Specialist Professional and Technical Services (SPATS) Framework
Lot 1 & Lot 2

Task 1127
Smart Motorway Incident and Infrastructure Investigation – Emergency Area Width Review

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Executive Summary

Highways England are committed to ensuring smart motorways are as safe as they can be and are undertaking 18 measures as set out within the 'Smart Motorway Safety Evidence Stocktake and Action Plan'. This report summarises the outputs of an exercise to review all emergency areas on Smart Motorways:

> *'DfT have heard concerns about the width of some existing emergency areas where it is less than the current 15-foot-wide standard when measured from the edge of the carriageway. Though these slightly narrower emergency areas are still significantly wider than an 11-foot-wide traditional hard shoulder, we are committing to review these and if feasible and appropriate we will widen to the current standard.'*

Since the completion of the M42 Active Traffic Management (ATM) pilot in 2006, Smart Motorway standards have been through a number of iterations but the prescribed width for an emergency area in all published versions of Interim Advice Notes (IAN)[1] has been 4.6m (15 foot). However, where constraints existed (for example limited available space) IAN 111/08, IAN 161/12 and IAN 161/13 permitted a relaxation to reduce the width to 4.0m (13 foot). The publication of IAN 161/15 removed this relaxation, meaning that any proposed emergency area width below 4.6m would require a Departure from Standard. IAN 161/15 has now been replaced by GD 301 *Smart motorways,* which retains the 4.6m width requirement without relaxation. This width equates to the 15-foot width referenced above.

A review of emergency areas on operational smart motorways has been completed utilising high definition imagery data captured from vehicle surveys alongside extensive ground and aerial LiDAR data. The width of each emergency area has been measured and where narrower than 4.6m (15 foot) the appropriateness and feasibility of widening considered. This report records that review.

Note that LiDAR data is not yet available for three recently completed schemes on the M23 (Junctions 8 to 10), M20 (Junctions 3 to 5) and M6 (Junctions 2 to 4). As such it has not been possible to include them within this review however the project teams for these schemes have confirmed that the as-built drawings detail all emergency area widths of 4.6m (15 foot).

A total of 249 emergency areas have been reviewed with three width measurements taken along the length of each; for 131 of these the average measured width was equal to or exceeded 4.6m (15 foot), with a further 105 equal to or exceeding 4.4m (79 of which exceeded 4.5m). The review of emergency areas identified thirteen emergency areas across the country with widths less than 4.4m. 4.4m equates to 14 foot and 5 inches.

In consideration of where widening could be appropriate, the potential operational safety benefits of widening emergency areas less than 4.6m (15 foot) wide has been reviewed (refer to the Appendix). This has considered the inherent variability of vehicle dimensions and driver aptitude, and the probability of a driver to attempt to manoeuvre past a parked car in an emergency area – an original consideration in layby design. The review found that a width of 4.4m (14 foot 5 inches) is likely to be indistinguishable in safety terms with one measuring 4.6m (15 foot). However, widths below 4.4m (14 foot 5 inches) would begin to make this manoeuvre more difficult and could result in some impact on Lane 1 operation and safety. For reference a typical car is approximately 2.0m (6 foot 6 inches) wide across the mirrors.

Therefore where an emergency area is between 4.4 and 4.6m (14 foot 5 inches and 15 foot) wide it has been considered that there is no measurable benefit to justify an intervention. As such it is recommended that only sites of width less than 4.4m (14 foot and 5 inches) are subject to further consideration in the investigation. In order for corrective measures to be justified, and in accordance with Highways England's standards for safety mitigation[2], at these sites the measures would need to:

[1] Interim Advice Notes are part of the suite of documents comprising the Design Manual for Roads and Bridges (DMRB).
[2] GG 104 *Requirements for Safety Risk Assessment*; cl 3.12-3.15.

- Not create other consequential risks to road users.
- Not create other non-compliant features.
- Not present disproportionate risk to construction operatives, which is likely to be avoided if accommodated as part of other planned works.
- Demonstrate value for money.

For the thirteen emergency areas that have a width below 4.4 metres (14 foot 5 inches), measures could be considered to determine their cost-benefit ratio. To inform this exercise a location specific high-level assessment has been undertaken to determine the feasibility of potential widening interventions. The table below provides a summary of this review.

					Prospective means of widening			
Motorway	Link	Direction	Marker Post	Scheme Type	Average Measured Width	Reduce lane width	Reduced Central Reserve width	Widen into verge
M1	J32-J33	NB	253/8	ALR	**4.18**	✖	✓	✖
M1	J30-J31	NB	241/0	ALR	**4.39**	✖	✖	✓
M1	J30-J31	NB	244/2	ALR	**4.39**	✖	✖	✓
M6	J5-J6	NB	180/6	DHS	**4.38**	✖	✖	✖
M25	J24-J23	WB	136/7	ALR	**4.38**	✖	✖	✓
M25	J5-J6	WB	39/0	ALR	**4.02**	✓**[1]**	✖	**TBC[2]**
M3	J3-J2	EB	38/5	ALR	**4.20**	✖	✖	✓
M42	J6-J5	SB	28/7	DHS	**4.39**	✖	✓	✖
M42	J4	SB	22/9	DHS	**4.39**	✓	✓	✖
M42	J4-J3a	SB	21/9	DHS	**4.30**	✓	✓	✖
M42	J4-J5	NB	25/6	DHS	**4.11**	✓	✓	✖
M5	J16-J17	SB	134/4	DHS	**4.06**	✖	✖	**Land[3]**
M5	J17-J16	NB	133/6	DHS	**3.95**	✖	✖	**Land[4]**

[1] This could only partially address the issue but could result in a width greater than 4.4m

[2] Land and environmental constraints would require further review.

[3] Risk that additional land would be required outside the highway boundary

[4] Highly likely that land would be required outside the highway boundary.

Key:

Coding	Incremental width below 4.4m
	4.20 – 4.39m
	4.00 – 4.19m
	3.80 – 3.99m

Three options have been considered for widening:

- Reducing the central reserve;
- Reducing lane overall widths; and,
- Widening into the verge.

For the first two, the design would need to avoid pavement joints being positioned within wheel tracks. Reducing the central reserve has been considered only where the existing safety barrier setback exceeds 1.2m (4 foot) and the emergency area is not on a righthand bend. Reducing the overall lane widths has been considered only where the overall carriageway width exceeds 13.75m (45 foot).

Of the thirteen emergency areas below 4.4m (14 foot 5 inches), one has been identified where it would be unlikely to be feasible to widen. This is located on the M6 J5-J6 Northbound at marker post A180/6 on Bromford Viaduct where the width of the existing structure limits the potential for widening. For the twelve other sites, one of which is located behind a permanent hard shoulder, a high level review indicates potentially feasible approach(es) exist to widening.

The possible interventions at the twelve emergency areas identified will be disruptive to network operation and need to be investigated to confirm whether they are cost effective or represent value for money. To confirm this, further information on the levels of use and safety performance at the locations would need to be collected and assessed.

Following this high level review a detailed site-specific review of these options and the potential benefits of making any changes should be undertaken.

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1. Introduction

1.1 Background

Smart motorways have been examined as part of the Smart Motorway Evidence Stocktake exercise, ordered by the Secretary of State for Transport. Highways England are committed to ensuring smart motorways are as safe as they can be and are undertaking 18 measures as set out within the 'Smart Motorway Safety Evidence Stocktake and Action Plan'. This report summarises the outputs of an exercise to review all emergency areas on smart motorways:

> *'DfT have heard concerns about the width of some existing emergency areas where it is less than the current 15-foot-wide standard when measured from the edge of the carriageway. Though these slightly narrower emergency areas are still significantly wider than an 11-foot-wide traditional hard shoulder, we are committing to review these and if feasible and appropriate we will widen to the current standard.'*

Since the completion of the M42 Active Traffic Management (ATM) pilot in 2006, Smart Motorway standards have been through a number of iterations but the prescribed width for an emergency area in all published versions of Interim Advice Notes (IAN)[3] has been 4.6m. However, where constraints existed (for example limited available space) IAN 111/08, IAN 161/12 and IAN 161/13 permitted a relaxation to reduce the width to 4.0m. The publication of IAN 161/15 removed this relaxation, meaning that any proposed emergency area width below 4.6m would require a Departure from Standard. IAN 161/15 has now been replaced by GD 301 *Smart motorways,* which retains the 4.6m width requirement without relaxation.

For comparison, it is noted that the current prescribed width for an equivalent layby for use on an all-purpose trunk road in CD 169 *The design of lay-bys, maintenance hardstandings, rest areas, service areas and observation platforms,* is 4.5m. Minimum (relaxation dimension) hard shoulder width in CD 127 *Cross-sections and headrooms* is 2.75m for an urban motorway and 3.0m for an existing rural motorway.

1.2 Purpose of Report

This report provides a summary of the exercise to review and measure all emergency areas on the operational smart motorway network. Section 2 defines the methodology for identifying emergency areas for further investigation, this is supplemented by Appendix A which provides a review of the appropriateness of completing works to widen emergency areas of varying width. Section 3 summarises the findings of the review of emergency areas and Section 4 reviews the feasibility of widening the emergency areas where deemed appropriate.

This report will provide assurance to Highways England and operational stakeholders in relation to the widths of the emergency areas on the operational smart motorway network and where widening measures might be feasible and appropriate. It is not intended to provide a fully costed, value assessment of the options to widen emergency areas, nor provide detailed optioneering.

[3] Interim Advice Notes are part of the suite of documents comprising the Design Manual for Roads and Bridges (DMRB).

2. Methodology

Review – measuring emergency areas

The Highways England smart motorway scheme status map (as updated 16/06/2020) records all operational and in construction smart motorways and was used to define operational schemes and their extents. Note that LiDAR data is not yet available for three recently completed schemes on the M23 (Junctions 8 to 10), M20 (Junctions 3 to 5) and M6 (Junctions 2 to 4). As such it has not been possible to include them within this review, however the project teams for these schemes have confirmed that the as-built drawings detail all emergency area widths of 4.6m.

Each operational scheme was then reviewed utilising the Highways England Asset Visualisation and Information System (AVIS) to identify and subsequently measure all emergency areas on operational smart motorways. To ensure the completeness of the data gathered this was supplemented by the use of online mapping tools, including the completion of an online drive through.

AVIS provides high definition imagery data captured from vehicle surveys, providing camera views along the SRN. Inventory is stored in system and displayed on map interface alongside Ordnance Survey data and can be queried using data tools. Light Detection And Ranging (LiDAR) technology captured is also loaded into AVIS, visualisation presented through 3D viewer, where a user can load a 3D model at any location.

Each emergency area within the SRN was located using the high definition imagery and Ordnance Survey data, then measured in the AVIS Advanced 3D Viewer. The screenshot below (figure.1) shows an emergency area with all the relevant measurements within the 3D Advanced Viewer. Quoted accuracy within AVIS is ±30mm.

To improve accuracy of the measured width read from the viewer, three separate measurements were taken within the emergency area (refer to Figure 1 – from left to right: at end of entry taper, at mid-point, and at start of exit taper). An overall average (mean) was calculated. The measurements are taken from the traffic face of the road marking to the front face of the kerb.

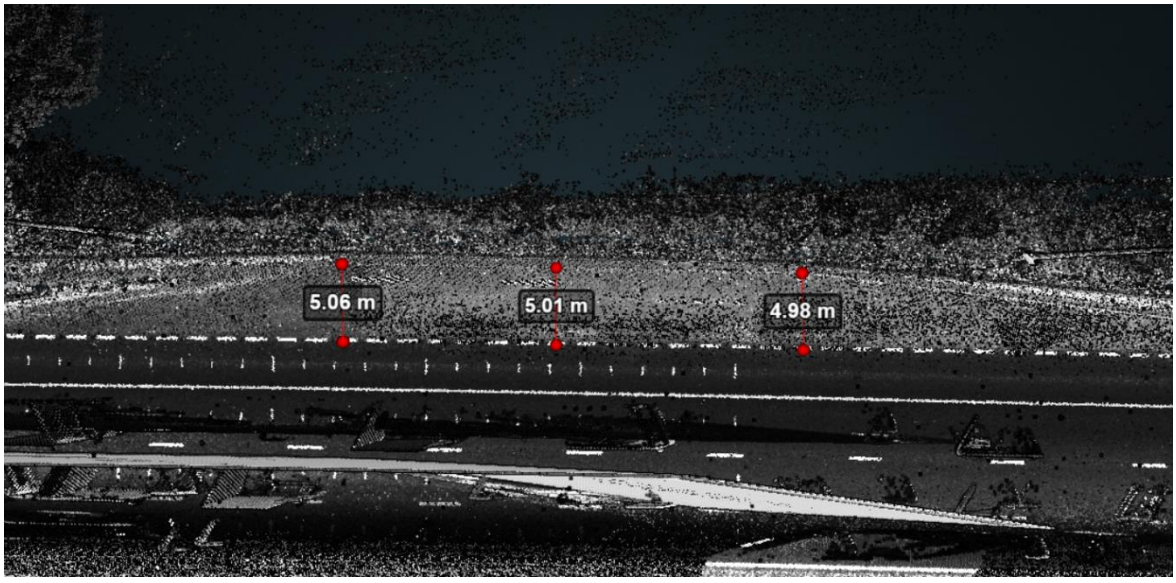

Figure.1 - AVIS 3D Advanced Viewer Screenshot

Appropriate – Rationale and review of risk

For those emergency areas that are below 4.6 metres wide Highways England are committed to determine whether it is feasible and appropriate to widen them. The risk presented by emergency areas which are marginally below 4.6m has been reviewed to consider whether widening could be appropriate. This review considered tolerances, potential usage of emergency areas and identified allowances for

passing a parked vehicle within the bay as a key consideration in setting the original width of 4.6m. The review demonstrated that where emergency areas are less than 0.2m below 4.6m (i.e. between 4.4m and 4.6m) the increased risk is likely to be indistinguishable – refer to Appendix. As such it is recommended that only sites of width less than 4.4m are subject to further investigation for feasibility of widening. In order for corrective measures to be justified at these sites they would need to:

- Not create other consequential risks to road users.
- Not create other non-compliant features.
- Not present disproportionate risk to construction operatives, it is likely this could be avoided if accommodated as part of other planned work.
- Demonstrate value for money.

Feasible – review of engineering

For those emergency areas that are below 4.6 metres wide Highways England are committed to determine whether it is feasible and appropriate to widen them. It may be appropriate to consider widening emergency areas less than 4.4m wide. The feasibility of widening each emergency area less than 4.4m wide has been reviewed and is documented in Section 4.

As explained in the background section of this report, LiDAR data, aerial photography and online mapping tools have been used to inform this review. A detailed review of site information and as-built scheme records will be required when decisions are being made on any widening, to confirm if any hidden constraints such as longitudinal ducting, are present.

The potential means of widening are considered in general terms and it is acknowledged that these could be a resource-intensive activity. To use central reserve width for example would need to realign all lines across the carriageway at an emergency area and then taper them back to adjacent cross-section alignments; however it is presented as a prospective means to achieve greater widths in accordance with the scope of this exercise. The value for money of such works would need to be assessed on a case by case basis.

3. Emergency area review findings – measured widths

A total of 249 emergency areas have been reviewed, for 131 of these the average measured width was equal to or exceeded 4.6m with a further 105 equal to or exceeding 4.4m (79 of which exceeded 4.5m).

The review identified thirteen emergency areas with widths less than 4.4m; table 1 summarises these and section four of this report considers each in more detail. Four of these are on the M42 ATM scheme for which the emergency areas were designed as 'aspects not covered by standards' (as this was a pilot scheme), but were based on TD 69/96. The other nine were designed to either IAN111/08, IAN161/12 or IAN161/13 which permitted emergency areas to be a minimum 4.0m at constraints.

The three measurements taken at each emergency area typically provided consistent values, with each emergency area on average having a difference in width of 0.09m along its length. Two emergency areas had notable differences across the three measurements: one on the M5 Junction 4a to 5 indicated emergency area width varied by 0.57m along the length for unknown reasons, however given the narrowest measured width within this emergency area was 4.55m the location was not considered further. The other emergency area with notably varying width is located on the M6 Junction 5 to 6 (Bromford Viaduct) and has a variance of 0.50m; here the minimum measurement is 4.08m and it is considered further in Table 1 and section 4 below.

Two emergency areas have measurements below 4.0m, with the minimum measured width of 3.90m, and only one emergency area had an average measured width less than 4.0m.

Motorway	Link	Direction	Marker Post	Area Team	Scheme Type	Design Standard	Average Measured Width
M1	J32-J33	NB	A 253/8	AREA 12	ALR	IAN 161/12 cl5.56	**4.18**
M1	J30-J31	NB	A 241/0	AREA 12	ALR	IAN 161/12 cl5.56	**4.39**
M1	J30-J31	NB	A 244/2	AREA 12	ALR	IAN 161/12 cl5.56	**4.39**
M6	J5-J6	NB	A 180/6	AREA 9	DHS	IAN 111/08	**4.38**
M25	J24-J23	WB	B 136/7	AREA 5	ALR	IAN 161/13 cl5.36	**4.38**
M25	J5-J6	WB	A 39/0	AREA 5	ALR	IAN 161/12 cl5.56	**4.02**
M3	J3-J2	EB	B 38/5	AREA 3	ALR	IAN 161/13 cl5.36	**4.20**
M42	J6-J5	SB	B 28/7	AREA 9	DHS	TD69 DfS-Pilot Scheme	**4.39**
M42	J4	SB	B 22/9	AREA 9	DHS	TD69 DfS -Pilot Scheme	**4.39**
M42	J4-J3a	SB	B 21/9	AREA 9	DHS	TD69 DfS -Pilot Scheme	**4.30**
M42	J4-J5	NB	A 25/6	AREA 9	DHS	TD69 DfS -Pilot Scheme	**4.11**
M5	J16-J17	SB	A 134/4	AREA 2	DHS	IAN 111/08	**4.06**
M5	J17-J16	NB	B 133/6	AREA 2	DHS	IAN 111/08	**3.95**

Table 1: Summary of EAs below 4.4m width

Key:

Coding	Incremental width below 4.4m
	4.20 – 4.39m
	4.00 – 4.19m
	3.80 – 3.99m

4. Emergency area widening - feasibility

This section provides a review of each emergency area which has been identified as having an average width less than 4.4m. It is intended to provide a summary of information for each emergency area and provide a high-level assessment of the feasibility of widening[4], utilising a qualitative RAG status where red indicates an unfavourable value, amber a neutral value and green a favourable value.

4.1 M1 J32-J33 Northbound 253/8 A

Figure 2: Streetview image of M1 J32-J33 Northbound 253/8 A © Google (LiDAR image not yet available)

M1 J32-J33 Northbound A253/8 emergency area information

The following tables provide a summary of the details collected for the emergency area;

Width (m)			
Start	Mid-Point	End	**Average**
4.14	4.30	4.10	**4.18**

Distance from preceding PRS[5]	Distance to next PRS	Carriageway type	Total Carriageway widths[6]	Setback to C/R[7] barrier
1.3km	1.8km	ALR	13.6m	1.9m

Notes

The emergency area is located approximately 400m from the tip of the ghost island for the Junction 32

[4] Widening is assumed to be provided as part of any future works in the area, however if it were to be delivered as a standalone intervention the costs and health and safety risks would increase.
[5] Place of relative safety – which could be another emergency area, a section of hard shoulder (mainline or slip road) or a motorway service area.
[6] The total trafficked width, from the trafficked side of the lane 1 edge line to the trafficked side of the lane 4 edge line – as per cross sections depicted in CD 127 *Cross-Sections and headrooms*.
[7] Central reserve.

merge. It is positioned in line with and at the end of a 275m section of nearside hatching, which is approximately the same width as the emergency area. As the emergency area is not set back from the nearside hatching, its position may increase the risk of collisions involving vehicles stationary in the emergency area as there is no physical protection on the approach to it.

Constraints

The below highlights the identified constraints at the emergency area, based on the information available from LiDAR and digital imagery. If further works are proposed a review of as-built data will be required.

Feature	Description	Comment
Highway Boundary	Located at top of cutting	Limited setback from cutting
Retaining wall / Earthwork	Reinforced Earth cutting slope	-
Road restraint system	Yes	Approx. 0.6m setback
Other infrastructure	Drainage chamber, including pollution contract device.	Exact location unknown

Notes

The emergency area is located directly under overhead power lines potentially limiting retaining wall options and location.

Options for widening

The below provides a qualitative assessment of the options to widen the emergency area by 420mm, intended to provide a high level consideration for the feasibility of widening.

Option	Feasible	H&S	Buildability	Disruption	Cost	Comment
Reduce lane widths		NA	NA	NA	NA	The existing carriageway is 13.6m, which is below the current standard 13.75m required by CD 127 Annex E/3 *Smart motorways*.
Reduced width Central Reserve						Appears feasible, straight section of carriageway with assumed good stopping sight distance and no drainage present. Traffic loading design for Central Reserve would need to be confirmed. Wheel track location may be potential issue. Impacts could be reduced through delivery with a maintenance scheme.
Widen into verge						This would require removal of existing reinforced earth wall and replacement with retaining wall. Significant buildability issues and road user disruption likely. Considered unlikely to be feasible as may be better value / safer / less disruptive to reconstruct new emergency area adjacent to this.

Conclusion

The emergency area at M1 A MP253/8 is located at the end of an area of nearside hatching with no physical protection on the approach. It is approximately 4.18m wide which would have been a permitted relaxation at the time of design and construction. There are significant constraints within the verge and it is unlikely to be appropriate to widen. The additional width may be provided through the narrowing of the central reserve, however any scheme would need to consider the wider implications, including the

risks from a reduced width central reserve, the position of pavement joints and the hazards during the construction works such as the overhead powerlines.

Protection for vehicles within the emergency area could be reviewed to ensure risks of over-run into the emergency area remain as low as reasonably required[8] for users.

[8] As per the requirement in GG 104 paragraph 3.9 and subsequent notes.

4.2 M1 J30-J31 Northbound 241/0 A

Figure 3: LiDAR image of emergency area M1 J30-J31 Northbound 241/0 A

M1 J30-J31 Northbound 241/0 A emergency area information

The following tables provide a summary of the details collected for the emergency area;

Width (m)			
Start	Mid-Point	End	**Average**
4.41	4.36	4.39	**4.39**

Distance from preceding PRS	Distance to next PRS	Carriageway type	Total Carriageway width	Setback to C/R barrier
2.3km	1.5km	ALR	13.8m	1.3m

Notes

The emergency area is located after the 1 mile advanced direction sign for Woodall Services, this may lead to a reduced use of the emergency area, particularly for non-emergency / illegal stops. It is situated on a right hand curve which may increase the risk of vehicles drifting into the emergency area. There is a police observation platform accessed from this emergency area.

Constraints

The below highlights the identified constraints at the emergency area based on the information available from LiDAR and digital imagery. If further works are proposed a review of as-built data will be required.

Feature	Description	Comment
Highway Boundary	Assumed to be located at fence line	Circa 12m from the kerb line
Retaining wall / Earthwork	At Grade	Very minor fall towards fence line.
Road restraint system	No	VRS terminals located within each taper.
Other infrastructure	Drainage chamber, (emergency roadside telephone) ERT and emergency area signing only	All infrastructure appears greater than 250mm from the kerb line.

Options for widening

The below provides a qualitative assessment of the options to widen the emergency area by 210mm, intended to provide a high-level consideration for the feasibility of widening.

Option	Feasible.	H&S	Buildability	Disruption	Cost	Comment
Reduce lane widths		NA	NA	NA	NA	The existing carriageway is 13.8m, which is above the current standard 13.75m required by CD 127 Annex E/3 *Smart motorways*, however it is insufficiently wide to materially improve the width of the emergency area.
Reduced width Central Reserve		NA	NA	NA	NA	Whilst above the minimum setback to the central reserve barrier, being located on a right-hand bend reducing the setback would adversely affect forward visibility for vehicles in lane 4.
Widen into verge						No significant constraints; this would require relocation of existing kerb drainage and the associated outfall.

Conclusion

The emergency area at M1 241/0 A is located on the link between Junction 30 and Woodall Services. It is approximately 4.39m wide which would have been a permitted relaxation at the time of construction. There are no apparent constraints within the verge that would restrict widening the emergency area to 4.6m and that appears a feasible option.

The emergency area is located following the 1 mile advance direction sign for Woodall Services which may reduce its usage, so occupancy rates and ERT use should be reviewed and confirmed to help understand potential level of benefits of making an improvement. If it is found that the emergency area has low usage it may not be appropriate to widen it, as the benefits of such work would be reduced and may not justify the risk to road workers and disruption caused. The measured width of 10mm below the 4.40m threshold would also be a material consideration in the next iteration of determining appropriate actions.

4.3 M1 J30-J31 Northbound 244/2 A

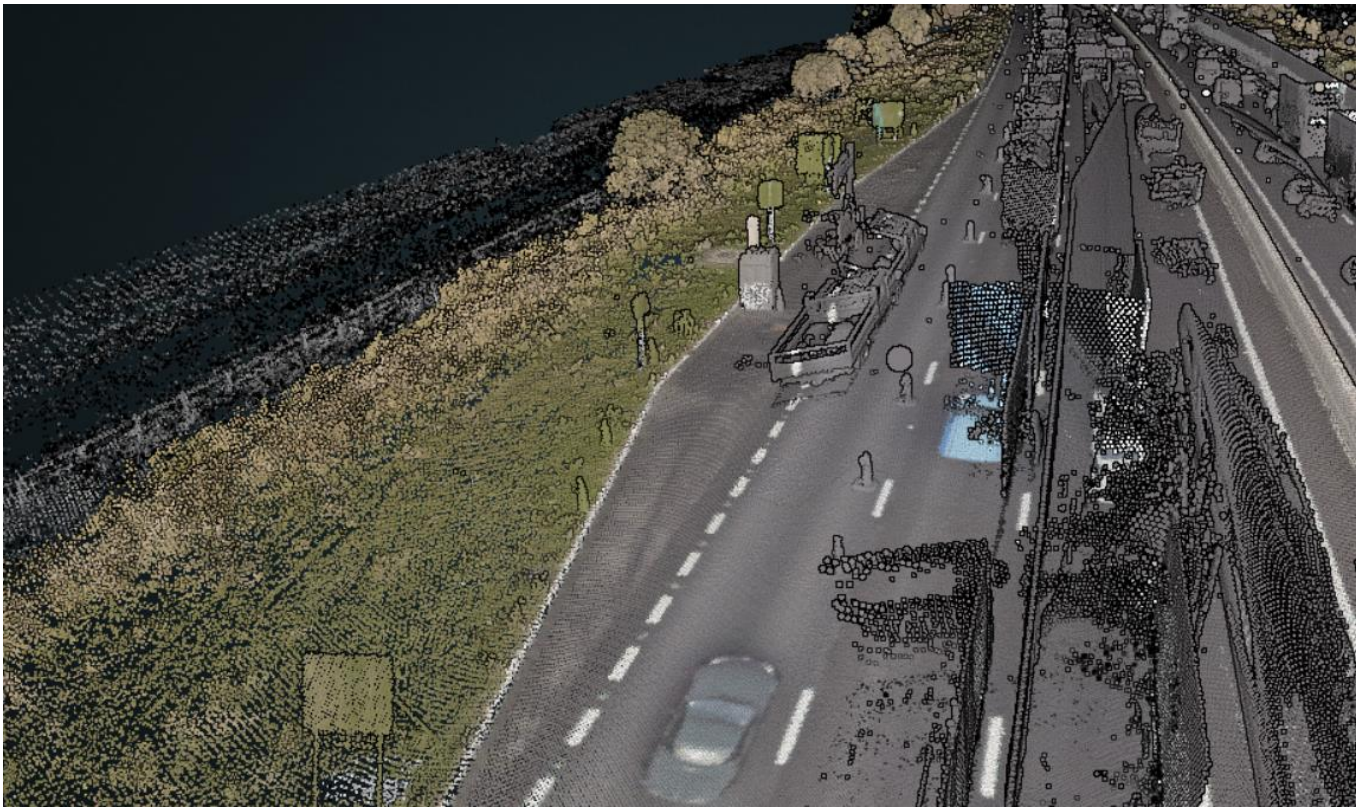

Figure 4: LiDAR image of emergency area M1 J30-J31 Northbound 244/2 A

M1 J30-J31 Northbound 244/2 A emergency area information

The following tables provide a summary of the details collected for the emergency area;

Width (m)			
Start	Mid-Point	End	**Average**
4.35	4.42	4.40	**4.39**

Distance from preceding PRS	Distance to next PRS	Carriageway type	Total Carriageway widths	Setback to C/R barrier
2.0km	1.6km	ALR	13.8m	1.7m

Notes

The emergency area is located between Woodall Services and Junction 31 on a left-hand bend. It is approximately 2km past the exit to the services which may lead to a reduced use of the emergency area, particularly for non-emergency / illegal stops.

Constraints

The below highlights the identified constraints at the emergency area based on the information available from LiDAR and digital imagery. If further works are proposed a review of as-built data will be required.

Feature	Description	Comment
Highway Boundary	Assumed to be located at fence line	Circa 12m from the kerb line
Retaining wall / Earthwork	At Grade	Very minor fall towards fence line.
Road restraint system	No	VRS terminals located within each taper.
Other infrastructure	Drainage chamber, ERT and emergency area signing only	All infrastructure appears greater than 250mm from the kerb line.

Options for widening

The below provides a qualitative assessment of the options to widen the emergency area by 210mm, intended to provide a high-level consideration for the feasibility of widening.

Option	Feasible.	H&S	Buildability	Disruption	Cost	Comment
Reduce lane widths		NA	NA	NA	NA	The existing carriageway is 13.8m, which is above the current standard 13.75m required by CD 127 Annex E/3 *Smart motorways*, however it is insufficiently wide to materially improve the width of the emergency area.
Reduced width Central Reserve						Appears feasible, located on left-hand bend with assumed good stopping sight distance in lane 4 and no drainage present. Traffic loading design for the central reserve would need to be confirmed. Wheel track location may be potential issue. Impacts could be reduced through delivery with a maintenance scheme.
Widen into verge						No significant constraints, it would require relocation of existing kerb drainage and the associated outfall.

Conclusion

The emergency area at M1 A 244/2 is located on the link between Woodall Services and Junction 31. It is approximately 4.39m wide which would have been a permitted relaxation at the time of construction. There are no apparent constraints within the verge that would restrict widening the emergency area to 4.6m, hence this appears a feasible option.

The additional width could alternatively be provided through the narrowing of the central reserve, however any scheme would need to consider the wider implications, including the position of pavement joints and the hazards during the construction works.

The emergency area is located following Woodall Services which may reduce its usage, so occupancy rates and ERT use should be reviewed and confirmed to help understand potential level of benefits of making an improvement. If it is found that the emergency area has low usage it may not be appropriate to widen it, as the benefits of such work would be reduced and may not justify the risk to road workers and disruption caused. The measured width of 10mm below the 4.40m threshold would also be a material consideration in the next iteration of determining appropriate actions.

4.4 M6 J5-J6 Northbound 180/6 A

Figure 5: LiDAR image of emergency area M6 J5-J6 Northbound 180/6 A

M6 J5-J6 Northbound 180/6 A emergency area information

The following tables provide a summary of the details collected for the emergency area;

Width (m)			
Start	Mid-Point	End	**Average**
4.58	4.49	4.08	**4.38**

Distance from preceding PRS	Distance to next PRS	Carriageway type	Total Carriageway widths	Setback to C/R barrier
3.6km	2.75km	DHS	13.3m	0.6m

Notes

The emergency area is located on Bromford Viaduct directly above a railway line. Due to cross-section constraints relating to the structure there is limited space to provide emergency areas, which results in increased spacing and a reduced width within the emergency area. The emergency area shape is not consistent along its length and is governed by the taper of a parapet. At the time AVIS data was taken the emergency area included parking markings which are positioned where the layby is narrowing; the width at the parking markings was measured at 4.08m. This has since been revised with the introduction of orange surfacing and subsequent re-marking (not yet captured within AVIS).

Constraints

The below highlights the identified constraints at the emergency area based on the information available

from LiDAR and digital imagery. If further works are proposed a review of as-built data will be required.

Feature	Description	Comment
Highway Boundary	NA	Located on viaduct
Retaining wall / Earthwork	NA	Located on viaduct
Road restraint system	Bridge parapet	Varying setback
Other infrastructure	NA	Other infrastructure is mounted on or behind the parapet

Options for widening

The below provides a qualitative assessment of the options to widen the emergency area by 220mm, intended to provide a high-level consideration for the feasibility of widening.

Option	Feasible.	H&S	Buildability	Disruption	Cost	Comment
Reduce lane widths		NA	NA	NA	NA	The existing carriageway is 13.3m, below the standard 13.75m required by CD 127 Annex E/3 *Smart motorways*.
Reduced width Central Reserve		NA	NA	NA	NA	Limited existing set back available
Widen into verge		NA	NA	NA	NA	It is not considered feasible to widen the structure to provide the additional width. The parapet taper angle could be increased but that may increase the severity of collisions involving vehicles colliding with it and increase the risk of the parapet failing during a collision.

Conclusion

The emergency area at M6 J5-J6 Northbound 180/6 A is located on Bromford Viaduct in a location where spacing of emergency areas does not comply with requirements (due to the constraints of the viaduct). Its average width is 4.38m which would have been a permitted relaxation at the time of construction, however its width varies and the narrowest point of the central section is 4.08m.

Parking markings were provided at a narrow point of the emergency area, however, orange surfacing and remarking have subsequently amended this arrangement.

There does not appear to be an appropriate viable option to widen this emergency area. Emergency areas on Bromford viaduct are equipped with occupancy sensors so regional control centre operators are automatically alerted when a vehicle stops, enabling them to set signals if required.

4.5 M25 J24-J23 Anticlockwise 136/7 B

Figure 6: LiDAR image of emergency area M25 J24-J23 Anticlockwise 136/7 B

M25 J24-J23 Anticlockwise 136/7 B emergency area information

The following tables provide a summary of the details collected for the emergency area;

Width (m)			
Start	Mid-Point	End	**Average**
4.43	4.37	4.33	4.38

Distance from preceding PRS	Distance to next PRS	Carriageway type	Total carriageway widths	Setback to C/R barrier
0.7km	2.3km	ALR	13.64m	1.14m

Notes

The emergency area is positioned mid-link on a relatively straight section of carriageway.

Constraints

The below highlights the identified constraints at the emergency area based on the information available from LiDAR and digital imagery. If further works are proposed a review of as built data will be required.

Feature	Description	Comment
Highway Boundary	Located at top of cutting	-
Retaining wall / Earthwork	Short reinforced concrete wall	Approx. 1.2m setback
Road restraint system	No	-
Other infrastructure	Hardened verge /path with dropped kerbs, providing access to ERT	Drainage details to be clarified.

Options for widening

The below provides a qualitative assessment of the options to widen the emergency area by 220mm, intended to provide a high-level consideration for the feasibility of widening.

Option	Feasible.	H&S	Buildability	Disruption	Cost	Comment
Reduce lane widths		NA	NA	NA	NA	The existing carriageway is 13.64m, which is below the current standard 13.75m required by CD 127 Annex E/3 *Smart motorways*.
Reduced width Central Reserve		NA	NA	NA	NA	Minimum setback available, reducing further considered undesirable.
Widen into verge						1.2m space to retaining wall could be reduced. Minimum width for walking with frame or wheelchair user is 900mm and access to the ERT could be improved by providing dropped kerbs in front of it. If the space to wall remained circa 1m, nearside access from vehicles would remain feasible.

Conclusion

The emergency area at M25 136/7 B is approximately 4.38m wide which would have been a permitted relaxation at the time of construction. It would be possible to reduce the space to the retaining wall to provide a width of 4.6m, but accessibility to the ERT would need to be considered. The impacts of widening in this manner on the length of the emergency area tapers would need to be considered as part of a design exercise. The measured width of 20mm below the 4.40m threshold would also be a material consideration in the next iteration of determining appropriate actions.

4.6 M25 J5-J6 Clockwise 39/0 A

Figure 7: LiDAR image of emergency area M25 J5-J6 Clockwise 39/0 A

M25 J5-J6 Clockwise 39/0 A emergency area information

The following tables provide a summary of the details collected for the emergency area;

Width (m)			
Start	Mid-Point	End	**Average**
4.16	3.98	3.91	**4.02**

Distance from preceding PRS	Distance to next PRS	Carriageway type	Total carriageway widths	Setback to C/R barrier
2.5km	2.4km	ALR	14.23m	1.03m

Notes

The emergency area is located adjacent to an area of mature vegetation, adjacent to lands of Grade 1 listed building (Barrow Green Court) which may present some environmental constraints to widening.

Constraints

The below highlights the identified constraints at the emergency area based on the information available from LiDAR and digital imagery. If further works are proposed a review of as-built data will be required.

Feature	Description	Comment
Highway Boundary	Unknown	Land database is unclear, the boundary does not align to highway and some land not registered. Fence line close to back of emergency area.
Retaining wall / Earthwork	Cannot be confirmed	Appears to include small retaining wall.
Road restraint system	Setback circa 1m	Assumed to protect retaining wall.
Other infrastructure	Post and wire fence (assumed) Footpath, central ERT.	Post and wire fence is assumed to be located at the top of a retaining wall.

Options for widening

The below provides a qualitative assessment of the options to widen the emergency area by 580mm, intended to provide a high-level consideration for the feasibility of widening.

Option	Feasible.	H&S	Buildability	Disruption	Cost	Comment
Reduce lane widths						The existing carriageway is 14.23m which is above the current standard 13.75m required by CD 127 Annex E/3 *Smart motorways*. This would present an opportunity to significantly increase the width of the emergency area. The scoring assumes it is delivered as part of a maintenance scheme.
Reduced width Central Reserve		NA	NA	NA	NA	Reduced setback available, reducing further is considered undesirable.
Widen into verge	TBC					Given the environmental unknowns it is not possible to confirm the feasibility of widening the emergency area. The setback to the safety barrier may be reduced slightly without affecting other infrastructure.

Conclusion

The emergency area at M25 J5-J6 Clockwise 39/0 A is approximately 4.02m wide which would have been a permitted relaxation at the time of construction; two of the measurements were below 4m but within construction tolerances.

It may be possible to widen the emergency area through the narrowing of the carriageway, but it could not be widened to 4.6m whilst maintaining compliant lane widths, as there is insufficient extra width.

Widening into the verge would require further investigation, however given the improvements that can be achieved from narrowing the traffic lanes, widening into the verge is unlikely to be justifiable.

4.7 M3 J3-J2 Eastbound 38/5 B

Figure 8: Streetview image of M3 J3-J2 Eastbound 38/5 B © Google (LiDAR image is not yet available)

M3 J3-J2 Eastbound 38/5 B emergency area information

The following tables provide a summary of the details collected for the emergency area;

Width (m)			
Start	Mid-Point	End	**Average**
4.26	4.16	4.18	4.20

Distance from preceding PRS	Distance to next PRS	Carriageway type	Total Carriageway widths	Setback to C/R barrier
2.5km	0.9km	ALR	13.39m	1.2m

Notes

The emergency area is located mid link at the end of left-hand curve.

Constraints

The below highlights the identified constraints at the emergency area based on the information available from LiDAR and digital imagery. If further works are proposed a review of as-built data will be required.

Feature	Description	Comment
Highway Boundary	Assumed to be close-boarded fence approximately 2.5m from kerb line.	A review of Highways England Lands Database is inconclusive as the land appears unregistered.
Retaining wall / Earthwork	Low level precast concrete retaining wall	Approx. 1.15m setback, assumed not designed for impact loading.
Road restraint system	Ground mounted safety barrier.	Setback back approximately 0.6m
Other infrastructure	ERT and emergency area signing.	

Options for widening

The below provides a qualitative assessment of the options to widen the emergency area by 400mm, intended to provide a high-level consideration for the feasibility of widening.

Option	Feasible.	H&S	Buildability	Disruption	Cost	Comment
Reduce lane widths		NA	NA	NA	NA	The existing carriageway is 13.39m which is below the current standard 13.75m required by CD 127 Annex E/3 *Smart motorways*.
Reduced width Central Reserve		NA	NA	NA	NA	Minimum setback available, reducing further is considered undesirable.
Widen into verge						The existing retaining wall could be replaced with one designed for impact loading and the safety barrier omitted, this would permit the width of the emergency area to be increased to 4.6m. The ERT would have to be wall mounted and appropriate accessibility improvements provided.

Conclusion

The emergency area at M3 J3-J2 Eastbound 38/5 B is approximately 4.20m wide which would have been a permitted relaxation at the time of construction. With the replacement of the existing mini retaining wall and safety barrier it may be possible to provide a compliant 4.6m wide emergency area.

4.8 M42 J6-J5 Southbound 28/7 B

Figure 9: LiDAR image of emergency area M42 J6-J5 Southbound 28/7 B

M42 J6-J5 Southbound 28/7 B emergency area information

The following tables provide a summary of the details collected for the emergency area;

Width (m)			
Start	Mid-Point	End	**Average**
4.38	4.39	4.40	4.39

Distance from preceding PRS	Distance to next PRS	Carriageway type	Total Carriageway widths	Setback to C/R barrier
0.6km	0.5km	DHS	13.76m	1.37m

Notes

The emergency area is located mid link on relatively straight section of carriageway with closely spaced emergency areas.

Constraints

The below highlights the identified constraints at the emergency area based on the information available from LiDAR and digital imagery. If further works are proposed a review of as-built data will be required.

Feature	Description	Comment
Highway Boundary	Assumed to be located at back of narrow verge	Fence likely to already be within the working width of the barrier
Retaining wall / Earthwork	At grade	
Road restraint system	Open box beam	Less than 0.6m from kerb, barrier overlap providing access to ERT
Other infrastructure	None visible	

Options for widening

The below provides a qualitative assessment of the options to widen the emergency area by 210mm, intended to provide a high-level consideration for the feasibility of widening.

Option	Feasible.	H&S	Buildability	Disruption	Cost	Comment
Reduce lane widths		NA	NA	NA	NA	The existing carriageway is 13.76m, consistent with 13.75m required by CD 127 Annex E/3 *Smart motorways*.
Reduced width Central Reserve						The section currently has steel central reserve safety barrier. If upgraded to rigid concrete barrier with a hardened central reserve the additional width could be provided. Scoring assumes widening provided as part of central reserve barrier scheme.
Widen into verge						The topography is relatively flat and minimum works would be required to widen the emergency area, however it is unlikely to be feasible as it would require land acquisition.

Conclusion

The emergency area at M42 J6-J5 Southbound B 28/7 is approximately 4.39m wide and was installed as part of the ATM pilot when emergency areas for motorways were an aspect not covered by standards. The highway boundary is in close proximity to the emergency area and widening would likely require land acquisition. The existing central reserve safety barrier is steel and a future maintenance upgrade to a narrower concrete central reserve barrier would provide an opportunity to widen the emergency area. The measured width of 10mm below the 4.40m threshold would also be a material consideration in the next iteration of determining appropriate actions.

4.9 M42 J4 Southbound 22/9 B

Figure 10: LiDAR image of emergency area M42 J4 Southbound 22/9 B

M42 J4 Southbound 22/9 B emergency area information

The following tables provide a summary of the details collected for the emergency area;

Width (m)			
Start	Mid-Point	End	**Average**
4.45	4.39	4.34	4.39

Distance from preceding PRS	Distance to next PRS	Carriageway type	Total Carriageway widths	Setback to C/R barrier
0.9km	1.0km	Intra junction controlled motorway	14.1m	1.83m

Notes

The emergency area is located intra-junction, behind a permanent hard shoulder which is not dynamically managed, approximately 200m upstream of the merge; the diverge upstream does not have a hard shoulder / place of relative safety.

Constraints

The below highlights the identified constraints at the emergency area based on the information available from LiDAR and digital imagery. If further works are proposed a review of as-built data will be required.

Feature	Description	Comment
Highway Boundary	NA	emergency area positioned between main carriageway and slip road
Retaining wall / Earthwork	Reinforced Earth cutting slope	Approx. 1.3m setback
Road restraint system	Open box beam	Less than 0.6m from kerb, barrier overlap providing access to ERT
Other infrastructure	Lighting columns	

Options for widening

The below provides a qualitative assessment of the options to widen the emergency area by 210mm, intended to provide a high-level consideration for the feasibility of widening.

Option	Feasible.	H&S	Buildability	Disruption	Cost	Comment
Reduce lane widths						The existing carriageway is 14.1m, which is sufficiently above the current standard 13.75m required by CD 127 Annex E/3 *Smart motorways*. Scoring assumes widening provided as part of a scheme to resurface the carriageway.
Reduced width Central Reserve						The section currently has steel central reserve safety barrier. If upgraded to rigid concrete barrier, with a hardened central reserve, the additional width could be provided. Scoring assumes widening provided as part of central reserve barrier scheme.
Widen into verge						The emergency area is positioned between the entry slip and the mainline and has a reinforced earthwork, which would require replacement with a retaining wall, potentially impacting both carriageways.

Conclusion

The emergency area at M42 J4 Southbound 22/9 B is approximately 4.39m wide and was installed as part of the ATM trial when emergency areas for motorways were an aspect not covered by standards. It is positioned behind a permanent hard shoulder, between two carriageways and has a reinforced earthwork behind it, this is likely to make widening into the verge more complex. However it is behind a permanent hard shoulder which may afford additional width and materially affects the benefits of further widening (since this emergency area is not adjacent to a traffic lane).

The existing central reserve safety barrier is steel and a future maintenance upgrade to a narrower concrete central reserve barrier would provide an opportunity to widen the emergency area – this could occur as part the planned conversion to all lane running. A reduction in overall lane widths to CD 127 Annex E/3 compliant widths as part of a resurfacing scheme could also provide added width for the emergency area. The measured width of 10mm below the 4.40m threshold would also be a material consideration in the next iteration of determining appropriate actions.

4.10 M42 J4-J3a Southbound 21/9 B

Figure 11: LiDAR image of emergency area M42 J4-J3a Southbound 21/9 B

M42 J4-J3a Southbound 21/9 B emergency area Information

The following tables provide a summary of the details collected for the emergency area;

Width (m)			
Start	Mid-Point	End	**Average**
4.33	4.26	4.32	4.30

Distance from preceding PRS	Distance to next PRS	Carriageway type	Total Carriageway widths	Setback to C/R barrier
1.0km	0.7km	DHS	14.0m	1.70m

Notes

The emergency area is located on the outside of a curve in close proximity to the Junction 4 southbound merge.

Constraints

The below highlights the identified constraints at the emergency area based on the information available from LiDAR and digital imagery. If further works are proposed a review of as-built data will be required.

Feature	Description	Comment
Highway Boundary	Assumed to be the fence line located at bottom of embankment	
Retaining wall / Earthwork	Emergency area on top of retaining wall	Approx. 1.1m setback
Road restraint system	Open box beam	Less than 0.6m from kerb, barrier overlap providing access to ERT
Other infrastructure	Guardrail along top of retaining wall	

Options for widening

The below provides a qualitative assessment of the options to widen the emergency area by 300mm, intended to provide a high-level consideration for the feasibility of widening.

Option	Feasible.	H&S	Buildability	Disruption	Cost	Comment
Reduce lane widths						The existing carriageway is 14.0m, which is above the current standard 13.75m required by CD 127 Annex E/3 *Smart motorways* and could be combined with minor widening into the central reserve. Scoring assumes widening provided as part of a scheme to resurface the carriageway.
Reduced width Central Reserve						The section currently has steel central reserve safety barrier. If upgraded to rigid concrete barrier with a hardened central reserve the additional width could be provided. Scoring assumes widening provided as part of central reserve barrier scheme.
Widen into verge						There is limited setback to the existing retaining wall which would require replacement with a new retaining wall. The type and height of the existing retaining wall is unknown.

Conclusion

The emergency area at M42 J4-J3a Southbound 21/9 B is approximately 4.30m wide and was installed as part of the ATM pilot when emergency areas for motorways were an aspect not covered by standards. It is located adjacent to a retaining wall which constrains the verge side.

The existing central reserve safety barrier is steel and a future maintenance upgrade to narrower concrete central reserve barrier would provide an opportunity to widen the emergency area. A reduction in overall lane widths to CD 127 Annex E/3 compliant widths would also provide sufficient width to widen the emergency area.

4.11 M42 J4-J5 Northbound 25/6 A

Figure 12: LiDAR image of emergency area M42 J4-J5 Northbound 25/6 A

M42 J4-J5 Northbound 25/6 A emergency area information

The following tables provide a summary of the details collected for the emergency area;

Width (m)			
Start	Mid-Point	End	**Average**
4.18	4.13	4.02	4.11

Distance from preceding PRS	Distance to next PRS	Carriageway type	Total Carriageway widths	Setback to C/R barrier
0.9km	1.0km	DHS	14.1m	1.87m

Notes

The emergency area is positioned mid-link, downstream of the secondary Advance Direction Sign for Junction 5.

Constraints

The below highlights the identified constraints at the emergency area based on the information available from LiDAR and digital imagery. If further works are proposed a review of as-built data will be required.

Feature	Description	Comment
Highway Boundary	Assumed to be located at back of narrow verge	Fence possibly within the working width of the barrier
Retaining wall / Earthwork	At grade	
Road restraint system	Open box beam	Less than 0.6m from kerb, barrier overlap providing access to ERT
Other infrastructure	Potential ducting	Concrete upstand visible that may contain ducts.

Options for widening

The below provides a qualitative assessment of the options to widen the emergency area by 490mm, intended to provide a high-level consideration for the feasibility of widening.

Option	Feasible.	H&S	Buildability	Disruption	Cost	Comment
Reduce lane widths						The existing carriageway is 14.1m, which is above the current standard 13.75m required by CD 127 Annex E/3 *Smart motorways* and could be combined with minor widening into the central reserve. Scoring assumes widening provided as part of a scheme to resurface the carriageway.
Reduced width Central Reserve						The section currently has steel central reserve safety barrier. If upgraded to rigid concrete barrier with a hardened central reserve the additional width could be provided. Scoring assumes widening provided as part of central reserve barrier scheme.
Widen into verge						The topography is relatively flat and minimum works would be required to widen the emergency area, however it is unlikely to be feasible as it would require land acquisition.

Conclusion

The emergency area at M42 J4-J5 Northbound A 25/6 is approximately 4.11m wide and was installed as part of the ATM pilot when emergency areas for motorways were an aspect not covered by standards. The highway boundary is in close proximity to the emergency area and widening would likely require land acquisition.

The existing central reserve safety barrier is steel and a future maintenance upgrade to narrower concrete central reserve barrier would provide an opportunity to widen the emergency area. This, in addition to a reduction in overall lane widths to CD 127 Annex E/3 compliant widths, would provide additional width for the emergency area.

4.12 M5 J16-J17 Southbound 134/4 A

Figure 13: LiDAR image of emergency area M5 J16-J17 Southbound 134/4 A

M5 J16-J17 Southbound 134/4 A emergency area information

The following tables provide a summary of the details collected for the emergency area;

Width (m)			
Start	Mid-Point	End	**Average**
4.08	4.02	4.08	4.06

Distance from preceding PRS	Distance to next PRS	Carriageway type	Total Carriageway widths	Setback to C/R barrier
2.0km	1.1km	DHS	13.9m	1.33m

Notes

The Emergency area is located mid-link, 2km south of Junction 16 on a righthand curve.

Constraints

The below highlights the identified constraints at the emergency area based on the information available from LiDAR and digital imagery. If further works are proposed a review of as-built data will be required.

Feature	Description	Comment
Highway Boundary	Likely acoustic barrier, circa 2m from kerb line.	Land database does not include registered land in this location, but the boundary appears to be in close vicinity to the highway.
Retaining wall / Earthwork	Small brick retaining wall	Does not extend full length of the emergency area
Road restraint system	Approximately 0.6m setback from carriageway	Overlap in safety barrier providing access to the ERT.
Other infrastructure	Drainage built into verge	

Options for widening

The below provides a qualitative assessment of the options to widen the emergency area by 540mm, intended to provide a high-level consideration for the feasibility of widening.

Option	Feasible.	H&S	Buildability	Disruption	Cost	Comment
Reduce lane widths						The existing carriageway is 13.9m which is above the current standard 13.75m required by CD 127 Annex E/3 *Smart motorways*. However, repositioning the lanes would not enable full 4.6m width to be provided. Scoring assumes widening provided as part of a scheme to resurface the carriageway.
Reduced width Central Reserve			NA	NA	NA	The emergency area is located on a right-hand curve, reducing setback may adversely affect forward visibility.
Widen into verge						Whilst there is limited available space to the highway boundary it may be possible to widen the emergency area, with the following options to be considered: Provision of a smooth faced retaining wall; provision of combined safety barrier / acoustic barrier; or combined retaining wall / acoustic barrier.

Conclusion

The emergency area at M5 J16-J17 Southbound A 134/4 is approximately 4.06m wide which would have been a permitted relaxation at the time of construction. Whilst the emergency area could be widened by utilising excess lane width, there is insufficient space to achieve a compliant 4.6m emergency area without also widening into the verge.

To provide a 4.6m wide emergency area in this location would require significant verge works including a new retaining wall, new acoustic barrier, relocating the lighting columns and safety barrier in addition to any unknown constraints. Whilst these works would be significant this emergency area is approximately 2km from the preceding place of relative safety which may increase its usage and the value of implementing any such changes.

4.13 M5 J17-J16 Northbound 133/6 B

Figure 14: LiDAR image of emergency area M5 J17-J16 Northbound 133/6 B

M5 J17-J16 Northbound 133/6 B emergency area information

The following tables provide a summary of the details collected for the emergency area;

Width (m)			
Start	Mid-Point	End	**Average**
4.01	3.90	3.94	**3.95**

Distance from preceding PRS	Distance to next PRS	Carriageway type	Total Carriageway widths	Setback to C/R barrier
1.9km	1.3km	DHS	13.6m	1.00m

Notes

The emergency area is located on the outside of a curve increasing the risk of vehicles drifting into the emergency area.

Constraints

The below highlights the identified constraints at the emergency area based on the information available from LiDAR and digital imagery. If further works are proposed a review of as-built data will be required.

Feature	Description	Comment
Highway Boundary	Located at back of verge	Potentially within working width of safety barrier
Retaining wall / Earthwork	At grade	
Road restraint system	Approximate 600mm setback	Overlap in safety barrier providing access to the ERT.
Other infrastructure	Lighting columns behind safety barrier.	

Options for widening

The below provides a qualitative assessment of the options to widen the emergency area by 650mm, intended to provide a high-level consideration for the feasibility of widening.

Option	Feasible.	H&S	Buildability	Disruption	Cost	Comment
Reduce lane widths		NA	NA	NA	NA	The existing carriageway is 13.6m which is below the current standard 13.75m required by CD 127 Annex E/3 *Smart motorways*.
Reduced width Central Reserve		NA	NA	NA	NA	1m existing setback available, reducing further considered undesirable as it would affect forward visibility. Split level carriageway removing option to reposition safety barrier.
Widen into verge						Approximate 1.8m available verge width between emergency area and highway boundary. It is likely any widening would require acquiring additional land. There is a potential for the safety barrier requirements to be reviewed which would provide the additional space however the remaining verge would be very narrow.

Conclusion

The emergency area at M5 J17-J16 Northbound B 133/6 is approximately 3.95m wide which would not have been a permitted relaxation at the time of construction, however it would have been within construction tolerances for a design at 4.0m width. With the provision of safety barrier, it is unlikely to be possible to provide a 4.6m wide emergency area without additional land. The ground is at grade; if the infrastructure present could be made passively safe it may be possible for the safety barrier to be safely omitted, which would also provide greater space for vehicle occupants to exit vehicles.

5. Conclusion

A review of operational smart motorways has identified 249 emergency areas; for 131 of these the average measured width was equal to or exceeded 4.6m with a further 105 equal to or exceeding 4.4m (79 of which exceeded 4.5m). The review of emergency areas identified thirteen emergency areas with widths less than 4.4m. One emergency area was identified which was less than 4.0m in average width (at 3.95m).

In consideration of whether widening could be appropriate, the risk presented by emergency areas less than 4.6m wide has been reviewed. The increase in risk for road users using emergency areas less than 4.6m but more than 4.4m wide is considered very low and there is unlikely to be any measurable benefit to justify an intervention.

Of the 13 emergency areas below 4.4m, measures could be considered to determine their cost-benefit ratio. A high level assessment at each of the emergency areas has been undertaken to determine the feasibility of potential widening interventions. For all sites, three options have been considered for widening:

- reducing the central reserve;
- reducing lane overall widths; and
- widening into the verge.

For the first two, the design would need to avoid pavement joints being positioned within wheel tracks. Reducing the central reserve has been considered only where the existing safety barrier setback exceeds 1.2m (4 foot) and the emergency area is not on a righthand bend. Reducing the overall lane widths has been considered only where the overall carriageway width exceeds 13.75m (45 foot).

One emergency area has been identified where widening is unlikely to be feasible. This is located on the M6 J5-J6 Northbound at marker post A180/6 on Bromford Viaduct, and the width of the existing structure limits the potential for widening. For the twelve other sites, one of which is located behind a permanent hard shoulder, a high-level review indicates that there are potentially feasible approach(es) to widening (refer to Table 2).

					Prospective means of widening			
Motorway	Link	Direction	Marker Post	Scheme Type	Average Measured Width	Reduce lane width	Reduced Central Reserve width	Widen into verge
M1	J32-J33	NB	253/8	ALR	**4.18**	✗	✓	✗
M1	J30-J31	NB	241/0	ALR	**4.39**	✗	✗	✓
M1	J30-J31	NB	244/2	ALR	**4.39**	✗	✗	✓
M6	J5-J6	NB	180/6	DHS	**4.38**	✗	✗	✗
M25	J24-J23	WB	136/7	ALR	**4.38**	✗	✗	✓
M25	J5-J6	WB	39/0	ALR	**4.02**	✓[1]	✗	**TBC[2]**
M3	J3-J2	EB	38/5	ALR	**4.20**	✗	✗	✓
M42	J6-J5	SB	28/7	DHS	**4.39**	✗	✓	✗
M42	J4	SB	22/9	DHS	**4.39**	✓	✓	✗
M42	J4-J3a	SB	21/9	DHS	**4.30**	✓	✓	✗
M42	J4-J5	NB	25/6	DHS	**4.11**	✓	✓	✗
M5	J16-J17	SB	134/4	DHS	**4.06**	✗	✗	**Land[3]**
M5	J17-J16	NB	133/6	DHS	**3.95**	✗	✗	**Land[4]**

Table 2: Improvement options

Key:

Coding	Incremental width below 4.4m
	4.20 – 4.39m
	4.00 – 4.19m
	3.80 – 3.99m

[1] This could only partially address the issue but could result in a width greater than 4.4m

[2] Land and environmental constraints would require review.

[3] Risk that additional land would be required outside the highway boundary

[4] Highly likely that land would be required outside the highway boundary

The possible interventions at the twelve emergency areas identified will be disruptive to network operation and need to be investigated to confirm whether they are cost effective or represent value for money. To confirm this, the specific risk and impacts of completing any works would need to be fully reviewed for each location along with an assessment of levels of use and safety performance. This should consider the collision and incident records at each of the identified locations along with detailed costings and establishment of a suitable benefit cost ratio for each intervention.

Widening exercises are considered more feasible where they can be packaged with other proposed or programmed improvement works, and have been assessed on this basis. For example, sharing temporary traffic management with other works would help to ensure that costs and customer impacts remain proportionate to the benefits of the intervention.

Appendices

Appendix A. Rationale and review of risk for widening emergency areas

Rationale for investigation criteria

This task seeks to review existing emergency areas and consider where emergency area widening may potentially be feasible and appropriate, and likely to deliver operational benefits for road users. For emergency areas of widths close to 4.6m, an assessment is required on whether an intervention would be appropriate and deliver meaningful benefits.

Over half of the emergency areas reviewed (131 out of 249) are compliant with the 4.6m criteria and require no further investigation.

Additionally, 105 emergency areas have an average width above or equal to 4.4m (but less than 4.6m). This appendix sets out rationale and risk review of whether an intervention in these cases would be appropriate.

A number of different aspects have been considered to assist in making a determination of the width below which it might be appropriate to widen emergency area: tolerances, road user risks and application of control measures. These are set out below.

Construction and measurement tolerance

Construction techniques attract some variances - Manual of Contract Documents for Highway Works (MCHW) and The Traffic Signs and General Directions (TSRGD) acknowledge this and incorporate appropriate tolerances (note, this is additional to measurement tolerances introduced via LiDAR and AVIS). Volume 1 of the Manual of Contract Documents for Highway Works (MCHW) provides some guidance on acceptable tolerances for specification:

Series 700 Road Pavements - General

Cl 702 (02/16) Horizontal Alignments, Surface Levels and Surface Regularity of Pavement Courses

Horizontal Alignments

> *1 (02/16) Horizontal alignments shall be determined from one edge of the pavement surface as described in contract specific Appendix 1/12. The edge of the pavement as constructed and all other parallel alignments shall be correct within a tolerance of 25 mm therefrom, except for kerbs and channel blocks which shall be laid with a smooth alignment within a tolerance of ±13 mm. Longitudinal road markings lateral tolerance shall be in accordance with sub-Clause 1212.20.*

Series 1200 Traffic Signs

Cl. 1212 Road Markings

Permanent Road Markings

> *4 (11/07) The width tolerances and thickness for screed, spray, preformed and extruded white or yellow lines shall be in accordance with The Traffic Signs Regulations and General Direction 2002. With the exception of the road markings listed in Regulation 32 (2) of The Traffic Signs Regulations and General Directions, in no case shall any materials be laid more than 6 mm thick*.

(05/04) Longitudinal Road Markings Lateral Tolerances

> *20 (05/04) For longitudinal road markings, the lateral tolerance shall be within ± 25mm from the designed position. Any discontinuities between road markings shall be replaced with a smooth taper from one road marking to the other. The length of the transition shall be derived from table below. All road markings shall comply with the dimensions, angles and proportions stated in the Traffic Signs Regulations and General Directions 2002 (Statutory Instrument 2002 No.3113) and any subsequent amending Regulations*.

The Traffic Signs Regulations and General Directions 2002 was updated in 2016. The relevant clauses are:

Dimensions and design of signs

7.-(1) This regulation is about the measurements specified in the Schedules for dimension of signs, and elements of signs, and about the overall design of signs provided for in these Regulations.

(9) Any dimension (not being specified as a maximum or minimum) given for a road marking is to be treated as permitted if it is varied in accordance with the following table.

(1) *Item*	*(2)* *Dimensions shown in road marking diagram*	*(3)* *Permitted variations*
1	3 metres or more	(i) Up to 15% of the dimension where the varied dimension is greater than the specified dimension; or (ii) Up to 10% of the dimension where the varied dimension is less than the specified dimension
2	300 mm or more, but less than 3 metres	(i) Up to 20% of the dimension where the varied dimension is greater than the specified dimension; or (ii) Up to 10% of the dimension where the varied dimension is less than the specified dimension
3	Less than 300 mm	(i) Up to 30% of the dimension where the varied dimension is greater than the specified dimension; or (ii) Up to 10% of the dimension where the varied dimension is less than the specified dimension

Table 2 - Tolerances in TSRGD

As such the permitted tolerance for an emergency area of 4.6m could be ±13mm for the kerb line at the back of the emergency area plus ±25mm for the edge of carriageway position, i.e. ±38mm or a range of 4.562-4.638m. As such any emergency area with a width of 4.562m or above could be considered compliant as within stated construction tolerances.
For the purposes of this investigation AVIS states an accuracy of ±30mm, so a further potential measurement tolerance exists within the process – as such a measured value of 4.532m or above could be indicative of a compliant emergency area width, above which it would not be appropriate to consider widening.

Road user risks associated with reduced width

The emergency area dimensions specified in IAN111/08 for dynamic hard shoulder running were developed in part of the Active Traffic Management (ATM) pilot on the M42. The design philosophy was to follow TA 69/96 *The location and layout of lay-bys*, the DMRB standard for all purpose trunk road lay-bys at the time.

The 4.6m wide Type B layby promoted by TA 69 was used to inform IAN 111/08. Consideration was given to a 4.0m wide EA (ERA at the time) but several safety concerns were raised:

1. A car could only just pass another parked car within 4.0m width.
2. An HGV with its door open and a person stood adjacent would require approx. 4.7m.
3. A pick-up truck passing an HGV would require approx. 6m.
4. An HGV with a car passing would require approx. 5m.

The concern was that drivers attempting these manoeuvres could enter Lane 1 or result in sudden lane changing of vehicles in Lane 1. The prescribed width of 4.6m allows for the first of these situations, even at 4.6m the other scenarios require some form of operational support, i.e. closure of Lane 1. As such the key risk of any reduction below 4.6m is a restriction on the ability of a car to pass a car.

If a typical car is approximately 2.0m wide across the mirrors[9], a 4.6m wide emergency area allows two cars side by side with 0.6m remaining to accommodate parking away from the kerb, space between

[9] The 2018 Ford Focus, a popular medium sized car, measures approximately 2.01m across the wing mirrors.

vehicles in the emergency area or even a partially open car door. At 4.4m, 0.4m remains to accommodate these factors, at which point the space between vehicles may begin to appear less generous than, for example, in a car park and encroachment into running lanes could become more likely. Given that light vans tend to be wider than cars[10], 4.4m would just allow a light van (e.g. a recovery or assistance vehicle) to pass a stopped car in an emergency area – although it should be noted that recovery or assistance vehicles will typically stop upstream of their customers.

To better understand the risk it is necessary to understand how often this event of passing within an emergency area may occur. The SM-ALR Overarching Safety Report 2019 reviewed emergency area usage and found that:

- The average rate of emergency area stops was 0.27 per hour.
- 71% of stops were non-emergency.
- The average durations of non-emergency and emergency stops were 2 minutes 35 seconds and 14 minutes 10 seconds, respectively.

Although not detailed in the report, the rate of stoppages and duration of stoppages suggests the likelihood of two vehicles using the facility at the same time as being low. The likelihood of the passing manoeuvre between unrelated vehicles is even less, although a recovery or assistance vehicle may be summoned in some cases. As such it seems likely that a width of 4.4m makes some allowance for this low frequency event and in doing so retaining the functionality of a compliant emergency area.

Emergency area widening as a control measure

The Design Manual for Roads and Bridges document, GG 104 *Requirements for Safety Risk Assessment*, provides a framework for determining whether control measures need to be introduced. When evaluating safety risks and deciding on controls there are different safety risk criteria for the different populations. For road users the 'reasonably required' principle is applied.

Whilst a full hazard identification and risk analysis has not been completed for the issue of narrow emergency areas, the principal road user risks have been considered. It is assumed the impact on road workers would be negligible as they would only make use of emergency areas at times of low demand, when no other vehicles were present or when the facility was closed.

The engineering assessment will consider the feasibility of different measures for increasing the width of an emergency area. Irrespective of the safety risk criteria it is logical for any measures to offer value money. In simple terms:

Value of safety benefit of measure > Cost of the measures.

The cost of the measure would include the engineering works themselves, the traffic management, the user delay during construction and an allowance for consequential safety impacts of providing the additional width during operation. GG 104 advises that the benefit to cost ratio of committed measure should be greater than 2.0, measures with a BCR of less than 1.0 should not be progressed. Where the BCR is between 1 and 2 there is some discretion on the application of the measure.

Whilst there has been no direct investigation into collisions and road worker accidents at emergency areas there have been very few collisions recorded. The SM-ALR Overarching Safety Report 2019 included reporting of all collisions in Place of Relative Safety (PRS). PRS locations on the schemes considered included emergency areas and retained hard shoulders on the schemes evaluated. Across the 9 schemes covered there was 1 slight and 1 serious collision recorded. Assuming, conservatively, that both these collisions were at emergency areas this represents a rate of 0.179 collisions per billion vehicle kms travelled. Whilst the data does not cover all 249 emergency areas measured as part of this exercise it would therefore be appropriate to assume that the likelihood of a collision at any emergency area is very small.

[10] The 2014 Ford Transit van measures up to 2.375m across the wing mirrors.

With such a small number of collisions the likelihood of a collision being related to a non-compliant width is even smaller. The case for a collision being treatable by widening of an emergency area would also be weak.

If widening an emergency area to 4.6m were, for example, to remove one serious collision over a 30 year design life, it would provide a benefit of £251,458 (in undiscounted 2018 values – refer to Table 3). To offer a benefit to cost ratio of 2.0 the works would need to cost less than £126,000. However, any significant work to widen an emergency area would result in closure of a traffic lane, significant earthworks and require traffic management and could reasonably exceed this value.

Accident/casualty type	Cost per casualty (£)	Cost per accident (£)
Fatal	1,958,303	2,196,534
Serious	220,058	251,458
Slight	16,964	26,087
Average for all severities	70,791	98,232
Damage only	-	2,344

Table 3 - 2018 Av. value of prevention per reported casualty and per reported road accident from DfT statistics RAS60001

Considering the small number of injury collisions recorded at emergency areas, and with no evidence that reduced width is resulting in collisions, the data suggests that none of the emergency areas above 4.4m in width justify further investigation. GG 104 requires a control measure to have a BCR of greater than 1 to be progressed. With no quantifiable safety benefit this is unlikely to be achieved except in extreme cases where:

- There is a low cost ‘fix’ to be applied and/or
- There is quantifiable evidence of a collision problem.

Conclusion

The available safety evidence for PRS on Smart Motorways suggests they perform well with less than 0.179 collisions per billion vehicle kms travelled. It is unlikely that corrective measures could be justified and achieve a BCR of greater than 1.0, particularly for emergency areas wider than 4.4m. Widening emergency areas measuring more than 4.4m wide would not therefore be considered appropriate.

Considering road user risk, the inherent variability of vehicle dimensions and driver aptitude, and the low likelihood of a car to attempt to manoeuvre past another car in an emergency area, a width of 4.4m is likely to be indistinguishable in safety terms with one measuring 4.6m. However, widths below 4.4m would begin to make this passing manoeuvre more difficult and could result in some impact on Lane 1 operation and safety.

As such it is recommended that only sites of width less than 4.4m are appropriate for further investigation for feasibility of widening. In order for corrective measures to be justified at these sites they would need to:

- Not create other consequential risks to road users.
- Not create other non-compliant features.
- Not present disproportionate risk to construction operatives, it is likely this could be avoided if accommodated as part of other planned work
- Demonstrate value for money.


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