

5.27 ERA's on steep gradients should be avoided wherever practicable.

5.28 Where ERA's are located on gradients greater than 2% the designer must determine that the frequency of refuge areas is appropriate from a safety and network performance perspective. The decision making process must be recorded in the DSR.

5.29 An ERA must not be located between the ½ mile (or ⅓ mile) ADS sign and an exit slip road. This requirement is to prevent road users confusing the ERA for an exit slip road.

5.30 An ERT must be provided at each ERA. The ERT should be located next to the mid-point of the main stopping area of the ERA.

5.31 Access to the ERT must provide for mobility impaired road users.

5.32 To mitigate the risk of people crossing the motorway to reach an ERT, the ERTs should be located opposite each other. If this cannot be achieved and the ERTs have to be staggered, then an assessment of the risk must be undertaken and detailed in the DSR. Consideration should be given to appropriate mitigation. This supersedes TA 73 paragraph A2.2.

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

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

5.35 The design length for the exit taper should be 45m.

5.36 If space permits then the desirable width of an ERA is 4.6m, although the minimum permissible width is 4.0m. The decision making process must be recorded in the DSR. Notwithstanding this, the width of the ERA should be such that:

- any planned maintenance activities from the ERA can be carried out safely without traffic management in the live lanes.
- that a HGV parked at the end of the stopping area can rejoin the carriageway without encroaching into lane 2.

5.37 Where ERA's are located on gradients greater than 2% then the designer must determine that the above dimensions are appropriate, and whether any additional mitigation is required. The decision making process must be recorded in the DSR.

5.38 The ERA must be surfaced in accordance with HD36/06, and should be of a similar construction to the adjacent carriageway.

5.39 Each ERA must have the following signs:

- "No stopping except in an emergency" (2 no.) TSRGD diag 642.3.



- "Emergency refuge area" with SOS phone picture (1 no.)



- Advanced SOS phone signing must be provided ½ and 1 mile upstream of each ERT.



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- "Driver must use SOS phone and await advice to rejoin main carriageway" (1 no.)

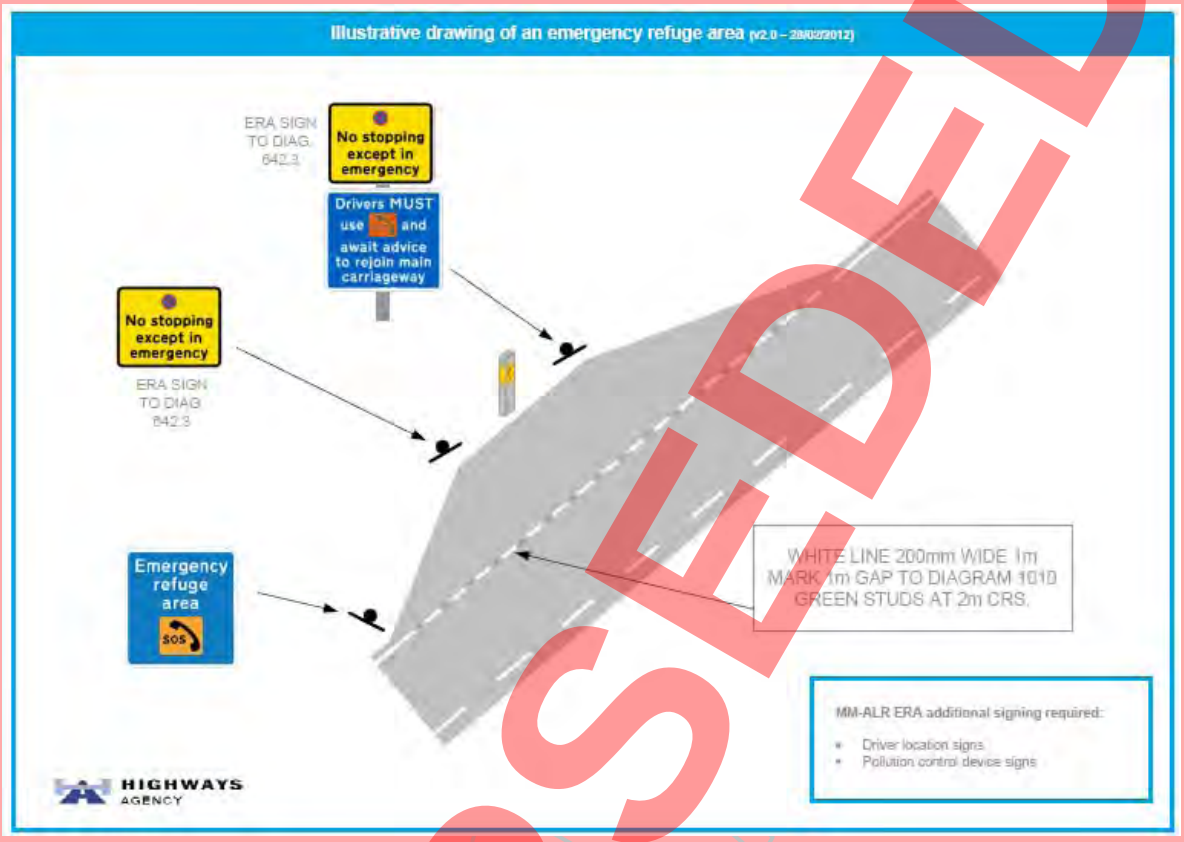


- Driver location signs must be located next to an ERA, co-located with the existing distance marker post. If the distance marker post is not located in the ERA, then a supplementary driver location sign must be provided within the ERA. The sign should be clearly visible from the phone.



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5.40 No road markings are required within an ERA.

5.41 Between the ERA and lane 1, the carriageway markings must be to diagram 1010 and incorporate green road studs in accordance with Chapter 5 of the TSM.

Stopping sight distance

5.42 Sufficient stopping sight distance (SSD) for vehicles entering and exiting the ERA is required. This may be one step below desirable minimum as defined in chapter 2 of TD 9/93. The measurement should be taken to/from a vehicle parked next to the ERT.

5.43 Visibility on exit from ERAs must conform to the requirements for a major/minor junction as set out in TD 42.

Other issues

5.44 There is no requirement for lighting an ERA.

5.45 No monitoring loops or other detection system is required within an ERA, however the full extent of each ERA must be fully included within the field of view of a PTZ CCTV camera and the associated ERT must represent a minimum of 10% of screen height.

5.46 Maintenance access to equipment from ERA's (and/or the use of ERA's as starting points for temporary traffic management) is beneficial but considered to be of secondary importance to paragraphs 5.14 to 5.43 above and should be provided whenever the primary requirements for the preferred location are not compromised.

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6 Technology

General

6.1 All roadside technology provided for MM-ALR, on the mainline carriageway, must have the functionality to enable software to be upgraded, and faults to be diagnosed, remotely. This will assist in minimising risk exposure to road workers, and traffic management costs, through reducing visits to the roadside.

6.2 Where existing technology is retained it must be upgraded or replaced to be compatible with the transmission protocol implemented as part of the scheme.

Vehicle detection system

6.3 This section should be read in conjunction with TD 45/05 and HD 20/05.

6.4 The following clauses in HD 20/05 are superseded:

3.9
3.11
3.12

6.5 A vehicle detection system must be provided, to include all running lanes, to support; incident detection, queue protection, VMSL and congestion management.

6.6 It is not the intention of this IAN to limit detector technologies that can be deployed in place of inductive loops.

6.7 Where non-loop based detection technologies are considered for the MM-ALR scheme's vehicle detection system, it must not compromise the required functionality of that vehicle detection system. The technology must be approved for use for the required application(s) and documented performance capability must be provided. Advice of the Highways Agency must be sought.

6.8 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

6.9 The objective is to position detectors where they are required to detect traffic queues. For MIDAS, this is 10m upstream of control signals, so that the signal settings relate as closely as possible to the traffic conditions.

6.10 Paragraphs 6.11 to 6.18 only apply to inductive loops. They, however, also indicate the level of provision required should an alternative to inductive loops be used.

6.11 Where inductive loops are used, each signal site must have detector loops located 10m upstream of it; this signal is referred to as the 'reference signal' for those loops. If this cannot be achieved due to site constraints, then they must be provided within 50m upstream to 10m downstream of the reference signal.

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6.12 Detector sites must be spaced as follows:

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

6.13 The detectors on exit slip roads must be provided ideally 100 metres downstream, but as a minimum not less than 50 metres downstream of the diverge tip of nose, or if provided, within 10 metres of exit slip signals.

6.14 For exit slip 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 vehicles can 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 slip (ideally 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.

6.15 On entry slip roads, the detectors must 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 must not be sited downstream of the final lane gain or merge information signs.

6.16 Within motorway to motorway link roads, detectors must be provided at a minimum distance of 100 metres from the diverge and merge nose tips. Between these two sites the requirements in paragraph 6.12 apply.

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

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.

Road user compliance

6.19 Each MM-ALR scheme must 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. This will enable enforcement to take place, which is a key element in achieving speed limit compliance.

Site data

6.20 Site data must include the implementation of speed and flow threshold levels (rising and falling) for congestion management algorithms to set speed limit aspects.

6.21 Applications for site data changes must be made at least 1 year in advance of the requirement to allow for inclusion in the Software Maintenance Contractor programme.

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6.22 MCH 1596 provides guidance on the procedures to be followed when planning and implementing changes to site data.

Transmission system

6.23 The existing transmission infrastructure, longitudinal cables and ducts, must be used wherever practicable. The philosophy adopted for the design of the transmission system must be logged in the DSR.

6.24 Early liaison must be carried out with the HA NRTS team and the NRTS contractor 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 and other NRTS assets should be assessed early in the design process.

6.25 A guide to working with the NRTS Contractor (GYS/RGD/USG/0038) can be found on the NRTS website www.nrtsco.com.

Cabinets

6.26 All cabinets provided for MM-ALR must be those available from HA Bulk Purchase. A departure from standard must be sought if non bulk purchase equipment is to be used.

Ambient light monitors (ALM)

6.27 Ambient light monitors (ALM) must be provided at appropriate intervals to control the brightness levels for the VMS and lane control signals.

CCTV general surveillance

6.28 TD 17/85 and MCH 2530 provide information on CCTV general surveillance.

6.29 Pan tilt zoom (PTZ) CCTV coverage of the main carriageway, refuge areas and maintenance hard standings (where provided) must form part of a MM-ALR scheme.

6.30 PTZ CCTV cameras deployed for MM-ALR schemes must provide comprehensive coverage in low light conditions, whether the carriageway is lit or not, as they will be used to confirm the location of incidents on the main carriageway. The coverage must be such that an operator can interpret correctly the nature of each incident in low light conditions within the designed viewing range. To achieve this, at the extreme of the required coverage, a 1.75m target should represent a minimum of 5% of screen height.

6.31 The designer must consider whether existing PTZ CCTV cameras can be used to provide comprehensive coverage. 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.

6.32 The location for the mounting of PTZ CCTV cameras is not stipulated and must be determined to provide comprehensive coverage (see paragraphs 6.30, 6.31 and 6.33) whilst taking into account environmental considerations, image stability, and whole life costs including providing adequate maintenance access. Where cameras are co-located with signals a shared foundation should be used where practicable.

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6.33 Blind spots due to structures and bends must be kept to a minimum and must not exceed 5% of the carriageway on each link, and at each junction.

6.34 Blind spots must not include refuge areas (except at MSAs), ERTs, maintenance hard standings (where provided) or locations where it is not possible for a vehicle to leave the carriageway in the case of a breakdown, for example viaducts.

6.35 Information must be provided to the operator so that they have confirmation of its reference number and geographic location.

Ramp metering

6.36 Existing ramp metering sites may need to be modified or even decommissioned upon the implementation of an MM-ALR scheme.

6.37 Existing ramp metering, within a proposed managed motorway scheme, must be re-assessed against the criteria in IAN 103/08, using forecast traffic figures for after the MM-ALR scheme implementation, to determine if the criteria for ramp metering provision will be met following the implementation of the MM-ALR scheme.

6.38 If it is forecast that, following the MM-ALR scheme implementation, ramp metering sites within the MM-ALR scheme continue to meet the criteria in IAN 103/08 the following actions must be carried out:

a) commissioning of new MIDAS outstation auxiliary link (OAL) if new or different MIDAS outstations are to be used for the ramp metering site.
b) re-configuration of the ramp metering controller (RMC) to take account of changes to the MIDAS design
c) re-calibration of the RMC to account for changes in traffic conditions and road layout as a result of managed motorway scheme implementation.

6.39 It must be considered whether changes to the road layout, as a result of the scheme implementation, result in a need to reposition the ramp metering signals and stop line. MCH 2470 provides guidance on the location of ramp metering signals and stop line.

6.40 If it is forecast that, following MM-ALR scheme implementation the criteria in IAN 103/08 are no longer met, advice from the Highways Agency must be taken to determine the extent to which the ramp metering signals should be decommissioned. This should be a joint decision between the Agency's task force and the region concerned.

Lighting

6.41 For MM-ALR schemes where the motorway is not currently lit, lighting shall not be considered.

6.42 Where it is identified that existing sections of lighting within a managed motorway scheme are no longer justified, the processes for removal of all lighting columns shall be implemented. If this is not practicable without additional traffic management, then the lighting should be switched off until such time it can be removed in conjunction with other works.

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6.43 Sections of lit motorway need to be assessed individually in order to ascertain as to whether they should remain lit. Schemes should be divided up in to sections as follows:

At junctions:

- 1.5 times the sight stopping distance to the give way line on the junction gyratory or intersection with a minor road
- the maximum length of slip road that can be lit without the need to light the main carriageway
- up to 300m upstream of the ½ mile ADS
- up to 300m upstream of the 1 mile ADS

On motorway links:

- the link length between up to 300m upstream of the 1 mile ADS of the upstream and downstream junctions.

6.44 Each section shall be assessed in accordance with the core TA 49/07 principles (of running costs versus predicted accident savings) to identify which sections need to remain lit. The data used for predicted accident savings to be applied in this case will only be the ones where the contributory factors (or absence of contributory factors) over the last 5 years of data give good reason to indicate lighting may potentially be beneficial (for example – excluding accidents involving drink, drugs, suicide, vehicle failures (e.g. tyre defects, brake failures), mobile phones, excessive speed, or compounded contributory factors such as following too close & too fast for conditions & swerved & sudden braking). If the evidence suggests there may be justification for lighting, this will then need to be supported with full compliance with the TA49/07 appraisal process.

6.45 The TA 49/07 appraisal should consider or include the following:

- a BCR of 1.0 or greater shall be achieved in order to justify lighting.
- only accident savings of 24% on slip roads and 10% on the main carriageway shall be used unless substantive evidence to the contrary can be provided.
- 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 road user.

6.46 Where lighting is not economically justified, in accordance with the core TA 49/07 principles (or the fully compliant TA49/07 criteria described above are not achieved), advice from the Highways Agency should be sought regarding lighting removal.

6.47 Where lighting is economically justified, through the Project Appraisal Process (PAR) as guided by TA 49/07, it shall be primarily designed for minimum on-road maintenance.

6.48 Where new lighting luminaires are justified the minimum lighting levels shall be:

- ME3a where junction separation is >3km
- ME2 where junction separation is <3km (or equal to 3km)
- no area/section shall be lit as a conflict area

6.49 Where new lighting is justified and is to be installed, it must be:

- able to be remotely controlled. That is, it must be connected to a compatible Central Management System allowing dynamic dimming and switching off.
- fitted with a light source that has a predicted life-time in excess of the electrical test

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interval, thereby reducing the requirement for non-scheduled maintenance visits.

6.50 In order to minimise costs, departures from the minimum lighting levels, overall uniformity and longitudinal uniformity shall be considered, if it results in use of the existing lighting, without alteration. Departures for light levels up to 5% below requirement level and/or overall uniformity down to 0.39 and/or longitudinal uniformity down to 0.6 below requirement are deemed likely to be approved.

Power and communications infrastructure

6.51 There should not be a presumption that there will be a wholesale replacement of technology infrastructure as part of a MM-ALR scheme. Wherever practicable, existing power and communications infrastructure must be re-used.

6.52 Each type of electrical equipment on a gantry must 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.

6.53 Super-span portal gantries must be capable of being isolated from either carriageway.

6.54 Cables for inductive loop detectors from the far carriageway must be routed via cross-motorway ducts where they exist and are proven. Where such ducts do not exist, consideration should be given to slot cutting across both carriageways. The Highways Agency must be consulted to ensure that any slot cutting does not compromise the road structure.

Security

6.55 The design should consider, in conjunction with the Senior User, the use of appropriate security measures at each equipment location to guard against metal theft and maintain the integrity of the installation.

6.56 Security should be considered when positioning roadside equipment, including the Distribution Network Operator (DNO) supplies and a risk assessment undertaken. The location of equipment in concealed or secluded areas should be avoided. Where equipment cannot be sited to avoid secluded or concealed areas, this must be approved by the PSCRG, agreed with the Senior User and recorded in the DSR.

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7 Signals and signs

General

7.1 This section shall be read in conjunction with TD 46/05 (DMRB 9.1.1) Motorway Signalling and IAN 149/11 Existing Motorway Minimum Requirements.

7.2 Variable message sign (VMS) and direction signs associated with a junction will normally be verge mounted, however where existing portal gantries are present then the designer must first consider re-using this existing infrastructure.

7.3 There must be no new provision of lane signalling on existing portal gantries, however where existing advisory lane signals exist they must be upgraded to those capable of displaying the aspects detailed in paragraph 7.17.

Direction signing

7.4 Direction signs must be located as described in figures 5-8 to 5-12 in IAN 149, and to the tolerances contained therein. There is no requirement to provide route confirmatory signs.

7.5 The amount of information shown on ADS will be dependant on the junction type.

7.6 For direction signing, other than the final direction sign, verge mounted signing should be used to minimise the need to implement temporary traffic management for maintenance of the sign. Overhead direction signing (e.g. mounted on a cantilever) may be used where operationally it is considered more appropriate to do so. Factors that can 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 HGVs leading to the risk of sign obscuration

7.7 The signing strategy must be agreed with the Highways Agency, and recorded in the DSR.

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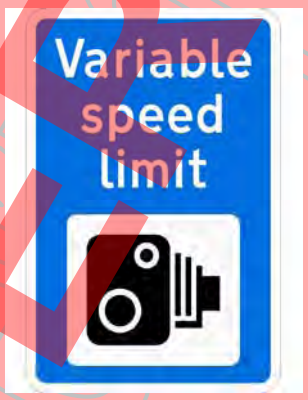
Verge signs

7.8 Countdown markers, marker posts and driver location signs must be provided in accordance with existing Highways Agency standards and advice unless otherwise stated in this document.

7.9 A 'Refuge areas for emergency use only' sign must be provided in the verge, downstream of the merge, at the end of each entry slip road, in a suitable location.



7.10 NP 409 'Variable speed limits ahead' 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 entry slip roads the sign should be located in the nearside verge before the nose taking into account the existing verge infrastructure. 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 entry slip location. A pair of signs must be provided on the mainline – one in the verge and one in the centre reserve. NP 409 sign is shown below and is a non-prescribed sign that must be authorised for use. Where the central reserve width is limited, a reduced 'x' height can be used to a minimum of 100mm.



7.11 Enforcement camera sign (TSRGD diagram 879) must be provided at each signalling location.



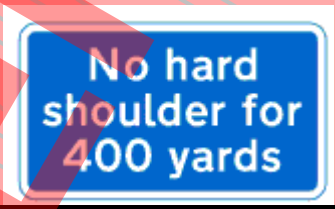
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7.12 Non prescribed combined fixed "Variable Speed Limit ENDS"/national speed limit signs to NP 409.1 must be provided at the exit points from the scheme, on the mainline, link roads and interchange links. If there is a merge the combined fixed "Variable 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. A pair of signs must be provided – nearside and offside. Where the central reserve width is limited, a reduced 'x' height can be used to a minimum of 100mm.



7.13 An information sign "No hard shoulder for XX miles" to TSRGD (diag. 820.1) must be provided on the main line at the downstream end of the intra-junction section entering the MM-ALR scheme and on all entry slip roads. The distance shown must 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 MM-ALR scheme. The sign must be located as close as is practicable and in advance of the start of the reduction in width/end of the hard shoulder.



Control signals

7.14 The following sections in IAN 149 are amended:

5.6.1
5.6.3
5.6.4

7.15 The following sections in IAN 149 are superseded:

5.5
5.6.6

7.16 At every signalling site the capability for variable message signing will also be provided. Where lane signalling is provided above each lane, a separate VMS must be co-located at the site; where carriageway signalling is provided, both this and the VMS capability will be integrated within one item of equipment, as shown on figure 2-1.

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VMS deployed for MM-ALR must 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.

7.17 Lane signals and VMS must be provided 300m (+/-100m) downstream of the entry datum point, as shown in figure 2-1 at the "Gateway signals and VMS" location.

Lane control signals deployed for MM-ALR must be capable of displaying:

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

7.18 For link lengths between 5km and 6km, where the link length is the distance measured from the gateway signal to the VMS downstream of the diverge back of nose, an assessment is required to decide whether an additional "lane signals and VMS" site should be provided, as shown in figure 2-1 at the "Intermediate signals and VMS" location. This assessment must be recorded in the DSR and the decision endorsed by the PSCRG. If the link length exceeds 6km an "Intermediate signal and VMS" site must be provided. The "Intermediate signal and VMS" site should be sited nominally at the mid-point of the link, subject to the requirements of paragraph 7.22.

7.19 Similarly, link lengths that exceed 10km, two "Intermediate signal and VMS" sites must be provided such that the link is sub-divided into three lengths of broadly equal distance, subject to the requirements of paragraph 7.22.

7.20 Elsewhere lane signalling is not required, with the exception of locations with 5 or more running lanes. In these locations, lane signalling and VMS must be deployed to meet the spacing requirements detailed in paragraph 7.22.

Paragraphs 7.17 to 7.20 replace IAN 149 paragraph 5.6.1 a) and b).

7.21 A VMS must be provided downstream of the diverge back of nose. Taking account of site constraints, the VMS must be provided as close to the diverge back of nose as practicable.

7.22 Spacing distances for control signalling/VMS:

a) at diverge junctions, carriageway signalling on a VMS must be located 300m (+/- 100m) upstream of the Primary and Secondary Advance Direction Sign (ADS). If these requirements cannot be met a departure from standard is not required however the reasons why must be detailed in the scheme DSR. Where existing portal gantries are present, the designer should first look to reuse this existing infrastructure, thereby co-locating the control signalling with the Primary, Secondary and Final Direction Signs.

b) mandatory control signals must be spaced between a minimum of 600m and up to a maximum of 1,500m apart, subject to the provision of a minimum

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unobstructed visibility of the signal as described in paragraph i), ii), iii) and iv) below.

i) in advance of the downstream signal for a distance of 350m. This is consistent with minimum sight line to an EMI stated in TA 74, A4.3 signal visibility.
ii) in advance of the downstream signal for a distance of at least ½ of the proposed spacing.
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 must not exceed 500m. Where a scheme design proposes non-visibility distances between 500m and 600m this must be endorsed by the PSCRG and recorded in the scheme DSR; a departure from standard must be submitted for non-visibility distances in excess of 600m.
iv) where the downstream signal is provided by a verge mounted VMS an unobstructed sight line must 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 must be provided to all of the signal mounted over lane 1 (right hand bend) or lane 4 (left hand bend). The shortest sight line must 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 paragraph 5.6.3.

7.23 An Intra-Junction VMS with combined signal must 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 requirements described in paragraph 7.22 b) of this document 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 paragraph 5.6.4.

Strategic variable message signing

7.24 Additional strategic VMS will not be required as part of the scheme, however where existing strategic VMS are present they must be retained or be repositioned. The sequence of sign and signalling installations on the approach to a junction shall be strategic VMS, VMS, and then the 1 mile ADS. This sequence is then repeated for the ½ mile ADS. The spacing between this roadside equipment is to be nominally equalised and must be no less than 200m. Where lane signalling is present the layout and sequence must follow the requirements of IAN 149.

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7.25 Where other existing VMS are used to provide a strategic signing capability by the National Traffic Operations Centre for strategic traffic management or driver information messages, the scheme must agree with the scheme Senior User and Traffic Management Directorate, the level of strategic signing capability which must be retained for each link, and how this should be provided.

7.26 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.

7.27 Any VMS used for this purpose must be prioritised for strategic use within the message hierarchy, and must have remote monitoring capability.

Entry slip signals

7.28 Entry slip signal(s) (ESS) must be provided at all junctions.

7.29 ESS must be located at the last decision point before accessing the motorway, normally the start of the slip road, such that drivers 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.

7.30 If there is a pair of existing ESS, capable of displaying advisory aspects and suitably located to provide adequate forward visibility, they can be retained provided the first signal downstream of the merge is visible from the entry datum point.

7.31 Existing ESS must be upgraded to ESS capable of displaying the aspects detailed in paragraph 7.17 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.

7.32 If existing ESS are not suitably located at the start of the slip or there are no existing ESS then a single mandatory ESS must be installed at the start of the slip road, located to provide adequate visibility for approaching traffic. If adequate visibility cannot be achieved with one signal, additional signals must be provided as necessary.

Paragraphs 7.28 to 7.32 supersede IAN 149 paragraph 5.6.6.

7.33 At motorway service areas (MSAs), existing ESS can 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 7.17. Where ESS are not currently installed they must only be provided if:

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

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8 Traffic modelling

8.1 As MM-ALR schemes involve the conversion of the hard shoulder to a permanent controlled running lane, unlike previous managed motorway schemes which made dynamic use of the hard shoulder, the traffic modelling and economic appraisal need to be undertaken using conventional techniques.

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 the Highways Agency.

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9 Structures

9.1 Highway structures i.e. overbridges, underbridges, retaining walls etc along the length of the MM-ALR scheme should be reviewed and any features that would not meet the requirements of the managed motorway scheme or are not compliant with current standards should be identified. This should include a review of completed assessment and inspection reports, and should consider the condition of the structures and any safety related defects. Headrooms should be checked on site. This should be undertaken at the earliest opportunity to allow potential mitigation measures to be agreed with the Highways Agency.

9.2 Particular focus must be placed on those structures which could restrict the operation of the MM-ALR 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.

9.3 Guidance on where assessments of structures must be in accordance with the principles set out in BD 95, although it should be noted that a MM-ALR scheme is not a widening scheme. Technical approval procedures in accordance with BD 2 are required.

Retention of existing gantries

9.4 Any existing gantries modified, repositioned or reused as part of a MM-ALR scheme will be subject to a special inspection and structural assessment. Attention is drawn to the need to consider wind and vehicle buffeting loading and fatigue effects. A geotechnical assessment will also be required where the foundation loadings increase significantly. This needs to be carried out early in the design process, so as to establish the need for gantry strengthening works. Inspections and assessments must address welds between critical structural members. Where agreed with the Highways Agency, welds should be tested.

New gantries

9.5 In accordance with IAN 86/07 gantries must not be provided with a fixed means of access for inspection and maintenance. A fully justified departure from standard should be submitted if a fixed means of access is required. A gantry support in the central reserve must not be provided as this would increase maintenance activities in the central reserve.

9.6 Gantries are required to be designed so that maintenance using mobile access equipment requiring lane closures is minimised and is as straightforward as possible.

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

9.8 The design life of gantries must be in accordance with IAN 86/07.

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Piers, parapets and gantries

9.9 IAN 91/07 and IAN 97/07 deal with the classification of 'Particularly at risk' piers and parapets that are not compliant with current standards respectively. They enable sites which are not compliant with current standards to be identified as high, medium, low, or negligible risk and advocate the following principles for mitigation:

High-Risk: high-priority upgrade/strengthening required in managed motorway scheme
Medium-Risk: upgrade at next suitable major maintenance scheme
Low-Risk: upgrade at next suitable major maintenance scheme
Negligible-Risk: upgrading not required (monitor only)

9.10 Clause 1.4 of BD 48/93 deals with the risks associated with potential vehicular impact protection to existing gantry legs.

9.11 Although MM-ALR schemes will modify the risks associated with pier, gantry leg or parapet impact (traffic running closer, narrower lane widths), the overall level of risk is generally considered unchanged.

9.12 For existing bridge piers the risk of vehicle impact shall be assessed using IAN 91.

9.13 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."

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.

9.15 For bridge parapet sites the risk of vehicle impact shall be assessed using IAN 97.

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 MM-ALR scheme. The upgrading work must be discussed and agreed with the Highways Agency.

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 MM-ALR scheme. The upgrading work must be discussed and agreed with the Highways Agency.

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Railway/third party infrastructure considerations

9.18 Bridges belonging to Railway Infrastructure Authorities or third parties may be affected by MM-ALR proposals. Where potential changes are considered to be significant (e.g. structural modifications, replacement of protective barriers, reduced setbacks etc.), the issues should be discussed with the Railway Infrastructure Authority or with the third party and should be reported to the Highways Agency.

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10 Environmental assessment

Screening

10.1 As required by HD47/08 managed motorway all lanes running schemes will need to undergo an environmental screening exercise. As these schemes will require new infrastructure (gantries, signs, ERAs, etc) they can be considered to be an improvement scheme. Improvement schemes are subject to compliance with the Highways Act Part VA Section 105 as amended. It is likely that these schemes will be judged as being an Annex II 'relevant project' leading to the production of a Record of Determination (RoD)/Notice of Determination (NoD). However projects should recognise that if the potential for significant effects is agreed then the project would become a Nationally Significant Infrastructure Project (NSIP) and would not need a RoD.

10.2 The RoD will need to be supported by an appropriate level of environmental assessment. It should be noted that until the basic scheme design is fixed (including gantry locations) the supporting assessment cannot be completed to support and allow the RoD to be signed off. It should be remembered that screening is not a one off exercise. Where projects change significantly then the screening should be revisited to ensure it is still valid.

Scoping

10.3 Based on current experience gained from previous managed motorways schemes the following picture emerges for those DMRB topics that are likely to be scoped in;

- Air quality – usually studied at a detailed level of assessment
- Cultural heritage – usually studied at a simple level
- Landscape – usually studied at a detailed level of assessment
- Nature conservation – usually studied at a simple level of assessment
- Materials – usually studied at a simple level of assessment
- Noise and vibration – usually studied at a detailed level of assessment

.

10.4 It should however be noted that each scheme may be different and a scheme specific scoping exercise will require to be concluded and agreed with the Highways Agency.

10.5 To aid consistency of data collection requirements across projects, particularly as Projects are progressing through the Highways Agency, Major Projects, Project Control Framework (PCF), Stage Gate process, projects are advised to use the checklists attached (see section 16):

- Checklist 1 - Existing data review
- Checklist 2 - Cable runs and infrastructure field appraisal
- Checklist 3 - Major equipment site field appraisal

Assessment of effects

10.6 It should be remembered that in common with normal practice the reporting of significance is made at an overall level i.e. for the project as a whole.

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10.7 It is also key that significance is judged within the project context. As far as magnitude of change is concerned, managed motorway schemes are generally adding to an existing motorway which is already a large scale physical intervention in the surrounding landscape.

Environmental reporting

10.8 The specific reporting framework for the environmental assessment process shall be based on HD 48/08, and should be utilised in conjunction with the requirements of the latest topic guidance. Attention is drawn to the requirements of Highways Agency, Major Projects, Project Control Framework.

Environmental design

10.9 The principles to be applied in environmental design and on the application of potential mitigation strategies shall follow those set out in the current DMRB Vol 10 guidance and supporting IANs. Particular attention is however drawn to sections 11 on drainage design philosophy and section 12 on earthworks of this IAN and the fact that any mitigation must be maintainable by the maintenance community.

10.10 Localised visual impact from nearby neighbouring properties must be considered for managed motorway schemes and this remains the case for MM-ALR schemes. However with reduced levels of gantries and signs and their associated design tolerances it should be possible to adjust the design and or location of the furniture so as to reduce these occurrences.

10.11 With reduced verge width it may not always be possible to mitigate localised impacts by landscape planting as it may not be maintainable. In such instances consideration must be given to others forms of screening. Combining noise barriers with visual barriers, where both are warranted, is one option to achieve efficiencies in the design.

10.12 Projects must detail any mitigation in the Outline Environmental Management Plan which forms part of the environment assessment, and ensure this information is carried though the CEMP and HEMP. This would include any environmental requirements (see IAN 84/10).

Environmental appraisal

10.13 Projects will continue to report environmental appraisal using the current WebTAG guidance. Particular attention is drawn to the appraisal requirements of Highways Agency, Major Projects, Project Control Framework.

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11 Drainage design philosophy

11.1 In line with guidance on environmental scoping above, it is suggested that no assessment of discharge rates, water quality and flood risk would normally be required for managed motorways schemes. The following summarises key issues set out in the scheme design assumptions:

- existing outfalls continue to discharge at existing established rates.
- where minor pavement area increases are required e.g. ERAs as part of the project, attenuation will be required to ensure existing discharge rates are not increased. The design should be assessed in accordance with Planning Policy Statement 25 (PPS25), Development and Flood Risk. Appropriate spillage control measures should also be included in the ERA design. Guidance is set out in HD33.
- flow width: managed motorways schemes are a managed environment where operational regimes can 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) an assessment should be made of how often this may occur and whether these events could reasonably be managed.
- keep surface and sub-surface waters separate in design process, but encourage permeable solutions.
- be mindful of safety issues associated with loose materials.
- manholes in what will be lane 1 should be avoided if possible, relocated or upgraded to ensure they meet the necessary wheel loading and skid resistance requirements.

11.2 Adoption of the above procedures and standards, which have been agreed with the Highways Agency, should both satisfy design and statutory requirements with reference to attenuation requirements and a pragmatic system for pollution incident control and management. The latter is anticipated to provide a ‘betterment’ to the existing pollution control management procedures, specifically when linked to the greater degree of control and monitoring provided under managed motorways schemes

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12 Earthwork and retaining structures design philosophy

12.1 Managed motorways utilise the full carriageway by converting the hard shoulder to a running lane, it is not a widening scheme. The design process shall be set out in the normal way using the Standard HD 22/08 'Managing geotechnical risk' mandatory geotechnical certification process. Early liaison with the Highways Agency will permit agreement on the appropriate reporting strategy.

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 HD41/03 '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.

- **Class 1D, 2A & 2B** areas of risk should have an agreed monitoring regime in place during the MM 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.

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 HA43/91. It provides a hierarchy of potential options, taking into consideration sometimes conflicting engineering and environmental objectives.

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 the designer's and Highways Agency, consideration should be given to the value of vegetation cover against the context of environmental assumptions and commitments given in the 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?**

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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 include 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.

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14 Glossary of acronyms and terms

Acronym/Term	Description
ADS	Advance Direction Sign
ALM	Ambient Light Monitors
CCTV	Closed Circuit Television
DfS	Departure from Standard
D3M	Dual 3 Lane Motorway
DMRB	Design Manual for Roads and Bridges
DLS	Driver Location Sign
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
HGV	Heavy Goods Vehicle
HSR	Hard Shoulder Running
IAN	Interim Advice Note
IP	Internet Protocol
Kph	Kilometres per hour
MAC	Managing Agent Contractor
MIDAS	Motorway Incident Detection and Automatic Signalling
MM	Managed Motorways
MM-ALR	Managed Motorway - All lanes running
MP	Major Projects directorate
MSA	Motorway Service Area
NetServ	Network Services directorate
NDD	Network Delivery and Development directorate
NRTS	National Roads Telecommunications Services
NVC	National Vegetation Classification
OAL	Outstation Auxiliary Link
PAR	Project Appraisal Report
PIA	Personal Injury Accident
PCF	Project Control Framework
PSCRG	Project Safety Control Review Group
PTZ	Pan-Tilt-Zoom
REA	Regional Environmental Advisors
RCC	Regional Control Centre
RPSG	Roads Programme Steering Group
SFAIRP	So Far As Is Reasonably Practicable
SMS	Safety Management System
SSD	Stopping Sight Distance
TMD	Traffic Management directorate
VMS	Variable Message Sign
VMSL	Variable Mandatory Speed Limits
VE	Value Engineering
VRS	Vehicle restraint system

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15 Normative and Informative References

Normative References

The following documents contained within the Design Manual for Roads and Bridges (DMRB), available from The Stationary Office:

GD 01/08 - Introduction to the Design Manual for Roads and Bridges (DMRB 0.1.2)

Environmental Design and Management, DMRB, Volume 10

Environmental Assessment, DMRB, Volume 11

TD/TA

TD 9/93 - Highway Link Design (DMRB 6.1).

TD 17/85 - 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 42/95 - Geometric Design of Major/Minor Priority Junctions (DMRB 6.2.6)

TD 45/05 - Motorway Incident Detection and Automatic Signalling (MIDAS) (DMRB 9.1.2)

TD 46/05 - Motorway Signalling (DMRB 9.1.1)

TA 49/07 - Appraisal of New & Replacement Lighting on the Strategic Motorway & All Purpose Trunk Road Network (DMRB 8.3.1)

TD 69/07 - 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)

Interim Advice Notes (IAN)

IAN 69/05 - Design for Maintenance

IAN 84/10 - Highways Agency Environmental Information System – EnvIS (Parts 1 and 2)

IAN 86/07 - Amendments to Design Requirements for Portal and Cantilever Sign/Signal Gantries

IAN 91/07 - Interim Advice on the Identification of 'Particularly At Risk' Supports

IAN 97/07 - Assessment and Upgrading of Existing Vehicle Parapets

IAN 103/08 - Advice Regarding the Assessment of Sites for Ramp Metering

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IAN 139/11 - Managed Motorways Project Safety Risk Work Instructions

IAN 149/11 - Existing Motorway Minimum Requirements

HD/HA

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

HD 22/08 - Managing Geotechnical Risk (DMRB 4.1.2)

HD 33/06 - Surface and Sub-surface Drainage Systems for Highways (DMRB 4.2.1).

HD 36/06 - Surfacing Materials for New and Maintenance Construction (DMRB 7.5.1)

HD 41/03 - Maintenance of Highway Geotechnical Assets (DMRB 4.1.3)

HD 47/08 - Screening of Projects for Environmental Impact Assessment (DMRB 11.2.3)

HA 43/91 - Geotechnical Considerations and Techniques for Widening Highway Earthworks (DMRB 4.1.1)

HD 48/08 - Reporting of Environmental Impact Assessments (DMRB 11.2.6)

MCH

MCH 1596 - HATMS Site Data Change Procedure

MCH 2470 - Ramp Metering Technical Design Guidelines

BD

BD 2/05 - Technical Approval of Highway Structures (DMRB 1.1.1)

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

BD 95/07 - Treatment of Existing Structures on Highway Widening Schemes (DMRB 1.2.3)

Other

Generic MM-ALR Safety Report

Transport Analysis Guidance (WebTAG)

Highways Act 1980

Traffic Signs Regulations and General Directions

Traffic Signs Manual - Chapter 5

BS 5489-1 Code of Practice for the Design of Road Lighting, Lighting of Roads and Public Amenity Areas

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Planning Policy Statement 25 (PPS25), Development and Flood Risk

Assessment of Environmental Effects Regulations 1999

Informative References

Managed Motorways - All lanes running - Concept of Operations

Asset Maintenance and Operational Requirements (AMOR)

Technology Management and Maintenance Manual (TMMM)

Traffic Officer Manual

TD 23/99 - Trunk Roads and Trunk Road Motorways Inspection and Maintenance of Road Lighting (DMRB 8.3.1)

TD 34/07 - Design of Road Lighting for the Strategic Motorway and All Purpose Trunk Road Network (DMRB 8.3.1)

IAN 126/09 - Environmental Impact Assessment: Reporting of Determination and Publication of Notices

HA 104/09 - Chamber Tops and Gully Tops for Road Drainage and Services Installation and Maintenance

PD CEN/TR 13201-1: 2004 - Road Lighting, Selection of Lighting Classes

MCH 2530 - Technical Requirements for the HA CCTV System

Highways Agency Major Projects MMP Project Control Framework

“M42 MM Monitoring and Evaluation Three Year Safety Review”, HCG, January 2011

http://www.highways.gov.uk/knowledge_compendium/assets/documents/Portfolio/Existing_Motorway_Minimum_Requirements_-_Worked_Example.pdf

www.nrtsco.com - A guide to working with the NRTS Contractor (GYS/RGD/USG/0038)

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16 Checklists

CHECKLIST 1	**EXISTING DATA REVIEW**		
PROPOSAL NAME			
SCHEME DESCRIPTION			
DESIGNATIONS	**Description / Sensitivity**	**Marker Post / Reference**	**Strategic Impact and Mitigation Outline**
AIR QUALITY			
CULTURAL HERITAGE			
LANDSCAPE			
NATURE CONSERVATION			
NOISE & VIBRATION			
MATERIALS			
KEY CONSTRAINTS / OUTLINE MITIGATION STRATEGY			
CONSULTATION REFERENCES	**Address Details**	**Contact Name**	**Comments / Responses**

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CHECKLIST 2		CABLE RUNS AND INFRASTRUCTURE FIELD APPRAISAL		
PROPOSAL NAME		*(eg M6 J5-8)*		
LOCATION REFERENCE		HA Environmental Database / Site Description / Impact Assessment	Mitigation	Residual Impact (If Applicable)
Cable Runs/Local Connections				
A Carriageway				
From:	**To:**			
B Carriageway				
From:	**To:**			

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CHECKLIST 3		MAJOR EQUIPMENT SITE FIELD APPRAISAL							
Location	**Type**	**Landscape Character**	**Site Description**	**Visual Impact Assessment**			**Biodiversity**	**Mitigation**	**Residual Effect** (after 15 years)
				Visual Receptors	**Sensitivity**	**Magnitude of Impact**			
(Motorway eg M6 J5-8)									
Detail Location eg M5 Eastern Slip									

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