Smart Motorways
Concept of operations
(to accompany IAN 161/15)
## Version control

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<th>Status</th>
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<td>Draft for review (Subject Matter Experts and Programme Board)</td>
<td>31 Jan 2012</td>
</tr>
<tr>
<td>0.2</td>
<td>Draft for Steering Group Review</td>
<td>5 Mar 2012</td>
</tr>
<tr>
<td>0.3</td>
<td>Draft for final comment by SRO</td>
<td>21 Mar 2012</td>
</tr>
<tr>
<td>1.0</td>
<td>Circulated version (v1.0)</td>
<td>23 Mar 2012</td>
</tr>
<tr>
<td>1.1</td>
<td>Draft at 2012/13 MROD contract end, highlighting areas which will need to be updated in support of IAN 161/13</td>
<td>25 Mar 2013</td>
</tr>
<tr>
<td>1.2</td>
<td>Version to support TPB review of draft IAN 161/13</td>
<td>12 Jul 2013</td>
</tr>
<tr>
<td>2.0</td>
<td>Issued version (v2.0) to accompany IAN 161/13</td>
<td>16 Aug 2013</td>
</tr>
<tr>
<td>2.1</td>
<td>Draft version incorporating updates to IAN 161/15, prepared for peer review</td>
<td>21 Jan 2015</td>
</tr>
<tr>
<td>2.2</td>
<td>Revised draft incorporating reviewer comments</td>
<td>28 Feb 2015</td>
</tr>
<tr>
<td>2.3</td>
<td>Updated version for internal review</td>
<td>31 Mar 2015</td>
</tr>
<tr>
<td>2.4</td>
<td>Revised version following internal feedback</td>
<td>30 Apr 2015</td>
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<tr>
<td>2.5</td>
<td>Issued for NDD Regional Divisional Director review</td>
<td>09 Oct 2015</td>
</tr>
<tr>
<td>2.6</td>
<td>Updated draft incorporating reviewer comments</td>
<td>30 Nov 2015</td>
</tr>
<tr>
<td>3.0</td>
<td>Issued version (v3.0) to accompany IAN 161/15</td>
<td>15 Apr 2016</td>
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## Approvals

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<tr>
<td>1.0</td>
<td>Mike Wilson</td>
<td>23 Mar 2012</td>
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<tr>
<td>3.0</td>
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<td>15 Apr 2016</td>
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For more information, please contact: smartmotorways@highwaysengland.co.uk
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1. Introduction

1.1 Purpose of document

1. This Concept of Operations document sets out, at a high level, guidance around the operational elements of smart motorway (SM) schemes designed to IAN 161/15, including both all lane running (ALR) and controlled motorway (CM) variants. Any operational differences between ALR and CM are clearly identified within this document.

2. The intended audience for this Concept of Operations is all those who will be responsible for either the design or operation of ALR or CM schemes designed to IAN 161/15; including those performing incident management or maintenance activities on these sections once built, as well as those involved with customer and stakeholder communications.

3. The material contained within this Concept of Operations is based on the experience gained by Highways England and its stakeholders in designing, constructing and operating parts of the network with features similar to those described by the smart motorway design. It has been prepared following consultation with subject matter experts from Highways England and its supply chain; through scheme designers sharing ideas and identifying best practice; and from the feedback gained during simulation exercises, surveys, trials, and the recent operation of smart motorway sections.

4. This high level document has been written to accompany the physical design guidance, and is intended to demonstrate how a scheme designed to IAN 161/15 can be safely operated and maintained. Detailed operational procedures and processes have been prepared, and appropriate training will be given on their use in advance of the first scheme becoming operational in a particular Highways England region, so are not described in depth within this document.

5. Reasons why the operation of a particular scheme might vary from this guidance should be discussed with, and approved by, the scheme’s senior user and recorded in the appropriate project control framework (PCF) products.

6. The specific PCF products that will be informed by material within this Concept of Operations are:

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1 An alternative Concept of Operations document exists for dynamic hard shoulder running schemes, designed to IAN 111.

2 Highways England is a new government company, created in April 2015, which has taken over the responsibilities previously held by the Highways Agency. Any references to Highways Agency can be considered to apply equally to Highways England.
1.2 Relationship to other guidance documents

This Concept of Operations supports interim advice note IAN 161/15 which provides guidance on the design, construction, and implementation of both ALR and CM variants of smart motorways.

The material contained within this document should be considered alongside existing standards, guidance and procedures governing how the strategic road network (SRN) is operated and maintained; the vast majority of which will continue to apply to a smart motorway scheme.

Highways England documents of particular importance in this regard are:

- the “Traffic officer manual”;
- the “Network management manual” (NMM);
- the “Routine and winter service code” (RWSC);
- the “Asset maintenance and operational requirements” (AMOR);
- the “Technology management & maintenance manual” (TMMM);
- the “HADECS3 implementation guidance”;
- “Major schemes: enabling handover into operations and maintenance”, [IAN 182]; and
- “Designing for maintenance”, [IAN 69].

A bibliography giving details of the latest version of all of the documents referenced within this Concept of Operations is available from the email address below.

1.3 Further information or clarifications

Requests for further information, or comments or suggestions for changes to this guidance, should be sent to the following address: smartmotorways@highwaysengland.co.uk

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3 Controlled all lane running (CALR) links within smart motorway schemes featuring a dynamic hard shoulder are covered by the relevant documentation for those schemes (IAN 111/09 and IAN 112/09). Even though CALR links do not themselves have a dynamic hard shoulder, in all other respects they can be considered as dynamic hard shoulder running schemes where the hard shoulder is always open.

4 AMOR is the replacement for Highways England's current routine and winter service code and network management manual (RWSC & NMM) in use by incumbent providers. The AMOR represents a shift to a more outcome based approach, to encourage efficiency savings for Highways England and innovation by the provider, with no compromise to safety.
2. The smart motorway design

2.1 The case for evolving the smart motorway design

Evaluation of the M42 active traffic management pilot demonstrated that smart motorways with dynamic hard shoulder running are able to deliver clear benefits in terms of: improved journey time reliability through reduced congestion; at lower cost and with less environmental impact than conventional widening programmes; and without negatively impacting the safety performance. The subsequent programme to roll out smart motorways with dynamic hard shoulder running designed to IAN 111 (referred to throughout as HSR) has delivered comparable benefits to conventional road widening programmes, but at significantly lower cost. The experience from these schemes suggested that there was scope to further reduce both the capital and operating costs, whilst continuing to meet the congestion and safety objectives. This led to the introduction of the ALR and CM designs, described in IAN 161.

2.2 Physical design elements

The table below summarises the key physical design elements of both the ALR and CM designs, and highlights where there are key differences:

<table>
<thead>
<tr>
<th>Design element</th>
<th>ALR</th>
<th>CM</th>
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<tbody>
<tr>
<td>Hard Shoulder</td>
<td>Converts the hard shoulder to a permanent traffic lane</td>
<td>Retains the existing hard shoulder provision</td>
</tr>
<tr>
<td>Variable Mandatory Speed Limits (VMSL)</td>
<td>Includes an associated automated enforcement / speed compliance system</td>
<td></td>
</tr>
<tr>
<td>Driver information</td>
<td>Regular driver information, including lane availability, is provided at intervals not exceeding 1500m</td>
<td></td>
</tr>
<tr>
<td>Vehicle detection system</td>
<td>Used to support queue protection and congestion management</td>
<td></td>
</tr>
<tr>
<td>Pan-tilt-zoom CCTV coverage</td>
<td>Full coverage of running lanes, refuge areas, and any maintenance hard standings</td>
<td>Comprehensive coverage of the entire scheme, including ERTs</td>
</tr>
<tr>
<td>Central reserve rigid concrete barrier</td>
<td>Provided on all ALR schemes (in accordance with TD 19/06)</td>
<td>To be considered for CM schemes, but not mandated</td>
</tr>
<tr>
<td>Refuge areas</td>
<td>Provided at maximum intervals of 2500m</td>
<td>Not required, as CM sections retain the hard shoulder</td>
</tr>
<tr>
<td>Emergency roadside telephones (ERT)</td>
<td>Provided in all dedicated refuge areas</td>
<td>Provided in line with existing guidance (TA 73)</td>
</tr>
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</table>

6 CCTV surveillance is provided to support event management, in line with TD 17/85.
7 A requirement, unless it can be demonstrated that the road worker safety objective can be met through alternative mitigation (i.e. that provision of RCB is not reasonably practicable).
2.3 Key features of the smart motorway design

2.3.1 The ALR design

The key feature of the ALR design is the replacement of the hard shoulder with a controlled running lane. In comparison with the HSR design, permanently removing the hard shoulder eliminates the complex operational processes associated with dynamically opening and closing it. By extension, the fixed hard shoulder monitoring cameras and the associated technology and systems used on HSR schemes to confirm that the hard shoulder can be opened safely will not be required on ALR schemes, and do not form part of the physical design.

The permanent removal of the hard shoulder is expected to impact the management of incidents to some degree, as it will affect the ability to move broken down or damaged vehicles and other debris from the live traffic lane into a dedicated hard shoulder, or to use the hard shoulder as an emergency access route, as is currently the case on the majority of the motorway network.

Safe maintenance access will often require the closure of live traffic lanes, and as such will require appropriate mechanisms to ensure the risk to road workers is mitigated, so far as is reasonably practicable.

Eliminating the dynamic hard shoulder element will serve to reduce any potential confusion over whether or not it is available as a running lane at a particular time, and will therefore eradicate hard shoulder abuse/misuse within the scheme (since there will no longer be a hard shoulder).

Refuge areas are included in the design requirements at up to 2.5km intervals, providing a place for vehicles to stop in an emergency or breakdown. Refuge areas may either be bespoke facilities such as an emergency refuge area (ERA); or alternatively may be converted from an existing facility, for example a wide load bay. A motorway service area (MSA), the hard shoulder on an exit slip/link road, or the retained hard shoulder within a junction may also be considered to provide a suitable refuge.

The 2.5km maximum spacing of refuge areas is consistent with the frequency with which lay-bys are provided on the all purpose trunk road network (APTR), as set out in TD 69/07. Subject to an appropriate risk assessment, refuge areas may also be used to provide maintenance access, or to assist with the recovery of vehicles or removal of debris during incident management.

Bespoke emergency refuge areas are provided with a dedicated emergency roadside telephone (ERT). Existing ERTs elsewhere will be removed, apart from those within a lane drop/lane gain junction where the existing hard shoulder is retained.

The provision of sufficient variable signing and signalling infrastructure is necessary to ensure that drivers receive adequate guidance of the mandatory speed limits and lane availability. Displaying the majority of information using verge mounted variable message signs (rather than utilising lane specific signals on every gantry) is expected to make a significant contribution to both capital and operational cost savings.

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8 TD 69/07: “The location and layout of lay-bys and rest areas”:
9 In comparison with the construction, operation, maintenance and renewal costs of a HSR scheme designed to IAN 111/09
Overhead lane specific signals will be provided at the start of each link, at intermediate gantries on longer links, at locations with more than four lanes, and where required to mitigate complex road layouts (such as near some junctions).

Figure 1 provides a “driver’s eye” perspective of a typical ALR scheme. The various operational regimes and associated methods of driver information provision are discussed in more detail in chapter 3.

Wherever strategic signing capability currently exists (including where driver information is provided through shared access to signs nominally provided for tactical use), that capability is to be retained. The exact strategic signing capability that will be included, and the positioning of signs to accommodate this, will be agreed for each scheme by the senior user, following discussions with representatives from Highways England’s operations directorate.

Creating and preserving the controlled environment on smart motorway schemes largely depends on the ability to achieve compliance with the posted speed restrictions and lane closures. The compliance and enforcement strategy is covered in more detail in Chapter 4. The setting of signs and signals provides notification of lane closures to road users, delivers safety benefits to road workers, and contributes to the achievement of the safety objectives.

Operators based in the Regional Control Centre (RCC) are able to access images from PTZ CCTV cameras, which are positioned to provide full coverage of the main carriageway, refuge areas, and any maintenance hard standings on that part of the network. Operators can use the CCTV images to remotely confirm incidents, as well as conduct general observation of conditions on the network. The management of incidents and other heightened situations is described in chapter 5.

10 Maintenance hard standings are only to be provided on sections of controlled motorway where a hard shoulder is retained. See section 2.3.2

11 The SM design does not require RCC resource to conduct close monitoring of CCTV images solely for the purposes of incident detection.
2.3.2 The CM design

27 In contrast to an ALR design, the CM design retains the existing hard shoulder. As on other parts of the motorway network, the hard shoulder provides a place of refuge in an emergency, a means of accessing incidents, and, subject to the necessary controls, a place from which maintenance access can be provided and/or temporary traffic management set out. This means there are no specific requirements for dedicated emergency refuge areas within CM sections.

28 The CM design also mandates the provision of sufficient variable signing and signalling infrastructure to ensure that drivers receive adequate guidance of the mandatory speed limits and lane availability. This helps to create and preserve the controlled environment.

29 Similarly, the ability of control room operators to set variable signs and signals provides road users with notification of lane closures and speed limits, delivers safety benefits to road workers, and contributes to the achievement of the scheme's safety objectives.

30 As with ALR sections, control room operators are able to access images from PTZ CCTV cameras, which can be used to remotely confirm incidents as well as conduct general observation of conditions on the network. On CM schemes, cameras are positioned to provide comprehensive\textsuperscript{12} coverage of the main carriageway, and any refuge areas or maintenance hard standings on that part of the network.

\textsuperscript{12} ‘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
2.4 Operational implications of smart motorways

Smart motorway schemes have successfully demonstrated how the provision of additional capacity on busy parts of the network can have a positive impact on performance metrics such as journey time reliability and safety.

Delivering a controlled environment encourages compliant driver behaviour, which is a key element in ensuring that smart motorway schemes can be safely operated. The design features (outlined in section 2.2) ensure clear, appropriate and unambiguous information is provided to drivers, for example regarding speed limits or lane availability. Information is delivered to the driver in such a way that it does not cause overload or leave the driver in doubt as to what compliant behaviour is required of them. Compliance (and enforcement) is covered in more detail in Chapter 4.

The “GD04 assessment” report and the “Generic safety report” show that the generic safety objective for all road users (as defined in GD 04/12: “Standard for safety risk assessments on the strategic road network”13), can be met for both ALR and CM variants of the smart motorway design. See IAN 161/15 section 2.1 for further information.

2.4.1 Operational implications of the IAN 161/15 design

The smart motorways philosophy is to provide the minimum amount of infrastructure required to safely and effectively operate the scheme. When compared to an HSR scheme (designed to IAN 111), the IAN 161/15 design has less roadside infrastructure, which in turn leads to a corresponding reduction in the amount of maintenance required.

Both the ALR and CM designs completely eliminate any requirement for dedicated hard shoulder monitoring (HSM) CCTV cameras and the associated control systems, leading to a corresponding drop in civil infrastructure expenditure; with fewer gantries, fewer refuge areas, and in many cases a reduced amount of near side vehicle restraint - since there are fewer assets to protect.

Eliminating the need to conduct dynamic hard shoulder pre-opening checks removes this element of operational workload in the control room, which is typically concentrated in the peak periods around the morning and evening rush hours. However, this is countered by a greater control room workload dealing with incidents (such as setting and clearing variable signs and signals), which may have a different intensity of work.

In addition, the increased live lane breakdown frequency expected on ALR sections requires a greater presence by on-road traffic officers in the carriageway, which can have implications on resourcing due to the concentration of breakdowns in peak periods.

Reducing the amount of technology installed, while improving the ability to remotely detect, diagnose, and repair faults will further reduce the costs of maintenance; although ensuring safe maintenance access provision without a dedicated hard shoulder does introduce certain challenges on ALR sections: these are addressed further in chapters 6-8.

The controlled environment contributes towards a scheme meeting the road user safety objective by delivering a reduction in the typical frequency and severity of collisions. This has a corresponding impact on the resources required for incident management. The implications that operating a scheme designed to IAN 161/15 is expected to have on RCCs and the traffic officer service (TOS) are discussed in more detail in chapter 9.

13 http://www.standardsforhighways.co.uk/dmrb/vol0/section2/gd0412.pdf
The majority of driver information is provided through verge mounted variable message signs (as opposed to signals mounted on overhead gantries). This means the frequency of traffic management associated with offside lane closures, and the challenges of conducting both emergency and routine repair and maintenance of infrastructure positioned above live lanes will both be significantly reduced compared to a HSR scheme. Where provided, central reserve rigid concrete barrier (RCB) will also contribute to a further reduction in the levels of maintenance activity required on the off-side of the carriageway.

The ALR design ensures that the additional capacity provided by the conversion of the hard shoulder to an extra running lane is available by default, meaning there are no critical technology faults that would prevent the extra lane from being made available to traffic. Unlike HSR schemes, this additional capacity will be available at all times, without necessarily requiring speed restrictions to be implemented. While the CM design does not typically add physical capacity to the network (in terms of increasing the number of lanes available); the implementation of variable mandatory speed limits as part of a congestion management system is expected to provide some additional network capacity as the controlled environment helps to smooth traffic flows, thereby increasing throughput.

Conceptually, the ALR design and its operation does not differ fundamentally from those sections of the existing motorway and APTR network without a dedicated hard shoulder. The added advantage of technology capable of detecting and monitoring events that are happening on the network, coupled with dedicated systems able to communicate appropriate advice or instructions to drivers - such as lane availability or mandatory speed limits - can be used together to help to create the necessary controlled, compliant environment. The CM design also benefits from the provision of additional technology, while the retention of the hard shoulder eliminates the requirement to mitigate its removal through, for example, provision of dedicated refuge areas.

In an emergency, drivers within an ALR section can exit the network at the next available downstream junction, or alternatively stop in a refuge area. In addition to a dedicated (i.e. bespoke) ERA or a motorway service area, the hard shoulder adjacent to an exit slip is also considered to provide a suitable location to stop in an emergency; however these locations will not usually be fitted with an ERT. On CM sections, the retained hard shoulder serves to provide a refuge area, with ERTs provided in line with the guidance contained within the design manual for roads and bridges (DMRB).

RCC operators will not automatically be alerted whenever a vehicle enters or leaves an ERA; although the driver will be instructed by fixed signs in the ERA to contact the RCC using the ERT. Operators will be able to observe the vehicle using (PTZ) CCTV, and if necessary dispatch a TOS patrol and/or set signs and signals to assist the vehicle’s safe exit.

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14 There is no automatic alert to the RCC when a vehicle enters an ERA because there is no dynamic lane alongside the ERA for the RCC to manage as there is in the HSR design, and provision of the alert does not mitigate any specific hazards. This is in line with the rest of the network, where there is no automated alert if a vehicle enters the hard shoulder or lay by. There is no requirement for the RCC to monitor an ERA unless alerted via the ERT or some other means that they need to do so.
3. Operating regimes

The following operating regimes describe, in broad terms, how a generic SM scheme built to IAN 161/15 is operated under ‘normal’ conditions, during both the peak and off-peak periods. They set out the principles of how Highways England and other stakeholders will respond to certain circumstances in order to ensure the intended benefits of the scheme are realised.

RCC operators will be able to remotely observe network conditions, confirm incidents and (where they are visible) verify signal settings by utilising the PTZ CCTV coverage provided throughout the scheme. The SM design and operation does not require additional close monitoring, although they may be considered higher priority in terms of patrolling, given that SM schemes tend to be built on the busiest parts of the network.

All the scenarios outlined below already exist on the network. For example, there are some sections of the motorway without a dedicated hard shoulder, and this type of environment is typical on the multi-lane APTR network. Maintenance work is conducted on these sections, and incidents do occur and are managed. Where necessary, on-road and control room based staff will be provided with (and trained in the use of) suitable procedures prior to an ALR scheme becoming operational in their particular region.

3.1 Off-peak operation

Off-peak operation describes a scenario where all lanes are available to use, traffic volumes are low and flowing freely, with large headways. These kind of conditions are typically expected to occur on weekdays; starting in the late evening, and continuing overnight. Off-peak conditions may also apply throughout the weekends; or between the morning and afternoon peak periods (the “inter-peak”), depending on the location and traffic patterns.

During these times the national speed limit will apply, and electronic signs and signals will not be required for operational purposes, and as such remain blank (if not required for other, non-smart motorways related purposes such as strategic signing, or campaign messages, etc.).

There are no additional requirements introduced by a SM scheme during these periods of off-peak operation (over and above the normal roles and responsibilities of operational staff). The off-peak period provides the most appropriate conditions to perform maintenance or other activities that may impact network availability, without unduly compromising network performance.

Management of ‘abnormal’ conditions, including the presence of debris or broken down vehicles, abnormal load movements, severe weather, and road works are addressed in chapter 5 of this document.
3.2 Operation during peak times

During peak periods, traffic volumes will be higher. Although the extra capacity provided on ALR schemes by the conversion of the hard shoulder to a running lane helps to maintain headways, on occasions flow breakdown may still occur.

The peak period will usually occur on weekdays: typically starting in the morning and extending into the early evening. Certain locations may also routinely experience peak conditions outside of these times – this will usually be apparent from the traffic flow profiles generated as an early deliverable by scheme designers and recorded in the combined operations PCF product; but may also be generated by infrequent demand increasing events (e.g. festivals, concerts, sporting events, etc.).

The vehicle detection system continuously monitors the flow of vehicles, and when necessary the congestion management system triggers the automatic setting of appropriate mandatory speed restrictions, applicable to the entire carriageway, in an attempt to first prevent, and subsequently limit the effects of flow breakdown.

3.3 Provision of driver information

3.3.1 Tactical driver information

To encourage compliant driver behaviour, information relating to current network conditions (e.g. speed restrictions, lane availability, etc.) is provided through roadside infrastructure. Although some driver information is provided through lane specific overhead signals, the majority will be displayed using verge mounted variable message signs (such as MS4s), also described as ‘carriageway signs’, since any information displayed on them is applicable to the entire carriageway.

Modifications to the existing signal control software enables a single variable message sign to display up to three simultaneous elements. In addition to a speed restriction and a supporting text legend, the sign will also be able to display either a warning pictogram (typically in the form of a ‘red triangle’ diagram) as shown here:

Or alternatively, a lane closure aspect, as indicated in the example below:
These ‘red X’ lane closure aspects were developed during consultation with the Department for Transport (DfT) to mean that drivers should not pass a sign in the lane indicated by the X. The signs are in the process of being introduced into the relevant legislation, making it an offence to enter the lane to which the X relates.

All message signs will retain the capability to display a higher priority message should the need arise, with prioritisation determined automatically by the signalling control software.

### 3.3.2 Strategic driver information

When variable message signs are used to display combinations of speed limits, lane closure aspects or pictograms, they will not be available to display text associated with strategic traffic management or driver information. This is because of the potential confusion for road users if the tactical information is displayed on the same sign as strategic information.

#### Retained infrastructure

To ensure that the strategic signing capability is not lost during the peak hours of operation, pre-existing strategic VMS (usually 3x18 MS3s) are required to be retained. There may be a need to re-position these signs within the link to ensure the sequence of sign and signalling installations on the approach to a junction follows the design set out in IAN 161/15.

At some locations, other (non-strategic) VMS are regularly set as part of the National Traffic Information Services (NTIS) remit to display strategic traffic management or driver information messages, and this capability may also need to be retained. The exact level of provision on each scheme is to be determined by the senior user, following consultation with NTIS.

Messages generated by the queue protection subsystem usually have a higher priority than strategic message settings, and as such would overwrite them. To prevent this, any retained message signs will be prevented from displaying system generated queue protection information. This is achieved within the site data by removing the retained signs from MIDAS pointers, where such systems exist.

#### Additional infrastructure

The IAN 161/15 design requires that certain gantries\(^\text{16}\) house both lane signals and a variable message sign. As information relating to lane availability and/or speed restrictions will be provided at those locations using the signals, the message sign is available to show supporting text legends, which may be of a strategic nature.

The message signs co-located with the signals on these gantries can, if required, be prioritised for strategic use within the message hierarchy. NTIS will also be granted lower priority access to the other message signs within the scheme, permitting their strategic use when not otherwise required for tactical purposes.

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\(^{16}\) Specifically, the “gateway signals and VMS” gantry located immediately downstream of a merge, and, where required on longer links, any “intermediate signals and VMS” gantries.
### 3.3.3 Speed restrictions

Unlike conventional motorways, the variable speed limits displayed within a smart motorway scheme are mandatory. To prevent conflicting information being provided to drivers, any signalling infrastructure retained within a scheme will need to be configured such that it is no longer capable of displaying advisory speed limits post scheme handover (i.e. once mandatory speed limits are deployed).

When variable mandatory speed limits are displayed, they can be enforced using strategically positioned digital cameras that are able to detect and record speeding offences and initiate the prosecution process. It is therefore critical that the displayed speed limit is appropriate to prevailing traffic conditions to protect the credibility of the system and enforcement regime.

The vehicle detection system determines the speed limit(s) necessary to keep traffic flowing smoothly: where a speed restriction is generated, appropriate mandatory speed limits are displayed on the signalling infrastructure.

Where the national speed limit is in operation, the signs and signals will either be blank (e.g. if there is no congestion), or will display the standard national speed limit symbol (e.g. to communicate that a previous speed restriction no longer applies). This is automatically determined by the signalling rules.

At locations where speed restrictions are displayed on verge mounted message signs, that speed limit applies to the entire carriageway. At locations where speed restrictions are communicated using lane specific signals, the same speed limit will be displayed above all the open lanes of a particular carriageway. Both methods are deemed to provide drivers with the ‘adequate guidance’ of the prevailing speed limit required for enforcement.

Although DMRB permits a maximum drop in the speed limit displayed on consecutive signals of 30mph; for safety reasons, operational policy is that the speed limit should not drop by more than 20mph. There may be instances on some schemes where the distance between signals makes even a 20mph drop in speed limit undesirable. Each scheme needs to consider this issue when preparing their combined operations PCF product.

When a primary signal is set, the signal sequencing rules automatically determine and set appropriate secondary supporting information, based on the primary settings and the distance between signals.

Configuration settings for the queue protection and congestion management systems (e.g. speed/flow threshold) should be tuned and reviewed regularly to ensure that appropriate speed limits continue to be set after the scheme has been handed over into operation. The monitoring approach should be documented in the plan for monitoring operations PCF product.

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17 With the exception of lane specific signal gantries which span multiple carriageways – for example those at complex junctions which extend across both the mainline carriageway and a parallel exit slip road or diverge.
4. Compliance and enforcement

A compliant environment is one in which drivers understand what is expected of them and behave accordingly. This is particularly important with smart motorways, where speed limits and lane configurations may change dynamically, and where the controlled environment provides the mitigation for certain hazards, particularly those associated with the removal of the hard shoulder in the ALR environment, contributing to the design meeting the safety objective.

In undertaking the design, designers should have due regard for the operation of the scheme and ensure that the creation of a compliant environment is undertaken in a holistic way for the entirety of the scheme, including the lead-in from the section immediately upstream and the lead-out into the next adjacent section downstream.

In designing for and evidencing that compliance can be achieved, designers should consider the application of “the four E’s” (engineering, education, encouragement and enforcement) and how, when appropriately implemented, these will achieve a compliant and operable environment that meets the scheme objectives.

4.1 Compliance issues specific to smart motorways

The SM design introduces a number of areas where compliance may be affected:

<table>
<thead>
<tr>
<th>Area of potential non-compliance</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exceeding variable mandatory speed restrictions.</td>
<td>Does not arise on a conventional motorway where any variable speed limits are advisory.</td>
</tr>
<tr>
<td>Driving under ‘stop’ indicator (solid red X) signals displayed above running lanes, or driving past closures set using red X lane closure aspects displayed on a message sign.</td>
<td>Potential for more abuse on SM schemes, due to the greater volume of signals and higher propensity for their use. On ALR sections, we expect more frequent lane closures (due to the increase in live lane breakdowns and incidents) and greater use of signals to support maintenance.</td>
</tr>
<tr>
<td>Non-emergency stops in an ERA.</td>
<td>Does not arise on a conventional or controlled motorway, (although unauthorised stops on the hard shoulder are observed).</td>
</tr>
</tbody>
</table>
4.2 Achieving compliance on individual schemes

79 As part of the combined operations PCF product, each scheme is required to produce a compliance strategy. This should identify appropriate measures to address all the potential forms of non-compliance referenced in section 4.1, and highlight any exceptions to the “HADECS3 implementation guidance”. The product should define the actions required by the scheme in order to ensure that an appropriate level of compliance is achieved.

80 The advice regarding the deployment of enforcement cameras and other infrastructure for encouragement purposes (e.g. for sending warning letters to non-compliant road users), coupled with the generic compliance strategy, forms part of the work of the Highways England professional and technical solutions directorate (PTS, formerly NetServ) and the emergency services liaison team. This advice is to be complied with unless exceptional circumstances warrant a departure, which must: be discussed with the regional enforcement co-ordinator; be agreed by the scheme’s senior user; be accepted by the enforcement authorities; and not conflict with the documented enforcement agreements (see section 4.3).

81 The compliance strategy section of the combined operations PCF product includes a requirement to assess the potential for non-compliance with specific rules; identifying any safety hazards that non-compliance would affect, in order to determine the overall impact on achieving the safety objective.

82 This assessment should take account of aspects such as: the physical characteristics of the road; the proportion of different vehicle types expected to use the scheme; and levels of motorist familiarity with smart motorways, recognising that the latter two may vary by time and day. It should consider engineering, education, encouragement and enforcement measures that could be deployed to improve compliance.

83 Compliance with signs and signals improves when drivers understand why they have been set. Wherever possible, supporting information (pictograms or text) should be set on the message signs to explain why lane closures and/or reduced speed limits have been implemented.

4.3 Agreements with enforcement authorities

84 Highway England previously agreed a national enforcement strategic agreement between themselves, the association of chief police officers (ACPO)\textsuperscript{18}, the crown prosecution service (CPS) and Her Majesty’s courts service (HMCS)\textsuperscript{19} on the enforcement regime for contravention of variable mandatory speed limits. The intention was that the processing of offenders would be conducted by one or two centralised police fixed penalty offices within a given region; with the payment of fixed penalties centralised into one or two court offices and the prosecution of offenders in one or two magistrates’ courts per region. Processing would be done regionally to encourage consistent standards.

85 Once the scheme has been delivered, the regional enforcement coordinator (REC) is responsible for managing the evidential trail, ensuring there is robust documentary support for any prosecution. Additionally, the REC is responsible for annually reviewing the memoranda of understanding (MoU) with the enforcement authorities, which must be set up during scheme delivery.

\textsuperscript{18} ACPO was replaced in 2015 by a new organisation, known as the national police chiefs council (NPCC).

\textsuperscript{19} HMCS merged with the ‘tribunals service’ in 2011 to become “Her Majesty’s courts and tribunals service”; and is now an executive agency of the Ministry of Justice.
4.4 Achieving compliance with specific features

4.4.1 Variable mandatory speed limits

Variable mandatory speed limits (VMSL) may be remotely enforced using Highways England’s automated digital enforcement compliance system (HADECS).

Highways England reimburses the local enforcement authorities for the resource required to process and prosecute variable mandatory speed limit offences on SM schemes. The enforcement of the national speed limit remains at the discretion of the enforcement authority and is not reimbursed by Highways England.

Each scheme needs to consider how many HADECS cameras it requires and where they should be deployed, in accordance with the “HADECS3 implementation guidance”.

If the RCC identify (or are made aware of) instances where automatically set speed limits are not credible or appropriate to traffic conditions, they should take immediate action to remove or amend those speed restriction settings. Where displayed limits are clearly not reasonable, compliance will be affected both on the link on which they are signed, as well as potentially on nearby links.

Once an incorrect or inappropriate sign has been removed, the RCC should notify the REC, or if not available, the enforcement authority, so that compliance with speed limits is not enforced during this period; and the Highways England traffic technology division (TTD), so that the cause of the incorrect setting can be investigated.

The enforcement authority may refuse to enforce limits that are clearly not reasonable, or which regularly lack credibility in their setting.

4.4.2 Lane closures

As with the rest of the network, enforcement of red X (stop) signals and red X lane closure aspects is currently only carried out by police at the scene. Full carriageway closure aspects are mandatory when accompanied by flashing red lanterns. It is the intention of Highways England to have an automated system of detecting red X infringements and this system is being developed.

Highways England is also developing encouragement solutions which involve the sending of warning letters and educational material to road users who do not comply with lane closure signals. Designers should seek the advice of PTS regarding the roadside infrastructure and systems needed to support this encouragement measure.

At their discretion, the police may additionally prosecute drivers for other driving offences, however, we encourage the police not to conduct mobile enforcement within ALR sections.
4.4.3 Non-emergency stops in ERAs

Data collected from existing smart motorway schemes indicates that emergency refuge areas are routinely used for non-emergency (and therefore unlawful) stops. Evidence from sections of the network where there is reduced provision for stopping (such as through road works, on bridges, or on elevated sections of road) shows that the location of refuge areas can influence the frequency of vehicle stops, according to whether they are seen as a desirable place to stop by the public.

The removal of the hard shoulder causes ALR schemes to experience a reduced rate of non-emergency stops compared to the levels observed before the scheme was built. The hazards associated with the entry, occupancy and exit of ERAs are factors that were considered when determining their levels of provision within the ALR design.

Given their potential attractiveness to drivers as a place to make short duration stops, engineering design has a particular impact on the appropriate use of emergency refuge areas. Observed examples of non-emergency use include drivers stopping for phone calls, comfort breaks, map reading, tachograph breaks, etc.

Education of road users is an important tool to remind them of the lawful purposes of ERAs, and of the dangers inherent in making stops in ERAs for non-emergency use. Scheme designers should consider the particular demographic of the expected users of their scheme to understand what type of non-emergency stops might be expected. For example, evidence suggests that where freight users constitute a high proportion of traffic, ERAs may be used more frequently for tachograph breaks. These issues should be addressed in the scheme’s communications plan PCF product.

The ALR design requires each ERA to be fitted with a pair of fixed “No stopping except in emergency” signs (to TSRGD diagram 642.3); and an additional non-prescribed “Driver must use SOS phone and await advice to re-join main carriageway” sign (NP 2937), to further discourage unlawful use. Near the start of each link, a verge mounted “Refuge areas for emergency use only” (NP 2935) sign shall also be provided.

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20 Not applicable to controlled motorways which do not feature emergency refuge areas as part of the design
5. Management of incidents and other heightened situations

Experience has shown that creating and maintaining a controlled driving environment results in a reduction in both the frequency and severity of collisions. However, with the removal of the hard shoulder on ALR sections, the number of live lane obstructions is expected to increase, since a proportion of the vehicles that would previously have stopped on the hard shoulder in an emergency will now be unable to reach the next refuge area, and will therefore have no option but to stop in one of the live lanes.

Once an RCC operator is made aware of an incident (for example: through an automated alert from the queue protection / congestion management system, from a phone call, via notification from an on-road resource, or by some other means) the PTZ CCTV cameras can be used to validate the location and confirm the key features of the incident.

The RCC operator also has the ability to set a lane closure pattern with supporting information messages and appropriate reduced mandatory speed limits. This warns approaching drivers of the potential hazard, enabling them to safely reduce their vehicle’s speed whilst merging into the remaining available lanes past the scene.

5.1 Dealing with incidents - key differences on SM schemes

Smart motorway schemes create a greater need for agreements (see Section 5.4) and clear communication between Highways England, and “core responders”. In this context, the term ‘Highways England’ is used to include the RCC and on-road TOS, as well as maintenance service providers, the national vehicle recovery manager (NVRM) and other parties contracted by Highways England. The term ‘core responders’ is used to refer to the emergency services, to vehicle recovery services, and to private motorist assistance organisations involved in responding to or otherwise managing an incident.

The greater need for commonly agreed processes and procedures arises due to the different operating environments encountered between smart motorway schemes and conventional motorways. Increased deployment of technology on the network provides staff in the relevant control rooms with greater knowledge of what is happening during incidents on the strategic network, as well as providing the opportunity to assist the on-road response with supporting signs and signals, and by providing timely information to responders’ en-route to the scene.

As with incidents on any road, the management process can be considered in four distinct phases, namely: incident detection and verification; initial response and access; scene management; and network restoration.

From the perspective of responding to and managing incidents and other ‘unusual’ situations, the main differences between a standard three lane motorway (D3M), and a smart motorway scheme are described below:

- **Incident detection & verification:**
  - The additional capacity and controlled environment are expected to deliver reductions in both the frequency and the severity of collisions on ALR when compared to the safety baseline; however more incidents will now affect a live lane.
  - During busy periods, live lane obstructions will quickly result in congested conditions, enabling slow moving or stationary vehicles to be detected by the queue protection system. This will automatically set messages designed to help prevent secondary incidents, and will also serve to alert the control room.
During off-peak conditions (typically high speed / low flow environments), the majority of vehicles experiencing potential breakdown are expected to be able to reach a place of refuge\(^{21}\).

PTZ CCTV camera coverage enables the location of any reported incident to be quickly verified, allowing an appropriate response to be determined by the control room, which may include the setting of lane closures and speed limits using signs and signals to warn traffic approaching the scene.

As with all live lane incidents, details should be passed to NTIS for onward dissemination.

- **Initial response & access:**
  - In ALR sections, the conversion of the hard shoulder to a controlled running lane means responders will need to attend incidents without relying on the hard shoulder as a dedicated access route. In CM sections, the hard shoulder may be used as an emergency access route, if appropriate.
  - Signals can be set to facilitate responder access using any appropriate lane(s).
  - In some circumstances it may be necessary to access an incident from downstream. The TOS has a procedure for this.
  - Early liaison is required with the users of any existing access and egress points (e.g. a works depot or turnaround point), particularly on longer links, to ensure that incident responders are able to reach the scene in a timely manner.

- **Scene management:**
  - Mandatory speed limits, whether automatically generated by a queue protection or congestion management system, or manually set by the operator, help to create and maintain a controlled environment, which provides a safety benefit to those involved in managing the incident.
  - Mandatory speed limits may be shown on either carriageway signs or lane signals, with consecutive information points provided at maximum intervals of 1500m to ensure all drivers receive adequate guidance.
  - Using verge mounted variable message signs provides operational flexibility, as the speed restriction can be accompanied by appropriate combinations of lane closure aspects, pictograms, or text on a single piece of infrastructure.
  - Information and instructions displayed on the variable message signs relate to the entire carriageway.
  - The RCC may be requested to set variable signs and signals, for example to provide advance warning and instruction to road users of an incident in a live lane.

- **Network Restoration:**
  - With no hard shoulder, a greater proportion of incidents on ALR sections will impact live lanes.
  - In these situations, vehicles will need to be recovered to an off–carriageway location, such as an ERA. Debris will also need to be cleared from live lanes.
  - The requirement in IAN 161/15 that refuge areas are provided on ALR schemes at intervals not greater than 2.5km will typically result in the provision of at least one refuge area per link. On CM sections, the retained hard shoulder provides this function.

5.2 General approach to managing incidents

Variable signs and signals are the primary mechanism through which the RCC is able to control traffic on a smart motorway. Before the lanes that are affected by an incident are confirmed, all variable signs and signals set will be non-lane specific (i.e. the same advice applies to all lanes). Until a report is confirmed, a 50mph restriction is put in place, supported by variable message signs bearing a legend such as “incident”.

Once the lanes that are affected by an incident have been confirmed, lane specific closures are able to be set: by displaying a ‘lane closure aspect’ on a variable message sign, or setting stop signals on a gantry containing lane specific signals. Once a lane closure has been set, the signal sequencing rules will automatically generate and set secondary signals (including upstream lane diverts, downstream ‘end’ aspects, and appropriate speed restrictions throughout the area).

At any time RCC operators may override an automated speed restriction with a lower speed limit. RCC operators should continue to ensure that all appropriate signs and signals are set (or cleared) according to the requirements of the lead responder on scene, in line with existing policy.

5.3 Operational challenges posed by smart motorways

The SM design affects the way in which some operational tasks are carried out, and the manner in which some services are delivered. The following sections discuss some of these operational challenges in more detail.

5.3.1 Ability to confirm incidents

Current policy on the use of variable signs and signals states that lane specific signals and VMS messages related to an incident can only be set once the location and the affected lanes have been confirmed by an approved source. Approved sources include a police officer, traffic officer, traffic incident management vehicle at the scene, maintenance service provider (including MAC/ASC, and TechMAC/RTMC), and NTIS.

Once alerted, RCC operators may use the images provided by the PTZ CCTV cameras to remotely confirm the incident details, and provide an appropriate response. The requirement in IAN 161/15 that PTZ CCTV cameras deployed for ALR schemes shall provide full coverage of the mainline carriageway running lanes, with no blind spots, supports this capability.

5.3.2 Accessing the scene

As soon as possible after confirmation of an incident, the RCC operator should identify the most appropriate access route for emergency responders and advise them accordingly. Once the choice is confirmed by the emergency responders, the RCC should set the signs and signals necessary to clear and protect this route. Guidance exists in TOS procedures as to the factors to consider when selecting which is the most appropriate lane to close.

If the TOS can convert a lane into a sterile area and can manage the incident from there to release the traffic, this should be their first choice, enabling access to the scene for other responders. If they cannot clear a lane (and if the situation warrants it) they may consider implementing reverse access, in readiness for larger response vehicles and recovery operators. Again, guidance exists in procedures.

22 In CM sections, it is likely that the retained hard shoulder will usually provide the most appropriate access route, although there may be instances where this is not the case.
5.3.3 Broken down and abandoned vehicles

Traffic officers have powers under the ‘removal and disposal of vehicles (traffic officers) (England) regulations 2008’ that enable them to deal with vehicles that have broken down and are either causing an obstruction or danger to others; are in contravention of a restriction or prohibition; or appear to have been abandoned without lawful authority.

On the majority of the network, where a vehicle has stopped in a location such that it does not cause an obstruction or danger (and if there is no police interest in the vehicle), drivers are given a “reasonable” time to organise their own recovery. If suitable arrangements are not or cannot be made, a statutory removal may be invoked by traffic officers.

As an ALR scheme has no hard shoulder, all lanes are live lanes. Any vehicle that is unable to leave the main carriageway (by continuing to the next exit slip road, or stopping in a refuge area), will become a candidate for statutory removal as it will, by definition, cause an obstruction.

Suitably trained and equipped traffic officers are able to clear most broken down vehicles to the nearest place of safety, which may be an ERA, a motorway service area, or a hard shoulder. This could regularly involve moving vehicles for distances of up to 2.5km, and in instances where the nearest place of safety is occupied or otherwise unavailable there may be a requirement to clear for even greater distances.

If traffic officers are unable to clear the vehicle (for example due to it being overweight, or damaged), they will set out emergency traffic management and follow the usual statutory removal process. Once in attendance they are to remain with the vehicle until it is removed or otherwise protected.

If a vehicle is broken down in (or cleared to) an ERA or other suitable place of refuge, the on road TOS patrol - as for any other road - should make an assessment of the obstruction or danger posed by that vehicle to determine whether a statutory removal is justified, or whether “owner’s choice” of vehicle recovery can be used.

The frequency of vehicle breakdowns is generally proportional to the flow of traffic, which means the distribution tends to have peaks and troughs which follow a similar profile to traffic flow. As such, demand for traffic officers to deal with live lane breakdowns might initially be expected to have a profile similar to the traffic profile for a scheme. However, a study of the workload encountered during early scheme operation has found that incidents occasionally occur in clusters, which can require multiple on-road resources to attend incidents simultaneously. This may have implications for patrol patterns and resourcing.

23 With the exception of intra-junction links that retain the hard shoulder and do not feature through junction running.
5.3.4 Debris retrieval

As elsewhere on the network, debris is categorised as either that requiring immediate collection (e.g. debris of a distressing or hazardous nature); or routine debris (e.g. tyre or exhaust debris).

- For “immediate collection” debris, an incident assessment will be made by the attending traffic officer who will determine whether the debris should be removed to the edge of the carriageway (or verge), or left in situ awaiting removal by the maintenance service provider.
  - If the debris is to be left in situ, the traffic officer will remain at scene, and deploy appropriate live lane procedures.
  - If the debris is to be moved to the edge of the carriageway (or verge), the traffic officer may need to return to support the service provider.

- For “routine collection” debris, the TOS may need to deploy an all lane rolling road block to temporarily hold traffic while the debris is removed to the verge and placed near to a marker post. The maintenance service provider will return in periods of lower flow, or when other maintenance work requires lane closures, to collect the debris. Supporting signs and signals will be set, as per agreed procedures, by the RCC.

5.3.5 Severe weather

The combination of message signs capable of displaying lane availability with supporting text and pictograms, coupled with the ability to implement mandatory speed limits, provides the operator with useful tools to mitigate the impacts of severe weather on traffic.

Certain weather conditions (e.g. fog, heavy rain) can reduce visibility and increase the risk of collisions. This risk is primarily related to excess speed. If drivers are driving slowly due to the conditions, the queue protection / congestion management system will automatically set appropriate speed restrictions to reduce the associated risk of collisions.

Each asset support contractor is required to produce a severe weather plan which must include the procedures and operational arrangements necessary for the delivery of an effective winter service, and as such should identify network features (such as smart motorway sections or ERAs) or local issues (such as high altitude or steep gradients) which require special consideration.

The severe weather plan will also define the process for snow clearance, for example by setting out the number of lanes to be kept clear for a particular route, and the order in which lanes should be cleared if a ‘phased’ approach is followed. Message signs and signals can be utilised to display warning information, or inform motorists if certain lanes are not available for use.
5.3.6 Road works management

As elsewhere on the network, road works will be scheduled to take place at times that minimise the impact on traffic. This means works will generally happen at night; in periods of lower flow in the middle of the day; or at weekends. As these periods are dependent on traffic flows they will need to be agreed on a scheme by scheme basis, adopting the principles of intelligence based road space management24.

During road works, the contractor should request that the RCC set signs and signals (where available) to support the setup, modification or removal of traffic management, in line with the generic method of setting out temporary traffic management (TTM).

Highway England’s “aiming for zero” programme is anticipated to deliver significant developments regarding TTM design and advance signing provision, including the potential replacement of fixed plate signage with electronic signals. Designers should ensure they are aware of the latest guidance and publications (see also section 8.3).

5.3.7 Abnormal load movements

Smart motorways do not fundamentally affect the preferred times or routes for abnormal loads, and normal guidance should be followed in scheduling such movements on an ALR scheme. As for other parts of the network, deviation from the agreed routes should not be made without appropriate consultation25.

Smart motorways provide significantly enhanced capabilities to monitor the movement of the abnormal load. NTIS will have (if possible) established communication with the driver of the abnormal load, and the RCC should communicate via NTIS to ensure that the driver is aware of downstream traffic conditions, and to facilitate communication should an incident occur.

24 For example, a road works management tool which uses historic data to predict lane demand through road work schemes. This allows for lane closures to be planned so as to cause minimal congestion, thereby reducing delays and other impacts of congestion.

25 For ‘special order’ movements, no deviation from the agreed route should be made without consultation with Highways England. For all other abnormal loads, no deviation from the agreed route should be made without consultation with the police abnormal loads officer and/or highway and bridge authorities or RCC team manager outside office hours. Any deviation must be considered suitable by them before being used.
5.4 Emergency responder national agreements and guidance

5.4.1 National agreements

Responding to incidents on SM schemes requires a collaborative approach that reflects the national character of the smart motorways programme.

To support the above, Highways England established jointly-agreed national positions with: the association of chief police officers (ACPO); the chief fire officers association (CFOA); and the association of ambulance chief executives (AACE), regarding the emergency response to incidents. These positions were captured within a national guidance framework.

5.4.2 Regional and Scheme Level Agreements

Individual schemes will establish agreements with the emergency services and other core responders in their region. These agreements should replicate the principles of the national agreement, unless a strong justification can be provided to deviate from them. Any variance should first be agreed with representatives from Highways England’s operations directorate, and subsequently approved by the scheme’s senior user.

The preference is for each region to have a single agreement, signed by all three of the emergency services, as an addendum to the existing “detailed regional operational agreements” (DROA) set up when the Traffic Officer Service was created. However, it is recognised that this may not be possible or desirable in all cases, and that individual agreements with the police, fire and ambulance services separate from the existing DROA may be necessary in exceptional cases.

Regardless of the precise form, agreements will need to take the principles of the national agreements, apply them to the characteristics of the individual scheme, and record the agreed operating practices based on scheme-specific requirements. It is anticipated that these agreements would record acceptance of the national principles via memoranda of understanding (MoU), apart from where specific exceptions are deemed necessary; these exceptions are to be included in chapter 5 of the scheme’s combined operations PCF product: “Management of incidents and other heightened situations”.

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26 ACPO was replaced in 2015 by a new organisation, known as the national police chiefs council (NPCC)
6. Meeting the road worker safety objective

The “Standard for safety risk assessments on the strategic road network” (GD 04/12) defines road workers as either:

- People directly employed by Highway England who work on the SRN (e.g. traffic officers); or
- People in a contractual relationship with Highways England, including national vehicle recovery contract operatives, all workers engaged in traffic management activities and incident support services, and any other activities where live traffic is present, (such as persons carrying out survey and inspection work).

There is no numerical safety objective or target for road workers on either ALR or CM schemes, and on both the risk must be managed in accordance with the 'so far as is reasonably practicable' principle. The Highways England “aiming for zero (AfZ)” strategy must be applied for further positive action to reduce the risk to road workers during maintenance and operation. One part of the strategy aims to eliminate all fatalities and serious injuries to road workers maintaining the strategic road network.

- The ALR ‘Generic safety report’ contains a qualitative risk comparison for specific road user groups; and shows that on balance, the safety objective for road users is likely to be achieved.
- The above report also concludes that achieving the ALR road worker safety objective is likely to require the provision of concrete central reserve barrier, application of the ERIC\(^{27}\) methodology, and introduction of fixed taper points and remotely operated signing for the installation of TTM.
- A separate ‘Generic safety report’ exists for the CM design variant. Both are available from the Highways England website.

Designers have a statutory duty through the construction (design and management) regulations 2015 (CDM) to reduce health, safety and welfare risks for (amongst other things) the maintenance of completed highway schemes. Although generic guidance on the implementation of the 2007 regulations exists\(^{28}\), at the time of writing this guidance has not yet been updated to reflect the 2015 regulations. Those affected (including designers and maintenance service providers) should ensure they are aware of the latest position.

All smart motorway projects are required to establish a Project Safety Control Review Group (PSCRG) at the inception of the project. Additional guidance on the selection and deployment of an appropriate safety management system can be found in IAN 191/16\(^{29}\). Each scheme should undertake its own specific review of the hazards associated with maintenance, and ensure that the scheme has been designed in such a way that it can be operated and maintained so that the risks are as low as reasonably practicable (ALARP).

\(^{27}\) The mnemonic ERIC (eliminate, reduce, isolate, control) is used to identify a hierarchy of risk control measures.

\(^{28}\) IAN 105/08: “Implementation of construction (design & management) 2007”
http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian105.pdf

\(^{29}\) IAN 191/16: “Safety Work Instructions”, introduced to replace IANs 139/11 and 151/11.
6.1 Designing for maintenance

There are two main threads to the strategy of reducing the risk exposure of maintenance operatives through the scheme design:

- Design the scheme to eliminate (where possible), or else minimise the frequency with which future maintenance interventions are required, and correspondingly reduce the amount of TTM required;
- Design the scheme so that when a maintenance intervention is required, it can be safely carried out.

In order to identify opportunities to lower the risk exposure of road workers, an ERIC assessment was carried out which considered all maintenance activities likely to be undertaken within a typical SM scheme.

The assessment then determined how frequently these activities occur, how they are currently performed, and how they might be performed in future. This enabled mitigation measures to be identified, allowing the risks to be managed in accordance with the ALARP principle.

6.2 The ‘ERIC’ approach to reducing risk

The following sections provide examples of risk reduction strategies under each of these four headings (eliminate, reduce, isolate and control).

Note that these items do not constitute an exhaustive list, as each scheme will have specific local issues; and this guidance does not detract from the designer’s responsibilities under the CDM regulations.

6.2.1 Eliminate

The most effective hazard reduction strategy is to simply eliminate the requirement to conduct maintenance at all. Examples of how this could be achieved include:

**Removal of assets**

Designers should catalogue all the assets that are currently installed within the scheme boundary, identify all redundant (or potentially redundant) infrastructure, and assess whether it should be removed. As is the policy for the rest of the network, non-essential infrastructure or technology, including soft estate, should be considered for removal.

Designers should also consider whether it is possible to utilise assets that do not require maintenance at all.

6.2.2 Reduce

If a particular maintenance activity cannot be eliminated, it may be possible to reduce the frequency with which maintenance access is required, or reduce the length of time the maintenance activity takes. Opportunities to do this include:

**Reduce site visit requirements**

Designers should reduce or eliminate the need for roadside maintenance activities for new and existing equipment on the mainline carriageway, so far as is reasonably practicable. Maintenance and repair should be undertaken away from the network unless there is no other alternative.
Where possible, roadside technology should have remote access capabilities, allowing faults to be detected, interrogated and in some cases resolved without requiring a site visit. (This is covered in more detail in Section 8.3.4).

**Bring forward renewal programmes**

In advance of the scheme’s construction, Highways England, designers and maintenance providers should consider undertaking maintenance interventions that are scheduled to take place during (or shortly after) the implementation of the scheme.

Highways England policy states that a five year period free from major asset renewal should be provided after scheme opening (unless otherwise agreed with the senior user). This activity will reduce the amount of maintenance that needs to take place once the scheme is operational.

**Utilise low maintenance items**

Designers should consider the use of longer life and/or lower maintenance items and assets where they will need to be replaced or installed as part of the scheme. This consideration should also include assets that have extended reactive maintenance periods (e.g. curing of concrete on bridge repairs) as this will greatly reduce planned and reactive maintenance requirements.

**Plan for access restrictions**

Typically, the delivery partner takes over responsibility for routine maintenance and inspections from the point at which the site is handed over into construction. This may provide an opportunity to take advantage of the TTM installed for the construction period of the scheme to undertake any necessary longer term maintenance activities, such as soft estate management, vegetation clearance for visibility, and other routine maintenance activities. This will enable maintenance service providers to reduce the time spent performing maintenance activities once the scheme becomes operational.

**Renew ‘problem’ assets**

Designers should work with the existing maintenance service provider to identify whether any existing technology assets are known to either be unreliable; or have unreasonably short maintenance intervention intervals, and should consider replacing those assets with more reliable alternatives or components requiring less frequent maintenance. Another example might be to implement a policy of regularly operating ‘remote control’ signs to improve their reliability.

**6.2.3 Isolate**

A risk can be isolated by separating the hazardous activity from the individuals exposed to it, either by physical protection (e.g. through the provision of guarding) or by limiting access (e.g. through the requirement for maintenance activity to only occur within predetermined ‘working windows’). Examples include:

**Re-positioning of assets**

Designers should assess all existing assets to ascertain whether any could be repositioned to enable their maintenance activities to be conducted either off network, or from within a designated area for maintenance. Where appropriate, items located in the former hard shoulder (such as manhole covers) should be removed from what would, under an ALR design, become a permanent running lane. The capital cost of moving the items should be weighed against the operational costs and risks of maintenance; and the associated loss of capacity over the life of the scheme.
**Provision of off-network access**

It may be possible to provide safe maintenance access to both new and existing assets without recourse to the motorway network (for example by locating the asset near to an over-bridge with pedestrian access). However, locations which can be easily accessed by maintainers may also increase the opportunity for asset theft, and so the guidance provided within Highways England’s metal theft toolkit should be observed.

**Combining asset locations**

When installing new assets, designers should consider co-locating them to enable multiple maintenance activities to be undertaken within the same deployment of any TTM required. The capital cost of co-locating items should be weighed against the operational costs and risks of maintenance and the associated loss of capacity over the life of the scheme.

**6.2.4 Control**

Control measures make it safer for the contractor to perform each maintenance activity, for example by providing a greater degree of protection, or by reducing the exposure time. Examples of controls include:

**Improved accessibility of new assets for maintenance**

Designers should ensure new assets are positioned to facilitate maintenance access. This could include locating components within a designated area for maintenance. This may mean additional assets are required in certain circumstances, but improving maintenance access is expected to deliver an overall safety and operational benefit. Designers should also consider providing mechanical access facilities to assets as part of the design.

**Fixed taper positions (FTP) & remote signalling**

In accordance with current guidance, designers of ALR schemes should identify fixed points at which a cone taper can be installed in order to support the setting out and removal of traffic management.

Sufficient taper locations should be identified to allow all the assets, including any signage required to support traffic management, to be maintained within a suitable TTM layout. Therefore, the frequency and location of the taper positions needs to be agreed by scheme designers and the maintaining agent. (See Section 8.3.3 for more detail).

**Improved installation / access techniques**

Designers and maintenance service providers should review the technology assets to be installed, and consider methods to enable easier/quicker swap out of faulty equipment to reduce the time spent performing maintenance actions.

Safe access provision must be determined by the designer, as it is the designers’ responsibility to ensure risks are managed to ALARP as part of their design liabilities under CDM regulations. Further guidance can be found within MPI-39-032015.
7. Determining the approach to maintenance

7.1 Contractual requirements

The “Asset maintenance and operational requirements” (AMOR) and the “Technology management & maintenance manual” (TMMM) together set out Highways England’s requirements in relation to carrying out maintenance and operational activities on the network.

Contained within the AMOR and TMMM specifications is the requirement that the maintenance service provider adopts a risk based approach to the execution of maintenance and operational activities, in order to deliver value for money whilst demonstrating that risks are acceptably mitigated, with no detriment to the safety of either road users or road workers.

The AMOR defines the primary risks to be mitigated by the maintenance service provider. These are grouped in two key areas; safety and network availability:

- **Safety**: risks must be mitigated to ensure that:
  - the area network is not dangerous to traffic;
  - the area network does not present an intolerable risk to road user or road worker safety; and
  - Highways England is provided with a ‘special defence’ under Section 58 of the Highways Act 1980.30

- **Availability**: risks must be mitigated to ensure the maintenance provider:
  - secures the expeditious movement of traffic on Highways England’s area network; and
  - facilitates the expeditious movement of traffic on road networks for which another authority is the traffic authority.

7.2 Delivering efficiencies

A requirement of AMOR is that the maintenance service provider prioritises their activities to optimise the use of (and achieve the best value from) the available resources. IAN 182/1431 provides guidance to all those involved in the delivery of major schemes and their acceptance into operation and maintenance. It sets out best practice and key considerations regarding a number of activities and responsibilities that are important to achieving successful scheme handover. The focus is on providing clarity around known issues, areas of complexity and key risk items.

Maintenance service providers are required to produce a quality plan, to include fully detailed processes, procedures and timescales in relation to inspection, make safe, and repair of the asset; detailing exactly what activities the provider will undertake to deliver the required outcomes whilst maintaining a tolerable safety risk for the road user.

30 Section 58 provides the defence that “the Authority had taken such care as in all the circumstances was reasonably required to secure that part of the highway to which that action related was not dangerous for traffic.”
31 IAN 182/14: “Major Schemes: Enabling Handover into Operation and Maintenance”
http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian182.pdf
This quality plan should reflect the fact that their ability to access certain assets may be compromised by factors including physical access (e.g. no hard shoulder), or other restrictions (e.g. no routine maintenance permitted during peak periods).

The maintenance service provider is also obliged to produce a maintenance requirements plan, detailing:

- the planned programme of inspections;
- the response and repair timescales, covering defect identification, verification, response and repair; and
- how work will be packaged to minimise network occupancy (including road space booking requirements, traffic management requirements, and temporary traffic regulation orders).

Designers and maintenance service providers should give careful consideration to the requirement to minimise network occupancy, with an ambition to reduce both the frequency of lane closures and the exposure of road workers to the risks of working adjacent to live traffic. The number of maintenance interventions requiring traffic management should be minimised wherever possible.

The maintenance service provider is required to deliver (and comply with) a network occupancy plan, containing occupancy booking procedures and pro-forma. They are to also maintain a fully populated record of all occupancies and any activities which cause an adverse impact on road users; with a view to optimising all occupancies, and minimising the effect of activities.

Although maintenance service providers have to consider safety in how they permit others to access the network, including whether or not to allow ERA use, there are no additional operational requirements for a "permit to access" system specific to smart motorway schemes. The requirements set out in AMOR for a network occupancy plan which outlines the provider’s processes and procedures for managing network occupancy are deemed to be sufficient.

Effective communication systems will be needed to ensure that if the RCC needs to request that maintenance personnel leave the network, the maintainer is able to comply with that request in an expeditious manner. Any system employed should ensure that the maintenance service provider is able to monitor and make contact with all contractors, including third-party maintainers. Any systems used to track road space bookings are to be operated entirely by the maintenance service provider themselves, with no expectation placed on the RCC to access these systems in order to obtain information.

AMOR also requires that separate plans are produced for key operational areas, including the severe weather service and incident response. These plans should detail the activities which will be undertaken to deliver the required outcomes and avoid danger to users of the highway.
8. Impact of SM on maintenance

Smart motorway schemes comprise a specific mix of technology and civil infrastructure. These assets require maintenance in order to remain functional, and so deliver the operational and safety benefits required of the scheme. However, the scheme’s design itself changes how maintenance service providers carry out maintenance, due to factors including:

- the pressure of road space booking, arising from the need to access the additional technology assets, roadside infrastructure and field electronics installed as part of the scheme design;
- operational restrictions on the time periods during which maintenance activities are able to be conducted, including the need to avoid lane closures during periods of high demand; and
- for ALR schemes, the lack of a hard shoulder from which to carry out maintenance, access roadside infrastructure, or set out temporary traffic management.

The following sections describe some of the likely impacts that the SM design is expected to have on the ability to plan, schedule, and conduct maintenance activities; as well as suggesting potential opportunities to mitigate those impacts.

8.1 Planning maintenance activities

8.1.1 Asset inventory

With access to assets on some schemes expected to provide additional challenges (when compared to D3M sections), survey work may prove more difficult and so the planning of routine maintenance activities needs to be more rigorous. During the construction phase of the scheme the scheme designer (supported by the maintenance service provider, delivery partner and construction contractor) should collate a full asset inventory, containing all assets, their quantities, location and condition, together with details of the date and nature of the most recent maintenance activity.

This inventory is to be kept up to date during the construction period. Once the scheme is operational, any survey activities necessary to keep the inventory current will need to be carefully planned to maximise the utilisation of any TTM being set out for maintenance work so as not to require any additional traffic management installations.

The asset inventory should be used to establish appropriate asset management plans, enabling work to be scheduled accordingly.

8.1.2 Plan for incident / longer term maintenance

Designers and maintenance service providers will need to review both existing and new structures within the SM scheme to identify any structures or assets that require TTM to be left in place for an extended period (i.e. longer than overnight), in order to allow a repair to be completed.

Examples might include the repair of a bridge parapet where the curing of the concrete requires protection for several days until the required minimum strength has been reached, or assets where non-stock materials are needed to make a repair, but traffic needs to be kept away from the vicinity while those materials are sourced.

Action plans for these circumstances need to be established and agreed, as it is a requirement of AMOR that they are included in the maintenance requirements plan.
8.1.3 Plan for severe weather

The permanent conversion of the hard shoulder into a controlled running lane will have an implication on the procedures and operational arrangements necessary for the delivery of an effective winter service plan for ALR schemes. Snow accumulations are likely to be ploughed and stored in running lanes (and ERAs) for a longer period of time; if snow is moved to lane 1 arrangements for clearing slip roads will have to be made. Wider carriageways will typically need echelon ploughing. Salting routes will need to be designed to allow all lanes to be fully treated. These arrangements will be defined in the severe weather plan (see also section 5.3.5 for implications on the RCCs).

8.2 Scheduling maintenance

The high traffic volumes that SM schemes are expected to experience during a typical weekday means that the main opportunity to conduct maintenance works will be overnight. Any activity that require lane closures during working days is likely to create significant congestion and delays to travellers. Hence weekday, inter-peak closures are not feasible (except for emergency works). Therefore the majority of activities will need to be scheduled at night, with additional temporary lighting provided as appropriate.

Intelligence based road space management will establish when it may be possible to permit lane closures during daylight hours to allow activities that are deemed to be unfeasible, or too high risk, to be carried out in the dark (e.g. litter picking, soft estate clearance). This will be scheme specific: designers and maintenance service providers should not assume that such a window exists; and so alternative methods of scheduling maintenance access may be required.

8.2.1 Scheduling planned maintenance activities

The performance objectives described in the road investment strategy (RIS) and outlined the Highways England strategic business plan (SBP) increase the requirement to minimise the number of occasions when TTM is in place, in order to minimise the safety risks to both road workers and road users, and to improve the efficiency of maintenance activities.

The maintenance requirements plan introduces the need to minimise network occupancy, meaning the number of activities that are carried out during a single installation of TTM have to be increased wherever possible.

Adopting this approach becomes even more crucial on SM schemes, where the opportunities for maintenance access are reduced. The ability to group maintenance activities together is subject to maintainers having adequate resources available to conduct the work, and there being no adverse impacts on safety associated with the undertaking of a number of activities within the same area.

Consideration must also be given to the road user safety risk associated with delaying a particular maintenance activity in order to use a scheduled traffic management intervention.
8.2.2 Scheduling reactive maintenance

Defects and equipment failures are inevitable. Except where the item can be safely accessed from off the network with the necessary tools, plant and materials; all repairs will require TTM. Both the frequency with which faults or defects occur, and the time needed to make a repair are key factors in determining the need for TTM.

Deciding when to undertake reactive maintenance requires an assessment of the operational criticality of each component to enable the network to continue to be safely operated despite the presence of a fault: either until a planned maintenance activity with the required TTM layout is in place; or until sufficient ‘other’ faults occur to enable them all to be repaired in a single maintenance intervention.

There is also the reverse opportunity in that some planned activities could be re-scheduled to make use of a TTM installation required to fix a fault or defect, for example using blockade working for planned maintenance. However, reactive maintenance is often required more quickly than is possible by waiting for the blockade period.

8.3 Conducting maintenance

8.3.1 Generic safe method for placing temporary traffic management

Safe installation of TTM for maintenance has been identified as a key challenge for ALR designers and operators. One potential approach to meeting this challenge is demonstrated by the ‘generic safe method’ [32], a guidance document produced in consultation with the road worker safety forum (RoWSaF) which includes features such as fixed taper positions and dedicated advance signage.

The maintenance service provider alone is responsible for developing a safe system of work that must reflect the assessment of risk, standard methods of work, and plant and equipment available. The designer’s responsibility is to ensure that the design can be maintained safely with elimination of hazards and the reduction of residual risks to be as low as reasonably practicable. The generic safe method merely demonstrates one such approach.

8.3.2 Installation of temporary traffic management

Where the need for a maintenance intervention cannot be avoided, TTM will be required. For an ALR scheme, the main differences when installing TTM on a road without a hard shoulder involve the safe installation of the advance warning signs and the initial set up of the taper. Once these are in place then the remainder of the installation is the same as for any motorway with a hard shoulder.

There are two key issues relating to the installation of TTM in an ALR environment: the initial positioning of signs and taper cones has to take place in live lanes; and setting out the offside signs to Chapter 8 [33] would otherwise require workers to cross four lanes of traffic. With concrete central reserve barrier there is no effective position of refuge for a road worker installing a sign adjacent to the barrier.

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32 http://www.standardsforhighways.co.uk/ha/standards/tech_info/files/Generic%20Safe%20Method%20for%20Placing%20TTM%20FINAL.pdf
33 i.e. chapter 8 of the traffic signs manual: https://www.gov.uk/government/publications/traffic-signs-manual
To combat this, the ‘aiming for zero’ programme is currently sponsoring a number of projects aimed at eliminating or reducing road worker exposure to risk during set up of TTM, particularly those risks relating to the crossing of the carriageway on foot. For example, the programme is assessing the suitability of using variable signs and signals to display advance warnings and variable mandatory speed limits to support roadworks.

The ‘aiming for zero’ programme is a rapidly developing work stream, and designers and maintainers should ensure they remain aware of potential TTM relaxations published in interim advice notes (IANs) during scheme development and operation phases.

### 8.3.3 Pre-determined taper positions and fixed traffic management signs

Pre-determined taper positions and remotely operated temporary traffic management (ROTTM) signs are used to support the setting out of TTM on ALR (and on CM where justified). Dedicated ROTTM signs installed upstream of each selected taper location at the distances described in Chapter 8 eliminate the safety hazards to road workers created by the requirement to physically place temporary fixed plate signs adjacent to a live running lane. ROTTM signs can be operated remotely from an accessible, secure, safe location (e.g. the maintenance service provider’s network control centre (NCC)).

The aiming for zero programme is developing guidance for the use of post-mounted ROTTM signs at roadworks and has provided advice on the subject of off-side sign removal through the publication of IAN 150 and CHE Memo 346.

Sufficient taper locations are to be identified which allow all the assets, including any signage required to support traffic management, to be maintained within a suitable TTM layout. Therefore, the number and location of the taper positions needs to be agreed by scheme designers and the maintenance service provider, and documented in the maintenance and repair strategy statement (MRSS) within PCF.

### 8.3.4 Remote access to technology assets

Remote access to technology assets is being developed and delivered in two phases. Phase 1 provides remote access to the latest generation of signs and signals; while phase 2 delivers remote access capability to all IP-enabled devices, including PTZ CCTV cameras.

Maintenance service providers should, wherever possible, make use of this facility to minimise visits to the roadside. The maintenance service provider will need to obtain permission from the RCC to take over control of the piece of equipment, as they would currently for physical repairs, to ensure that the equipment is not simultaneously required for operational purposes.

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34 ROTTM Signs Guidance Note v7-4 150317
9. RCCs and the Traffic Officer Service

9.1 Staffing levels

An initial exercise established the likely staffing needs, taking into account the resources required to safely operate smart motorway schemes. This work is being reviewed in light of experience gained operating early ALR schemes, and will consider the workload of staff based in the RCC, as well as on-road traffic officers, to inform future resourcing models.

The combined operations PCF product for each scheme will need to record that an assessment has been completed, and that the staffing requirements to operate the scheme have been agreed.

9.2 RCC space requirements

As neither ALR nor CM schemes have a dynamic hard shoulder, there is no need for a hard shoulder monitoring (HSM) subsystem to be housed within the RCC, so it is not anticipated that any additional server space will be required for this purpose.

9.3 Traffic officer procedures for smart motorways

To ensure national consistency across smart motorways operations, a single, standardised set of core procedures has been produced by the TOS procedures team, and approved by both the national health & safety team (NHST) and the resource and capability group (R&CG).

It is the responsibility of each scheme to identify any specific considerations that require a “non-standard” operational procedure. In particular, the scheme will need to identify any specific hazards not included in the relevant generic hazard log, and where necessary determine appropriate mitigations.

The national TOS procedures team will then work with each scheme to develop a set of procedures to cover such scheme specific conditions and to gain the necessary approvals. Where applicable these will form a set of regional procedures that will be described for each TOS region. Such procedures may include setting of variable signs and signals for TTM, and will need to ensure that operation of any permanent advance signs do not conflict with signs and signals set by the RCC.

The TOS procedures team centrally maintain the core and regional (scheme specific) procedures on the traffic officer manual, which is stored on the Highways England portal.

9.4 Learning requirements

Highways England’s operations directorate will coordinate the national approach to all traffic officer learning requirements associated with SM schemes.

To deliver this work, the TOS procedures team will analyse the competence requirements associated with the operation of each scheme for all TOS roles (mapping legal, safety and national standards requirements), and determine whether any gaps exist between the current operational standards, and any new standards required to safely operate the scheme(s).

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36 R&CG was formerly known as the traffic learning centre (TLC)
This will enable new learning interventions and assessments to be created which deliver the required competence standards, and allow for individual achievements against the standards to be recorded.

To ensure that the relevant personnel have been appropriately trained, detailed training delivery plans will be agreed with each region before the first SM scheme in that region becomes operational.
# 10. Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>ACPO</td>
<td>The association of chief police officers; an organisation that has now been replaced by the national police chiefs council (NPCC)</td>
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<tr>
<td>ADS</td>
<td>Advance direction sign</td>
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<tr>
<td>ALARP</td>
<td>As low as reasonably practicable</td>
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<tr>
<td>ALR</td>
<td>All lane running. Refers to a smart motorway scheme where the hard shoulder is permanently converted to a controlled running lane</td>
</tr>
<tr>
<td>AMOR</td>
<td>Asset maintenance and operational requirements. Together with the technology management &amp; maintenance manual (TMMM) these documents serve as the replacement for the network management manual (NMM) and the routine &amp; winter service code (RWSC)</td>
</tr>
<tr>
<td>APTR</td>
<td>The all-purpose trunk road network</td>
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<td>ASC</td>
<td>Asset support contractor</td>
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<tr>
<td>CCTV</td>
<td>Closed circuit television</td>
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<tr>
<td>CDM</td>
<td>Construction, design and management regulations (2015)</td>
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<tr>
<td>CHE</td>
<td>Chief Highway Engineer</td>
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<tr>
<td>CM</td>
<td>Controlled motorway</td>
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<tr>
<td>COBS</td>
<td>Control office base system</td>
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<tr>
<td>DMRB</td>
<td>The design manual for roads and bridges</td>
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<td>ERA</td>
<td>Emergency refuge area</td>
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<tr>
<td>ERIC</td>
<td>The mnemonic ERIC (eliminate, reduce, isolate, control) is used to identify a hierarchy of risk control measures</td>
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<tr>
<td>ERT</td>
<td>Emergency roadside telephones</td>
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<td>ESS</td>
<td>Entry slip signals</td>
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<tr>
<td>FTP</td>
<td>Fixed taper points</td>
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<tr>
<td>HADECS</td>
<td>Highways England’s automated digital enforcement and compliance system</td>
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<td>HSM</td>
<td>Hard shoulder monitoring</td>
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<tr>
<td>HSR</td>
<td>Hard shoulder running. Refers to a smart motorway scheme featuring dynamic use of the hard shoulder, designed to IAN 111/09 standards</td>
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<tr>
<td>IAN</td>
<td>Interim advice note</td>
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<tr>
<td>ISU</td>
<td>Incident support unit</td>
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<tr>
<td>MAC</td>
<td>Managing agent contractor. Being replaced by ASC.</td>
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<tr>
<td>MIDAS</td>
<td>Motorway incident detection and automatic signalling</td>
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<tr>
<td>MPI</td>
<td>Major projects instruction</td>
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<td>MRSS</td>
<td>The maintenance and repair strategy statement – a PCF product</td>
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<tr>
<td>MSA</td>
<td>Motorway service area</td>
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<td>MSP</td>
<td>Maintenance service provider</td>
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<tr>
<td>MSS</td>
<td>The message sign subsystem (a subsystem of COBS)</td>
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<td>NCC</td>
<td>Network control centre</td>
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<tr>
<td>NMM</td>
<td>Network management manual</td>
</tr>
<tr>
<td>NPCC</td>
<td>The national police chiefs council; an organisation which has replaced the association of chief police officers</td>
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<tr>
<td>NTIS</td>
<td>National traffic information service</td>
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<td>NTOC</td>
<td>National traffic operations centre</td>
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<tr>
<td>NVRM</td>
<td>National vehicle recovery manager</td>
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<tr>
<td>Term</td>
<td>Definition</td>
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<td>---------------------------------------------------------------------------</td>
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<tr>
<td>OD</td>
<td>Operations directorate (within Highways England)</td>
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<td>PCF</td>
<td>Project control framework - a joint Department for Transport (DfT) and Highways England approach to managing major projects.</td>
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<tr>
<td>PTS</td>
<td>Professional and technical solutions, a directorate within Highways England (formerly NetServ)</td>
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<tr>
<td>PTZ</td>
<td>Pan-tilt-zoom (CCTV cameras)</td>
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<tr>
<td>RCB</td>
<td>Rigid concrete barrier</td>
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<tr>
<td>RCC</td>
<td>Regional control centre</td>
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<tr>
<td>REC</td>
<td>Regional enforcement coordinators</td>
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<tr>
<td>RIS</td>
<td>Road investment strategy</td>
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<tr>
<td>ROTTM</td>
<td>Remotely operated temporary traffic management (signs)</td>
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<tr>
<td>RTMC</td>
<td>Regional technology maintenance contract (the replacement for TechMAC)</td>
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<tr>
<td>RWSC</td>
<td>Routine and winter service code</td>
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<tr>
<td>SRN</td>
<td>Strategic road network</td>
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<tr>
<td>SRO</td>
<td>Senior responsible owner</td>
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<tr>
<td>TMMM</td>
<td>Technology management &amp; maintenance manual</td>
</tr>
<tr>
<td>TOS</td>
<td>The traffic officer service</td>
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<tr>
<td>TSRGD</td>
<td>Traffic signs regulations and general directions</td>
</tr>
<tr>
<td>TTD</td>
<td>Traffic technology division (part of the information &amp; technology directorate within Highways England)</td>
</tr>
<tr>
<td>TTM</td>
<td>Temporary traffic management</td>
</tr>
<tr>
<td>VMS</td>
<td>Variable message signs</td>
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<tr>
<td>VMSL</td>
<td>Variable mandatory speed limits</td>
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This page is left intentionally blank