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10 SAFETY

10.1 Approach to safety for smart motorways

10.1.1 The Agency's road network currently has high performance in terms of safety and it is an objective of this Scheme to maintain that high standard. During the pre- application phase, the Scheme design has been the subject of a Road Safety Audit and an assessment of operational safety.

10.2 Road safety audit

~~a)~~10.2.1 A Stage ~~1~~2 Road Safety Audit, in accordance with the DMRB (Ref 17), was carried out on the Preliminary Design and the resultant report is included as Annex D.

~~a)~~10.2.2 The ~~Alliance's~~Designer's response to the Road Safety Audit is included as Annex E.

10.3 Operational safety

10.3.1 Due to the inherent nature of smart motorways, the Agency has developed bespoke procedures for dealing with incidents and undertaking operational and maintenance activities where there is no hard shoulder. This is supplemented by a media campaign to educate drivers ~~(Ref 19).~~.

10.3.2 Incident management for the Scheme is outlined above at 9.4.

Hazard log

10.3.3 When initially assessing the feasibility of ALR prior to the implementation of any scheme it was not possible to rely on past accident statistics. Instead the Agency performed a risk assessment to determine the expected safety performance. This used hazard analysis to take account of road users and road workers and is a proven technique used in many industries such as nuclear, oil and gas, automotive, railways, aviation and defence. The outcome of this work was a generic hazard log which is reviewed ~~for~~on each individual scheme.

10.3.4 A hazard log is a database that contains a list of operational hazards, the associated risk from each hazard, and mitigations to reduce the risk to an acceptable level. The Agency's generic hazard log contains 135 hazards that specifically relate to smart motorways. Each hazard is assessed to understand how often it occurs, how likely it will be to lead to an accident, how severe a typical accident is likely to be and how the risk can be managed. A hazard log approach was first used for the M42 pilot scheme that introduced the successful use of the hard shoulder as a running lane in the UK.

10.3.5 The 20 highest scoring hazards account for around 90% of the total risk and include: driver fatigue, driving too fast, rapid change of general vehicle speed, tailgating, vehicle stopping in a running lane, pedestrians in running lanes and vehicle recovered from refuge area. After analysis, the top nine scoring hazards were (in descending order of magnitude):

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a. driver fatigued – unable to perceive hazards effectively;
b. individual vehicle is driven too fast;
c. vehicle stops in running lane – off-peak;
d. pedestrian in running lane – live traffic;
e. tailgating;
f. vehicle stops in running lane – peak;
g. rapid change of general vehicle speed;
h. maintenance workers setting up and taking down work site; and
i. vehicle recovered from ~~ERA.~~an emergency area (EA).

10.3.6 Some of the hazards can be mitigated, and the design and use of technology to create a controlled environment where drivers comply with signs and speeds, allows the Agency to manage these risks to an acceptable level. For instance, the hazards of a vehicle being driven too fast or the occurrence of tailgating are mitigated through the use of VMSL and enforcement.

10.3.7 The Agency consider that drivers also have a major role to play in helping to reduce the risk of incidents on ALR schemes by:

a) leaving enough space between vehicles, and complying with all signs, especially speed limits and lane closure signs, e.g. Red X;
b) only stopping in an emergency if absolutely necessary and using motorway service areas, on-slips, off-slips or ~~ERAs~~EAs whenever possible; and
c) preparing ~~the~~their vehicle and themselves prior to undertaking a journey e.g. having enough fuel, regularly serviced vehicle, etc.

10.3.8 The hazard log developed for the M42 ~~has been updated for the Scheme~~ to reflect the different operation of ALR and the hazard log report is included in Annex F. The hazard log shows that for most of the highest scoring hazards of the Scheme, the risk score for the baseline and the change in risk for the implementation of the smart motorway is the same as that in the generic ALR hazard log. However, there are four hazards where the risk score for the Scheme differs from the generic risk score.

a) for H37 'Individual vehicle is driven too fast' the risk reduction for the Scheme is slightly greater than for a generic ALR scheme because of higher peak traffic volume when the benefit of mandatory speed limits and the provision of a controlled motorway are greatest;
b) for H138 'Driver ~~fatigued~~fatigue - unable to perceive hazards effectively' the 'before' score is slightly lower than the generic score due to the presence of a MSA between junction 11 and junction 12, which should help decrease driver fatigue;

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c) for H135 'Vehicle stops in running lane - off peak' the risk score for the Scheme is lower than the score in the generic ALR hazard log as a result of lower off peak traffic flows; and

d) for H52 'Maintenance workers setting up and taking down work site' the risk score is also slightly lower. The hazard score is from applying the Agency's road worker safety assessment tool, which shows that with mitigation such as RCB and remote control TM signing the risk from this hazard remains broadly unchanged from the level before implementation of the smart motorway.

10.3.9 The risk score for the Scheme is slightly higher for H149 'Vehicle drifts off carriageway (i.e. leaving the carriageway as a result of road environment)'. The increase in risk for this hazard (compared to 'no change' in the generic ALR case) was endorsed at the 12 September 2013 Project Safety Control Review Group ("PSCRG"). PSCRG proposed that the same change to the risk score should be considered for the generic ALR hazard log. As the current design for the M4 junction 5 to junction 4b link is for four lanes plus a hard shoulder, the increase in risk for this hazard could be slightly lower than the revised generic score.

10.3.10 The change score for H11 'Driver ignores closed lane(s) signals that are protecting an incident' has been changed from a '-0.2' to a '0' since the publication of the SGAR2 (previous Options phase of the scheme development) version of this hazard log report in line with changes to the generic ALR hazard log. The change in score reflects results from monitoring of the M25 ALR sections, which show that, at times, significant number of drivers ignore Red X lane closure signals. The score change was endorsed by the PSCRG on 11 December 2014.

10.3.11 The risk reduction for H154 'Vehicle stopped on hard shoulder (D3M) or verge (ALR)' is lower for the proposed Scheme compared to the generic ALR hazard log as a hard shoulder is retained through junctions 3, 4b, 5, 6, 8/9, 10, 11 and 12, whereas the generic design assumes the provision of Through Junction Running (TJR) throughout.

10.3.12 Hazard H62 'On road resources work unprotected' (S06) has been eliminated from the hazard log. On road resources always work under protection from either the Traffic Officer Vehicle ("TOV") or Emergency Traffic Management ("ETM"). This applies to both the current motorway and after ALR implementation. It is noted that the Agency was recently issued with a Crown Censure – the equivalent of a criminal prosecution – for safety failings after the fatality of a Traffic Officer who was struck by a vehicle on the M25. The Health and Safety Executive ("HSE"), which investigated, took the decision to deliver a Censure after identifying failures in the Agency's quarterly supervision checks at the Dartford outstation. This has been taken into account within the hazard log but it is noted that this incident was due to correct safety procedures not being followed.

10.3.13 Hazard H95 'TO/maintainer in running lane' covers situations where a traffic

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officer (“TO”) or maintainer crosses one or several running lanes (e.g. to retrieve debris), which historically would have involved using the hard shoulder as a starting point. The generic ‘before’ risk score for this hazard was originally assessed as an E8.0. Since the original assessment, operational practices have changed and rolling road blocks are now used more regularly, rather than starting from stopping on the hard shoulder. Therefore, the generic ALR ‘before’ risk score for H95 has been reduced from an E8.0 to an E6.5 whilst the ‘before’ risk score for H34 ‘Incident management - rolling block’ has increased from E5.0 to E6.0.

10.3.14 For H95 the generic hazard log assumes that with the introduction of ALR no areas of hard shoulder remain from which to start work. The risk from H95 has therefore been eliminated from the generic hazard log. However, the proposed Scheme will retain some areas of hard shoulder through junctions 3, 4b, 5, 6, 8/9, 10, 11 and 12. Therefore, the risk from this hazard, although significantly reduced, is not completely eliminated and a residual risk remains, which is reflected by the risk reduction score of ‘-1.5’ and the ‘after’ score of E5.0

Incident management

10.3.15 Approximately half of vehicles that breakdown on a motorway will be capable of reaching an ~~ERA~~EA. Drivers are then required to contact the RCC for assistance using the emergency telephone.

10.3.16 During incident management the advanced motorway indicators and variable message signs will be set to protect the scene of an incident and assist the access of emergency services, core responders and the Traffic Officer Service. On the advanced motorway indicators, speed limits and lane availability will be indicated through the use of VMSL and lane divert arrow signals (with flashing amber lanterns) and Red ‘X’ signals (with flashing red lanterns) as shown in Figure ~~46~~43.

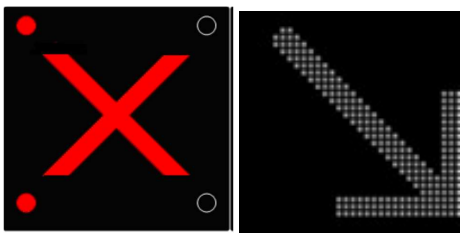

Figure ~~41~~43 Red X (stop) and lane divert signals

10.3.17 Appropriate supporting information will be displayed on the VMS to further encourage compliant driver behaviour. Modifications to the signal control software will enable a single variable message sign to display three simultaneous elements: in addition to the speed restriction and supporting text legend, the sign will also be able to display either a warning pictogram (typically a ‘red triangle’) or lane closure ‘wicket’ aspect, as shown in Figure ~~45~~42.

10.3.18 Evidence from the M42 pilot (Ref 18) demonstrates that using the hard shoulder

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as a running lane has not compromised safety. It is expected that the frequency of stoppages in live lanes will be substantially less (approximately half) than the existing frequency of stoppages on the hard shoulder, as a significant proportion of breakdowns will be able to get to a ~~refuge area.~~ place of relative safety. A place of relative safety is a facility where road users can stop in an emergency and includes only the following; a motorway service area, an emergency area, an existing hard shoulder and a new section of hard shoulder located on a diverge connector road that is 100m in length and a minimum 3m wide.

10.3.19 However some broken down vehicles will not be capable of 'limping' to a ~~refuge area~~place of relative safety and will come to a stop in a live running lane. The extra controls provided through smart motorway features will mitigate this risk, by being able to detect vehicles through the stopped vehicle detection system, queue protection system, use of full CCTV coverage to find vehicles and the ability to set lane closures to protect vehicles.

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10.3.20 The stopped vehicle detection system will utilise new radar units monitoring the motorway in both directions for vehicles that have stopped, typically within 20 seconds, and will alert a control room operator who can see the incident on camera, close lanes and dispatch a National Highways Traffic Officer to attend the stopped vehicle.

Maintenance

~~10.3.20~~10.3.21 As part of the development of the Scheme, the Agency has prepared a Maintenance and Repair ~~Strategy~~ Statement ("~~MRSS~~MRS") which provides a strategy and guidance for the post implementation maintenance and repair of the Scheme.

~~10.3.21~~10.3.22 The ~~MRSS~~MRS was prepared for preliminary design and will be developed further as the Scheme progresses to detailed design and subsequently construction. To develop this strategy, consultation has and will continue to take place with relevant organisations to assure appropriate standards are met to comply with the Construction (Design and Management) Regulations 2007 (Ref 20). The Maintenance Service Providers ("MSPs") have been appraised of the operational concept and design as it has developed and have helped shape the final design solution.

~~10.3.22~~10.3.23 There are two fundamental maintenance considerations that result from the implementation of smart motorways, namely:

a) the impact on existing maintenance access and maintenance operations resulting from removal of the hard shoulder; and

b) the impact of the increased technology equipment and associated infrastructure that is required to operate a smart motorway.

~~10.3.23~~10.3.24 The removal of the hard shoulder presents the greatest challenge (noted within IAN 161/13's supporting document - the Demonstration of Meeting the Safety Objective report), as it changes the existing procedures used by MSPs to set

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out and take down TM. It also means that access to the verge will almost always require the closure of a live lane. This, in conjunction with the increased technology and its maintenance, could result in an increase in volume of relaxed (when traffic flows are low and weather is good) TTM works, unless carefully managed.

Traffic management strategy

10.3.2410.3.25 The strategy for the deployment of TTM incorporates the use of permanently located remote control TTM signs in the verge and central reserve in conjunction with fixed taper locations. This will provide flexible advance TTM signing coverage for all relaxed works lane closures. To further support these signs,and relevant lane closure information will be shown by the MS4s and AMIs during the setting up, operation and taking down of the TTM work site.

Meeting the road worker (maintenance) safety objective

10.3.2510.3.26 To meet the road worker safety objective of the Agency's Policy 'Aiming for Zero'As Low As Reasonably Practical (ALARP) and critically the Health and Safety legislative requirements for road workers, the scheme will:

a) remove the need to implement TTM so far as is reasonably practicable;
b) consider off network access where feasible;
c) incorporate a design for safe TTM deployment (described in 10.3.24);
d) replace the existing steel barrier in the central reserve with RCB to reduce maintenance requirements;
e) use remote interrogation and resetting of MS4s and AMIs;
f) provide a maintenance environment that allows the MSP to use increased programme rationalisation of maintenance works; and
g) implement a mandatory 40mph speed limit while TTM is being established or removed.

10.3.2610.3.27 The safety assessment work that has been undertaken suggests that if the proposed mitigation measures are implemented, the safety objective for maintenance workers is expected to be met. These proposed mitigation measures have been drafted on the basis of a worst case assessment, as it should be noted that actual data is unavailable on the benefits or risks associated with smart motorways, as no on-road trials have been conducted. Results from the monitoring of the first ALR schemes on the M25 will be reviewed in due course and any learning points incorporated into the Scheme design and MRSS.

Project Safety Control Review Group ("SCRG")

10.3.27 The PSCRGSCRG comprises stakeholders from the Agency's Designers, the Agency's project team, the Agency's internal stakeholders including: Customer ::Operations, Network Services Directorate and Network DeliverySafety, Engineering and Development Directorate;Standards and the Agency's MSPs for Areas 3 and 5.

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Meetings are held to discuss Scheme-specific issues which may impact on operational safety of the Scheme. This ensures that road safety is properly considered in accordance with the Agency's procedures.

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