

Monitoring of Emergency Refuge Areas

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Research

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Executive Summary

The intention of the study was to monitor and evaluate the use of Emergency Refuge Areas (ERAs) on the current Smart Motorway Hard Shoulder Running (SM-HSR) schemes to provide a robust level of data for their future provision. This would provide the Agency with a level of confidence in their current provision, particularly with respect to the latest Smart Motorway All Lane Running (SM-ALR) requirements detailed in IAN 161/13 and validate the assumptions made in the Generic Hazard Log.

In order to undertake the study and analysis, data was provided via a detailed report from the Traffic Officer Service Command & Control system prepared by the Strategic Development Team, HA Traffic Management Directorate. It should be acknowledged that this is only recorded information and does not account for ad-hoc on-site actions not documented. A study period of one month was agreed and July 2013 was identified as an 'average' month to be utilised. A series of areas for analysis were identified which would provide the information necessary to evaluate the requirements and assumptions.

The evaluations confirmed that the ERAs are providing an emergency safe haven for vehicles although the requirement for the spacing of them on the network could be reconsidered. Similarly the response by the RCC and TOS suggest that the provision of an ERT and information signing suggest that no other monitoring system other than the current CCTV requirement for SM-ALR is necessary.

The validation of the assumptions did identify that the current assumptions are conservative in nature and therefore erring towards the worst case scenario, that is erring on the safe side, and that the calculation of a small number of assumptions impacts on others and decision making.

A number of recommendations have been identified:

1. A requirement of IAN 161/13 is for signing provision instructing drivers to use the ERT to obtain advice when re-joining the main carriageway. This sign does not exist as a requirement for the existing Smart Motorway schemes designed to IAN 111 although the risks are very similar when the hardshoulder is used as a running lane during periods of high flow. Consideration should be given to retrofitting of this sign on existing schemes designed to IAN 111 and amending the legend to instruct drivers using the ERT when occupying an ERA.
2. The study has identified risks/aspects for which either the data was not available or was outside the scope of the study. The collection of the data and inclusion for further analysis should be included with the forthcoming Task 271 - 'Monitoring of the First Smart Motorways – All Lane Running Scheme'. These are:
 - 2.1. Vehicle collisions caused by vehicles re-joining the main carriageway – No data was collected for this study and there is no anecdotal information of collisions. This raises uncertainty on the requirement for notification and advice prior to re-joining the main carriageway. Therefore further data investigation could be undertaken.
 - 2.2. ERA Utilisation – The study identified that the distance between junctions and the availability of ERAs impacts on a drivers decision to utilise an ERA. Further collection of ERA utilisation data will confirm the trend and subsequently determine a possible review of the IAN 161 requirements with respect to ERA provision and spacing.
 - 2.3. Illegal use of ERAs – The study data only included for utilisations recorded as incidents, there is potential that further utilisation may have occurred and either the vehicle left without assistance or the TOS patrol instructed the offending vehicle to vacate the ERA and after considering the '15 minute' rule, no incident was recorded. The collection of this data will verify the volume of illegal usage.
 - 2.4. TOS attendance to vehicles in the ERA – Study data analysis identified that only 36% of utilisations reported via the ERT by the general public were attended by a TOS patrol. This suggests sufficient assistance was provided by the RCC operator. The collection of further data with respect to the assistance provide by the RCC operator and TOS patrol will determine the necessity for a TOS patrol to attend a vehicle within an ERA. This could be considered as a separate specific study.

3. The review of the Hazards and Assumptions which impact on the determination of ERA requirements identified that the current assumptions are conservative. Consideration should be given to either amending the data used in the calculations within the Generic Hazard Log for SM-ALR (dated 14th August 2013) to provide more realistic scenarios, or for the collection of data in the forthcoming Task 271 - 'Monitoring of the First Smart Motorways – All Lane Running Scheme' and carry out recalculations.

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1 Glossary of Frequently Used Terms

CCTV	Close Circuit Television
C&C	Traffic Officer Service Command and Control system
DfT	Department for Transport
ERA	Emergency Refuge Area
ERT	Emergency Roadside Telephone
HA	Highways Agency
HALOGEN	Central source for Highways Agency Traffic Management System (HATMS) logged data
IAN	Interim Advice Note
MIDAS	Motorway Incident Detection and Automated Signalling
NVRM	National Vehicle Recovery Manager
SM-ALR	Smart Motorways – All Lane Running
SM-HSR	Smart Motorways – Hard Shoulder Running
RCC	Regional Control Centre
SDT	Strategic Development Team
TO	Traffic Officer
TOS	Traffic Officer Service

2 Introduction

2.1 Background

This Task was to monitor and evaluate the usage of Emergency Refuge Areas (ERAs) on a number of existing Smart Motorways Hard Shoulder Running (SM-HSR) schemes to provide information for informed decisions on the future provision of ERAs on Smart Motorways All Lane Running (SM-ALR) schemes. These schemes are M42 Jct 3a – 7 opened in 2006, M6 Jct 4 – 5 opened in 2009, M6 Jct 8 – 10a opened in 2011 and M1 Jct 10 – 13 opened in 2012. See **Appendix 1** for ERA locations on the respective schemes.

The original SM-ALR concept developed in 2010 contained no ERAs, however concerns were expressed by key stakeholders such that some ERA provision was included in the final SM-ALR requirements (latest version - IAN 161/13 [1]) primarily due to the calculated increase in risk due to vehicles stopped in live lanes off peak. The requirement is for ERAs to be provided at regular intervals (maximum 2.5km spacing) in lieu of the hard shoulder. This spacing has been increased through the progression of Smart Motorways (previously known as Managed Motorways). The generic safety assessment for Smart Motorways included assumptions regarding the usage of ERAs and there is currently limited data.

The provision of ERAs on SM-ALR schemes is to mitigate a number of safety risk hazards, but they also bring in new safety risks that did not exist before. Fewer or no ERAs would provide significant capital costs savings and associated operational and maintenance savings. The provision of ERAs on SM-ALR schemes is to mitigate a number of the hazards that show an increase in risk from the use of ALR including the stopping of vehicles in live lanes. The occupation of ERAs also creates new hazards and risks such as when vehicles leave the ERA to re-join Lane 1, therefore the task includes a review of the safety risk analysis associated with the provision of ERA.

The current requirements in IAN 161/13 [1] (paragraph 5.45) does not include for the installation of detection loops or other detection equipment within an ERA, although they must be included in the field of view of a PTZ CCTV camera. There is also no requirement for the Regional Control Centre (RCC) to monitor an ERA unless alerted via the ERT or some other means that they need to do so. It is also assumed that the reduced number of ERAs will provide less attractiveness to drivers as a place for making short duration stops for non-emergency (and therefore illegal) activities.

This work reviewed a significant number of ERAs across the schemes to provide a robust level of data in order to validate these assumptions/hazards and aid informed decisions on the provision of ERAs on future schemes.

The evaluation determined the amount and nature of the utilisation for operational ERAs (legitimate and illegitimate) and evaluates the findings. The findings are appraised against the assumptions in the generic hazard log for SM-ALR in order to support current and future recommendations.

2.2 Methodology

The original intention was to extract data from HALOGEN, which is the central source for the Highways Agency Traffic Management System (HATMS) logged data. The data provides details when the detection loops within an ERA have been activated; providing dates and timings. This information was to be collected daily and following the determination of potential ERA occupations, the data compared against RCC Command & Control incident data and CCTV recordings to obtain further details. The interrogation of the RCC Command & Control was to be undertaken by members of the research team.

Unfortunately following detailed discussions with the Traffic Officer Service (TOS) it was identified that access was not possible without Highways Agency (HA) security clearance, training on the systems and approval to use them. This was not practical due to the anticipated delay in obtaining clearance and the unavailability of TOS operators to train the research team. It was then proposed that a Traffic Officer (TO), on light duties, would be able to assist, but this was unsatisfactory for a number of reasons. It was

during these discussions in Quinton (West Midlands RCC) that it was identified that due to constant loop activations, incidents were not raised on the system unless:

- The activation happened to be also viewed on the CCTV and the purpose could be identified immediately
- The vehicle had occupied the ERA for in excess of 15 minutes.

These issues were identified in the Interim Report dated 18th March 2013. The report incorporated a revised proposal for an extension to the original task period therefore allowing the following actions:

- Members of the Research Team obtain security clearance and are trained on the systems
- The period of data collection is redefined
- Determine if the number of ERAs to be monitored should be reduced in line with the most commonly used.

Unfortunately the access to, and training on the HA systems was still found to be difficult to achieve due to TOS availability, therefore it was agreed in discussions with the HA Project Manager that Command & Control (C&C) data obtained from the Strategic Development Team, HA Traffic Management Directorate would be utilised as the definitive C&C information.

As in the original proposal, one specific month's data is treated as being representative. The details of the required data were agreed in consultation with Katherine Wilson-Ellis of the Strategic Development Team.

If further information was required, this was requested accordingly. As identified in the Interim Report conclusions, the information contained in this report is very reliant on the RCC Operator utilising the correct closure codes.

It was also agreed that HALOGEN data would still be considered as a guide to potential occupations and actions undertaken by the RCC operator.

The data period was agreed with the HA Project Manager to be July 2013.

A site inspection was undertaken of every ERA location in order to identify the physical and topographical attributes which may impact on the utilisation.

2.3 Deliverables

A series of deliverables were identified in the task specification to be employed in determining the utilisation of existing ERAs and identify the provision requirements of ERAs on future schemes. These deliverables were:

- How often was an ERA utilised and for what reason (legitimacy)
- Date/time and length of time of usage of the ERA and whether the hard shoulder was open or closed
- What type of vehicle was using the ERA and indication of foreign drivers
- How many vehicles have had assistance from the TOS in re-entering the running lanes
- How many occupants utilised the ERT within the ERA
- Assess the findings against the assumptions in the generic hazard logs for SM-HSR and SM-ALR to potentially provide recommendations for modification of the assumptions
- Provide recommendation on future provision based on the above findings. This will include consideration against the guidance detailed in IAN 111/09 [2] and 161/13 [1].

3 Data Sources

3.1 HALOGEN data

As identified previously the requirements in IAN 161/13 [1] do not include detection loops in ERAs. It was recognised that this data should be collected and used in the analysis as it was recognised that not all utilisations was recorded by the RCC, for example, if the occupation period was short. The data provided from HALOGEN was not as initially expected and there are no available report formats which gave details of the activation of the detection loops or when the Smart Motorway link was open (i.e. hard shoulder available for use by running traffic) or closed.

It was therefore necessary to download raw data from the MIDAS data within HALOGEN namely the Alertlog. A separate log is created daily for each of the Regional Control Centre (RCC) areas and includes details of all loop and signal activations within the area. For the identified schemes, the logs were extracted for the West Midlands RCC (reference Co40) and South East RCC (reference Co30). These logs varied in the number of records but usually extended between 40,000 – 80,000.

As there were no available reports on the HALOGEN system and the helpdesk was unable to assist in developing a specific report, it was necessary to develop MACROs to extract the required data. The following MACROs were created:

- | | |
|---------|---|
| MACRO 1 | Extracting all ERA loop data and if possible linking entry loop (no.5) and exit loop (no.6) for an ERA. |
| MACRO 2 | Correlation of the linked loop data from MACRO 1 providing assumed ERA utilisations |
| MACRO 3 | Utilising the data from MACRO 2 to split periods of loop activations into time bands |
| MACRO 4 | Signal activations indicating when links were open / closed |

It was evident from the data extracted using MACRO 1 and the correlation provided by MACRO 2 that on the M6 and M42 the high number of loop activations could not be linked with the short extent of the utilisation periods exhibited. This suggests that the loops were being activated by passing traffic and were not actual occupations. There was also an indication that in several locations the detection loops had possibly been incorrectly jointed and numbered as expected, therefore suggesting that the ERA was being exited before it was entered.

The following ERA utilisation time period assumptions were made for the study:

- | | |
|----------------|--|
| < 3 minutes | False reading – adjacent traffic activation |
| 3 – 15 minutes | Illegal Usage – assistance unable to be provided in less than 15 minutes |
| > 15 minutes | Legal Usage |

The report created from MACRO 2 provided the calculated duration of each of the ERA occupations and these were banded into set time periods when applying MACRO 3 to the data.

The data provided by MACRO 3 was extracted and the daily number of ERA occupations determined and the most used ERA locations identified.

The data provided by MACRO 4 was utilised in conjunction with the Command & Control data to identify whether the link was open or closed. An open link is defined as being when the hardshoulder is available as a running lane and therefore a closed link is when the hardshoulder is available as a refuge.

3.2 Command & Control data

The Command & Control (C&C) data provided specific incident information extracted from the RCC C&C system. This was provided by the Strategic Development Team within the Traffic Management Directorate and the information provided was identified following discussions with Katherine Wilson-Ellis

on the Task requirements. For clarification purposes for this study, an incident is an unforeseen event which directly or indirectly affects the network and causes or has the potential to cause a disruption to the free flow of traffic or threatens the safety of the public. The closure codes utilised on the C&C system were amended in April 2013 to provide a better description of an incident. It was agreed that the data listing to be provided would include for ALL incidents occurring within the identified Smart Motorway sections with the following information:

- Incident number
- Location detail
- Date and time of incident
- TOS attendance
- Incident duration and live lane impact duration
- Call origin
- Incident description / detail
- Vehicle details
- Link Open/Closed (Link Open indicates the hardshoulder is used as a running lane)

An extract from the report is included in **Appendix 2**.

For analysis purposes, it was identified that an incident which had the following call origin details would be considered as an ERA utilisation:

- Automated Detection
- General Public – ERT with a reference number relating to a location within 100 metres of the ERA
- Traffic Officer – Routine with a marker post location within 100 metres of the ERA
- Traffic Officer – Prompt with a marker post location within 100 metres of the ERA

3.3 Topographical and physical information for each ERA

A site inspection was undertaken for each ERA to confirm the location/layout and identify any specific topographical features for that particular site. Details are included in **Appendix 3**.

The arrangement for all the ERAs is consistent with only minor variations. On the M42 there are 2no. locations where the ERAs are situated on a slight gradient (MP 21/2 and 27/7) and all have a lighting facility. The noticeable feature on the M6 ERAs is the lack of roadstuds at 7no. locations, although there is a lighting facility. The M1 in contrast does not provide a lighting facility and 5no. ERAs are situated on a gradient.

4 Data Analysis

Several areas of analysis have been undertaken to determine the required deliverables and establish conclusions on the current utilisations of ERAs; the monitoring of the ERAs and identifying recommendations for the future provision of ERAs. Any trends and areas of consistency or irregularity have been identified. A period of one month (July 2013) was utilised as the period of data analysis.

The analysis is detailed in the following sections. Halogen data has only been used for **Section 4.1** for reasons given below.

4.1 Halogen and C&C data correlation

It was mentioned in **section 2.2** that during discussions with the TOS at the West Midlands RCC irregular loop activations had resulted in a decision being made that an incident would not be raised unless a vehicle had been within the ERA in excess of 15 minutes. The irregular activations suggest that the inclusion of detection loops was unsatisfactory. In order to confirm the decision to remove the loops from the requirements of IAN 161 or potentially consider their reinstatement, it was determined to undertake a review of halogen and C&C data.

The halogen data was extracted and analysed to identify when the automatic detection system was or could have been utilised. However, the C&C data does not provide exact entry and exit timings therefore the ERA utilisation period was assumed to be the incident duration.

The aim of this correlation was to identify how many occupations there were and how many were recorded in the C&C data. The C&C data has been further divided to identify whether the incident was logged following automated detection (the loops) or other methods. Notification methods are detailed further in **section 4.3**. The location given is generally the known location of the ERA, if automatically detected; marker post details provided by the reporting party or the ERT number on which the call had been made.

Details are provided in tables 1a, 1b and 1c below.

ERA Location	< 3mins			3-15 mins			> 15 mins		
	HALOGEN	C&C Data		HALOGEN	C&C Data		HALOGEN	C&C Data	
		Auto	Other		Auto	Other		Auto	Other
M6/5728A	3	-	-	8	-	-	2	-	1
M6/5735A	84	-	-	82	-	1	2	1	8
M6/5744A	78	-	-	62	-	1	5	1	4
M6/5749A	33	-	-	24	-	-	3	-	-
M6/5768B	101	-	-	95	-	-	13	1	9
M6/5770A	72	1	1	63	1	-	5	2	11
M6/5945A	690	-	-	34	-	1	3	1	5
M6/5945B	48	-	-	37	-	-	4	-	5
M6/5966A	53	-	3	48	-	-	7	1	4
M6/5968B	-	-	-	-	-	-	-	-	4
M6/5979A	53	-	-	62	-	-	4	-	-
M6/5983B	29	-	-	32	-	-	1	-	-
M6/5998A	76	-	-	66	-	-	4	1	2
M6/5999B	46	-	2	34	-	-	3	-	4
M6/6007A	69	-	-	54	-	-	1	3	3
M6/6008B	22	-	-	28	-	-	3	-	3
M6/6014B	61	1	1	47	-	-	-	-	7
M6/6015A	63	-	-	54	-	2	1	-	3
M6/6021B	44	-	1	36	-	1	5	2	5
M6/6022A	259	-	-	13	-	-	3	1	3

Table 1a: M6

ERA Location	< 3mins			3-15 mins			> 15 mins		
	HALOGEN	C&C Data		HALOGEN	C&C Data		HALOGEN	C&C Data	
		Auto	Other		Auto	Other		Auto	Other
M42/6302A	133	-	2	25	-	-	15	-	3
M42/6306A	-	-	-	-	-	-	-	-	1
M42/6306B	63	-	-	9	-	1	-	-	-
M42/6312A	-	-	-	-	-	-	-	3	3
M42/6312B	-	-	-	-	1	-	-	1	7
M42/6316A	79	-	1	8	-	1	4	-	-
M42/6319B	-	-	-	-	-	-	-	-	2
M42/6323A	114	-	-	10	-	1	7	-	-
M42/6329B	44	-	-	8	-	-	5	-	-
M42/6331A	69	-	-	13	-	-	2	-	-
M42/6338B	94	-	-	9	-	-	1	-	2
M42/6343A	-	-	-	-	-	1	-	1	2
M42/6344B	54	2	-	16	-	-	1	-	-
M42/6349A	75	-	-	24	-	-	-	-	3
M42/6351B	-	-	1	-	-	-	-	-	3
M42/6357B	132	-	-	27	-	-	4	-	5
M42/6358A	81	-	-	17	-	-	2	-	3
M42/6368A	53	-	-	9	-	-	2	-	-
M42/6369B	39	-	-	4	-	-	-	-	-
M42/6377A	77	-	-	5	-	-	4	-	2
M42/6377B	659	-	-	10	-	2	3	-	2
M42/6381B	58	-	-	11	-	-	1	-	3
M42/6387A	66	-	-	18	-	-	6	-	3
M42/6388B	60	-	-	6	-	-	3	1	2
M42/6392A	66	-	-	5	-	-	3	-	3
M42/6392B	-	-	-	15	-	-	3	1	1
M42/6396A	61	-	-	8	-	-	-	-	1
M42/6396B	109	-	-	19	-	-	4	1	1
M42/6402A	62	-	1	9	-	-	-	-	-
M42/6403B	83	-	-	14	-	-	1	-	-
M42/6409B	106	-	-	14	-	-	5	-	1
M42/6410A	80	-	-	12	-	-	2	-	1
M42/6413B	216	-	-	22	-	-	8	-	2
M42/6434A	153	-	1	14	-	-	1	-	3
M42/6437B	73	-	1	7	-	-	1	-	3
M42/6441A	-	-	-	-	-	-	-	-	2
M42/6441B	78	-	-	13	-	1	2	1	2
M42/6448A	68	-	-	12	-	-	2	-	2
M42/6448B	82	-	-	19	-	-	2	1	3

Table 1b: M42

ERA Location	< 3mins			3-15 mins			> 15 mins		
	HALOGEN	C&C Data		HALOGEN	C&C Data		HALOGEN	C&C Data	
		Auto	Other		Auto	Other		Auto	Other
M1/2510B	57	-	-	15	4	-	4	2	3
M1/2511A	60	2	-	68	1	-	2	7	2
M1/2517B	57	-	-	40	-	1	4	1	3
M1/2519A	57	-	-	55	1	-	3	2	3
M1/2524A	38	-	-	28	1	1	1	1	-
M1/2526B	64	-	1	52	1	2	6	5	2
M1/2532A	50	-	-	37	-	-	1	2	1
M1/2558A	55	-	-	34	1	1	5	3	-
M1/2559B	54	1	-	30	-	-	6	3	1
M1/2578A	63	-	-	55	2	-	4	4	1
M1/2580B	67	1	-	40	-	-	6	6	3
M1/2598A	28	-	1	17	-	-	-	-	1
M1/2598B	61	-	-	21	1	-	2	-	3
M1/2641B	33	-	-	10	1	-	5	1	5
M1/2642A	58	-	1	59	-	-	7	4	4
M1/2652A	66	1	-	43	1	-	3	1	1
M1/2653B	25	-	-	15	-	-	5	1	1
M1/2664A	70	1	-	73	1	1	1	2	3
M1/2664B	28	-	-	28	-	1	4	-	-
M1/2673A	43	1	2	39	3	-	2	1	2
M1/2673B	37	-	-	31	2	-	1	-	1
M1/2682A	31	-	-	47	1	2	4	2	1
M1/2683B	33	-	-	20	1	-	3	2	-
M1/2689B	45	-	-	22	1	-	2	3	-
M1/2690A	51	-	-	37	2	-	3	4	4
M1/2695B	35	-	-	29	1	-	2	3	1
M1/2700A	30	-	-	26	1	-	4	4	2
M1/2705B	67	-	-	50	-	-	12	3	3
M1/2706A	43	-	-	35	-	-	1	2	-
M1/2712B	67	-	-	52	-	-	13	6	4

Table 1c: M1

The high number of possible ERA utilisations under 3 minutes and between 3 – 15 minute duration and the high number of single loop activations within paired loop sets (not included in the tables due to their high numeracy), suggests that the loops are providing misleading information and prompts to the RCC operators.

Incidents have been recorded on the C&C system within these time bands but these account for only a very small percentage of ERA utilisations (see table 1d), although there is no overriding reason. Further consideration to incident utilisations is provided in **section 4.4**.

There is a high percentage of recorded incidents over 15 minutes on the M1 which are logged with automatic detection as the method of notification suggesting that the East RCC operators do continue consider the loop activations.

The low percentage of automatic detection notifications confirm that the removal of detection loops from the requirements appears correct although it raises a further question regarding whether the number of over 15 minutes duration incidents on the M1 would have been identified.

Route	Percentage of incidents logged against loop activations		
	< 3 minutes	3 – 15 minutes	> 15 minutes
M6	0.11	0.11	20.29
M42	0.06	0.24	10.64
M1	0.48	2.44	64.66

Table 1d: Percentage of incidents against loop activations

There are instances of an ERAs not having being utilised during the trial period. On the M6, these are the ERAs at MP 197/9 northbound and MP 198/3 southbound, both locations are within Junction 10 and therefore any driver/vehicle experiencing difficulties is likely to have exited the motorway before reaching them. On the M42 there are 5 no. locations, 1no. northbound (MP 23/1) and 4no. southbound (MP 22/9, 26/9, 27/7 and 30/3, all except the ERA at MP 30/3 are either situated within an interchange or just prior to the exit slip road. Therefore the reason for no utilisations is likely to be the same as identified on the M6. The ERA at MP 30/3 lies between junction 6-5 interestingly the ERA on the northbound carriageway at the same location has only one utilisation, but there appears to be no obvious reason, there is no service area within the link and the motorway is on a level gradient.

4.2 Link Operation

It was recognised that the Halogen data which identifies when the automatic signing has been set by the RCC operator, would be a good indicator of when a particular link is either open or closed, therefore it was utilised to determine when the SM links were in operation. Open link refers to when the hardshoulder is available a normal running lane and closed link is when normal designation is in operation.

In general, the links are open during the weekday morning and evening peak periods together with any periods of congestion, although on the M6 northbound and southbound the links between Junction 8 – 10A tend to be open from the start of the morning peak until the end of evening peak.

4.3 Notification Methods

The notification methods of the ERA utilisation can be from a number of sources:

- Automatic detection – notification by the MIDAS loops. The alerts are no longer monitored as a matter of procedure by the RCC operator and only usually recorded when the duration of the stay is in excess of 15 minutes. CCTV is utilised to confirm the presence of a vehicle.
- CCTV – the RCC operator may note the presence of a vehicle in an ERA whilst scanning the CCTV cameras
- Traffic Officer – either by an initial prompt from the RCC Operator or observing an ERA utilisation during a routine patrol.
- Police – A routine patrol will have observed an ERA utilisation and informed the RCC accordingly
- ERT notification – A driver requiring assistance will have used the ERT within the ERA to request assistance from the RCC

There are also several other methods of notification of utilisation but these numbers are small and include HAIL and other On-road Service Providers.

Route	Direction	Link	Automatic Detection	CCTV	General Public - ERT	Traffic Officer Prompt	Traffic Officer - Routine	Police	Other (HAIL, Service Provider etc.)
M6	North	J4 – 4A	2	3	5	1	4	-	2
		J4A – 5	3	2	2	1	5	-	2
	South	J5 – 4A	2	2	4	-	3	-	-
	North	J8 - 9	1	3	1	-	1	1	-
		J9 – 10	1	1	1	-	3	1	1
		J10 – 10A	5	3	5	-	3	-	2
	South	J10A – 10	3	4	7	-	11	1	1
		J10 – 9	-	-	-	-	2	-	2
		J9 – 8	-	1	3	-	-	-	1
	Totals			17	19	28	2	32	3
Percentage Split			15.2	17.0	25.0	1.8	28.6	2.7	9.8

Table 3a: M6 Notification Methods

Route	Direction	Link	Automatic Detection	CCTV	General Public - ERT	Traffic Officer Prompt	Traffic Officer - Routine	Police	Other (HAIL, Service Provider etc.)
M42	North	J3A – 4	3	1	2	-	8	-	1
		J4 – 5	2	1	6	-	2	-	-
		J5 - 6	-	3	2	-	6	-	-
		J6 – 7	-	2	4	-	2	-	-
	South	J7 – 6	2	2	2	1	3	1	1
		J6 – 5	3	3	1	1	8	-	1
		J5 – 4	2	-	6	-	4	1	-
		J4 – 3A	2	1	4	-	3	2	-
Totals			14	13	27	2	36	4	3
Percentage Split			14.1	13.1	27.3	2.0	36.4	4.0	3.0

Table 3b: M42 Notification Methods

Route	Direction	Link	Automatic Detection	CCTV	General Public - ERT	Traffic Officer Prompt	Traffic Officer - Routine	Police	Other (HAIL, Service Provider etc.)
M1	North	J10 – 11	17	3	1	-	3	-	-
		J11 – 12	10	1	1	1	1	-	-
		J12 - 13	31	8	4	1	7	-	3
	South	J13 – 12	25	1	6	-	6	-	5
		J12 – 11	13	1	2	1	3	-	-
		J11 – 10	13	8	3	1	3	-	1
Totals			109	22	17	4	23	-	9
Percentage Split			59	12	9	2	13	0	5

Table 3c: M1 Notification Methods

The most common method of notification of ERA utilisation on the M1 scheme is through automatic detection in spite of the unreliability reported on the M6 and M42 schemes. This could be because there is a lower number of ERAs (30 against 59) and therefore a quick observational check is possible; or that the loop installations are of a better standard. There is also higher number of notifications by CCTV observation on the M1 which may again be related to the number of ERAs or there is an improved monitoring procedure in the East RCC. The most common method of notification on the M6 and M42 is by Traffic Officer – Routine, which relates to TO patrols observing utilisations during routine operations. This suggests that very little attention is paid to the automatic detection and subsequently CCTV for identifying ERA utilisation. The observation of the ERAs by TO patrols may also be a factor in the low number of illegal and Tacho utilisations identified in **section 4.5**, in that these utilisations may have been ‘moved on’ and considered within the course of normal duties therefore may have not been recorded as incidents. A further recommendation would be to determine how much importance is placed on the detection loops by the East RCC.

TOS attendance / assistance with respect to the method of detection is identified in **section 4.9**

4.4 ERA Utilisation with respect to Open / Closed Links

ERAs have been incorporated into SM schemes to provide a place of safe refuge for broken down vehicles and other emergency use when all lanes, including the hard shoulder, are being utilised by running traffic.

We can reflect on the usage of an ERA by considering two assessments, namely the number of ERA utilisations with respect to the number of incidents within each link section and also the number of ERA utilisations when the DHS on the SM link was open or closed to traffic. The number of total incidents has been reduced by the removal of Road Traffic Collisions because it was deduced that in many cases the damaged vehicles can either be moved only a short distance or are unmoveable. The reasons for utilisation are considered in **section 4.5**.

Interestingly on the M42, the ERAs are utilised more when the link is closed (the hard shoulder is available as a safe refuge) than when it is open. This is mirrored on the M6 except on the southbound between Jct 10A – 8. In contrast, on the M1 the ERAs are used more when the links are open, which is primarily their purpose.

Route	Direction	Link	Total Incidents	ERA Utilisations			
				Link Open		Link Closed	
				No.	% of incidents	No.	% of incidents
M6	North	J4 – 4A	35	-	-	15	42.9
		J4A – 5	28	5	17.9	10	35.7
	South	J5 – 4A	29	3	10.3	8	27.6
	North	J8 - 9	29	1	3.4	5	17.2
		J9 – 10	13	4	30.8	5	38.5
		J10 – 10A	40	7	17.5	11	27.5
	South	J10A – 10	46	20	43.5	7	15.2
		J10 – 9	11	2	18.2	1	9.1
		J9 – 8	10	3	30	2	20

Table 4a: M6 Incidents v Utilisations

Route	Direction	Link	Total Incidents	ERA Utilisations			
				Link Open		Link Closed	
				No.	% of incidents	No.	% of incidents
M42	North	J3A – 4	18	4	22.2	10	55.5
		J4 – 5	14	2	14.3	9	64.3
		J5 - 6	21	2	9.5	9	42.9
		J6 – 7	17	-	-	8	47.1
	South	J7 – 6	21	3	14.3	9	42.9
		J6 – 5	26	2	7.7	16	61.5
		J5 – 4	25	6	24	7	28
		J4 – 3A	21	4	19	8	38.1

Table 4b: M42 Incidents v Utilisations

Route	Direction	Link	Total Incidents	ERA Utilisations			
				Link Open		Link Closed	
				No.	% of incidents	No.	% of incidents
M1	North	J10 – 11	31	14	45	10	32
		J11 – 12	32	6	19	8	25
		J12 - 13	67	30	45	24	36
	South	J13 – 12	52	25	48	18	35
		J12 – 11	35	13	37	7	20
		J11 – 10	35	19	54	10	29

Table 4c: M1 Incidents v Utilisations

Considering the number of ERA utilisations with respect to the number of incidents, we can determine the following:

Route	Number of Incidents	ERA Utilisations	Percentage
M6	241	99	41%
M42	163	95	58%
M1	252	184	73%
Total	656	378	58%

Table 4d: Incidents v ERA Utilisation

Considering the number of incidents and ERA utilisations against the traffic flows, we can determine the following:

2012 AADF figures (averaged for each motorway and rounded to nearest 000))

- M6 123,000 vehicles/day = 0.123 million vehicles
- M42 135,000 vehicles/day = 0.135 million vehicles
- M1 109,000 vehicles/day = 0.109 million vehicles

Route	Incidents / Traffic Flow (%)	ERA Utilisations / Traffic Flow (%)
M6	0.20	0.08
M42	0.12	0.07
M1	0.23	0.17

Table 4e; Incidents / ERA utilisations v Traffic Flow

The percentage of incidents which use an ERA on the M6 (41%) is lower than the M42 (58%) and the M1 (73%). With respect to the M42, this might be explained by the change in SM design criteria of an increase in distance between ERAs, though this is not supported by the M1 usage. The distances between junctions on the M6 schemes is also relatively short and it can be assumed that a high proportion of drivers will endeavour to get their vehicles off the motorway to reduce risk to themselves.

and passengers if they have to leave the vehicle. On the M1 scheme, there is a distinctly higher number of incidents on the J12-13 and J13-12 links but it must be noted that this a particularly long link (10.6km) with 8no. ERAs northbound and 9no. ERAs southbound. The M6 southbound links between J10A – 8 are also in operation longer than any other links (hard shoulder operating as a traffic lane) and this provides evidence for the higher number of ERA utilisations when the link is open than closed,. The M1 scheme is the only scheme where the ERA utilisation (with the exception of one link) is consistently higher when the link is open.

Although, the high volume of utilisations would confirm a requirement for the provision of ERAs, the fact that on the M6 and M42 the higher proportion of usage is when the link is closed and potentially only being used because they are 'available'. Similarly, the percentage of ERA utilisation v traffic flow and percentage of incidents v traffic flow is in close proximity. Therefore, the findings confirm the suggestion made in the previous report 'Managed Motorways – All Lane Running - Evaluation of the Provision of Refuge Areas' [3], that by decreasing the frequency of refuge areas there will be no detrimental effect on traffic flow.

The high number of ERA utilisations with respect to the number of incidents indicates the importance of a refuge for emergency situations, in that there were potential 656 (total number of incidents), instances when vehicles may have stopped in live lanes (although these figures include both legal and non-legal usage – see **section 4.5**). Although there is no data available on the number of instances when a driver potentially experiencing difficulties continued and left the motorway rather than use an ERA in order to provide a comparison. The gender and age of drivers using the ERAs is also not available and therefore the confidence, ability and safety consciousness of certain groups cannot be considered.

4.5 Reason for Utilisation

Using the descriptions provided in the C&C data, the utilisation of an ERA can be categorised into three types:

- Breakdown – this has been recognised within the C&C data as 'Breakdown – not in live lane', clearly defining that the incident would either be within an ERA, or on the hardshoulder dependant whether the link is open/closed. During interrogation of the data it was identified that in some incidents recorded under 'Breakdown – in live' there is a further note that 'vehicle cleared by Traffic Officer from live lane'. It has been presumed that if the incident occurred when the link was open, then the vehicle would have been moved to the ERA.
- Other non-legal use of hardshoulder or ERA – as described earlier, ERAs are provided in lieu of the hardshoulder to provide a refuge when the hardshoulder is open and used as a running lane. Therefore any other use other than breakdown is a non-legal use of the provision and has been identified under this single term.
- Tacho break – these are breaks taken by LGV drivers to ensure that they do not contravene the regulatory allowed driving hours. In general, these breaks will be taken at rest areas, but in some instances the drivers may miscalculate time and distance and therefore are required to take a stop. These stops are illegal in ERAs.

The tables below indicate that the majority of use for the ERA is for breakdowns although it also confirms the assumption that they are being used illegally. Although the number of illegal usage appears relatively small the recorded amount do account for 14% of all utilisations; 4% for Tacho breaks and 10% for other illegal use. Over a longer period this would be a significant number. The reason for the illegal use has not been identified although the average duration of these utilisations will be discussed later. The number of illegal use could actually be higher as there are no records of all instances when vehicles have been 'moved on' by TOS patrols.

The number of foreign drivers using the ERAs illegally is minimal and not significant, although this may be attributed to the recording of information.

Route	Direction	Link	Breakdown	Other non-legal Use		Tacho Break		Breakdown TO Removal
			No.	No.	Foreign drivers	No.	Foreign drivers	No.
M6	North	J4 – 4A	14	2	-	-	-	-
		J4A – 5	12	-	-	-	-	3
	South	J5 – 4A	8	1	-	-	-	1
	North	J8 - 9	5	2	1	-	-	-
		J9 – 10	5	1	-	2	-	2
		J10 – 10A	14	-	-	2	-	2
	South	J10A – 10	23	1	-	1	-	2
		J10 – 9	3	-	-	-	-	1
		J9 – 8	5	-	-	-	-	-
Totals			89	7	1	5	-	11

Table 5a: M6 ERA utilisation

Route	Direction	Link	Breakdown	Other non-legal Use		Tacho Break		Breakdown TO Removal
			No.	No.	Foreign drivers	No.	Foreign drivers	No.
M42	North	J3A – 4	10	4	-	1	-	-
		J4 – 5	9	-	-	1	1	1
		J5 - 6	9	1	-	1	-	-
		J6 – 7	6	1	-	1	1	-
	South	J7 – 6	10	2	2	-	-	-
		J6 – 5	14	2	-	-	-	2
		J5 – 4	12	-	-	-	-	1
		J4 – 3A	9	-	-	-	-	3
Totals			79	10	2	4	2	7

Table 5b: M42 ERA utilisation

Route	Direction	Link	Breakdown	Other non-legal Use		Tacho Break		Breakdown TO Removal
			No.	No.	Foreign drivers	No.	Foreign drivers	No.
M1	North	J10 – 11	19	3	-	2	-	-
		J11 – 12	11	3	-	-	-	-
		J12 - 13	42	8	-	4	-	-
	South	J13 – 12	34	4	-	-	-	5
		J12 – 11	18	-	-	-	-	2
		J11 – 10	22	6	-	-	-	1
Totals			146	24		6		8

Table 5c: M1 ERA utilisation

Although the reason for the breakdown is not identified in the C&C data, it can be assumed that the requirement for recovery assistance suggests the incapability of vehicles to leave the motorway and therefore identifying the importance of a safe refuge area. This would confirm that the provision should be retained in some capacity within the requirements of IAN 161 (see Table 5d)

Route	No. of Breakdowns (Breakdowns + TO Removal)	Recovery			
		Private	NRVM	Other	None
M6	100	68	1	12	19
M42	86	62	0	12	12
M1	154	84	3	15	52

Table 5d: Recovery Detail

4.6 Timing of ERA Utilisation

As identified in **section 4.2**, the hardshoulder within links is generally open during the weekday morning and evening peak period (highlighted in blue) or other periods of congestion. The tables below have been developed by dividing the 24 hour into convenient time bands as the actual peak periods vary slightly day to day and motorway to motorway. The evidence confirms that the high ERA utilisation during these periods. Although an immediate viewing of the data would suggest that these is more utilisation between 10:00 – 16:00hrs; this is an 8 hour time window in contrast to 4 to 5 hours during the peak periods. For the M6 J8-10A link the open period usually extends for between 05:00 – 20:00hrs.

Route	Direction	Link	00:00 – 05:00hrs	05:00 – 10:00hrs	10:00 – 16:00hrs	16:00 – 20:00hrs	20:00 – 24:00hrs
M6	North	J4 – 4A	-	4	7	2	4
		J4A – 5	2	3	6	2	2
	South	J5 – 4A	1	2	3	5	-
	North	J8 – 9	2	2	-	1	2
		J9 – 10	1	1	3	1	2
		J10 – 10A	1	4	5	5	3
	South	J10A – 10	-	6	8	10	3
		J10 – 9	-	3	1	-	-
		J9 – 8	-	-	3	-	2
	Totals			7	25	36	26

Table 6a: M6 Timing of ERA Utilisation

Route	Direction	Link	00:00 – 05:00hrs	05:00 – 10:00hrs	10:00 – 16:00hrs	16:00 – 20:00hrs	20:00 – 24:00hrs
M42	North	J3A – 4	2	2	5	5	1
		J4 – 5	1	2	6	-	2
		J5 – 6	-	1	8	1	1
		J6 – 7	-	2	3	2	1
	South	J7 – 6	1	5	1	1	4
		J6 – 5	-	1	10	4	3
		J5 – 4	-	5	2	5	1
		J4 – 3A	-	7	2	1	2
Totals			4	25	37	19	15

Table 6b: M42 Timing of ERA Utilisation

Route	Direction	Link	00:00 – 05:00hrs	05:00 – 10:00hrs	10:00 – 16:00hrs	16:00 – 20:00hrs	20:00 – 24:00hrs
M1	North	J10 – 11	2	5	8	8	1
		J11 – 12	1	1	7	5	-
		J12 – 13	2	6	20	26	-
	South	J13 – 12	2	19	6	13	3
		J12 – 11	-	6	5	9	-
		J11 – 10	-	8	9	9	3
Totals			7	45	55	70	7

Table 6c: M1 Timing of ERA Utilisation

4.7 Duration of Utilisations

In **section 2.2**, it was stated that, in agreement with the HA Project Manager, any ERA utilisation under 15 minutes would be considered as illegal. The tables below indicate that incidents under this time limit have been recorded.

A further investigation of the < 15 minutes data with respect to the M6 and M42 identified that the majority (21 out of 35) has a call origin of 'Traffic Officer – Routine', 18no. of which also provide a description of 'Breakdown – not in live lane' which suggest that the real utilisation period was probably in excess of the time detailed, but could not be confirmed. In contrast on the M1, 34no. of the under 15 minute utilisations (47no.) were following 'Automatic Detection' and an immediate response actioned.

When the duration periods are cross referenced with the reason for utilisation (**section 4.5**), the illegal use and Tacho break incidents are all within the below 15 minutes or 15 – 60 minutes time bands which would indicate that the vehicle vacates the ERA following attendance by the TOS. A driver must take a minimum break of at least 45 minutes after 4.5hrs driving, although this may take the form of two breaks within that period. Drivers are also subject to the requirements within the Working Time Directive. This would suggest that the drivers may be miscalculating the break requirements and utilising the ERAs as being the nearest available area without diverting from their preferred route. The utilisations over 60 minutes are primarily breakdowns waiting for recovery.

An area to be investigated is the high proportion of the legal utilisations that are over 120 minutes in duration. The majority of these relate to the recovery of Large Goods Vehicles by private recovery agents which are assumed to be contracted direct to the hauliers. There are incidents in excess of 180 minutes (M6 – 6, M42 – 6, M1 – 19) and the longest durations on each of the routes are between 335 – 362 minutes; all involve private recovery.

Route	Direction	Link	< 15 minutes	15 – 60 minutes	61 – 120 minutes	> 120 minutes
M6	North	J4 – 4A	2	5	6	4
		J4A – 5	2	3	6	4
	South	J5 – 4A	1	3	3	4
	North	J8 - 9	1	4	-	2
		J9 – 10	3	3	1	1
		J10 – 10A	3	4	7	4
	South	J10A – 10	6	6	11	4
		J10 – 9	-	-	3	1
		J9 – 8	-	-	4	1
	Totals			18	28	41

Table 7a: M6 Duration of Utilisation

Route	Direction	Link	< 15 minutes	15 – 60 minutes	61 – 120 minutes	> 120 minutes
M42	North	J3A – 4	5	2	6	2
		J4 – 5	1	6	3	1
		J5 – 6	1	5	4	1
		J6 – 7	1	2	4	1
	South	J7 – 6	2	4	4	2
		J6 – 5	2	7	3	6
		J5 – 4	3	1	7	2
		J4 – 3A	2	2	7	1
Totals			17	29	38	16

Table 7b: M42 Duration of Utilisation

Route	Direction	Link	< 15 minutes	15 – 60 minutes	61 – 120 minutes	> 120 minutes
M1	North	J10 – 11	6	7	8	3
		J11 – 12	4	5	2	3
		J12 – 13	17	14	13	10
	South	J13 – 12	7	13	8	15
		J12 – 11	3	7	2	8
		J11 – 10	9	7	7	6
Totals			46	53	40	45

Table 7c: M1 Duration of Utilisation

4.8 Type of Vehicle

There are several other factors which have to be taken in to consideration when reviewing the table below. The larger vehicles (Large Goods Vehicles, Coaches) have certain mechanical defects which prevent further travel and many therefore stop as soon as the defect manifests itself. Although the number of foreign drivers has not been recorded sufficiently, all those recorded were in Large Good Vehicles for Tacho breaks. There were incidents recorded of foreign drivers using the hardshoulder for Tacho breaks when the links were closed, suggesting that not all foreign drivers are fully conversant with the regulations for the use of ERAs and the hard shoulder in the UK.

Route	Direction	Link	Car	Large Goods Vehicle (over 7.5 tonnes)	Light Goods Vehicle (7.t tonnes or less)	Coach	Minibus / Motorhome	Motorcycle	Trailer / Caravan	Not Known	
M6	North	J4 – 4A	10	3	2	-	1	1	-	-	
		J4A – 5	8	5	1	-	-	-	1	-	
	South	J5 – 4A	5	4	1	-	1	-	-	-	
	North	J8 – 9	5	1	-	-	-	-	-	-	1
		J9 – 10	4	2	2	-	-	-	-	-	-
		J10 – 10A	13	3	1	-	-	-	-	-	1
	South	J10A – 10	15	5	4	-	-	1	1	1	1
		J10 – 9	1	1	2	-	-	-	-	-	-
		J9 – 8	3	-	-	-	2	-	-	-	-
Totals			64	24	13	-	4	2	2	3	

Table 8a: M6 Type of Vehicle

Route	Direction	Link	Car	Large Goods Vehicle (over 7.5 tonnes)	Light Goods Vehicle (7.t tonnes or less)	Coach	Minibus / Motorhome	Motorcycle	Trailer / Caravan	Not Known	
M42	North	J3A – 4	7	5	2	-	-	-	-	1	
		J4 – 5	5	-	2	-	1	-	1	2	
		J5 – 6	5	1	4	-	1	-	-	-	
		J6 – 7	5	-	2	-	-	-	-	1	
	South	J7 – 6	2	6	2	-	-	-	-	-	2
		J6 – 5	11	2	3	-	1	-	-	1	
		J5 – 4	9	3	-	-	1	-	-	-	
		J4 – 3A	8	1	2	-	-	1	-	-	
Totals			52	18	17	-	4	1	1	7	

Table 8b: M42 Type of Vehicle

Route	Direction	Link	Car	Large Goods Vehicle (over 7.5 tonnes)	Light Goods Vehicle (7.5 t or less)	Coach	Minibus / Motorhome	Motorcycle	Trailer / Caravan	Not Known
M1	North	J10 – 11	9	11	2	-	-	-	-	2
		J11 – 12	6	7	1	-	-	-	-	0
		J12 - 13	28	17	4	1	1	-	-	3
	South	J13 – 12	23	13	2	1	-	-	-	4
		J12 – 11	9	6	2	1	-	-	-	2
		J11 – 10	16	8	4	-	-	-	-	1
Totals			91	62	15	3	1	-	-	12

Table 8c: M1 Type of Vehicle

4.9 Traffic Officer Service Attendance/Assistance

TOS attendance/assistance to drivers occurs when a vehicle is in an ERA, on the hardshoulder or when a vehicle has broken down in a live lane, particularly when the HS is open to traffic (i.e. the hard shoulder is not available for emergency use). When a vehicle is observed within the ERA and no TOS patrol is in attendance or the driver does not initiate contact with the RCC, the operator is required to attempt to contact the driver by calling the ERT to check if assistance is required. Unfortunately whether this actually takes place is not recorded within the information provided. The operator in the RCC has the facility to apply sign settings warning other road users of the potential for a slow moving vehicle re-entering the running lanes. This is carried out by the setting of a 'lane divert right' LDR aspect on the sign above LBS1 upstream of the ERA.

The tables below detail the information given in the C&C data regarding attendance/assistance provided by the TOS. In general the TOS have been in attendance for 83% of all recorded utilisations; however further investigation of the notifications by the general public using the ERT identified only 36% have been attended. It can therefore be assumed that the RCC operator has been able to assist the driver sufficiently that no actual attendance on site is required. Although sign setting has been recorded it only occurred during 14% of all ERA utilisations. There is no indication whether the provision was specifically to assist vehicles re-joining traffic lanes; this would require further investigation with RCC operators.

Route	Direction	Link	Non-Attendance	Attendance only	Attendance + Sign setting	Sign Setting only	Removal from Live lane to ERA
M6	North	J4 – 4A	4	11	2	-	-
		J4A – 5	2	3	7	-	3
	South	J5 – 4A	3	5	2	-	1
	North	J8 - 9	2	4	1	-	-
		J9 – 10	-	6	1	-	1
		J10 – 10A	6	9	1	1	2
	South	J10A – 10	5	16	4	1	2
		J10 – 9	2	-	1	-	1
		J9 – 8	3	-	2	-	-
Totals			27	54	21	2	10

Table 9a: M6 Traffic Officer Attendance/Assistance

Route	Direction	Link	Non-Attendance	Attendance only	Attendance + Sign setting	Sign Setting only	Removal from Live lane to ERA
M42	North	J3A – 4	2	12	1	-	-
		J4 – 5	6	3	1	-	1
		J5 – 6	2	8	1	-	-
		J6 – 7	5	3	-	-	-
	South	J7 – 6	2	9	1	-	-
		J6 – 5	1	11	4	-	2
		J5 – 4	4	7	1	-	1
		J4 – 3A	4	4	1	-	3
Totals			26	57	10	-	7

Table 9b: M42 Traffic Officer Attendance/Assistance

Route	Direction	Link	Non-Attendance	Attendance only	Attendance + Sign setting	Sign Setting only	TOS Removal from Live lane to ERA
M1	North	J10 – 11	-	20	4		-
		J11 – 12	2	10	2		-
		J12 - 13	4	47	3		-
	South	J13 – 12	3	31	4		5
		J12 – 11	1	15	2	1	2
		J11 – 10	-	21	7	-	1
Totals			10	144	22	1	8

Table 9c: M1 Traffic Officer Attendance/Assistance

(note: sign setting only is also included in non-attendance figures)

5 Generic Hazard Log – Assumption Review

In order to undertake a review of the assumptions made in the generic hazard logs for Smart Motorways - All Lane Running, 2no. documents have been considered:

- Managed motorways all lane running: Demonstration of meeting safety objective report [4]
- Generic Hazard log for MM-ALR Final (dated 14th August 2013) [5]

The purpose of the first document is to demonstrate that the safety objectives for SM-ALR are likely to be achieved and identifies hazard log preparation and scoring together with the determination of assumptions made. The generic hazard log for SM-HSR was used as a basis for the development of the SM-ALR hazard log and the hazards removed were predominantly with respect to hazards around the use of the hard shoulder as a running lane, this is defined as LBS1 for SM-HSR. New hazards were identified and included in the SM-ALR hazard log. Therefore in order to consider the generic hazard logs for both SM-HSR and SM-ALR, the SM-ALR hazard log only has been used. The existing Generic SM-ALR justification has been used as a base for the review calculations in order to provide comparison and transparency. Data used for the review has been determined from the report or provided in the command & control data detailed in **section 3.2**. There are no details for any stops etc. for which an incident log was not completed.

All hazards have been analysed for the report and utilising a risk scoring ratio in the second document; high, medium and low scoring hazards have been identified. For this study only the hazards with either a reference to or relates to the use of an ERA have been considered and the assumptions reviewed. It should be recognised that these are only based on a study period of 1 month. The hazards identified for review are in the table below:

Scoring	Hazard	Description	Relation to ERA
High	H135	Vehicle stops in a running lane – off-peak	TOS removes vehicle from live lane and tows to ERA
	H152	Vehicle recovered from ERA	Self-explanatory
	H120	Vehicle re-joins running lane	Self-explanatory
Medium	H141	HGV-LGV-Bus exits from ERA	Self-explanatory
	H113	Vehicle exits ERA	Self-explanatory
	H116	Vehicle misjudges entry to ERA	Self-explanatory
	H150	Vehicle in ERA obtrudes into lane 1	Self-explanatory

Table 5a: Generic Hazard review

5.1 Hazard - H135 – Vehicle stops in running lane – off-peak

Generic Hazard Log calculation – 64no. closures off-peak per motorway mile per year.

The calculation includes for the number of lane closures per day per motorway mile and multiplying by 365. There is no data for the number of collisions provided for this study and can therefore not be assessed.

5.2 Hazard - H152 – Vehicle recovered from ERA

Generic Hazard Log calculation – 71 vehicles per year per motorway mile recovered from ERA.

Existing Assumption A22: Number of Breakdowns per day per motorway mile – 1.56

Assumption A22 Review:

Generic SM-ALR Assumption Justification:

*Assume a breakdown rate of 12 per million vehicle mile (From calculation of vehicle stoppage rates assumes 130,000 AADT). $(130,000 * 12) / 1000000 = 1.56$ breakdowns per day per motorway mile.*

In order to review this figure against actual data, the number of breakdowns per day per mile can be calculated by:

Number of breakdown / number of days in test period / length of scheme

Number of breakdowns = all incidents excluding illegal stops (data source: C&C data log)

M6 241 – 28 = 213

M42 163 – 25 = 138

M1 252 – 30 = 222

Trial month – July - 31 days

Length of scheme (rounded to nearest mile)

M6 – 13 miles

M42 – 28 miles

M1 – 15 miles

M6 213 / 31 / 13 = **0.53**

M42 138 / 31 / 28 = **0.16**

M1 222 / 31 / 15 = **0.48** Average = **0.39 breakdowns per day per motorway mile (A22)**

The original assumption data is based on a national figure of 12 breakdowns per million vehicle miles. if we challenge this figure based on the figures above divided by the 2012 AADF data, we can determine the breakdown rate per million vehicle mile;

Considering 2012 AADF figures (averaged for each motorway and rounded to nearest 000)

M6 123,000 vehicles/day = 0.123 million vehicles miles

M42 135,000 vehicles/day = 0.135 million vehicles miles

M1 109,000 vehicles/day = 0.109 million vehicles miles

Therefore,

M6 0.53 / 0.123 = 4.3 breakdowns per million vehicle miles

M42 0.16 / 0.135 = 1.2 breakdowns per million vehicle miles

M1 0.48 / 0.109 = 4.4 breakdowns per million vehicle miles

Average = 3.3 breakdowns per day per million vehicle miles

Therefore undertaking a calculation review for Hazard 152

Percentage of breakdowns that reach ERA (data source: Table 5d) (Log assumption = 50%)

M6 $100 / 213 = 47\%$

M42 $86 / 138 = 62\%$

M1 $154 / 252 = 61\%$

Average = **57%**

Percentage of breakdowns that cannot be fixed in an ERA and wants towing (data source: Table 5d) (Log assumption = 25%).

M6 $(100 - 17) / 100 = 83\%$

M42 $(86 - 12) / 86 = 86\%$

M1 $(154 - 52) / 154 = 66\%$

Average = **78%**

Convert to 'per motorway mile per year' using average figures

$0.39 \times 0.57 \times 0.78 = 0.173 \times 365 = \mathbf{63 \text{ vehicles per year per motorway mile recovered from ERA}}$

The major influence in this calculation is assumption A22; this has a major effect not only in this hazard calculation but in a number of others detailed below.

The calculation review raises several issues. An assumption has been made in the original assumption calculation that there are 12 breakdowns per day per million vehicle miles, however over the 3no. schemes we are able to calculate a significantly lower figure of 3.3 breakdowns per day per million vehicle miles. If this figure is taken as the average breakdown rate per million vehicle mile it will drastically reduce the calculated figure when undertaking an assumption calculation. Interestingly when using revised assumption figures for the calculation of hazard 152, the number of breakdowns per year per motorway mile which require recovery from an ERA is lower than the original calculation. Therefore utilising the original figure provides a more conservative assessment.

The percentage of breakdowns which reach an ERA is slightly higher (57% v 50%) but the percentage of which requires towing is significantly higher (78% v 25%) compared to the assumption. It should be noted that there is no record as to whether the vehicles was simply removed to be repaired off the network and not fully recovered.

For this hazard the generic calculated figure of 71 vehicles per year per motorway mile is erring on the side of caution and could be retained, but a revision of the number of breakdowns per year per motorway mile should be considered.

5.3 Hazard - H120 – Vehicle re-joins running lane

Generic Hazard Log calculation – 1708 vehicles re-join running lane.

Existing Assumption A70: Total number of stops per day per motorway mile – 9.36

Generic SM-ALR Assumption Justification:

Total number of Breakdowns per day = 1.56 (A22) and Total number of Comfort stops and Vehicle Checks = 7.8 (A23). Per day total = 9.36.

Assumption 23 states that the number of comfort stops and vehicle checks is assumed to be 5 x the number of breakdowns (5 x 1.56 = 7.8)

Using Study data figures:

Number of illegal stops within scheme (data source: C&C data log)

M6 28
M42 25
M1 32

Trial month – July - 31 days

Length of scheme (rounded to nearest mile)

M6 – 13 miles
M42 – 28 miles
M1 – 15 miles

Assumption A23 Review

Illegal stops and Tacho break data has been utilised for Comfort stops and vehicles checks (A23)

M6 28 /31 /13 = 0.07 per day per motorway mile
M42 25 /31 /28 = 0.03 per day per motorway mile
M1 32 /31 /15 = 0.07 per day per motorway mile Average = **0.06**

Therefore for the hazard calculation and using the original formulae:

Total number of stops per day per motorway mile (A70) = Assumption A22 + illegal use of hardshoulder or ERA (A23)

M6 = 0.53 + 0.07 = **0.60**
M42 = 0.16 + 0.03 = **0.19**
M1 = 0.46 + 0.07 = **0.53**

Using the original assumption that 50% of drivers do not use the hardshoulder to accelerate after stopping and convert to 'per mile of motorway per year'

M6 0.6 x 0.5 x 365 = **109.5 vehicles re-join running lane**
M42 0.19 x 0.5 x 365 = **34.7 vehicles re-join running lane**
M1 0.53 x 0.5 x 365 = **96.7 vehicles re-join running lane** Average = **80.3**

The major impact on these calculations is the original assumption (A23) of 5 times as many comfort / vehicle checks than there are breakdowns. It should be noted that the study only includes instances which have been recorded on the C&C log and probably there are other occasions when the vehicles has been 'moved on' but not recorded and also those not seen by TOS patrols or RCC operators. The original assumption is also based on national figures and actual figures will vary dependant on traffic flows and topography of the location.

It is advised that the number of number of comfort stops and vehicle checks should be reconsidered.

5.4 Hazard - H141 - HGV-LGV-Bus exits ERA

Generic Hazard Log calculation: Events per mile per year = 37

(Events = HGV-LGV-buses exits ERA)

Number of breakdowns = see **section 5.2**

Assumption A22 revision (see **section 5.2**) = 0.39

Percentage of breakdowns that reach ERA (data source: Table 5d) (Log assumption = 50%)

M6 100 / 213 = 47%

M42 86 / 138 = 62%

M1 154 / 252 = 61%

Average = **57%**

Number of HGVs / LGVs / Buses using ERAs for breakdowns

M6 39

M42 34

M1 80

Percentage of HGVs / LGVs / Buses breakdowns in ERA (Hazard log assumption = 13%)

M6 39 / 100 = 39%

M42 34 / 86 = 40%

M1 80 / 154 = 52%

Average = **44%**

Therefore using calculation in the Hazard log narrative:

Events per mile per year

$0.39 \times 0.57 \times 0.44 \times 365 = 35.7$

This figure is only slightly lower than the existing assumption (37) and therefore it is advised that the assumption is unaltered

5.5 Hazard - H113 Vehicle exits ERA

Generic Hazard Log calculation: Total number of stops in ERA per motorway mile annually = 590

Using Study data to review calculation:

A22 calculated in **section 5.2** (0.39) x 365

$0.39 \times 365 = 142.4$ vehicles per year per motorway mile

This figure is considerably lower than the original calculation (590) and although this is only based on recorded information it would indicate that the figure is very conservative. Therefore a revision of the figure should be considered.

5.8 Other New Generic Assumptions to be reviewed

A38 - Percentage of Breakdowns that fail to reach a 'safe area of refuge' – 50%

Original Justification:

Extrapolation of data presented in "Safe haven layby frequency and specification" report (Oscar Faber, 2001)

Stick with general assumption

Using study data:

Number of breakdown

M6	213 total	reaching ERA	100
M42	138 total	reaching ERA	86
M1	215 total	reaching ERA	154

Percentage of breakdowns that fail to reach ERA

M6 (213-100) / 213 = 53%

M42 (138-86) / 138 = 38%

M1 (215-154) / 215 = 28%

Average = **40%**

The study calculation is 10% lower than the assumption therefore the calculations incorporating the original assumption will deliver a more conservative figure and therefore could be retained.

A66 - Total Number of Comfort and Vehicle Checks Stops in ERAs per day per motorway mile – 0.78

Original Justification:

7.8 comfort stops per day. However, ERAs are for emergency use only so assume 10% of this figure

Using study data:

Comfort stops etc. in month

M6	28 total	using ERA	11	39%
M42	25 total	using ERA	14	56%
M1	32 total	using ERA	30	94%

Trial month – July - 31 days

Length of scheme (rounded to nearest mile)

M6 – 13 miles

M42 – 28 miles

M1 – 15 miles

Total Number of Comfort and Vehicle Checks Stops in ERAs per day per motorway mile

M6 11 / 31 / 13 = **0.03**

M42 14 / 31 / 28 = **0.02**

M1 30 / 31 / 15 = **0.06**

Average = **0.04**

The study calculations are considerably lower than the assumption figure (0.78), Therefore the current assumption figure is again conservative.

A67 - Total Number of Breakdowns in ERAs per day per motorway mile – 0.78

Original Justification:

1.56 breakdowns per day. Assume 50% in ERAs

Using study data:

Total number of breakdowns in ERA / days in the study month / length of scheme

M6 $100 / 31 / 13 = 0.25$

M42 $86 / 31 / 28 = 0.10$

M1 $154 / 31 / 15 = 0.33$ Average = **0.23**

The hazard log assumption is greater than that calculated from the study data and will therefore provide a more conservative figure. The calculation for assumption A22 is critical and re-assessment should be considered.

A69 - Total Number of Stops in ERAs per day per motorway mile (Comfort Stops, Vehicle Checks and Breakdowns) – 1.56

Original Justification:

A66+A67

Using study data:

Breakdowns + comfort/vehicle check stops / days in Month / length of scheme

M6 $100 + 14 = 114 / 31 / 13 = 0.28$

M42 $86 + 16 = 102 / 31 / 28 = 0.12$

M1 $154 + 30 = 184 / 31 / 15 = 0.4$ Average = **0.27**

The hazard log assumption is greater than the calculated figure and will therefore provide a more conservative figure

6 Conclusions

The aim of the study was to determine if the requirements detailed in IAN 161/13 with regards to ERAs are appropriate. These include:

- Are ERAs required?
- Is the spacing appropriate?
- Is a detection system required?
- Is the signing within an ERA appropriate and sufficient?

These aims are answered in the sections below with particular recommendations made based on the analysis undertaken.

When considering these conclusions it should be noted that difficulties were experienced in the initial stages of the study which resulted in a change in data collection and consequently the study period was only one month (July 2013) and based on recorded incident data. Therefore there is the potential of instances of hardshoulder and ERA utilisations which have not been recorded and may impact on the statistics, but it is expected that these will be minimal in number and are likely to be illegal uses.

6.1 Notification / Monitoring of ERA Utilisation

Initial data from the M6 and M42 schemes indicated that detection loop data was unreliable with an excessive number of false activations. This led to an operational decision in the WMRCC that only activations in excess of 15 minutes would be considered 'real'. This contributed to the removal of the loop requirement from IAN 161/13; however the M1 scheme data indicates that the majority of notifications are by this method would suggest that this may not necessarily have been correct.

In order to determine the necessity of a detection system, it is essential to consider what safety hazards have been considered and the control measures adopted; what is achieved by detection and whether it is required. Some of the leading safety controls include:

- Vehicles are out of the traffic lanes and in a place of relative safety reducing the risk of collisions with stopped vehicles
- The ERA is set back from the traffic lanes and the ERT provision reduces the risk of pedestrians walking on the network

There is still the risk of vehicle collision when the vehicle leaves the ERA to re-join the main carriageway unfortunately the data with respect to collisions was not available for this task in order to provide comment. Within IAN 161/13 there is a requirement for the inclusion of a sign stating that drivers MUST use the ERT to receive advice before re-joining the main carriageway. This provides a control measure for the hazard of leaving an ERA and this provision should be considered within ERAs on existing IAN 111 schemes and amending the legend to instruct drivers using the ERT when occupying an ERA.

RECOMMENDATION 1

The lack of data with respect to collisions when vehicles leave ERAs and no anecdotal information suggest that a detection system is not required. However the lack of data does raise uncertainty and therefore further data investigation could be included in the forthcoming 'Monitoring of the First Smart Motorways – All Lane Running scheme' task. **RECOMMENDATION 2.1**

The control measures which have been recognised and established in the design of the ERAs including the requirement to use the ERT when re-joining the main carriageway would seem to have adequately controlled any safety risk and therefore no detection or further monitoring should be required.

6.2 Utilisation

The study indicates that there were 656 incidents and 378 ERA utilisations recorded on the three schemes within the month under consideration this equates to a 58% utilisation. A breakdown of the utilisation of the ERAs identifies it is lower on the M6 than both the M42 and M1 (41% v 58% and 71%).

The M6 scheme has, like the M1, an increased ERA spacing than the M42 but the distances between junctions are less. The consequence is that drivers who are experiencing difficulties with their vehicles are more able to reach the next junction and exit the motorway. The reduced ERA spacing on the M42 provides a greater number of ERAs potentially giving the impression of an ERA being a layby rather than an emergency area. On the M1 scheme the high percentage of breakdowns that utilise an ERA is potentially a consequence of the increased spacing between ERAs, compared to the M42, and the distances between junctions. The greater distance that is necessary for a vehicle to travel before leaving the motorway potentially influences a driver's decision to use an ERA. The ERAs which are sited within junctions were not used in the study period. This concludes that the provision of ERAs remains a valid requirement but the siting/spacing is dependent on the distance between junctions and potential close proximity of a junction.

With respect to the breakdown data developed for hazard 152 (**section 5.2**), although there is a higher proportion of breakdowns which reach the ERA on the M1 only 71% actually required a recovery service compared to the M6 and M42 when 83% and 86% respectively required a recovery service.

The analysis indicates that the greater distance between junctions and availability of an ERA does impact on a driver's decision making whether to use an ERA. The inclusion of ERA utilisation data in the forthcoming 'Monitoring of the First Smart Motorways – All Lane Running Scheme' task can confirm the identified trends and impact on the requirements of IAN 161 with respect to ERA provision and spacing.

RECOMMENDATION 2.2

These findings confirm that although ERAs should remain an integral part of the design for Smart Motorways, an additional consideration in the frequency of their spacing should be the distance between junctions. Comparing the M6 and M1, the difference in ERA utilisation could be attributed to the short distances between junctions therefore allowing drivers to exit the motorway easier.

There is evidence of illegal use of the ERAs (14% of all ERA utilisation), although this is only based on recorded occupations on the C&C log and only 4% of this is due to Tacho breaks. It is very likely that other illegal utilisations occurred when either the vehicle left without assistance or a TOS patrol has requested an offending driver/vehicle to vacate the ERA and after considering the '15 minute' rule, no incident recorded. The collection of this data could be included in the forthcoming 'Monitoring of the First Smart Motorways – All Lane Running Scheme' task to verify the volume of illegal usage.

RECOMMENDATION 2.3

The majority of utilisations occur, as expected, when the link is open and the hard shoulder available as a normal running lane. This is generally during the morning and afternoon peak periods, Monday – Friday, although there is evidence of the southbound links being in operation on Sunday evenings both on the M6 and M1 schemes. These are renowned busy periods. The duration of the utilisations exceeding 60 minutes can be explained by the high percentile of which require a recovery operator (M6 – 95%, M42 – 92%, M1 – 60%) and therefore the high proportion of the time is waiting for the recovery to attend. An area of concern is the volume of utilisation which exceeds 120 minutes and particularly 180 minutes.

The most common vehicle using the ERAs is cars, but the high volume of Large Goods Vehicles utilisations on the M1 scheme potentially reflects the location of the scheme whereby vehicles are travelling to and from London and the channel ports. However, although foreign drivers have been recorded on some incidents, none have been identified on the M1 scheme; although this may be due to a lack of notification to the RCC operator.

6.3 Traffic Officer Service Assistance

Although the TOS attend the vast majority of recorded ERA utilisations, there are only a small number of occasions when sign setting has been undertaken and there are no details on whether these were used to facilitate vehicles re-joining the running lanes.

Only 36% attendance to utilisations reported on the ERT by the general public suggests that sufficient assistance has been provided by the RCC operator, however with respect to the actual attendance at the ERA there is no indication as to how long the TOS patrols were physically in attendance or what assistance they provided.

This raises uncertainties on what is achieved by the attendance of the TOS patrol when a vehicle is already within an ERA. This could be evaluated by further specific investigation either by a separate study or by the inclusion of data on the assistance provided by RCC operator/TOS patrol within the forthcoming 'Monitoring of the First Smart Motorways – All Lane Running Scheme' task.

RECOMMENDATION 2.4

6.4 Generic Hazard Log – Assumption Review

The assumption review should be put in context that the study was based on 3no. discrete schemes and; a study period of only one month although it was assumed that it was an 'average' month and the data used was from the Command & Control logs. Therefore as previously identified this may not include all utilisations of the ERAs or hardshoulder occupations. The data used in the hazard log in comparison was based on feedback provided over a 12 month period.

The review confirmed that in general the current assumptions made in the generic hazard log are conservative and therefore erring towards the worst case scenario. But are they too conservative? Do they need to be revised to a lower figure and therefore provide a more realistic scenario whilst still erring towards a worst case scenario? **RECOMMENDATION 3**

The calculated hazards and assumptions which have been identified in the study that require reconsideration are tabulated below:

Hazard /Assumption Number / Detail	Current Assumption	Reviewed Assumption	Calculation Location
H152 – Vehicle recovered from ERA	71	62	Section 5.2
H120 – Vehicle re-joins running lane	1708	80	Section 5.3
H141 – HGV-LGV-Bus exits ERA	37	35.7	Section 5.4
H113 – Vehicle exits ERA	590	142	Section 5.5
H116 – Vehicle misjudges entry to ERA	29	1.4	Section 5.6
H150 – Vehicle in ERA obtrudes into Lane 1	7.4	2.2	Section 5.7
A22 – Number of Breakdowns per day per motorway mile	1.56	0.39	Section 5.2
A23 – Number of Comfort Stops and Vehicle Checks per day per motorway mile	7.8	0.06	Section 5.3
A66 - Total Number of Comfort and Vehicle Checks Stops in ERAs per day per motorway mile	0.78	0.04	Section 5.8
A67 - Total Number of Breakdowns in ERAs per day per motorway mile	0.78	0.23	Section 5.8
A67 – Total number of Stops in ERAs per day per motorway mile (Comfort Stops, Vehicle checks and Breakdowns)	1.56	0.27	Section 5.8
National Figure for Breakdown rate per million vehicle miles	12	3.3	Section 5.2

Percentage of HGVs / LGVs / Buses breakdowns in ERA	13	44	Section 5.4
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6.5 Overall Conclusion

The overriding conclusions are that ERAs are providing an emergency safe haven for vehicles although the requirements for the spacing of them on the network could be reconsidered (though noting that the current hazard log assumptions err on the side of caution). The provision of adequate control measures for safety hazards with respect to the inclusion of an ERT and information signing endorse the current requisite that no additional monitoring system, other than the current scheme CCTV coverage, is required. Although the signing legend could be amended to instruct drivers to use the ERT when occupying an ERA but this requires further consideration.

7 Recommendations

Following the study and the conclusions reached there are a number of recommendations that have been identified for consideration

1. A requirement of IAN 161 is for signing provision instructing drivers to use the ERT to obtain advice when re-joining the main carriageway. This sign does not exist as a requirement for the existing Smart Motorway schemes designed to IAN 111 although the risks are very similar when the hardshoulder is used as a running lane during periods of high flow. Consideration should be given to retrofitting this sign on existing schemes designed to IAN 111 and amending the legend to instruct drivers using the ERT when occupying an ERA.
2. The study has identified risks/aspects for which either the data was not available for this study or was outside the scope of the study. The collection of the data and inclusion for further analysis should be included with the forthcoming Task 271 - 'Monitoring of the First Smart Motorways – All Lane Running Scheme'. These are:
 - 2.1. Vehicle collisions caused by vehicles re-joining the main carriageway – No data was collected for this study and there is no anecdotal information of collisions. This raises uncertainty on the requirement for notification and advice prior to re-joining the main carriageway. Therefore further data investigation could be undertaken
 - 2.2. ERA Utilisation – The study identified that the distance between junctions and the availability of ERAs impacts on a drivers decision to utilise an ERA. Further collection of ERA utilisation data will confirm the trend and subsequently determine a possible review of the IAN 161 requirements with respect to ERA provision and spacing.
 - 2.3. Illegal use of ERAs – The study data only included for utilisations recorded as incidents, there is potential that further utilisation may have occurred and either the vehicle left without assistance or the TOS patrol instructed the offending vehicle to vacate the ERA and after considering the '15 minute' rule, no incident was recorded. The collection of this data will verify the volume of illegal usage.
 - 2.4. TOS attendance to vehicles in the ERA – Study data analysis identified that only 36% of utilisations reported via the ERT by the general public were attended by a TOS patrol. This suggests sufficient assistance was provided by the RCC operator. The collection of further data with respect to the assistance provide by the RCC operator and TOS patrol will determine the necessity for a TOS patrol to attend a vehicle within an ERA. This could be considered as a separate specific study.
3. The review of the Hazards and Assumptions which impact on the determination of ERA requirements identified that the current assumptions are conservative. Consideration should be given to either amending the data used in the calculations within the Generic Hazard Log for SM-ALR (dated 14th August 2013) to provide more realistic scenarios, or for the collection of data in the forthcoming Task 271 - 'Monitoring of the First Smart Motorways – All Lane Running Scheme' and carry out recalculations.

8 References

[1]	Interim Advice Note 161/13, Managed Motorways All lane running
[2]	Interim Advice Note 111/09, Managed Motorway implementation guidance, Hard shoulder running
[3]	Managed Motorways – All Lane Running, Evaluation of the provision of Refuge Area (MMFD-ERA-030- Final Issue)
[4]	Managed Motorways – All Lane Running, Demonstration of Meeting Safety Objective Report
[5]	Generic Hazard Log for MM-ALR dated 14 th August 2013

9 Appendices

Appendix 1: Emergency Refuge Area Locations

M6 ERA Locations

Junction Marker Post	Link	Northbound		Southbound	
		ERA Number	Loop Geographical Address	ERA Number	Loop Geographical Address
172/0	J4 - 4A	172/8A	M6/5728A5		
			M6/5728A6		
		173/5A	M6/5735A5		
			M6/5735A6		
		174/4A	M6/5744A5		
			M6/5744A6		
		174/9A	M6/5749A5		
			M6/5749A6		
175/2	J4A - 5			176/8B	M6/5768B5
					M6/5768B6
178/0		177/0A	M6/5770A5		
			M6/5770A6		

194/0	J8 - 9	194/5A	M6/5945A5	194/5B	M6/5945B5
			M6/5945A6		M6/5945B6
195/7	J9 - 10	196/6A	M6/5966A5	196/8B	M6/5968B5
			M6/5966A6		M6/5968B6
		197/9A	M6/5979A5	198/3B	M6/5983B5
			M6/5979A6		M6/5983B6
198/0	J10 - 10A	199/8A	M6/5998A5	199/9B	M6/5999B5
			M6/5998A6		M6/5999B6
		200/7A	M6/6007A5	200/8B	M6/6008B5
			M6/6007A6		M6/6008B6
		201/5A	M6/6015A5	201/4B	M6/6014B5
			M6/6015A6		M6/6014B6
203/0	202/2A	M6/6022A5	202/1B	M6/6021B5	
		M6/6022A6		M6/6021B6	

M42 ERA Locations

Junction Marker Post	Link	Northbound		Southbound					
		ERA Number	Loop Geographical Address	ERA Number	Loop Geographical Address				
19/6	J3A - 4	20/2A	M42/6302A5						
			M42/6302A6						
		20/6A	M42/6306A5			20/6B	M42/6306B5		
			M42/6306A6				M42/6306B6		
		21/2A	M42/6312A5			21/2B	M42/6312B5		
			M42/6312A6				M42/6312B6		
		21/6A	M42/6316A5			21/9B	M42/6319B5		
			M42/6316A6				M42/6319B6		
		22/3A	M42/6323A5			22/9B	M42/6329B5		
			M42/6323A6				M42/6329B6		
		23/0	J4 - 5			23/1A	M42/6331A5	23/8B	M42/6338B5
							M42/6331A6		M42/6338B6
24/3A	M42/6343A5			24/4B	M42/6344B5				
	M42/6343A6				M42/6344B6				
24/9A	M42/6349A5			25/1B	M42/6351B5				
	M42/6349A6				M42/6351B6				
25/8A	M42/6358A5			25/7B	M42/6357B5				
	M42/6358A6				M42/6357B6				
26/8A	M42/6368A5			26/9B	M42/6369B5				
	M42/6368A6				M42/6369B6				
27/0	J5 - 6			27/7A	M42/6377A5	27/7B	M42/6377B5		
					M42/6377A6		M42/6377B6		
					28/1B	M42/6381B5			
					M42/6381B6				
		28/7A	M42/6387A5	28/8B	M42/6388B5				
			M42/6387A6		M42/6388B6				
		29/2A	M42/6392A5	29/2B	M42/6392B5				
			M42/6392A6		M42/6392B6				
		29/6A	M42/6396A5	29/6B	M42/6396B5				
			M42/6396A6		M42/6396B6				
		30/2A	M42/6402A5	30/3B	M42/6403B5				
			M42/6402A6		M42/6403B6				

Junction Marker Post	Link	Northbound		Southbound	
		ERA Number	Loop Geographical Address	ERA Number	Loop Geographical Address
	J5 - 6	31/0A	M42/6410A5	30/9B	M42/6409B5
			M42/6410A6		M42/6409B6
				31/3B	M42/6413B5
					M42/6413B6
32/0	J6 - 7	33/4A	M42/6434A5	33/7B	M42/6437B5
			M42/6434A6		M42/6437B6
34/1A		M42/6441A5	34/1B	M42/6441B5	
		M42/6441A6		M42/6441B6	
35/3	34/8A	M42/6448A5	34/8B	M42/6448B5	
		M42/6448A6		M42/6448B6	

M1 ERA Locations

Junction Marker Post	Link	Northbound		Southbound	
		ERA Number	Loop Geographical Address	ERA Number	Loop Geographical Address
49/0	J10 - 11	51/1A	M1/2511A5	51/0B	M1/2510B5
			M1/2511A6		M1/2510B6
		51/8A	M1/2519A5	51/8B	M1/2517B5
			M1/2519A6		M1/2517B6
		52/4A	M1/2524A5	52/7B	M1/2526B5
			M1/2524A6		M1/2526B6
53/2A	M1/2532A5				
	M1/2532A6				
54/5	J11 - 12	55/8A	M1/2558A5	55/9B	M1/2559B5
			M1/2558A6		M1/2559B6
		57/8A	M1/2578A5	58/1B	M1/2580B5
			M1/2578A6		M1/2580B6
		59/7A	M1/2598A5	59/7B	M1/2598B5
			M1/2598A6		M1/2598B6
62/4	J12 - 13	64/2A	M1/2642A5	64/1B	M1/2641B5
			M1/2642A6		M1/2641B6
		65/3A	M1/2652A5	65/3B	M1/2653B5
			M1/2652A6		M1/2653B6

Junction Marker Post	Link	Northbound		Southbound	
		ERA Number	Loop Geographical Address	ERA Number	Loop Geographical Address
72/8	J12 - 13	66/3A	M1/2664A5	66/4B	M1/2664B5
			M1/2664A6		M1/2664B6
		67/3A	M1/2673A5	67/3B	M1/2673B5
			M1/2673A6		M1/2673B6
		68/3A	M1/2682A5	68/3B	M1/2683B5
			M1/2682A6		M1/2683B6
		69/0A	M1/2690A5	69/0B	M1/2689B5
			M1/2690A6		M1/2689B6
		69/9A	M1/2700A5	69/6B	M1/2695B5
			M1/2700A6		M1/2695B6
		70/5A	M1/2706A5	70/4B	M1/2705B5
			M1/2706A6		M1/2705B6
				71/2B	M1/2712B5
					M1/2712B6

Appendix 2: Command & Control data extract

RCC Region Description	Incident Number	Start Date	ClearanceDate (only recorded if live lane effected)	Incident Duration (Start to finish) (mins)	Live Lane Impact Duration (mins)	Attendance	Location Description	Call Origin Description	Response Grade Description	Final Description	cc2	sub1	sub2	sub3	sub4	sub5	sub6
East	1	01/07/2013 00:00	NULL	81	N/A	Non Attended	T2690A J12/13 M1 AREA8 BEDS	GENERAL PUBLIC - ERT	NON-ATTENDANCE	Breakdown - not in live lane	Car	Vehicle Recovered - NVRM	MM link closed				
East	11	01/07/2013 00:07	01/07/2013 00:18	105	10	Attended	J13/1 M1 AREA8 BEDS	TRAFFIC OFFICER - ROUTINE	IMMEDIATE	Breakdown - live lane	Car	Vehicle Recovered - privately	Signal / sign setting	MM link closed	1 lane closed		Vehicle cleared by Traffic Officer from live lane
East	74	01/07/2013 03:38	NULL	63	N/A	Non Attended	P57/7A J11/12 M1 AREA8 BEDS	AUTOMATED DETECTION	PROMPT	Breakdown - not in live lane	Car	Vehicle Recovered - privately	MM link closed				
East	84	01/07/2013 04:24	NULL	191	N/A	Attended	P51/2A J10/11 M1 AREA8 BEDS	TRAFFIC OFFICER - ROUTINE	ROUTINE	Breakdown - not in live lane	Managed Motorways	LGV (Large Goods Vehicle: over 7.5 tonnes)	Vehicle Recovered - privately	MM link closed			
East	108	01/07/2013 06:02	NULL	226	N/A	Attended	J13M M1 AREA8 BEDS	TRAFFIC OFFICER - ROUTINE	PROMPT	Breakdown - not in live lane	Managed Motorways	Car	Vehicle Recovered - privately	MM link open			
East	121	01/07/2013 06:23	NULL	29	N/A	Attended	P69/6B J13/12 M1 AREA8 BEDS	TRAFFIC OFFICER - ROUTINE	ROUTINE	Breakdown - not in live lane		MM link closed	Car				
West Midlands	185	01/07/2013 07:11	NULL	159	N/A	Attended	P24/1A J4/5 M42 AREA9 CMPG	CCTV	PROMPT	Breakdown - not in live lane		MM link closed	LGV (Large Goods Vehicle: over 7.5 tonnes)	Traffic Officer ETM in place longer than 20 minutes	Signal / sign setting	Hard shoulder closed	
West Midlands	210	01/07/2013 07:29	01/07/2013 07:50	96	21	Attended	P21/3B J4/3A M42 AREA9 CMPG	POLICE	IMMEDIATE	Breakdown - live lane	Car	MM link open	2 lanes closed	Signal / sign setting		Vehicle cleared by Traffic Officer from live lane	
East	234	01/07/2013 07:44	NULL	87	N/A	Attended	P51/9A J10/11 M1 AREA8 BEDS	TRAFFIC OFFICER - ROUTINE	ROUTINE	Breakdown - not in live lane	Managed Motorways	LGV (Large Goods Vehicle: over 7.5 tonnes)	Vehicle Recovered - privately	MM link closed			
West Midlands	244	01/07/2013 07:54	01/07/2013 08:07	202	13	Attended	P177/5B J5/4A M6 AREA9 CMPG	POLICE	IMMEDIATE	Breakdown - live lane	Car	MM link open	1 lane closed	Signal / sign setting		Vehicle cleared by Traffic Officer from live lane	Vehicle Recovered - privately
East	332	01/07/2013 08:54	01/07/2013 09:07	135	13	Attended	P55/8B J12/11 M1 AREA8 BEDS	OTHER ON-ROAD SERVICE PROVIDER	IMMEDIATE	Breakdown - live lane	Managed Motorways	Car	Vehicle Recovered - privately	MM link open			
West Midlands	379	01/07/2013 09:30	01/07/2013 09:56	25	25	Attended	P199/5B J10A/10 M6 AREA9 CMPG	HA CONTRACTOR	IMMEDIATE	Breakdown - live lane		MM link open	LGV (Large Goods Vehicle: over 7.5 tonnes)	Signal / sign setting	1 lane closed		Vehicle Recovered - privately
West Midlands	442	01/07/2013 10:25	NULL	269	N/A	Attended	T6015A J10/10A M6 AREA9 CMPG	GENERAL PUBLIC - ERT	NON-ATTENDANCE	Breakdown - not in live lane	Managed Motorways	Car	Vehicle Recovered - privately	MM link open			
West Midlands	565	01/07/2013 12:22	NULL	222	N/A	Attended	P199/2A J10/10A M6 AREA9 CMPG	CCTV	IMMEDIATE	Breakdown - not in live lane		MM link closed	LGV (Large Goods Vehicle: over 7.5 tonnes)	Vehicle Recovered - NVRM	Signal / sign setting		Traffic Officer ETM in place longer than 20 minutes
West Midlands	677	01/07/2013 13:33	NULL	52	N/A	Attended	P28/5B J6/5 M42 AREA9 CMPG	CCTV	PROMPT	Breakdown - not in live lane	Managed Motorways	Car	Hard shoulder closed	MM link closed	Signal / sign setting		
East	735	01/07/2013 14:06	NULL	51	N/A	Non Attended	P56/7A J11/12 M1 AREA8 BEDS	OTHER ON-ROAD SERVICE PROVIDER	ROUTINE	Breakdown - not in live lane	Car	MM link closed	Vehicle Recovered - privately				
East	839	01/07/2013 15:13	NULL	3	N/A	Non Attended	P51/0B J11/10 M1 AREA8 BEDS	AUTOMATED DETECTION	IMMEDIATE	Breakdown - not in live lane		LGV (Large Goods Vehicle: over 7.5 tonnes)	MM link open				
West Midlands	882	01/07/2013 15:35	NULL	93	N/A	Non Attended	T6349A J4/5 M42 AREA9 CMPG	GENERAL PUBLIC - ERT	NON-ATTENDANCE	Breakdown - not in live lane	Managed Motorways	Car	Vehicle Recovered - privately	MM link closed			
East	886	01/07/2013 15:37	NULL	3	N/A	Non Attended	P52/4A J10/11 M1 AREA8 BEDS	AUTOMATED DETECTION	IMMEDIATE	Breakdown - not in live lane		Light Goods (Van / Lorry: 7.5 tonnes or less)	MM link open				
West Midlands	904	01/07/2013 15:46	NULL	143	N/A	Attended	P176/6B J5/4A M6 AREA9 CMPG	CCTV	ROUTINE	Breakdown - not in live lane	Managed Motorways	LGV (Large Goods Vehicle: over 7.5 tonnes)	Vehicle Recovered - privately	Variable crewing : single crew deals with incident	MM link open		
North East	912	01/07/2013 15:50	01/07/2013 17:02	72	2	Attended	T2106A J27/28 M62 AREA12 WYOR	AUTOMATED DETECTION	PROMPT	Breakdown - not in live lane	Car	MM link open	Signal / sign setting	1 lane closed		Vehicle Recovered - privately	

Appendix 3: ERA Topographical data

M6

ERA Number	Direction	Reference	M/Post	Horizontal Alignment	Edge Line diagram no.	Roadstud Colour	Lighting Present	Mount Height	ERT	ERT Location
1	NORTHBOUND	172/8A	172/8	Level	1010	Green	✓	8m	✓	PRIOR ERA
2	NORTHBOUND	173/5A	173/5	Level	1010	Green	✓	8m	✓	PRIOR ERA
3	NORTHBOUND	174/4A	174/4	Level	1010	Green	✓	8m	✓	PRIOR ERA
4	NORTHBOUND	174/9A	174/9	Level	1010	Green	✓	8m	✓	PRIOR ERA
5	SOUTHBOUND	176/8B	176/8	Level	1010	No Studs	✓	8m	✓	PRIOR ERA
6	NORTHBOUND	177/0A	177/0	Level	1010	Green	✓	8m	✓	PRIOR ERA
ERA Number	Direction	Reference	M/Post	Horizontal Alignment	Edge Line diagram no.	Roadstud Colour	Lighting Present	Mount Height	ERT	ERT Location
7	NORTHBOUND	194/5A	194/5	Level	1010	Green	✓	12m	✓	PRIOR ERA
8	SOUTHBOUND	194/5B	194/5	Level	1010	No Studs	✓	12m	✓	PRIOR ERA
9	NORTHBOUND	196/6A	196/6	Level	1010	Green	✓	8m	✓	PRIOR ERA
10	SOUTHBOUND	196/6B	196/6	Level	1010	No Studs	✓	12m	✓	PRIOR ERA
11	NORTHBOUND	197/9A	197/9	Level	1010	No Studs	✓	8m	✓	PRIOR ERA
12	SOUTHBOUND	198/3B	198/3	Level	1010	No Studs	✓	12m	✓	PRIOR ERA
13	NORTHBOUND	199/8A	199/8	Level	1010	Green	✓	8m	✓	PRIOR ERA
14	SOUTHBOUND	199/9B	199/9	Level	1010	No Studs	✓	8m	✓	PRIOR ERA
15	NORTHBOUND	200/7A	200/7	Level	1010	Green	✓	8m	✓	PRIOR ERA
16	SOUTHBOUND	200/8B	200/8	Level	1010	Green	✓	8m	✓	PRIOR ERA
17	SOUTHBOUND	201/4B	201/4	Level	1010	Green	✓	8m	✓	PRIOR ERA
18	NORTHBOUND	201/5A	201/5	Level	1010	Green	✓	8m	✓	PRIOR ERA
19	SOUTHBOUND	202/1B	202/1	Level	1010	Green	✓	8m	✓	PRIOR ERA
20	NORTHBOUND	202/2A	202/2	Level	1010	No Studs	✓	8m	✓	PRIOR ERA

M42

ERA Number	Direction	Reference	M/Post	Horizontal Alignment	Edge Line diagram no.	Roadstud Colour	Lighting Present	Mount Height	ERT	ERT Location
1	NORTHBOUND	20/2A	20/2	Level	1010	Green	✓	12m	✓	PRIOR ERA
2	NORTHBOUND	20/6A	20/6	Level	1010	Green	✓	12m	✓	PRIOR ERA
3	SOUTHBOUND	20/6B	20/6	Level	1010	Green	✓	12m	✓	PRIOR ERA
4	NORTHBOUND	21/2A	21/2	Decline Gradient	1010	Green	✓	12m	✓	PRIOR ERA
5	SOUTHBOUND	21/2B	21/2	Incline Gradient	1010	Green	✓	12m	✓	PRIOR ERA
6	NORTHBOUND	21/6A	21/6	Level	1010	Green	✓	12m	✓	PRIOR ERA
7	SOUTHBOUND	21/9B	21/9	Level	1010	Green	✓	12m	✓	PRIOR ERA
8	NORTHBOUND	22/3A	22/3	Level	1010	Green	✓	12m	✓	PRIOR ERA
9	SOUTHBOUND	22/9B	22/9	Level	1010	Green	✓	12m	✓	PRIOR ERA
10	NORTHBOUND	23/1A	23/1	Level	1010	Green	✓	12m	✓	PRIOR ERA
11	SOUTHBOUND	23/8B	23/9	Level	1010	Green	✓	12m	✓	PRIOR ERA
12	NORTHBOUND	24/3A	24/3	Level	1010	Green	✓	12m	✓	PRIOR ERA
13	SOUTHBOUND	24/4B	24/5	Level	1010	Green	✓	12m	✓	PRIOR ERA
14	NORTHBOUND	24/9A	24/9	Level	1010	Green	✓	12m	✓	PRIOR ERA
15	SOUTHBOUND	25/1B	25/1	Level	1010	Green	✓	12m	✓	PRIOR ERA
16	SOUTHBOUND	25/7B	25/7	Level	1010	Green	✓	12m	✓	PRIOR ERA
17	NORTHBOUND	25/8A	25/8	Level	1010	Green	✓	12m	✓	PRIOR ERA
18	NORTHBOUND	26/8A	26/8	Level	1010	Green	✓	12m	✓	PRIOR ERA
19	SOUTHBOUND	26/9B	26/9	Level	1010	Green	✓	12m	✓	PRIOR ERA
20	NORTHBOUND	27/7A	27/7	Decline Gradient	1010	Green	✓	12m	✓	PRIOR ERA
21	SOUTHBOUND	27/7B	27/7	Incline Gradient	1010	Green	✓	12m	✓	PRIOR ERA
22	SOUTHBOUND	28/1B	28/1	Level	1010	Green	✓	12m	✓	PRIOR ERA
23	NORTHBOUND	28/7A	28/7	Level	1010	Green	✓	12m	✓	PRIOR ERA
24	SOUTHBOUND	28/8B	28/8	Level	1010	Green	✓	12m	✓	PRIOR ERA

ERA Number	Direction	Reference	M/Post	Horizontal Alignment	Edge Line diagram no.	Roadstud Colour	Lighting Present	Mount Height	ERT	ERT Location
25	NORTHBOUND	29/2A	29/2	Level	1010	Green	✓	12m	✓	PRIOR ERA
26	SOUTHBOUND	29/2B	29/2	Level	1010	Green	✓	12m	✓	PRIOR ERA
27	NORTHBOUND	29/6A	29/6	Level	1010	Green	✓	12m	✓	PRIOR ERA
28	SOUTHBOUND	29/6B	29/6	Level	1010	Green	✓	12m	✓	PRIOR ERA
29	NORTHBOUND	30/2A	30/2	Level	1010	Green	✓	12m	✓	PRIOR ERA
30	SOUTHBOUND	30/3B	30/3	Level	1010	Green	✓	12m	✓	PRIOR ERA
31	SOUTHBOUND	30/9B	30/9	Level	1010	Green	✓	12m	✓	PRIOR ERA
32	NORTHBOUND	31/0A	31/0	Level	1010	Green	✓	12m	✓	PRIOR ERA
33	SOUTHBOUND	31/3B	31/3	Level	1010	Green	✓	12m	✓	PRIOR ERA
34	NORTHBOUND	33/4A	33/4	Level	1010	Green	✓	12m	✓	PRIOR ERA
35	SOUTHBOUND	33/7B	33/7	Level	1010	Green	✓	12m	✓	PRIOR ERA
36	NORTHBOUND	34/1A	34/1	Level	1010	Green	✓	12m	✓	PRIOR ERA
37	SOUTHBOUND	34/1B	34/1	Level	1010	Green	✓	12m	✓	PRIOR ERA
38	NORTHBOUND	34/8A	34/8	Level	1010	Green	✓	12m	✓	PRIOR ERA
39	SOUTHBOUND	34/8B	34/8	Level	1010	Green	✓	12m	✓	PRIOR ERA

M1

ERA Number	Direction	Reference	M/Post	Horizontal Alignment	Edge Line diagram no.	Roadstud Colour	Lighting Present	Mount Height	ERT	ERT Location
1	SOUTHBOUND	251/0B	51/0	Level	1010	Green	×	N/A	✓	PRIOR ERA
2	NORTHBOUND	251/1A	51/1	Level	1010	Green	×	N/A	✓	PRIOR ERA
3	NORTHBOUND	251/8A	51/8	Level	1010	Green	×	N/A	✓	PRIOR ERA
4	SOUTHBOUND	251/8B	51/8	Level	1010	Green	×	N/A	✓	PRIOR ERA
5	NORTHBOUND	252/4A	52/4	Decline Gradient	1010	Green	×	N/A	✓	PRIOR ERA
6	SOUTHBOUND	252/7B	52/7	Level	1010	Green	×	N/A	✓	PRIOR ERA
7	NORTHBOUND	253/2A	53/2	Level	1010	No Studs	×	N/A	✓	PRIOR ERA

ERA Number	Direction	Reference	M/Post	Horizontal Alignment	Edge Line diagram no.	Roadstud Colour	Lighting Present	Mount Height	ERT	ERT Location
8	NORTHBOUND	255/8A	55/8	Level	1010	Green	×	N/A	✓	PRIOR ERA
9	SOUTHBOUND	255/9B	55/9	Level	1010	Green	×	N/A	✓	PRIOR ERA
10	NORTHBOUND	257/8A	57/8	Level	1010	Green	×	N/A	✓	PRIOR ERA
11	SOUTHBOUND	258/1B	58/1	Level	1010	Green	×	N/A	✓	PRIOR ERA
12	NORTHBOUND	259/7A	59/7	Level	1010	No Studs	×	N/A	✓	PRIOR ERA
13	SOUTHBOUND	259/7B	59/7	Level	1010	Green	×	N/A	✓	PRIOR ERA
14	SOUTHBOUND	264/1B	64/1	Level	1010		×	N/A	✓	PRIOR ERA
15	NORTHBOUND	264/2B	64/2	Level	1010	Green	×	N/A	✓	PRIOR ERA
16	NORTHBOUND	265/3A	65/3	Level	1010	Green	×	N/A	✓	PRIOR ERA
17	SOUTHBOUND	265/3B	65/3	Level	1010	Green	×	N/A	✓	PRIOR ERA
18	NORTHBOUND	266/3A	66/3	Level	1010	Green	×	N/A	✓	PRIOR ERA
19	SOUTHBOUND	266/4B	66/4	Level	1010	Green	×	N/A	✓	PRIOR ERA
20	NORTHBOUND	267/3A	67/3	Level	1010	Green	×	N/A	✓	PRIOR ERA
21	SOUTHBOUND	267/3B	67/3	Level	1010	Green	×	N/A	✓	PRIOR ERA
22	NORTHBOUND	268/3A	68/3	Incline Gradient	1010	Green	×	N/A	✓	PRIOR ERA
23	SOUTHBOUND	268/3B	68/3	Decline Gradient	1010	Green	×	N/A	✓	PRIOR ERA
24	NORTHBOUND	269/0A	69/0	Incline Gradient	1010	Green	×	N/A	✓	PRIOR ERA
25	SOUTHBOUND	269/0B	69/0	Decline Gradient	1010	Green	×	N/A	✓	PRIOR ERA
26	SOUTHBOUND	269/6B	69/6	Level	1010	Green	×	N/A	✓	PRIOR ERA
27	NORTHBOUND	269/9A	69/9	Level	1010	Green	×	N/A	✓	PRIOR ERA
28	SOUTHBOUND	270/4B	70/4	Level	1010	Green	×	N/A	✓	PRIOR ERA
29	NORTHBOUND	270/5A	70/5	Level	1010	Green	×	N/A	✓	PRIOR ERA
30	SOUTHBOUND	271/2B	71/2	Level	1010	Green	×	N/A	✓	PRIOR ERA

