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## 1 Summary

1.1 This technical note has been prepared as part of Package Order 1 to investigate the Operating Regime for the Smart Motorway Programme for Design Fix 1. This report summarises the justification supporting the proposals to extend the M27 scheme beyond its initial set limits. This technical note considers the extension of the M27 Junction 4 to 11 scheme to Junction 3 in the west and Junction 12 in the east.

### 1.2 Document summary:

1.2.1 The operational concept has been determined from the best available traffic information and takes account of the scheme constraints as understood at this stage in the scheme development. Indicative support of the principles of the scheme extension has been provided by Network Delivery and Development Directorate (NDD).

### 1.3 Recommendations:

1.3.1 That the proposals for the M27 Junctions 4 to 11 scheme be extended to Junction 3 and Junction 12 to be adopted as outlined below.

#### **M27 Extension from Junction 4 to Junction 3**

1.3.2 Dual 3 lane Smart Motorways All Lanes Running (SM ALR) is required on the M27 through Junction 4 to meet the expected traffic demand (the existing lane configuration is D2M with hard shoulder). As such, the operational regime is required to terminate beyond Junction 4.

1.3.3 The M27 between Junction 3 and 4 currently;

- Incorporates gantry signs and signals providing queue protection and advisory speed limits,
- Incorporates a Rigid Concrete Barrier (RCB) in the central reserve, and
- Operates as D4M with hard shoulder.

1.3.4 The preferred operational solution (Option 2) is a low risk option to extend the Controlled Motorway (CM) technology to Junction 3. This will maximise the operational and safety benefits associated with the ability to set Variable Mandatory Speed Limits (VMSL) and lane closures when managing incidents. The upgrade would only require the swapping of overhead MS1s with AMIs on existing gantries and the provision of additional MS4 and super-span gantry with AMIs. This option has the support of NDD who would like to extend the Controlled Motorway to Junction 3. It is expected this will be designed to standard.

The do minimum operational solution (Option 1) is a medium risk option to start/terminate the CM and VMSL between Junction 3 and 4 to the east of the Rownhams Service Area, abutting the existing advisory speed limit operating and technology regime. There are challenges with signal consistency and it is likely to require a Departure from Standards (from IAN 161) to terminate mid-link. The adoption of the recommended operating regime will therefore extend the scheme to Junction 3.

#### **M27 Extension from Junction 11 to 12**

1.3.5 On both the carriageways 4 lanes Controlled Motorway (with hard shoulder) is proposed at the existing climbing lane sections with the remaining length of the link being a 4 lane SM-ALR. This facilitates the extension of the CM with VMSL to the connection with the M275 and the A3/A27.

It is recommended that Highways England Smart Motorways Programme Board approve the proposal to extend the M27 Junction 4 to 11 scheme as outlined in this paper.

## 2 Introduction

2.1 The initial proposed operational concept of the M27 between Junction 4 and 11 is detailed in Figure 1. This regime was developed from a review of the scheme constraints and was presented to the Operations Technical Leadership Group (Ops TLG) on 26th February 2015. Approval, by the SM Programme, of these proposals to extend the scheme limits will enable the details of the operating regime to be developed for presentation to the Ops TLG at the programmed June 2015 meeting.

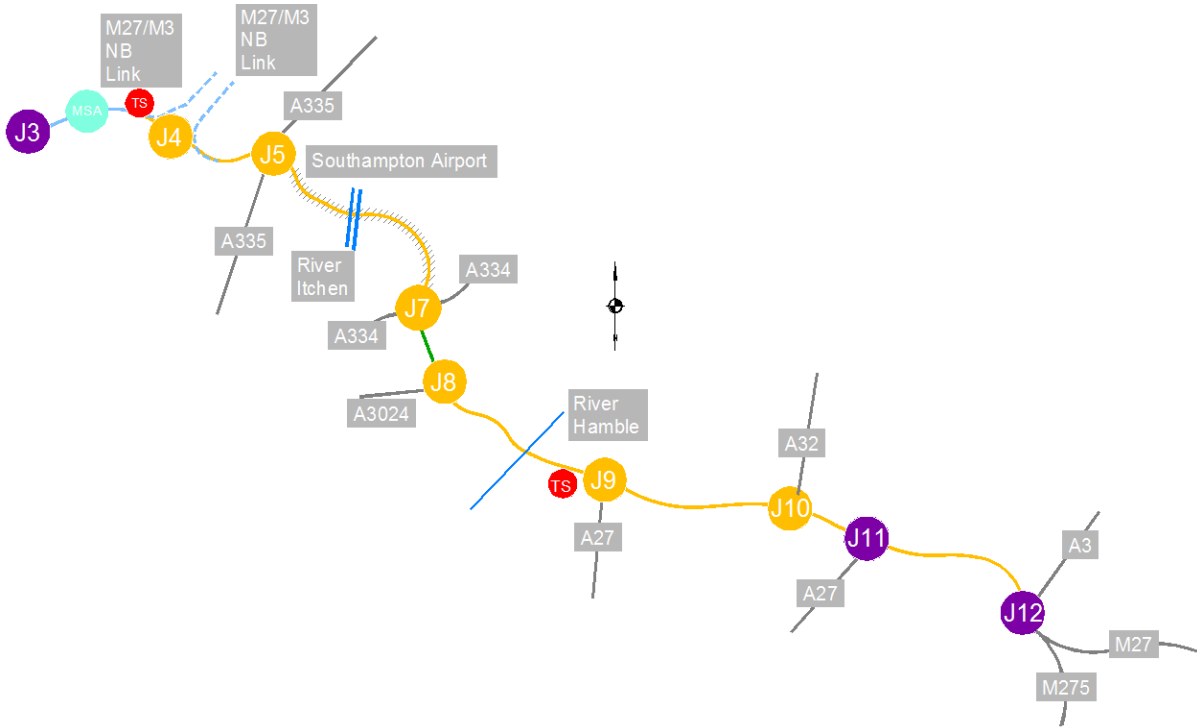




Figure 1 scheme operational concept

Note\* Junction 11 to 12 will be Controlled 4 Lanes motorway with hard shoulder for parts owing to existing D4M with hard shoulder section.

Note\*\* There is no junction 6

### KEY:

	Proposed ALR Link (Both Carriageways)		Proposed CM Link (Motorway to Motorway)
	Proposed CM Link Retaining Existing Road Cross-section (Both Carriageways)		Junction Proposed For TJR
	Transmission Station Location (Off Motorway Access)		Junction Proposed For No - TJR
	Proposed CM Link with existing D4M & hard shoulder		Proposed ALR Link (Both Carriageways). Existing Concrete Pavement Section
			Motorway Service Area

- 2.2 MMG/WSP | Parsons Brinkerhoff were commissioned in November 2014 to develop the operational regime concepts for the smart motorway schemes on the M3 Junction 9 to 14 and M27 Junction 4 to 11; these being delivered as part pf the SR13 Smart Motorways Programme.
- 2.3 As part of the commission the team were asked to consider links outside of the published scheme extents and this report highlights these changes.

### 3 Technical challenge(s)

- 3.1 The technical challenge is to present a consistent, self-enforcing and intuitive driver experience for the road user whilst providing additional capacity where needed to meet the future traffic demand through the permanent trafficking of the hard shoulder to create 4 lane all lanes running (ALR) environment. There is also the need to ensure the proposed operating regime is consistent with the operating regimes beyond the scheme limits to provide a consistent driver experience as well as optimise the throughput of traffic safely.

### 4 Project proposal

#### Extension of M27 from Junction 4 to Junction 3

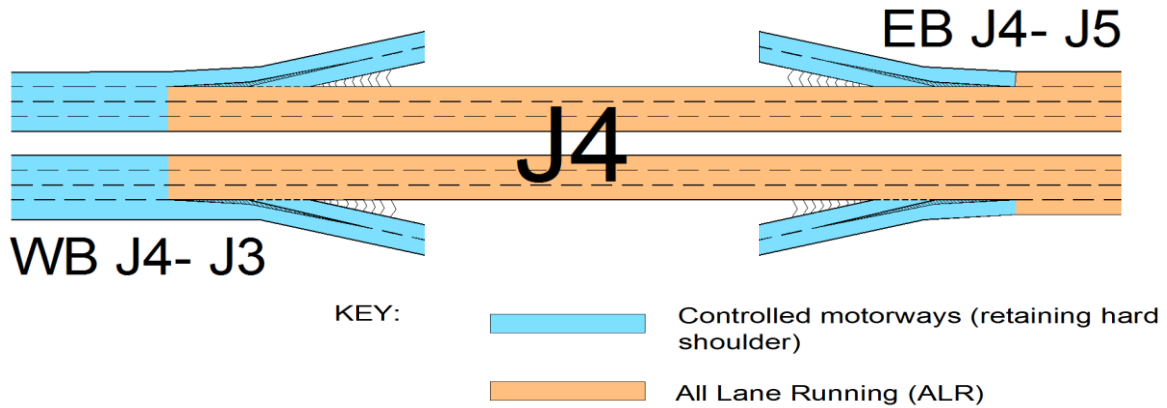
- 4.1 The Road Investment Strategy for the 2015/16 – 2019/20 Road Period published by the Department for Transport in March 2015 defined the scheme limits as M27 Junction 4 to 11. Consideration of the initial operating regimes has indicated that the scheme limits should be extended so as to achieve best value for money and to provide an operating regime that meets the network requirements.
- 4.2 Factored forecast traffic flow data (at 2035), obtained using MIDAS loop data dated October 2014, indicates that four lanes would be required, on the basis of maximum lane capacity of 1,800 vehicles per lane per hour, where the traffic flow lies in the range of 5,400 to 7,200; proportionately, traffic flows in the range of 3,600 to 5,400 would require three lanes (see Table 1 below).

Link	Direction	Max traffic flow 2035 (HGV %)	Existing lane provision	Lane requirement
Jn 3-4	East bound	7,757 (7.8%)	D4M	4 ALR (retain existing lanes)
Intra Jn 4	East bound	4,520 (8.6%)	D2M	3 ALR
Jn 4 - 5	East bound	7,158 (7.6%)	D3M	4 ALR
Jn 5-4	West bound	6,668 (5.6%)	D3M	4 ALR
Intra Jn 4	West bound	4,080 (8%)	D2M	3 ALR
Jn 4-3	West bound	7,264 (9%)	D4M	4 ALR (retain existing lanes)

Table 1 Lane Requirements for forecast traffic flows, M27 J3-5

- 4.3 The M27 from Junction 3 to Junction 4 is currently a D4M (with hard shoulder) with an operating regime providing queue protection and advisory speed limits. This section has over-lane MS1s and MS3 gantries. It is proposed to retain the existing lane arrangements from Junction 3 to the approach of the diverge and merge slip roads to/from the M3 at Junction 4.

4.4 Intra- junction 4 future traffic demand requires 3 traffic lanes so it is proposed to traffic the existing hard shoulder to create the third traffic lane utilising Controlled Motorway techniques in accordance with IAN161/13 (see figure below).

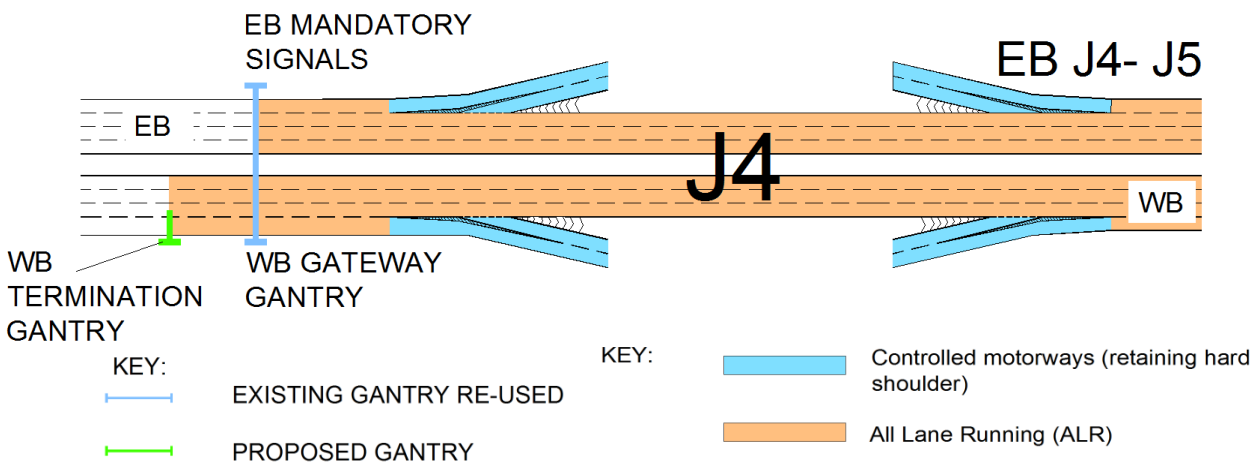


4.5 It is proposed to retain the existing lane arrangements on the M27/M3 link roads (D2M plus hard shoulder) approaching/leaving the M27 but impose the Controlled Motorway operating regime; this will provide consistency between the operating regimes on the M3 (proposed ALR with Controlled Motorway).

4.6 Future Traffic demand from Junction 4 to 5 requires a 4 lane ALR with Controlled Motorway on both carriageways.

4.7 The following options for the scheme have been considered extending the scheme limits to the west of Junction 4.

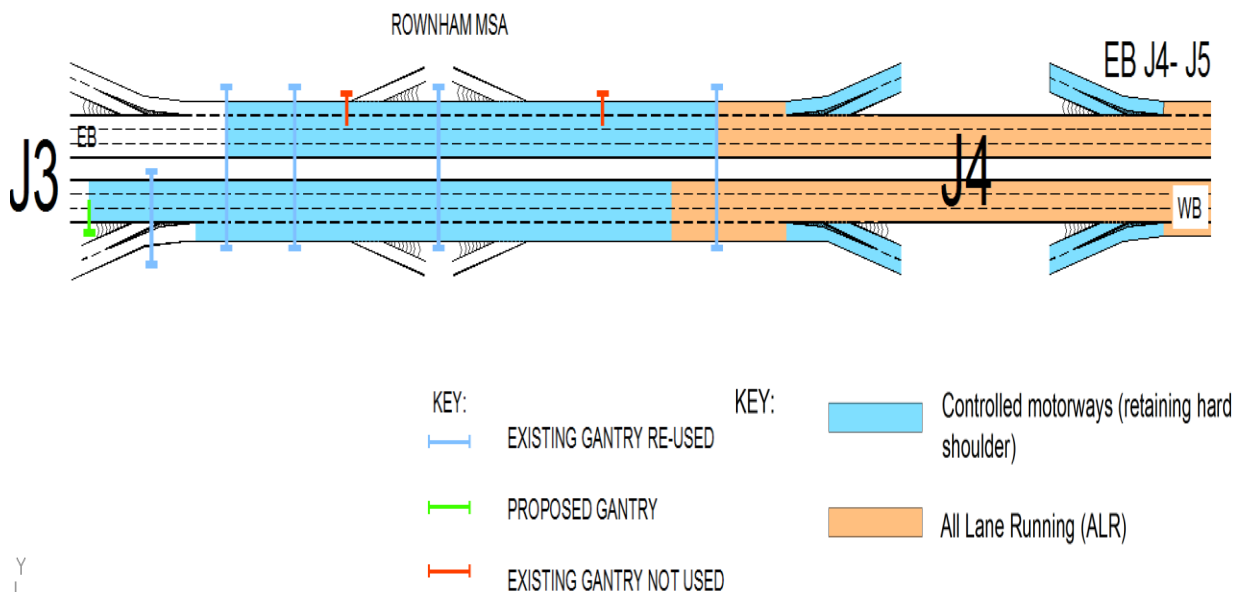
4.8 **Option 1:** The “essential” or “do minimum” is to provide the minimum infrastructure change so as to be able to deliver the 4 lane ALR requirements from Jn 4 eastwards to Jn 5. This will also require the creation of the third lane for the intra junction section. The start/end point of the ALR will be located to the west of Jn 4 (see figure below).



4.9 This would mean that the ALR/Controlled Motorway environment would abut the existing advisory speed limit regime between Junction 4 and Junction 3; Gateway gantries would be required to introduce drivers entering the controlled regime. In addition, when leaving the VMSL regime there would be a need to avoid immediate visibility to the next advisory AMIs to enable a clear distinction to be made by drivers that they have left a VMSL operating regime before entering an advisory speed limit regime. This will require an operational

regime change mid-link and does not provide the most appropriate option for sign and signal consistency. It is noted that NDD would prefer to have Controlled Motorway technology with VMSL provided through to Junction 3.

- 4.10 This option is therefore considered to carry a medium level of risk due to changing the operating regime mid link and presenting an inconsistent driver experience to the road user.
- 4.11 **Option 2:** The “desirable” or “preferred” option is to extend the Controlled Motorway technology from Junction 4 to 3 so as to provide continuity of the driver environment/operating regime along this entire link and to make the best use of existing technology at a nominal cost to the scheme as a whole. The lane requirements are as shown in figure below. This would require the existing over lane MS1s to be replaced with AMIs which is understood would not require any further change to the cabling or power supplies.



- 4.12 This option has full support from NDD who wish to see the Controlled Motorway with VMSL extended to Junction 3 to optimise the management of traffic on this extremely busy section of motorway and to provide a consistent driver experience over the M27 to Junction 12.
- 4.13 This Option is therefore considered to present low level of risk in terms of providing a consistent driver experience from Junction 3 and in making the best use of the existing infrastructure.
- 4.14 **Option 3:** This is an intermediate solution to provide Controlled Motorway from Junction 4 to 3 on the westbound carriageway by replacing existing overhead MS1s with AMIs, and on the eastbound carriageway to commence the Controlled Motorway at the west of Jn 4 (as shown in Option 1) rather than at Junction 3 thereby retaining the existing technology and saving the cost of the additional gantries and AMI swap out. This solution is not recommended for further consideration as it is unlikely to be supported by NDD. In addition, the operation of advisory speed limits on one carriageway and VMSL on the other is not seen as an ideal operating regime as it adds unnecessary complication operationally and is likely to add to driver confusion presenting a medium to high level of risk compared with the other two options. This option is therefore not recommended.

### Extension of M27 to Junction 12

- 4.15 The Road Investment Strategy for the 2015/16 – 2019/20 Road Period published by the Department for Transport in March 2015 defined the scheme limits as M27 Junction 4 to 11. The M27 between Junctions 11 and 12 carries a high volume of traffic (the highest trafficked section between Junctions 3 and 12) and initial consideration of the operational regime suggested that the scheme should be extended to Junction 12 to provide best value for money and a consistent operating regime connecting with the M275 and A3/A27.

Factored forecast traffic flow data (at 2035), obtained using MIDAS loop data dated October 2014, indicates that four lanes would be required, on the basis of maximum lane capacity of 1,800 vehicles per lane per hour, where the traffic flow lies in the range of 5,400 to 7,200; proportionately, traffic flows in the range of 3,600 to 5,400 would require three lanes (see Table 2 below).

Link	Direction	Max traffic flow 2035 (HGV%)	Existing lane provision	Lane requirement
Jn 10-11	East bound	7,180 (6.3%)	D3M plus hardshoulder	4 lane ALR
Intra Jn 11	East bound	5,655 (6.4%)	D3M plus hardshoulder	Existing lane arrangement to be retained.
Jn 11-12	East bound	8,250 (6.3%)	D4M (including a climbing lane plus hardshoulder to crest of the hill and D3M plus hardshoulder thereafter to J12)	4 lane ALR (with hardshoulder only through the climbing lane section).
Jn 12-11	West bound	7,169 (5.5%)	D4M (including a climbing lane plus hardshoulder to crest of the hill and D3M plus hardshoulder thereafter to J11)	4 lane ALR (with hardshoulder only through the climbing lane section).
Intra Jn 11	West bound	4,641 (9.1%)	D3M plus hardshoulder	Existing lane arrangement to be retained.
Jn 11-10	West bound	6,611 (6.9%)	D3M plus hardshoulder	4 lane ALR

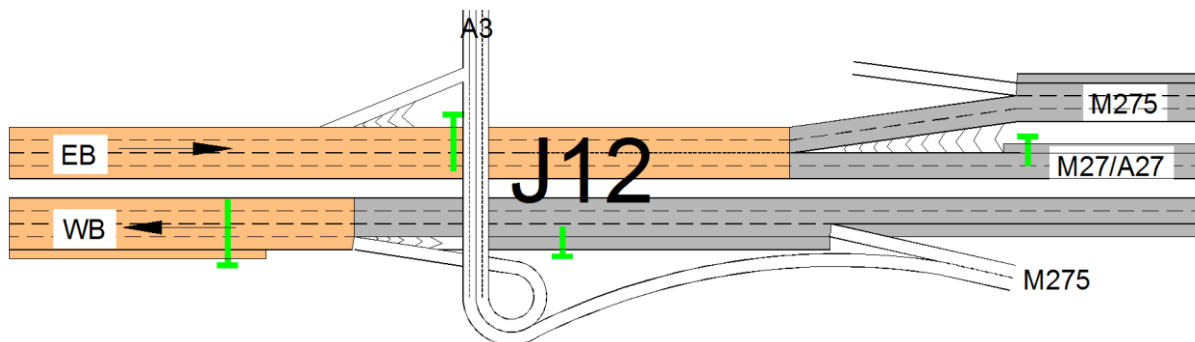
Table 2 - Lane Requirements for forecast traffic flows, M27 J11-12

- 4.16 The link between Junctions 11 to 12 experiences the highest traffic volume on the M27. Exclusion of this link from the current ALR scheme would not be recommended as the provision of the additional capacity and Controlled Motorway should return significant benefits and potentially provide a higher BCR value through achieving significant benefit in congestion and accident relief.
- 4.17 The M27 eastbound carriageway from Junction 11, currently has a lane gain arrangement with the additional lane continuing for approximately 2.5km over a gradient of 2.5% up to the crest (as a climbing lane) before losing the climbing lane to revert back to a D3M plus hardshoulder layout.
- 4.18 On the westbound carriageway from Junction 12, there is currently an additional lane created from the offside at approximately 1km after the Jn 12 merge. This additional lane continues for approximately 1.5km over a gradient of 2.5% up to the crest before being closed from the off side and reverting back to a D3M plus hard shoulder layout.
- 4.19 It is currently proposed to provide a dual 4 lane motorway (SM-ALR) but retain the hardshoulder at the existing climbing lane sections (technically two separate lengths of



partial Controlled Motorway). Please refer to Technical Note M27 J11 – J12 Operational Regime: HA5446451302-MMGJV-GEN-M27-TN-D-001 for further details of proposed operational regime between Jn 11 to Jn 12.

- 4.20 The M27 Junction 12, and to the east of the junction, links to and from A27/A3 and the M275 respectively. The first diverge slip road on the east bound approach to Junction 12 is signed for the A27 (and A3) and it is proposed to terminate Controlled Motorway on the link road prior to the traffic signal junction with the A3/A27. Eastbound, the termination of the CM and VMSL would be just after the second diverge slip road to the M275 as this diverge slip road, and entry to the M275, has an imposed fixed 60mph speed limit.
- 4.21 The second diverge slip road at junction 12 east bound links to the M275 southbound. The M275 has a speed limit of 60 mph reducing to 50 mph (signed using fixed plate signs) just after the merge with the slip road from the A3/A27 junction. Whilst there are limited gantry and AMI signals on the M275 it is not a Controlled Motorway. It is therefore proposed to terminate the M27 CM and VMSL just after the M275 diverge.
- 4.22 The M27 extends (east) beyond Junction 12 as D2M before merging with the M275 northbound. It is considered that the CM and VMSL should be terminated prior to the merging of the slip road from the M275 (going east bound) so as to avoid complications with having VMSL and a maximum speed limit less than the national speed limit. There may be a case for extending the CM and VMSL on to the A27 depending on the development proposals for operating the A27.
- 4.23 The M275 link road northbound to M27 west bound, has a mandatory speed limit of 60 mph up the diverge slip road that connects with the A3 /A27 link at Junction 12. It is proposed to continue the existing operational regime beyond this diverge point and commence the CM and VMSL prior to the A3/A27 merge with the M27 at Junction 12 which will be the start point for the CM and VMSL on the M27 west bound carriageway.
- 4.24 Please refer to the figure below for the proposed operational arrangement at Jn 12.



- 4.25 The benefits resulting from extending the scheme to encompass Junction 12 and extending the Controlled Motorway and VMSL to the connecting roads to the A3/A27 and the M275 arise from having a consistent operating regime from the remainder of the scheme to the end of the M27. The elimination of the climbing lanes also removes the accident potential (seen in the accident cluster information) at the termination of the climbing lane by losing the off side lanes.

## 5 Consultation

- 5.1 NDD have expressed their overall support for the M27 Smart Motorways with the provision of ALR between Junctions 4 and 11 with the extension of the Controlled Motorway to Junction 3 and to the end of the M27 at Junction 12.



## **6 Governance**

### 6.1 Governance challenges

6.1.1 The scheme extension as described in this technical paper will not require any additional Departures from Standards.

### 6.2 Key risks

6.2.1 It is not envisaged that the scheme extension as described will add any additional risks.

## **7 Conclusion / recommendations**

### 7.1 Conclusion

7.1.1 It is concluded that:

- The M27 scheme should be extended to Junction 3 in the west by providing Controlled Motorway and VMSL operating regime that facilitates the lane requirements at Junction 4 and obtains best value by utilising as much of the existing gantry and technology as possible. This is described as Option 2.
- The M27 scheme be extended to Junction 12 in the east enabling 4 lane ALR to be provided to Junction 12 to match capacity requirements and enable Controlled Motorway to be extended to the roads connecting the M275 and the A3/A27.

### 7.2 Recommendations

7.2.1 It is recommended the Highways England SM Programme Board approve that the proposal to extend the limits of this M27 scheme to be from Junction 3 in the west and Junction 12 in the east.