

M42 Junction 7-10 Study:

17/06/2020

Step C: Options Assessment Report

Reference number GB01T19C69 – 18OAR

STEP C: OPTIONS ASSESSMENT REPORT



SYSTRA

M42 JUNCTIONS 7-10 STUDY

STEP C: OPTIONS ASSESSMENT REPORT

IDENTIFICATION TABLE

Client/Project owner	Highways England
Project	M42 Junctions 7-10 Study
Study	Step C: Options Assessment Report
Type of document	FINAL Report
Framework	Highways England Spatial Planning
Reference number	GB01T19C69 – 18OAR
Date	17/06/2020

APPROVAL

Version	Name	Position	Date	Modifications
1	Author		07/01/2020	Report updated to reflect Ben Simms April 2020 comments.
	Checked by		28/02/2020	
	Approved by		28/02/2020	
2	Author		15/06/2020	
	Checked by		17/06/2020	
	Approved by		17/06/2020	

EXECUTIVE SUMMARY

This report sets out the approach that has been used to identify and assess a range of potential solutions for the delivery of capacity improvements to the M42 between Junctions 7 and 10. There have been previous studies conducted on specific junctions along the M42 corridor i.e. Junction 9 and Junction 10, however these studies have not considered the detail of the M42 mainline carriageway.

This study seeks to identify measures to address the current and future capacity conditions experienced on the M42 mainline, including interactions with the M6 and M6 Toll Motorways through to M42 Junction 9 and Junction 10. The main objective is to establish what effective short and long-term interventions would enable the corridor to provide for better utilisation of the existing asset and to facilitate future traffic growth.

The report summarises the option assessment work undertaken to consider the generation and sifting of options and has been developed based on the assessment of existing needs and future traffic growth arising from housing and employment development in the region in the short term (to 2023) and long term (to 2036). Future forecasting has also taken into account implications arising from changing traffic flows associated with committed investments in strategic transport infrastructure such as Smart Motorways and HS2.

At this stage of the study an initial sift of options has been undertaken with the aim of developing a cost-effective package of short-term improvements to the network that do not conflict with longer term solutions that have been identified to be necessary to address traffic growth in future years.

Through the sift a package of short-term improvement options has been identified to support improved capacity and traffic flow along the M42 Junction 7-10 corridor. Most benefit can be gained predominantly through the reassignment of existing carriageway capacity around the merge / diverge areas where the M42 interchanges with the M6 and M6 Toll routes (Junction 7/7A).

Short term improvements to the mainline interaction with Junction 9 have been identified to have few benefits although some improvements to the operation of M42 Junction 10 could also be gained through improvement of the merge/diverge areas.

Highways England has not yet had an opportunity to comment on the sifted options therefore these remain open for comment by Highways England or by other stakeholders as appropriate, to inform any changes to the options. The proposed package of short-term options is subject to wider discussions and agreement, prior to further development and appraisal for delivery.

Development of these options will require further engineering design and value management activities, plus feedback from stakeholders on deliverability. It is recommended this include consultation with Highways England's Progressive Asset Delivery (PAD) partner Kier Services.

TABLE OF CONTENTS

1.1	PURPOSE OF THE REPORT	6
1.2	STRUCTURE OF THE REPORT	6
2.	UNDERSTANDING THE CURRENT SITUATION	7
2.1	AREA CONTEXT	7
2.2	STRATEGIC CONTEXT	10
2.3	CURRENT TRAVEL DEMANDS	11
3.	ESTABLISHING THE NEED FOR INTERVENTION	13
3.1	EXISTING AND FUTURE TRANSPORT-RELATED ISSUES	13
3.2	ENGINEERING ASSESSMENT OF THE ROUTE	14
3.3	MERGE AND DIVERGE ASSESSMENTS	14
3.4	LINK AND LANE CAPACITY	17
3.5	CURRENT SAFETY ASSESSMENT	17
3.6	KEY EXISTING ISSUES	19
4.	FUTURE YEAR ASSESSMENT	20
4.1	FORECASTING FUTURE TRAFFIC FLOWS	20
4.2	TRAFFIC GROWTH TRENDS	20
4.3	MERGE / DIVERGE ASSESSMENT - RESULTS	21
5.	OPTION GENERATION AND ASSESSMENT	25
5.1	INITIAL OPTIONS	25
5.2	SHORT TERM SOLUTIONS	25
	LONG TERM SOLUTIONS	27
5.3	OPPORTUNITIES AND RISKS THAT COULD AFFECT ALL SOLUTIONS IN THE LONG TERM	29
6.	OPTION SELECTION	30
6.1	SIFTING	30
6.2	PREFERRED SHORT TERM SOLUTIONS	31
6.3	RECOMMENDED LONG TERM SOLUTIONS	32
6.4	CONCLUSIONS & NEXT STEPS	33

Appendix

Appendix A. 2016 Traffic Flows
Appendix B. Merge Diverge Assessments
Appendix C. Link Capacity Requirements
Appendix D. Collision Mapping
Appendix E. Future Year Traffic Flows
Appendix F. Full Options List and Key Issues in Assessment

List of figures

Figure 1. M42 Junctions 7-10	7
Figure 2. M42 Junction 7a (south) & (north)	8

M42 Junctions 7-10 Study

Step C: Options Assessment Report

FINAL Report

GB01T19C69 – 18OAR

17/06/2020

Figure 3. M42 Junction 9	9
Figure 4. M42 Junction 10	10
Figure 5. Extract from Highways England Route Strategy Evidence Report April 2014	13
Figure 6. Motorway Merging and Diverging Diagrams (Fig 3.12b and Fig 3.26b CD122)	15
Figure 7. Reproduction of Figure 3.14a layout A option 1 – taper merge CD122	16
Figure 8. Reproduction of Figure 3.14h layout F option 2 – lane gain with ghost island CD122	16
Figure 9. Annual collisions Summary for 2014-2018	18
Figure 10. M42 Junction 10 - Merge / Diverge assessment	21
Figure 11. M42 Junction 9 - Merge / Diverge assessment	22
Figure 12. M42 Junction 7/7a - Merge / Diverge assessment	23
Figure 13. Strategic Risks and Opportunities all options	29
Figure 14. Selected - Short Term Options	31
Figure 15. Selected - Long Term Options	32
Figure 16. Link flows J9 Diverge	49
Figure 17. Link flows J10 Diverge	50
Figure 18. Crashmap accident data – M42 Junction 7a north (2015 – 2018)	45
Figure 19. Crashmap accident data – M42 Junction 7a south (2015 – 2018)	45
Figure 20. Crashmap accident data – M42 Junction 9 (2015 – 2018)	46
Figure 21. Crashmap accident data – M42 Junction 9 (2015 – 2018)	46
Figure 22. Long list of options	51

List of Tables in the Appendix

Table 1. M42 J7a (south), 2016 North & South peak mainline and merge flows	34
Table 2. M42 J7a (north) 2016 North & South peak mainline and diverge flows	34
Table 3. M42 J9 2016 North & South peak mainline and merge/diverge flows	35
Table 4. M42 J10 2016 North & South peak mainline and merge/diverge flows	35
Table 5. Link flows J7a Merge	47
Table 6. Link flows J7a Diverge	48
Table 7. Link flows J9 Merge	49
Table 8. Link flows J10 Merge	50
Table 9. Merge Diverge Assessment for 2016 flows	36
Table 10. Merge Diverge Assessment for 2023 flows	37
Table 11. Merge Diverge Assessment for 2036 flows	38
Table 12. M42 J7a Merge areas required number of lanes	39
Table 13. M42 J7a Diverge required number of lanes	39
Table 14. M42 J9 Merge required number of lanes	40
Table 15. M42 J9 Diverge required number of lanes	40
Table 16. M42 J10 Merge required number of lanes	41
Table 17. M42 J10 Diverge required number of lanes	41
Table 18. J7a Merge required number of lanes	42
Table 19. J7a Diverge required number of lanes	42
Table 20. J9 Merge required number of lanes	43
Table 21. J9 Diverge required number of lanes	43
Table 22. J10 Merge required number of lanes	43
Table 23. J10 Diverge required number of lanes	44

INTRODUCTION

1.1 Purpose of the report

- 1.1.1 This Option Assessment Report (OAR) aims to set out solutions to the objective of addressing existing and future traffic issues arising along the M42 between Junctions 7-10, located to the east of Birmingham.
- 1.1.2 The report assesses issues arising on the M42 mainline and the implications of future traffic growth on its operation and the potential need for improvement.
- 1.1.3 The report will establish the need for intervention along the corridor and will document the development of potential improvement options to mitigate existing and future issues.
- 1.1.4 It is recognised that a wider package of infrastructure investments including at the M42 junctions, the surrounding local highways and national transport networks will have implications for the corridor. It is also recognised that parallel work is underway, led by Warwickshire County Council, to assess the needs of M42 Junction 9 itself. The purpose of the study and OAR are therefore to focus on issues relating to the M42 motorway mainline.
- 1.1.5 The key objectives of this stage of the project are to:
 - Review and document the current situation
 - Identify the need for intervention
 - Analyse the future situation
 - Identify short and long-term options to improve the M42 mainline
 - Review and assess the potential options

1.2 Structure of the Report

- 1.2.1 The remainder of the report is structured as follows:
 - Chapter 2 outlines the current situation
 - Chapter 3 establishes the need to intervention
 - Chapter 4 details the future situation
 - Chapter 5 details the option generation and initial assessment
 - Chapter 6 outlines selection and sifting of options and references preferred options

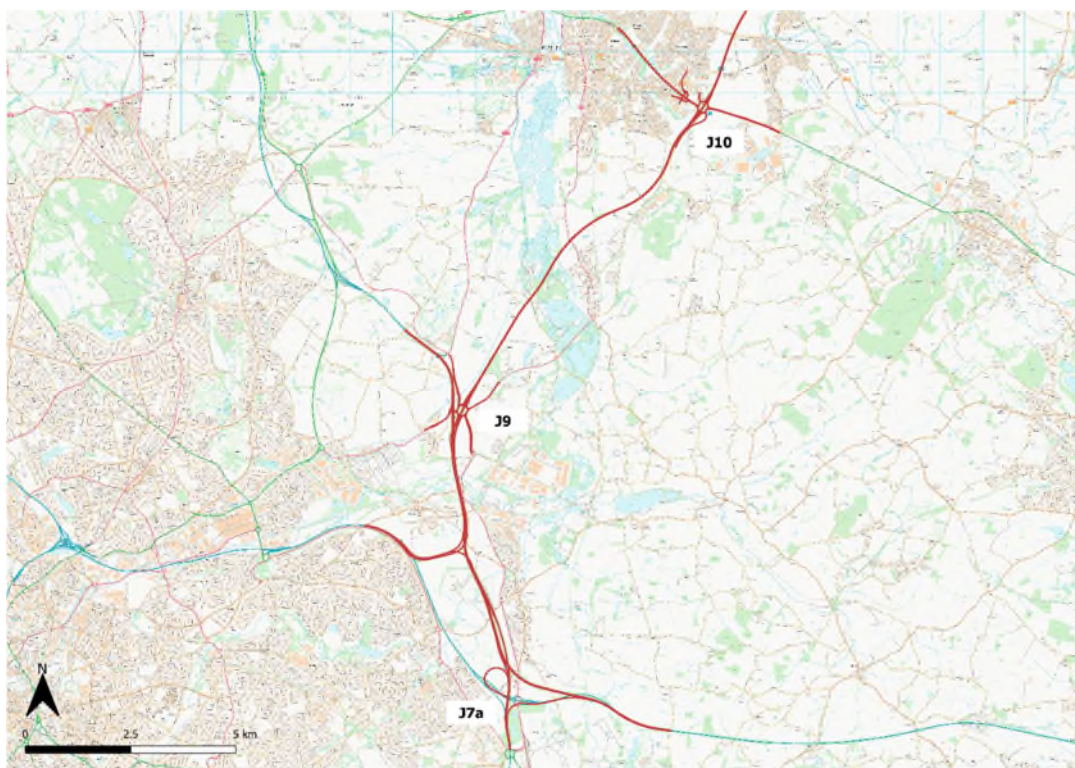
2. UNDERSTANDING THE CURRENT SITUATION

2.1 Area Context

M42 Junctions 7-10

- 2.1.1 The M42 motorway is a section of the Strategic Road Network (SRN) located to the east of Birmingham that runs north east from Bromsgrove in Worcestershire to south west of Ashby-de-la-Zouch in Leicestershire, passing Redditch, Solihull, the National Exhibition Centre and Tamworth on the way. A plan of the study area in the context of the wider geography is provided in the following figure:

Figure 1. M42 Junctions 7-10

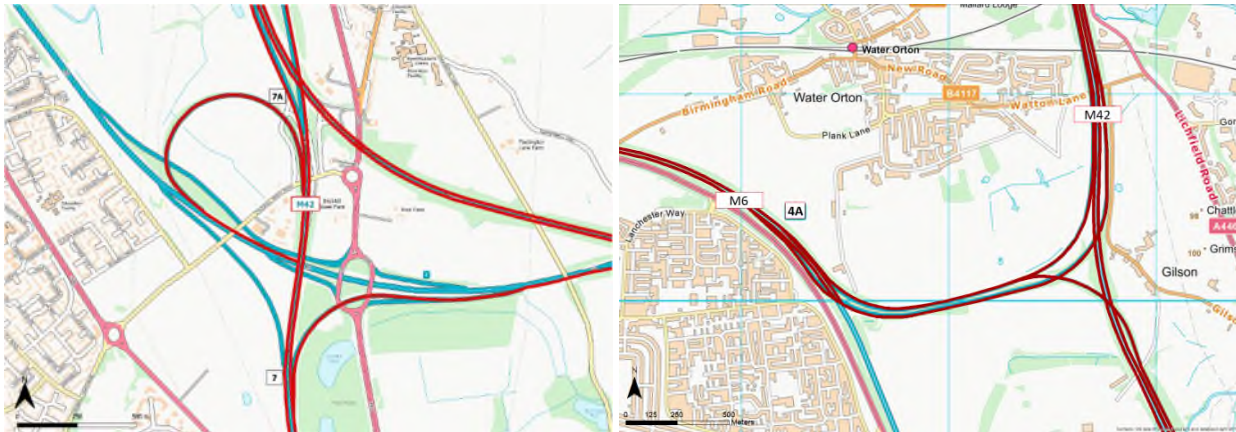


- 2.1.2 The SRN network within the study area offers provision for both local movements and as a primary north/south route, by commercial, commuter and tourist traffic traveling between the north and the Midlands. Furthermore, the M42 Junction 10 connects to the A5, a key east/west route, connecting both the East and West Midlands.
- 2.1.3 Heavy goods vehicles account for approximately 25% of traffic on the route.

M42 Junction 7-7a

- 2.1.4 The M42 Junction 7 to 7a section of the route forms a highway link characterised as comprising northern and southern sections. Each section of which provides for limited movements interchange with the M6 motorway and part of the M6 Toll route via a grade separated junction as shown in Figure 2.

Figure 2. M42 Junction 7a (south) & (north)



M42 Junction 7a (south)

- 2.1.5 At the southernmost section of the study area the M42 provides an interchange between the M42 northbound carriageway and the M6 motorway (in both directions). It also provides interchanges for both M42 southbound and M6 Toll southbound (which run parallel) with the M6 southbound.
- 2.1.6 The M42 and M6 Toll traffic cannot directly interchange with M6 Junction 4 which is located adjacent to the M42 section. Therefore, this section of the route does not provide for access to the local road network. For onward travel to nearby destinations, such as Solihull and Birmingham Airport, traffic can continue along the M42 to Junction 6 outside of study area to the south.

M42 Junction 7a (north)

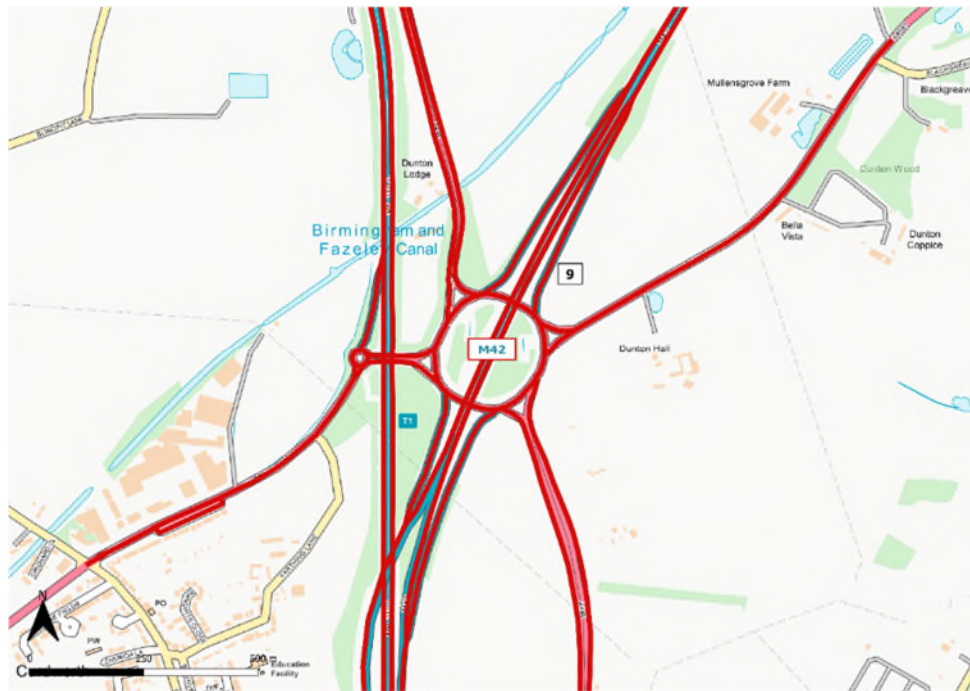
- 2.1.7 The northern section of M42 Junction 7a is located approximately 1.5 miles north of the southern section forming a short parallel network to the M6 route. For signing purposes from the M6 the junction is also referred to as M6 Junction 4a.
- 2.1.8 The junction provides a grade separated interchange for movement between M42 northbound and southbound carriageways and the M6 southbound. It also provides access from M42 southbound to M6 northbound.

M42 Junction 9

- 2.1.9 M42 Junction 9 is a large grade separated junction that provides interchange between the M42 and M6 Toll Motorways which combines with a grade separated gyratory junction for the local road network including the A446 and A4097 routes.

- 2.1.10 Free flow interchange is provided between the M42 (south) and M6 Toll with all other movements being accommodated for by the junction gyratory including via a secondary roundabout that provides access for local traffic to the M6 Toll as Figure 3 illustrates.

Figure 3. M42 Junction 9



- 2.1.11 For local connectivity purposes the junction provides access to the eastern areas of Birmingham including Sutton Coldfield and Minworth as well as parts of North Warwickshire. Significant housing and employment led development is planned in these areas that is anticipated to have an impact on the operation of the junction. This is considered in further detail in Section 3 of this report.

M42 Junction 10

- 2.1.12 M42 Junction 10 is a grade separated junction that provides interchange between the M42 and A5 Trunk Road as well as access to the local road network including Trinity Road and Green Lane leading to Tamworth Motorway Service Area.
- 2.1.13 Free flow traffic movements are only possible for traffic continuing along the M42 mainline any traffic interchanging between the M42 and A5 routes must utilise the roundabout located above the M42 which is a large 6 arm roundabout as Figure 4 shows.

Figure 4. M42 Junction 10



- 2.1.14 A significant proportion of traffic utilising the junction comes from the areas of Tamworth (to the west) and North Warwickshire (to the east) as well there being a strategic flow along the A5 corridor.
- 2.1.15 A high proportion of local traffic uses the M42 to travel south towards the West Midlands conurbation. The functional relationship between these areas gives rise to an identified 'tidal' pattern of traffic flow in the northern part of the study area. This generates a greater proportion of traffic flow in the southbound direction in the AM peak (for travel into the conurbation) and a corresponding reverse for northbound traffic flows in the PM peak.

2.2 Strategic Context

- 2.2.1 The M42 motorway forms a key SRN corridor between the East and West Midlands connecting the central Birmingham Box area to Nottinghamshire and the M1 motorway. This part of the report focuses on the constraints affecting the section between Junction 7 and M42 Junction 10 where regular commuting traffic between North Warwickshire and parts of Staffordshire mixes with longer distance traffic.

- 2.2.2 Towns and settlements to the north of the study area have a satellite relationship with the West Midlands conurbation such that they form part of the wider economic area as represented through bodies such as the Greater Birmingham and Solihull Local Enterprise Partnership and Warwickshire Local Enterprise Partnership.
- 2.2.3 The impacts of growth contained in Local Plan of North Warwickshire, Tamworth and Lichfield in the north of the study area, as well as those of Birmingham and Solihull to the south are expected to increase demand for travel along the M42 corridor. Growth in Birmingham includes significant urban extensions at Peddimore (employment led) and Langley (residential) both of which are forecast to have impacts on the operation of the M42 and M42 Junction 9 in particular.
- 2.2.4 A number of committed transport schemes are anticipated to increase demand for travel along the M42 J7-10 corridor as improvements elsewhere on the network are implemented. This includes current and committed improvements along the M42 and M6 to the south and east of the study area.
- 2.2.5 HS2 is also anticipated to result in increased vehicular travel on the M42 corridor due to the close vicinity of the planned Birmingham Interchange station and the combined implications of the proposed UK Central development area surrounding it which is currently being promoted by Solihull Council.
- 2.2.6 The role of the M42 as a focal point for regionally important economic development supports a strategic case for investment in the highway network throughout the study area.

2.3 Current travel demands

Survey context

- 2.3.1 It was recognised at the outset of the study that the context of the ongoing highways works within the Birmingham Motorway Box area (M5, M6 and M42) during the development of the M42 study would require a traffic base line comprising data sets from 2016 and 2017 to be used in the study. This was due, in particular, to major road works including those being undertaken on M5 Oldbury viaduct that significantly affected road conditions around the West Midlands motorway network. Therefore any 2018 or 2019 datasets would not be accurate or reflect typical traffic conditions on the SRN. It was therefore agreed with Highways England that the use of the traffic data obtained prior to the road works would be more appropriate.
- 2.3.2 The data sources which were used to assess existing conditions through traffic modelling undertaken for the study were as follows:
- WebTRIS link flows
 - M42 J9 MCC data from 21st June 2017 collected by Warwickshire County Council (WCC)
 - M42 J10 MCC collected on 16th June 2016 by WCC
 - TIS mobile network origin-destination data
 - TrafficMaster travel time data for J9 and 10 local roads (supplied by WCC)
 - TRIS journey time data and turn flows for 2016 for the M42 main carriageway and slips

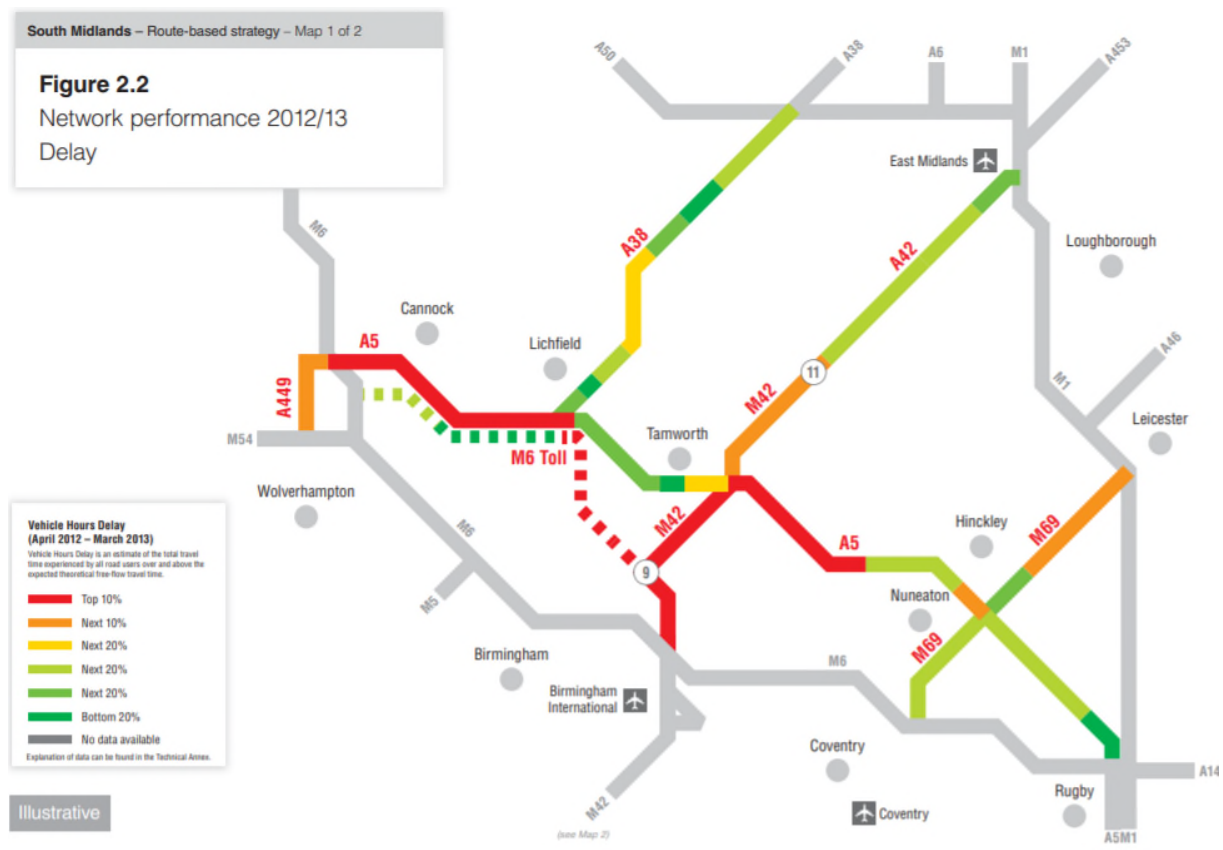
- 2.3.3 **Appendix A Tables 1 to 4** summarise the 2016 AM and PM peak period mainline, merge and diverge flows for M42 Junctions 7a, 9 and 10.
- 2.3.4 A broad characteristic of the corridor is that traffic levels are higher in the south of the study area than the north. Traffic flows increase as strategic flows joining from the A5, M6 and M6 Toll motorways converge towards the West Midlands metropolitan region and are joined by traffic with a more local purpose including commuting traffic which has an identified ‘tidal’ pattern of traffic flow occurring in the AM and PM weekday peak hours.
- 2.3.5 Mainline and merge/diverge traffic flows are highest through Junction 7/7a and on the M42 south of Junction 9. This area of the network with the greatest provision of highway capacity including up to 5 lanes for each of the northbound and southbound carriageways. Notwithstanding this capacity this section of the route must accommodate high traffic flows and the complex movements of weaving, merging and diverging traffic associated with the interchange of three motorways (M6, M6 Toll and M42) as well as local traffic accessing the SRN via M42 Junction 9.
- 2.3.6 The lowest traffic flows along the mainline corridor are found on the dual 2 lane carriageway section north of Junction 10 as the significant proportion of traffic travelling between Junctions 9 and 10 enter/exit at this junction without a correspondingly large flow travelling between Junction 10 and the areas to the north of the study area. The section of network between Junctions 9 and 10, also formed of a dual 2 lane section, has substantially high volume of traffic relative to its capacity compared to the M42 north of Junction 10. These issues are considered in Section 3 of this report.

3. ESTABLISHING THE NEED FOR INTERVENTION

3.1 Existing and Future transport-related issues

- 3.1.1 Traffic along the M42 between junctions 7 and 10 regularly experiences significant congestion affecting journey times during peak hours.
- 3.1.2 Traffic issues along this section of the network were acknowledged within Highways England's Route Strategies Report (April 2015) for the South Midlands which identified congestion associated with growth around Birmingham and M42 J9 as shown in Figure 5. This section of the network has been identified as being in the worst 10% of sections of the SRN for network performance and delay.

Figure 5. Extract from Highways England Route Strategy Evidence Report April 2014



- 3.1.3 A number of traffic constraints exist on the mainline sections which impact on the practical operating capacity of the M42. This relates to both the existing highway link (and lane) capacity as well as the capacity and design of the areas of merge and diverge at the junctions along the corridor.
- 3.1.4 Strategic growth planned in the area will place further pressure on the M42. By 2023, the M42 corridor is forecast to accommodate approximately 7% more journeys (compared to 2016) and by 2036 approximately 18% more journeys.

- 3.1.5 How future traffic growth will affect existing identified needs over time and give rise to new issues is considered in Section 4 of this report.

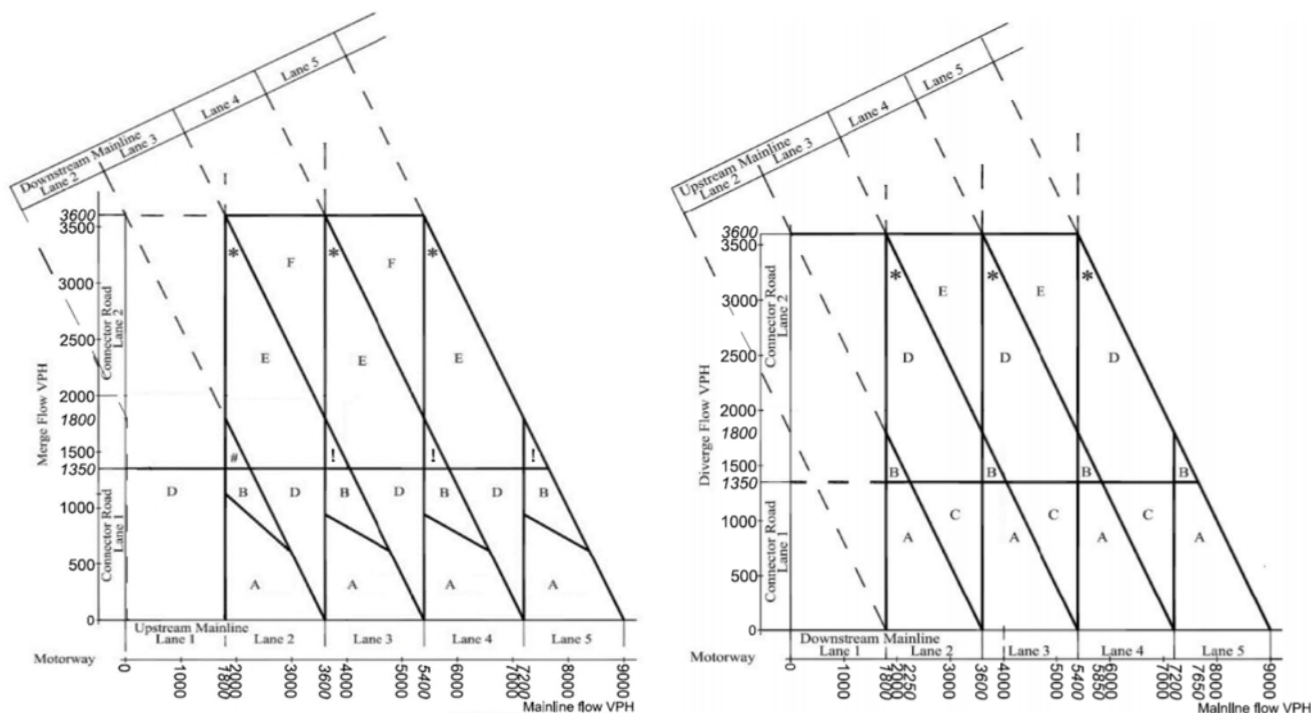
3.2 Engineering Assessment of the Route

- 3.2.1 The main features of a motorway mainline that affect capacity and traffic flow are the number of lanes, weaving movements and the suitability of the merge/diverge areas at junctions.
- 3.2.2 Based upon historic traffic flows and development trip generation predictions, the current merges and diverges are generally designed in accordance with TD 22/06 Layout of Grade Separated Junctions and TD 39/94 The Design of Major Interchanges. However, both TD22/06 and TD 39/94 have recently been replaced by CD122 Geometric Design of Grade Separated Junctions which became the relevant standard in August 2019.
- 3.2.3 According to CD 122, the design capacity of any motorway link shall be taken as a maximum of 1,800 vehicles per hour (vph) per lane. The value of maximum vph per lane does not represent the maximum hourly throughputs that is possible, but that greater flows often result in decreasing levels of service and safety. Traffic issues on a motorway link will typically begin to occur around this volume dependent on the particular features of the section and in all cases significantly prior to reaching the theoretical lane capacity due to variations in traffic flow.
- 3.2.4 The overall link and individual lane capacity of each mainline section and adjoining connector roads have been considered to assess their Volume to Capacity (V/C) ratio. The assessment allows for those links that are at or over their design capacity to be identified and therefore likely to be experiencing traffic flow issues. A comparison to Google Maps traffic identified that exiting traffic issues which occur during peak hours will often extend back from one link or section to those preceding. Observed issues on the network have been reviewed against traffic data to determine the cause of issues.
- 3.2.5 Assessments have identified that a significant number of the merge/diverges in the study area are not in accordance with current standards based upon either existing or forecast future traffic flows. These are areas of particular constraint where weaving and merging traffic reduce the practical capacity of links further below their theoretical capacity.
- 3.2.6 Where existing constraints are associated with merge/diverges opportunities exist to rebalance the number of lanes provided to the merge/diverge within current available road space subject to a suitable redesign. In other areas the existing carriageway widths are a physical constraint that would suggest that widening (or other appropriate solution) is necessary to provide additional lane capacity. Potential solutions to the issues identified are considered in Section 5 of this report.

3.3 Merge and Diverge Assessments

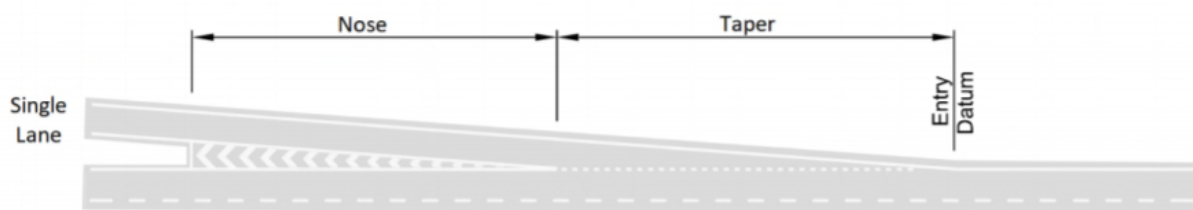
- 3.3.1 CD 122 sets out the method for assessing motorway merge and diverges including the methodology for calculating adjusted hourly design flows which should be based upon the worst-case peak flows. For motorway merging areas these should be assessed using Figure 3.12b and Figure 3.26b of the standard for diverges as reproduced in Figure 6 below.

Figure 6. Motorway Merging and Diverging Diagrams (Fig 3.12b and Fig 3.26b CD122)



- 3.3.2 The merge and diverge assessments were undertaken using the 2016 Base data and forecast years demand for 2023 and 2036. The full results including comparison to the existing layout are summarised within **Appendix B**.
- 3.3.3 The assessment compares the form of the existing merge / diverge areas along the route to the requirement DMRB arising from CD 122 for both AM and PM peak hour flows. Although CD122 has recently been adopted, and the assessment methodology refreshed since TD 22/06, the implications of this change are not significant for the overall conclusions of the assessment. The principles from the earlier standard have largely been consistently applied with some adjustments in the methodology for calculating traffic flows and a renumbering of certain merge/diverge types.
- 3.3.4 Consequently, recent changes to the DMRB are not seen as an issue driving the identification of a number of merge/diverges as not fitting the standard. The issues set out below instead largely arise from different needs of current traffic flows (or the future forecast flows) against the design traffic flows that will have been determined at the time the motorway was constructed.
- 3.3.5 During the design of a merge or diverge for a conventional grade separated junction the level of provision provided to the connector road will increase in accordance with the relative level of traffic flows on both the mainline section and connector. The simplest form of merge or diverge – Type A Options 1 and 2 merge and Type A Options 1 and 2 diverge are all formed by a taper from the mainline without any reduction in the number of lanes provided to the mainline. Figure 7 reproduces a ‘simple’ type of taper merge design in the form of Layout A Option 1 from CD122.

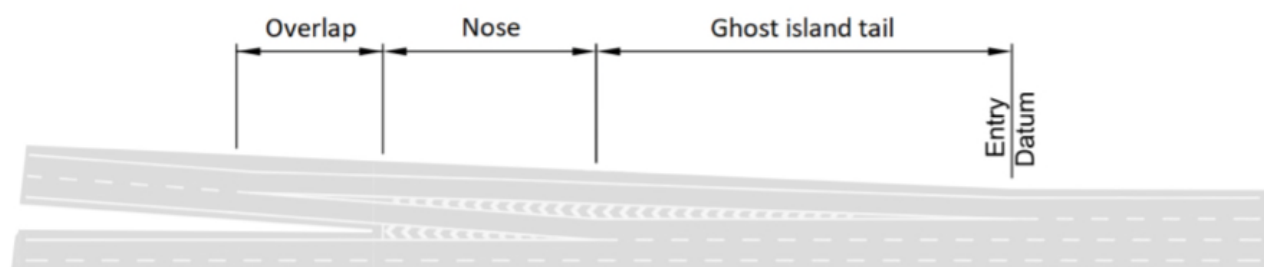
Figure 7. Reproduction of Figure 3.14a layout A option 1 – taper merge CD122



- 3.3.6 The Type A merge/diverge forms are typical of the merge / diverge at M42 Junction 10, and the north facing side of Junction 9. Although in the southbound direction M42 Junction 10 merge is formed of Type B parallel merge which provides some slight benefits to traffic flow.
- 3.3.7 As traffic flows increase on a connector road, more capacity is required for the merge/diverge. Above 1350 vph on the connector road a lane/gain or lane drop is usually required (with some exceptions).
- 3.3.8 The final form of the merge/diverge will depend on the balance of future flows expected between the main line and connector road. Figure 8 reproduces the more complex circumstance of a two-lane gain merge that is similar to the M42 Junction 9 southbound merge. Although it should be noted M42 J9 does not include the hatched area of the ghost island.

Figure 8. Reproduction of Figure 3.14h layout F option 2 – lane gain with ghost island CD122

Figure 3.14h Layout F - 2 lane gain with ghost island



- 3.3.9 The summary results of the merge/diverge assessment are set out for the base year (2016) alongside the forecast year assessment for 2023 and 2036 in Section 4 of this report.
- 3.3.10 In relation to Junction 7/7A there are sections of the highway under consideration that do not accord with the design principles of CD122. While historical design standards have varied over time, a number of non-standard sections exist due to the unique engineering design of the interchanges between the M42, M6 and M6 Toll.
- 3.3.11 In particular at the point of the M42's merge / diverge between the M6 and M6 Toll the M42 route is often not the 'mainline' in design or operational terms.

- 3.3.12 The mainline of a motorway in accordance with DMRB is at a junction (or fork) is the carriageway which continues to the right (adjacent to the central reserve). This presents the issue that the higher traffic flows continuing along the M42 route must perform the merge/diverge manoeuvre, while the lower traffic flows continue on the mainline.
- 3.3.13 Were the motorway interchanges built to the current standards in accordance with CD122, the higher traffic flow should form the mainline, and lower flow (M6 / M6 Toll traffic) should undertake the weaving manoeuvre and merging/diverge movements. This arrangement would be safer and more efficient. The current situation results in traffic issues and network constraints that arise at much lower levels of traffic flow than would be expected to occur based solely upon a course understanding of the link type (and number of lanes).

3.4 Link and Lane Capacity

- 3.4.1 A review of every highway link and individual traffic lane of the link was undertaken utilising the base VISSIM traffic model developed to support the study. A spreadsheet assessment method was then undertaken to establish how the Volume to Capacity of each link and lane would vary based on changes in traffic demand in future years.
- 3.4.2 In accordance with CD 122, this approach was used to identify the required number of traffic lanes per highway link, which would be likely to require improvement. Details of the lane requirements for the base and future years along each section of the route are provided in detail within **Appendix C** of this report.
- 3.4.3 From review of the corridor several sections have been identified where the required number of lanes will be insufficient to accommodate traffic flows in the future years of 2023 and 2036.
- 3.4.4 In addition, traffic flow evidence already identifies for both northbound and southbound carriageways between M42 Junction 9 and 10 the link flow is already approaching capacity, operating above the recommended flow of 1800 vph albeit only slightly above this threshold.

3.5 Current Safety Assessment

- 3.5.1 In order to understand the safety issues that currently exist along the study corridor, an initial collision analysis was undertaken using the Crashmap online database for the junctions and mainline within the study area for the period from January 2014 to December 2018.
- 3.5.2 Crashmap is a tool that produces a data visualisation of the official STATS19 data published by the Department for Transport which is based on records submitted to them by police forces. This assessment has been undertaken to understand whether there are likely to be specific clusters of accidents that would require further particular investigations along the route. A further assessment could then be undertaken utilising the more detailed STATS19 records available to Highways England if required.
- 3.5.3 Figure 9 shows a summary of all recorded collisions in the study area by year, junction and severity. The incidents listed are only the ones located on the section of the mainline motorway immediately before/after a diverge/merge and on the section of the merge/diverge connector roads themselves.

3.5.4 Very few accidents occur within the mainline highway link sections outside of these areas. The severity of collisions is recorded as slight, serious or fatal and are colour coded to replicate this.

Figure 9. Annual collisions Summary for 2014-2018

JUNCTION	2014			2015			2016			2017			2018		
	S	S	F	S	S	F	S	S	F	S	S	F	S	S	F
Junction 7a north Northbound Merge	1									1					
Junction 7a north Southbound Diverge				1			1								
Junction 7a south Northbound Merge															
Junction 7a south Northbound Diverge										2					
Junction 9 Northbound Diverge										1					
Junction 9 Southbound Diverge				1			1								
Junction 9 Northbound Merge				2											
Junction 10 Southbound Merge	1												1		
Junction 10 Northbound Merge							1			1					
Junction 10 Southbound Diverge													1		
TOTAL	2	0	0	4	0	0	3	0	0	4	1	0	2	0	0
	2			4			3			5			2		

3.5.5 As shown in Figure 9, the year with the highest number of recorded collisions was 2017, when there were 4 slight and 1 serious collision recorded in the study area. The 2017 serious collision was the only serious incident recorded between 2014-2018, which means that approximately 6% of all collisions are in the fatal or serious injury category.

3.5.6 The junction with the most incidents overall was junction 7a. However, this is a substantially larger and more complex interchange than Junctions 9 and 10 and the number of collisions associated with the merge / diverge areas remains small overall and therefore does not raise particular safety concerns.

3.5.7 The locations of the collisions in the vicinity of junctions 7a, 9 and 10 junctions are provided in **Appendix D**.

3.5.8 No particular cluster of accidents is determinable across the study area. Safety remains an important concern in the design of any intervention, but it is not a major factor in considering the need for improvements at this location.

3.6 Key Existing Issues

- 3.6.1 The main existing issues relate to the non-standard design of the merge/diverges. Despite the tidal nature of traffic flows the southbound direction experiences notably higher traffic delays associated with these issues at present than the northbound direction.
- 3.6.2 As is set out further in Section 4 a number of the existing merge and diverge provisions are substandard in the base and forecast years. This predominately relates to mismatches between the historical design flows and current actual traffic flows.
- 3.6.3 Where the M42 has its junction with M6 and M6 Toll roads the merge/diverge assessment demonstrates areas where the flow ranges are outside those considered by CD 122 Figures 3.12b and 3.26b.
- 3.6.4 The requirement of the standard is that the minor flow diverts from the motorway mainline, whereas, for legacy reasons, it is often the case that the majority of traffic flow diverts from the mainline where the M42 is not given the priority as the mainline. This leads to much higher levels of weaving than would otherwise be necessary. The weaving combined with an under provision of merge/diverge capacity for M42 traffic produces a bottle neck at several merge/diverge areas.
- 3.6.5 South of M42 Junction 9, there are issues with the M6 Toll interaction with the M42 being constrained, otherwise there is adequate capacity for traffic growth between the M42 mainline and the south facing parts of Junction 9 itself.
- 3.6.6 There is a link capacity issue currently between Junction 9 and 10 (in both directions) with the existing Dual 2 motorway having insufficient capacity to accommodate further traffic growth. In the PM peak hour, the northbound link is already operating above its theoretical design capacity.
- 3.6.7 The current traffic flows between Junctions 9 and 10 provide constraints which affect merging traffic in the southbound direction during the AM peak which will be worsened in future years.

4. FUTURE YEAR ASSESSMENT

4.1 Forecasting Future Traffic Flows

- 4.1.1 Following development of the traffic base model and assessment of base year traffic flows, future year forecast assessments have been conducted for the forecast years of 2023 and 2036.
- 4.1.2 The forecast year assessments were developed to consider traffic growth arising from Local Plan sites and committed schemes with an adjusted TEMPro growth rate for each year to reflect Local Plan figures.
- 4.1.3 For light vehicle traffic individual development traffic matrices were calculated, utilising relevant published Transport Assessments where sufficient data was available, these were constrained to relevant zones in the model with an appropriate adjusted TEMPro assessment. This reflects housing and employment forecast developments contained in Local Plans within the different zones of the model as follows:
- For Sutton Coldfield (to constrain growth West of J9)
 - For Birmingham (to constrain M6 West growth)
 - For North Warwickshire (i.e. the Atherstone area East of J10)
 - For Nuneaton and Bedworth (to apply to the area East of J9)
 - For Rugby (to constrain the M6 East growth)
 - For Tamworth (to constrain growth West of J10)
 - For Lichfield and Cannock (to constrain M6 Toll growth)
 - M42 through trips –West Midlands growth with all adjustments applied
- 4.1.4 In accordance with WebTAG guidance forecasting for heavy vehicle traffic was developed separately and is constrained to DfT Road Traffic Forecasts.
- 4.1.5 The Future forecasts have also considered implications arising from changing traffic flows associated with committed investments in strategic transport infrastructure such as Smart Motorways and HS2.
- 4.1.6 The future year forecast traffic flows for individual links are included **Appendix E** of the report.

4.2 Traffic Growth Trends

- 4.2.1 There is an increase in flows in the future of approximately 7% more journeys in 2023 and 18% in 2036.
- 4.2.2 In terms of the highest absolute increases in traffic flows the section of the network for M42 Junction 7a northbound including the merging section experiences the highest increase in traffic flows in both the 2023 and 2036 AM and PM peaks. Similarly, heading southbound, the merging mainline at Junction 7a experiences a similarly high increase in flows in the 2023 and 2036 AM and PM peaks.

- 4.2.3 At Junction 9 the northbound mainline merge and the southbound mainline merge show the greatest increases in traffic flows at the junction in the 2023 and 2036 AM peaks. The northbound mainline and southbound mainline also experiencing large increases in traffic flows in the 2023 and 2036 PM peaks.
- 4.2.4 At Junction 10, the northbound mainline diverge and the southbound mainline merge have the highest increases in traffic flows in both 2023 and 2036 forecast years. In particular, the increase are experienced in the southbound direction in the AM peak and northbound direction in the PM peak.
- 4.2.5 This traffic is associated with development and resulting traffic growth in North Warwickshire and Tamworth (A5 Corridor) continuing the trend of ‘tidal travel’ into the West Midlands conurbation.

4.3 Merge / Diverge Assessment - Results

- 4.3.1 The results of the merge diverge assessments for 2016, 2023 and 2036 are presented below. These are compared with the AM and PM peak hour flows for 2016 and the corresponding Volume to Capacity ratio for each link with 100% V/C representing the maximum design capacity of 1800vph per lane. It should be therefore noted that traffic flows above 100% are possible as the design capacity is only a guide to the practical capacity of a highway link.
- 4.3.2 For each existing M42 mainline section and adjoining connector road, the appropriate merge/diverge type is in accordance with DMRB CD 122. A summary of these assessment is included in Figures 10 to 12.

M42 Junction 10

Figure 10. M42 Junction 10 - Merge / Diverge assessment

Junction 10		2016 Link Flow		V/C 2016		CD122 Existing Type	DMRB Merge Diverge - Required Type		
Merge / Diverge	Link Flow (total veh)	AM	PM	AM	PM		2016	2023	2034
Merge	NB Mainline Upstream (Merge) NB Merge Connector	2722	3014	76%	84%	A1	A	A	A
	SB Mainline Upstream (Merge) SB Merge Connector	3506	3322	97%	92%	B	B	D	D
Diverge	NB Mainline Downstream (Diverge) NB Diverge Connector	3427	3650	95%	101%	B2	C	D	D
	SB Mainline Downstream (Diverge) SB Diverge Connector	3123	2895	87%	80%	A	A	A	C

- 4.3.3 Figure 10 demonstrates that the northern section of the M42 Junction 10 does not experience any existing traffic constraints. Also, the existing merge and diverge operate within their design parameters in both 2016 and 2023 year. By 2036 the Junction 10 to 11 southbound mainline flows are forecast to approach the link capacity of the Dual 2 lane mainline. Therefore, the southbound diverge would be likely to require improvement only as part of a widening scheme between junctions 10 and 11 which does not appear to be necessary prior to this year.
- 4.3.4 For the south section of M42 Junction 10 the link capacity between Junction 9 and 10 is close to being reached in the base year in both directions and during both peak hours. During the PM peak in the northbound direction the M42 mainline has already marginally exceeded its design capacity (101%).

- 4.3.5 In the forecast years the design capacity is exceeded and a need for improvement to both the merge diverge sections by 2023. This could only be made as part of a scheme of widening between Junctions 9 and 10 as the traffic flows require a lane gain / lane drop solution to 3 lane wide motorway.

M42 Junction 9

Figure 11. M42 Junction 9 - Merge / Diverge assessment

Junction 9		2016 Link Flow		V/C 2016		CD122 Existing Type	DMRB Merge Diverge - Required Type		
Merge / Diverge	Link Flow (total veh)	AM	PM	AM	PM		2016	2023	2034
Merge	NB Mainline Upstream (Merge) NB Merge Connector	3418	3635	95%	101%	A1	D	D	D
	SB Mainline Upstream (Merge) SB Merge Connector	5224	4491	73%	62%	N/A (Not CD122)	E	F	F
Diverge	NB Mainline Downstream (Diverge) NB Diverge Connector	4533	5321	63%	74%	E	D	D	D
	SB Mainline Downstream (Diverge) SB Diverge Connector	3511	3305	98%	92%	A	A	C	C

- 4.3.1 Figure 11 demonstrates the north section of Junction 9 (southbound diverge and northbound merge) exhibits a mirror to the issues on the southern side of M42 Junction 10 with the capacity of the Junction 9-10 link being a constraint. The southbound diverge is still within capacity in 2016 but would require improvement in 2023, whereas the northbound merge already exceeds capacity.
- 4.3.2 At Junction 9 in the 2036 future year, the northbound mainline merge requires layout type D in the AM and layout type B in the PM peak compared to the current layout type A1. The southbound diverge requires layout type C rather than type A which is currently provided. Where there is a difference between the requirements of peak hours the provision of the higher is generally preferred, however this may not always be possible.
- 4.3.3 For the south section from Junction 9 the V/Cs and merge/diverge assessment demonstrate that the northbound diverge section benefits from an over provision in capacity as it is formed of a Type E double lane drop. While this is not necessary in pure traffic terms the design is associated with the end of a 5-lane section of carriageway and successive diverges from the M6 Toll (considered below under M42 junction 7/7a).
- 4.3.4 Correspondingly, although the southbound merge is not designed in accordance with any of the current DMRB requirements, as a 2-lane parallel merge the design does, in practical terms provide a similar level of traffic capacity to a Type F – 2 lane ghost island merge. Consequently, this existing non-standard solution has been identified to be sufficient in capacity terms even in the 2036 forecast year.

M42 Junction 7/7A

- 4.3.5 It can be seen from the overall pattern of V/C results for 2016, and the results of the merge diverge assessment outlined in Figure 12 there is a misalignment between the theoretical available capacity of the mainline sections and the suitability of the current merge diverge arrangements from the base year through to 2036.

Figure 12. M42 Junction 7/7a - Merge / Diverge assessment

Junction 7a		2016 Link Flow		V/C 2016		CD122 Existing Type	DMRB Merge Diverge - Required Type		
Merge / Diverge	Link Flow (total veh)	AM	PM	AM	PM		2016	2023	2034
Merge	NB Mainline (M6 WB) M42 NB (Merging with M6 WB)	4408	5740	61%	80%	G1	G1	N/A	N/A
	NB Mainline NB Merge from M6 EB	5716	7639	64%	85%	E	D	E	F*
	SB Mainline (M6 Toll SB) M42 SB (Merging with M6 Toll SB)	6146	4804	85%	67%	E	N/A	N/A	N/A
	SB Mainline SB Merge from M6 EB	5966	4925	110%	91%	C	E	E	E
	NB Mainline NB Diverge to M6 EB	4345	5199	80%	96%	A	A	C	C
Diverge	NB Mainline (M6 Toll NB) NB Diverge to M42 NB	5712	7634	63%	85%	N/A (Not CD122)	N/A	N/A	N/A
	SB Mainline SB Diverge to M6 WB	5237	4487	73%	62%	E	B	B	D
	SB Mainline (M6 EB is Mainline) SB Diverge to M42 (M42 is diverge)	6143	4811	85%	67%	N/A (Not CD122)	N/A	N/A	N/A

*A Type F merge is required however the link flow would require a 6 lane mainline which would necessitate a departure from standard

- 4.3.6 A significant number of the existing merge and diverge provisions are not to standard when assessed with 2016 flows for either the morning or evening peak hours. which is only partly changed in the forecast years.

Junction 7/7a (north) - M42 interchange with the M6 Toll

- 4.3.7 The current arrangement of the M42 and M6 Toll carriageways result in an unusual merge/diverge assessment on account of the significantly lower traffic flows utilising the M6 Toll verses the M42 motorway for both northbound and southbound directions. The M6 Toll forms the 'mainline' at this interchange yet the M42 carries significantly higher traffic flows that are required to weave at the point of the northbound diverge and southbound merge.
- 4.3.8 This arrangement is not accommodated for in CD122, therefore the resulting merge/diverge assessment are marked N/A in terms of there being no applicable design standard (note they were also not provided for within the withdrawn standards of TD22/06 and TD39/94). Any design for this interchange is therefore subject to a requirement for a Departure from Standard.
- 4.3.9 The M6 Toll route is afforded a significant over provision of lane capacity which limits the available lane capacity afforded to traffic on the M42. While the mainline section between the M6 Toll and M6 interchanges provides for 5 lanes of traffic in the northbound direction and 6 lanes in the southbound direction, this highway is not efficiently used at the merge/diverge areas.
- 4.3.10 Capacity constraints already occur on the M42 southbound movements in the AM and northbound movements in PM peak hours in 2016. These issues worsen in the forecast years.

Junction 7/7a (south) - M42 interchange with the M6

- 4.3.11 Where the M42 interchanges with the M6 at Junction 7/7a (south) the most significant traffic issue relates to the merge of the M42 southbound with the M6 eastbound (signed southbound).

- 4.3.12 These routes run parallel for an approximately 1.5 miles with 3 lanes provided for the M42 mainline and 2 lanes to the M6 eastbound connector road. This merges to a 3-lane carriageway through a Type C ghost island merge which is wholly insufficient in capacity terms for current AM peak hour and future year flows for both peaks. The link capacity for the downstream section, at 3 lanes, is a fundamental bottleneck for this section of the route.
- 4.3.13 Immediately prior to this merge the M42 diverges to the M6 eastbound, although the M42 has the higher traffic flows at the diverge the M6 forms the 'mainline' section thus the larger flow weaves to the diverge. This type of arrangement is not catered for within CD122 and the traffic flows associated with this section also do not result in any merge/diverge design that is in accordance with current standards. While this arrangement may be sub-optimal, in theoretical terms any change would require improvement to the M42 mainline to add capacity upstream prior to the diverge which does not appear to be necessary.
- 4.3.14 For the M42 northbound direction, merging traffic for the M42 mainline from both the M6 eastbound and westbound directions do not typically present issues in 2016 and the current arrangements either represents a slight over provision (M6 eastbound merge) or is in accordance with the current standards of CD122 (M6 westbound merge). The operating traffic conditions are however forecast to deteriorate in the future years such that by 2036 both merges are not in accordance with the required standards. By 2036 traffic flows are forecast to be too high for any solution to be in accordance with CD122 which would therefore necessitate the design of a solution that required a departure from standard.
- 4.3.15 The M42 northbound diverge to M6 eastbound is also identified to be over capacity in future years This is predominantly a PM peak hour issue, however and is related to link capacity of the 3-lane section.

5. OPTION GENERATION AND ASSESSMENT

5.1 Initial Options

- 5.1.1 An options generation process has been developed by SYSTRA following on from the engineering assessment of the study area to consider a range of potential schemes to provide both short and/or long-term solutions to the needs of the corridor. At the current stage of development of the OAR this list remains open subject to comment from Highways England or other stakeholders.
- 5.1.2 The principal objective of the majority of interventions is to provide additional capacity for traffic or to make better utilisation of existing highway capacity where it has been identified that the current highway layout is suboptimal for present and future traffic flows.
- 5.1.3 A brief summary of each option is included below including a brief description of each option. A numerical cross reference is provided to a more detailed consideration of each option which is listed in **Appendix F** where the strengths and weaknesses of the identified options are also considered. The implications of this assessment are considered further in Section 6 of this report.
- 5.1.4 Options are divided into short-term and long-term options with the distinguishing difference that short term options are likely to be implementable within a timescale of the next 5 years subject to local funding opportunities arising, such as potential stimulus funding. These schemes are therefore similar to previous pinch point funding and are not expected to require the levels of investment that would be required to be identified for delivery through the Road Investment Strategy. A description as a 'short term' option does not automatically imply an option only has a short life span.

5.2 Short term solutions

- 5.2.1 The identified short-term interventions are set out below:

Network wide

1a Review signage provision to provide more direction / warning information

Improve wider strategic signage to avoid capacity constraints within the study area. Improve local signage to better manage weaving and merge/diverge

Junction 7 to 9 northbound

2a Reassign lane capacity at M6/M42 northbound merge

Drop M6 from 3 lanes to 2 lanes prior to merge area and provide more capacity to the M42 merge

2b Re-assign lane allocation at M42 northbound diverge from M6 Toll Road

Re-assign lane allocation providing additional road space to accommodate additional lane for M42, whilst restricting two lanes ahead on Toll Road.

Junction 9 to 7 southbound

3a Re-assign lane allocation at M6 diverge from M42

Re-assign lane allocation providing additional road space to M42 southbound traffic and reduce current over provision of capacity to M6 (N) diverge. A number of sub options to can be explored in this change in diverge type from the current Type E to ether a Type D1 or D2 which will be recommended for the future year o 2034, or to Types C, B1 or B2based on shorter term horizon forecast traffic flows.

3b Re-assign lane allocation at M42 merge with Toll Road

Re-assign lane allocation providing additional road space to accommodate additional lane for M42, whilst restricting to two lanes ahead on Toll Road (currently benefits from substantial spare capacity).

Junction 9

5a Ramp metering- northbound on slip

Provide a ramp metering system for M42 northbound on slip

5b Replace existing Type A (Option 2) merge with Type C ghost island merge slip lane - northbound on slip

Redesign northbound on slip to M42 to provide additional capacity for merging traffic

Junction 9 Note: No short-term improvement measures have been identified to be necessary for the merge/diverge areas for the southbound off-slip, northbound on slip or southbound on slip roads. Improvement needs related to the capacity of the roundabout junction are being considered separately by Warwickshire County Council in conjunction with Highways England through a separate assessment of needs.

Junction 10

8a Junction 10 northbound on slip merge improvement

Review existing Type B parallel merge arrangement with a view to see if Type C ghost island merge increases capacity

8b Junction 10 southbound on slip merge improvement

Review existing Type B parallel merge arrangement with a view to see if Type C ghost island merge increases capacity

Junction 10 Note: No short-term improvement measures have been identified to be necessary for either, northbound or southbound off slip road diverge areas. It is assumed that improvements associated with Junction 10 roundabout junction may be required in the longer term due to previously identified needs however these issues lie outside the scope of this assessment.

Long term solutions

- 5.2.2 The identify longer term interventions which would require more significant investment in the preparation and delivery stages of development as well as significantly greater capacity costs are set out below:

M42 Junction 9 to 7 – Northbound and Southbound

4a M42 southbound merge with Toll Road - localised widening

Provide additional lane between / from Junction 9 and M6 diverge by means of introducing a lane gain arrangement requiring localised carriageway widening.

4b M42 diverge from M6 southbound - lane reallocation

Re-assign lane allocation providing 2 lanes for M6 main line and three lanes for M42 diverge, by removing shared lane. This option is identified to potentially require further physical segregation of the carriageway.

4c Full carriageway widening between M6 southbound merge/diverge and M6 Toll merge/diverge - northbound and southbound directions

Full or partial widening of the M42 carriageway to provide additional lane in northbound and southbound direction to priority links

4d Conversion to Smart Motorways ALR between M6 southbound merge/diverge and M6 Toll merge/diverge - northbound and southbound hard shoulder

Use of the Hard Shoulder as a running lane to achieve similar traffic capacity benefits of full or partial widening to northbound /southbound to priority links without physical carriageway widening.

Junction 9

6a Northbound on slip to M42 - Upgrade merge type (long term)

Replace existing Type A (Option 2) merge with Type D lane gain merge or Type C ghost island merge with Type E lane gain merge. Option is dependent upon capacity improvement to Junction 9 -10 such as widening or Hard Shoulder conversion to Smart Motorways.

M42 Mainline - Junction 9 to 10

7a Convert hard shoulder to running lane to provide a SMART Motorway.

Use of the Hard Shoulder as a running lane to achieve similar traffic capacity benefits of full or partial widening to northbound /southbound to priority links without physical carriageway widening.

7b Conventional carriageway widening – upgrade to Dual 3 lane motorway

Full widening of the M42 carriageway to provide an additional lane in both northbound and southbound directions to provide an additional running lane.

7c Add additional capacity to the network by means of providing a parallel route

Identify an alternative parallel route for M42 traffic by providing a new parallel carriageway - such as an historic example of proposals for new M6 route between J12 and J19.

Other Long-Term proposals

9a Local network improvements to investigate if solutions can be found using both SRN and the local highway network in conjunction to direct traffic away from M42 junctions 7 to 10.

Improving the parallel A446 route for current journeys passing through M42 Junction 9 and M6 junction 4. Noted that local transport improvements could deliver benefits to the SRN without expensive widening works to the motorway.

9b Construct new infrastructure to remove identified traffic movements away from junctions 7 to 10 for example

- i. Extend Toll Road to join M6 further south for northbound traffic.
- ii. Provide new motorway from north of junction 9 to link with M6 north which would remove 'right turning' vehicle movements from study area.

5.3 Opportunities and Risks that could affect all solutions in the long term

5.3.1 Consideration has also been given to the further strategic opportunities and risks which may impact on the selection of individual options within the long list which are shown in Figure 13. These consider strategic external issues that lay outside of the capability of a scheme envelope to control.

Figure 13. Strategic Risks and Opportunities all options

M42 Junction 7 – 10 Mitigation Options		OPPORTUNITIES	RISKS
1	The alignment of the HS2 scheme is known to cross the Motorway at three locations within the study area: i. Between junctions 7a & 8 ii. Between junctions 8 & 9 iii. North of junction 9	i. Access to potential alternative funding streams.	i. Building new structures across the SRN to facilitate the HS2 alignment will create further restrictions on any improvement works, unless potential schemes can be safeguarded, and structures built accordingly. ii. Build period of HS2 which is likely to be a considerable number of years will impact upon the delivery period of any improvements to this section of Motorway.
2	Changes to Toll Road – if the toll charge were to be removed traffic patterns would change.	i. Potential to remove through traffic off the M6 and reduce congestion around the Birmingham Box.	i. Likely to result in increases in traffic flow through junction 7 to 9, M42.

6. OPTION SELECTION

6.1 Sifting

- 6.1.1 The main objectives for Highways England for the M42 Junction 7-10 study is to support economic growth and the safe operation of the network through the identification of short and longer-term intervention options. Short term options can then be developed through the appraisal processes ready to be delivered should funding become available.
- 6.1.2 It is further a necessary step and longer-term priority to identify where constraints on the M42 mainline will prevent the delivery of existing planned growth. Short term options will be most appropriate where they are either compatible with potential long-term needs or where they do not result in an intervention of limited expected life where a later intervention is required.
- 6.1.3 The shorter- and longer-term options presented within the Figures 14 and 15 have therefore been identified as having merit to proceed to further detailed appraisal, although at this stage the potential to consider other options has not been ruled out subject to feedback from Highways England and other stakeholders.
- 6.1.4 Short term options are anticipated to proceed towards delivery via Highways England's Operations Directorate following further detailed investigation. Long term options are defined as those requiring such significant capital investment that further assessment and escalation to Highways England Strategic and Planning Directorate would be required.
- 6.1.5 The selected short-term options identified below are proposed to form a preferred package of measures. Such options could also be delivered individually or in a smaller package if deliverability issues are identified during the value management or design stages.
- 6.1.6 As well as the selected short-term options package which are identified could move quickly towards delivery via Highways England's Operations Directorate (OD) a series of initial long-term options have been identified which would be required to deliver adequate capacity for the full forecast growth within the corridor.
- 6.1.7 Due to the scale of these options they would require further assessment via escalation to Highways England Strategic and Planning directorate. Those that relate to proposals for Smart Motorways would be subject to a future programme for Smart Motorways continuing following the Government's stocktake review. It is not anticipated therefore that any of these options could come forward before 2025 as part Road Investment Strategy (RIS) period 3 at the earliest.

6.2 Preferred Short term solutions

6.2.1 The preferred short-term interventions are set out in Figure 14 below:

Figure 14. Selected - Short Term Options

M42 JUNCTION	SHORT TERM SOLUTIONS	KEY RATIONALE
Network level	Increased signage - Review local and strategic signage along the corridor to support more efficient traffic movements	Low Cost, Supports Safety, Supports Customer and benefits to traffic
7-7a Northbound	Reassign lane capacity at M6/M42 northbound merge by dropping M6 from 3 lanes to 2 lanes prior to merge area and providing more capacity to M42 merge	Low Cost, Likely to provide high value for money
7-7a Southbound	Reassign capacity from M6 Toll merge to M42 mainline via ghost out lane 1 approach from M6 Toll Reassign capacity from M6 northbound diverge from M42 mainline by changing the diverge type (a number of sub options can be explored) Reassign capacity at M42 diverge from M6 southbound by providing 2 lanes for M6 mainline and 3 lanes for M42 diverge, by removing shared lane.	Low Cost, Likely to provide high value for money
9 Northbound	None selected	Significant traffic benefits unlikely without widening of J9-10
9 Southbound	None selected	Not a short-term priority
9-10 Mainline	None selected	Significant traffic benefits unlikely without widening of J9-10
10 Northbound	Review length of parallel diverge	Low Cost, Supports Safety, Customers and benefits to traffic
10 Southbound	Review length of parallel merge	Low Cost, Supports Safety, Customer and benefits to traffic

6.3 Recommended Long term solutions

6.3.1 The following longer-term interventions are recommended for further investigation and are set out in Figure 15 below:

Figure 15. Selected - Long Term Options

M42 JUNCTION	LONG TERM SOLUTIONS	KEY RATIONALE
7-7a Northbound	Smart Motorways - convert hard shoulder to running lane (third lane) and amend merge/diverge areas providing capacity to M42 movements	Most cost-effective long-term improvement option – subject to review of Smart Motorways programme
7-7a Southbound	Smart Motorways - convert hard shoulder to running lane (third lane) and amend merge/diverge areas providing capacity to M42 movements	Most cost-effective long-term improvement option – subject to review of Smart Motorways programme
9 Northbound	Convert from Type A merge to Type D (Lane gain) merge as part of widening / Smart Motorways	Provides coherent joined up solution to traffic growth for junction issues compatible with mainline capacity improvement
9 Southbound	None selected	Not an identified priority
9-10 Mainline	Smart Motorways - convert hard shoulder to running lane (third lane)	Most cost-effective long-term improvement option – subject to review of Smart Motorways programme
10 Northbound	Convert from Type A merge to Type B merge	Could be delivered in short term but only a long-term need
10 Southbound	Convert from Type B parallel merge to Type E Lane gain merge	Meets long term needs but could only be delivered as part of future widening)

6.4 Conclusions & Next Steps

- 6.4.1 The above selected short-term options are recommended to be developed further should funding become available during the RIS2 period (2020-2025). These could form a package of measures to support short-term operational improvements of the corridor.
- 6.4.2 A stakeholder engagement process is also recommended to seek feedback on the preferred options from Highways England's key partners, to identify any opportunities to refine the package and consider whether any 'in principle' concerns arise with deliverability.
- 6.4.3 The delivery route for the preferred option package will require a further stage of engineering development. This is to work up an initial design for each component of the package that can deliver the broad solutions identified in accordance with the DMRB standards. It is recommended this be undertaken in conjunction with Highways England's Progressive Asset Delivery (PAD) partner for Area 9, Kier Services.
- 6.4.4 The preferred option package will be required to demonstrate it can achieve a positive Benefit Cost Ratio (BCR) as part of Highways England's Value Management process. Therefore, the journey time benefits of the preferred schemes should be assessed through the VISSIM microsimulation model and a cost estimate developed for the scheme.
- 6.4.5 The Longer-term options identified in this report are not recommended for immediate delivery but could form part of Highways England's future priorities for major schemes to be delivered under the Road Investment Strategy (RIS) post-2025.

Appendix A – 2016 Traffic Flows

Tables 1 to 4 summarise the 2016 AM and PM peak period mainline, merge and diverge flows at the M42 Junctions 7a, 9 and 10.

The AM peak period is 07:30 – 08:30 and PM peak is 16:30 – 17:30

Table 1. M42 J7a (south), 2016 North & South peak mainline and merge flows

DIRECTION	LINK TYPE	AM	PM
Northbound	NB Mainline (M6 WB)	1062	1548
	M42 NB (Merging with M6 WB)	3346	4192
	NB Mainline	4415	5731
	NB Merge from M6 EB	1301	1908
Southbound	SB Mainline (M6 Toll SB)	2539	1551
	M42 SB (Merging with M6 Toll SB)	3607	3253
	SB Mainline	4378	3670
	SB Merge from M6 EB	1588	1255

Table 2. M42 J7a (north) 2016 North & South peak mainline and diverge flows

DIRECTION	LINK TYPE	AM	PM
Northbound	NB Mainline	3346	4192
	NB Diverge to M6 EB	999	1007
	NB Mainline (M6 Toll NB)	1184	2305
	NB Diverge to M42 NB	4528	5329
Southbound	SB Mainline	3607	3253
	SB Diverge to M6 WB	1630	1234
	SB Mainline (M6 Toll SB)	1765	1551
	SB Diverge to M6 EB	4378	3675

Table 3. M42 J9 2016 North & South peak mainline and merge/diverge flows

DIRECTION	LINK TYPE	AM	PM
Northbound	NB Mainline (J9-10)	2939	3023
	NB Merge Connector	479	612
	NB Diverge Connector	1594	2298
Southbound	SB Mainline (J9-10)	2973	2864
	SB Merge Connector	2251	1627
	SB Diverge Connector	538	441

Table 4. M42 J10 2016 North & South peak mainline and merge/diverge flows

DIRECTION	LINK TYPE	AM	PM
Northbound	NB Mainline (J10-11)	2033	3023
	NB Merge Connector	689	639
	NB Diverge Connector	1394	1275
Southbound	SB Mainline (J10-11)	2375	2262
	SB Merge Connector	1091	1060
	SB Diverge Connector	839	633

Appendix B – Merge Diverge Assessments

2016 Year Assessment

Table 5. Merge Diverge Assessment for 2016 flows

JUNCTION	LINK TYPE	EXISTING PROVISION	REQUIRED PROVISION AM	REQUIRED PROVISION PM
JUNCTION 7/7a	NB Mainline (M6 WB) M42 NB (Merging with M6)	G1	N/A – non standard requirement*	N/A – non standard requirement*
	NB Mainline NB Merge from M6 EB	E	D	E
	SB Mainline (M6 Toll SB) M42 SB (Merging with M6)	E	N/A – non standard requirement*	N/A – non standard requirement*
	SB Mainline SB Merge from M6 EB	C	E	B
	NB Mainline NB Diverge to M6 EB	A	C	A
	NB Mainline NB Diverge to M42 NB	N/A – non standard requirement	N/A – non standard requirement*	N/A – non standard requirement*
	SB Mainline SB Diverge to M6 WB	E	B	C
	SB Mainline SB Diverge to M6 EB	N/A – non standard requirement *	N/A – non standard requirement*	N/A – non standard requirement*
JUNCTION 9	NB Mainline Upstream (Merge)	A1	A	D
	SB Mainline Upstream (Merge)	N/A – non standard requirement *	E	E
	NB Mainline Downstream (Diverge)	E	D	E
	SB Mainline Downstream (Diverge)	A	A	A
JUNCTION 10	NB Mainline Upstream (Merge)	A1	A	A
	SB Mainline Upstream (Merge)	B	B	B
	NB Mainline Downstream (Diverge)	B2	B	C
	SB Mainline Downstream (Diverge)	A	A	A

* Nonstandard merge/diverge type is where traffic flows do not result in a Layout Type in accordance with DMRB CD 122. - See Report Section 4

2023 Year Assessment

Table 6. Merge Diverge Assessment for 2023 flows

JUNCTION	LINK TYPE	EXISTING PROVISION	REQUIRED PROVISION AM	REQUIRED PROVISION PM
JUNCTION 7	NB Mainline (M6 WB) M42 NB (Merging with M6 WB)	G1	N/A – non standard requirement*	N/A – non standard requirement*
	NB Mainline NB Merge from M6 EB	G2	E	E
	SB Mainline (M6 Toll SB) M42 SB (Merging with M6 Toll SB)	F	N/A – non standard requirement*	N/A – non standard requirement*
	SB Mainline SB Merge from M6 EB	C	E	B
	NB Mainline NB Diverge to M6 EB	A	A	C
	NB Mainline NB Diverge to M42 NB	N/A – non standard requirement*	N/A – non standard requirement*	N/A – non standard requirement*
	SB Mainline SB Diverge to M6 WB	E	D	C
	SB Mainline SB Diverge to M6 EB	C	N/A – non standard requirement*	D
JUNCTION 9	NB Mainline Upstream (Merge)	A1	D	D
	SB Mainline Upstream (Merge)	D	F	E
	NB Mainline Downstream (Diverge)	E	D	N/A – non standard requirement*
	SB Mainline Downstream (Diverge)	A	C	N/A – non standard requirement*
JUNCTION 10	SB Mainline Upstream (Merge)	B	D	N/A – non standard requirement*
	NB Mainline Downstream (Diverge)	B2	D	D

* Nonstandard merge/diverge type is where traffic flows do not result in a Layout Type in accordance with DMRB CD 122. - See Report Section 4

2036 Year Assessment

Table 7. Merge Diverge Assessment for 2036 flows

JUNCTION	LINK TYPE	EXISTING PROVISION	REQUIRED PROVISION AM	REQUIRED PROVISION PM
JUNCTION 7	NB Mainline (M6 WB) M42 NB (Merging with M6 WB)	G1	N/A – non standard requirement*	N/A – non standard requirement*
	NB Mainline NB Merge from M6 EB	G2	E	E
	SB Mainline (M6 Toll SB) M42 SB (Merging with M6 Toll SB)	F	N/A – non standard requirement*	N/A – non standard requirement*
	SB Mainline SB Merge from M6 EB	C	E	E
	NB Mainline NB Diverge to M6 EB	A	A	C
	NB Mainline NB Diverge to M42 NB	N/A – non standard requirement*	N/A – non standard requirement*	N/A – non standard requirement*
	SB Mainline SB Diverge to M6 WB	E	D	B
	SB Mainline SB Diverge to M6 EB	C	N/A – non standard requirement*	E
JUNCTION 9	NB Mainline Upstream (Merge)	A1	D	B
	SB Mainline Upstream (Merge)	D	F	E
	NB Mainline Downstream (Diverge)	E	D	N/A – non standard requirement*
	SB Mainline Downstream (Diverge)	A	C	C
JUNCTION 10	NB Mainline Upstream (Merge) NB Merge Connector	A1	N/A – non standard requirement*	B
	SB Mainline Upstream (Merge) SB Merge Connector	B	D	D
	NB Mainline Downstream (Diverge)	B2	D	D

* Nonstandard merge/diverge type is where traffic flows do not result in a Layout Type in accordance with DMRB CD 122. - See Report Section 4

Appendix C – Link Capacity Requirements

Tables 8 - 13 set out the existing and required number of traffic lanes for each section of the study area in accordance with the requirements of CD 122 for 2016 traffic year based upon the link flows for M42 mainline and adjoining links and connector roads at the point of the merge / diverge areas.

The required number of lanes for both 2023 and 2036 future years at each junction based on existing provision are provided in Tables 14 to 19.

Table 8. M42 J7a Merge areas required number of lanes

TIME PERIOD	NORTHBOUND LINK TYPE	CURRENT LANES (2016)	DMRB REQUIRED LANES	SOUTHBOUND LINK TYPE	CURRENT LANES (2016)	DMRB REQUIRED LANES
07:30 – 08:30	NB Mainline (M6 WB)	3	1*	SB Mainline (M6 Toll SB)	3	2*
	M42 NB (Merging with M6 WB)	3	2*	M42 SB (Merging with M6 Toll SB)	2	3
	NB Mainline	4	3	SB Mainline	3	3
	NB Merge from M6 EB	2	1	SB Merge from M6 EB	2	1
16:30 – 17:30	NB Mainline (M6 WB)	3	1*	SB Mainline (M6 Toll SB)	3	1*
	M42 NB (Merging with M6 WB)	3	3	M42 SB (Merging with M6 Toll SB)	2	2
	NB Mainline	4	4	SB Mainline	3	3
	NB Merge from M6 EB	2	2	SB Merge from M6 EB	2	1

Table 9. M42 J7a Diverge required number of lanes

TIME PERIOD	NORTHBOUND LINK TYPE	CURRENT LANES (2016)	DMRB REQUIRED LANES	SOUTHBOUND LINK TYPE	CURRENT LANES (2016)	DMRB REQUIRED LANES
07:30 – 08:30	NB Mainline	3	2	SB Mainline	2	3
	NB Diverge to M6 EB	1	1	SB Diverge to M6 WB	2	1*
	NB Mainline	3	1*	SB Mainline	3	1*
	NB Diverge to M42 NB	4	3*	SB Diverge to M6 EB	3	3

TIME PERIOD	NORTHBOUND LINK TYPE	CURRENT LANES (2016)	DMRB REQUIRED LANES	SOUTHBOUND LINK TYPE	CURRENT LANES (2016)	DMRB REQUIRED LANES
16:30 – 17:30	NB Mainline	3	3	SB Mainline	2	2
	NB Diverge to M6 EB	1	1	SB Diverge to M6 WB	2	1*
	NB Mainline	3	2*	SB Mainline	3	1*
	NB Diverge to M42 NB	4	3	SB Diverge to M6 EB	3	3

Table 10. M42 J9 Merge required number of lanes

TIME PERIOD	NORTHBOUND LINK TYPE	CURRENT LANES (2016)	DMRB REQUIRED LANES	SOUTHBOUND LINK TYPE	CURRENT LANES (2016)	DMRB REQUIRED LANES
07:30 – 08:30	NB Mainline Upstream	2	2	SB Mainline Upstream	2	2
	NB Merge Connector	1	1	SB Merge Connector	2	2
16:30 – 17:30	NB Mainline Upstream	2	2	SB Mainline Upstream	2	2
	NB Merge Connector	1	1	SB Merge Connector	2	2

Table 11. M42 J9 Diverge required number of lanes

TIME PERIOD	NORTHBOUND LINK TYPE	CURRENT LANES (2016)	DMRB REQUIRED LANES	SOUTHBOUND LINK TYPE	CURRENT LANES (2016)	DMRB REQUIRED LANES
07:30 – 08:30	NB Mainline Downstream	2	2	SB Mainline Downstream	2	2
	NB Diverge Connector	2	1	SB Diverge Connector	1	1
16:30 – 17:30	NB Mainline Downstream	2	2	SB Mainline Downstream	2	2
	NB Diverge Connector	2	2	SB Diverge Connector	1	1

Table 12. M42 J10 Merge required number of lanes

TIME PERIOD	NORTHBOUND LINK TYPE	CURRENT LANES (2016)	DMRB REQUIRED LANES	SOUTHBOUND LINK TYPE	CURRENT LANES (2016)	DMRB REQUIRED LANES
07:30 – 08:30	NB Mainline Upstream	2	2	SB Mainline Upstream	2	2
	NB Merge Connector	1	1	SB Merge Connector	1	1
16:30 – 17:30	NB Mainline Upstream	2	2	SB Mainline Upstream	2	2
	NB Merge Connector	1	1	SB Merge Connector	1	1

Table 13. M42 J10 Diverge required number of lanes

TIME PERIOD	NORTHBOUND LINK TYPE	CURRENT LANES (2016)	DMRB REQUIRED LANES	SOUTHBOUND LINK TYPE	CURRENT LANES (2016)	DMRB REQUIRED LANES
07:30 – 08:30	NB Mainline Downstream	2	2	SB Mainline Downstream	2	2
	NB Diverge Connector	1	1	SB Diverge Connector	1	1
16:30 – 17:30	NB Mainline Downstream	2	2	SB Mainline Downstream	2	2
	NB Diverge Connector	1	1	SB Diverge Connector	1	1

**There is a substantial over provision of lanes for the original design. This is for a number of reasons unique to each link but includes purpose such as maintaining continuity of lanes on the mainline carriageway between merging sections and due design flows for the M6 Toll flow being substantially different from actual flows.*

Required number of lanes 2023 and 2036 flows

Table 14. J7a Merge required number of lanes

TIME PERIOD	NORTHBOUND LINK TYPE	CURRENT LANES (2016)	REQUIRED LANES 2023	REQUIRED LANES 2036	SOUTHBOUND LINK TYPE	CURRENT LANES (2016)	REQUIRED LANES 2023	REQUIRED LANES 2036
07:30 – 08:30	NB Mainline (M6 WB)	3	1*	1*	SB Mainline (M6 Toll SB)	3	2*	2*
	M42 NB (Merging with M6 WB)	3	2	3	M42 SB (Merging with M6 Toll SB)	2	3	3
	NB Mainline	4	3	3	SB Mainline	3	3	3
	NB Merge from M6 EB	2	2	2	SB Merge from M6 EB	2	2	2
16:30 – 17:30	NB Mainline (M6 WB)	3	1*	2*	SB Mainline (M6 Toll SB)	2	1*	2
	M42 NB (Merging with M6 WB)	3	3	3	M42 SB (Merging with M6 Toll SB)	3	2	3
	NB Mainline	4	4	4	SB Mainline	3	3	3
	NB Merge from M6 EB	2	2	2	SB Merge from M6 EB	2	1	2

Table 15. J7a Diverge required number of lanes

TIME PERIOD	NORTHBOUND LINK TYPE	CURRENT LANES (2016)	REQUIRED LANES 2023	REQUIRED LANES 2036	SOUTHBOUND LINK TYPE	CURRENT LANES (2016)	REQUIRED LANES 2023	REQUIRED LANES 2036
07:30 – 08:30	NB Mainline	3	3	3	SB Mainline	4	3	3
	NB Diverge to M6 EB	1	1	1	SB Diverge to M6 WB	2	2	2
	NB Mainline (M6 Toll NB)	3	1*	1*	SB Mainline	3	3	3
	NB Diverge to M42 NB	4	3	3	SB Diverge to M6 EB	2	1*	2
16:30 – 17:30	NB Mainline	3	3	3	SB Mainline	4	2	3
	NB Diverge to M6 EB	1	1	1	SB Diverge to M6 WB	2	1	2
	NB Mainline (M6 Toll NB)	3	2*	2*	SB Mainline	3	3	3
	NB Diverge to M42 NB	4	4	4	SB Diverge to M6 EB	2	2	2

Table 16. J9 Merge required number of lanes

TIME PERIOD	NORTHBOUND LINK TYPE	CURRENT LANES (2016)	REQUIRED LANES 2023	REQUIRED LANES 2036	SOUTHBOUND LINK TYPE	CURRENT LANES (2016)	REQUIRED LANES 2023	REQUIRED LANES 2036
07:30 – 08:30	NB Mainline Upstream	2	2	2	SB Mainline Upstream	2	2	2
	NB Merge Connector	1	1	1	SB Merge Connector	2	2	2
16:30 – 17:30	NB Mainline Upstream	2	2	2	SB Mainline Upstream	2	2	2
	NB Merge Connector	1	1	1	SB Merge Connector	2	2	2

Table 17. J9 Diverge required number of lanes

TIME PERIOD	NORTHBOUND LINK TYPE	CURRENT LANES (2016)	REQUIRED LANES 2023	REQUIRED LANES 2036	SOUTHBOUND LINK TYPE	CURRENT LANES (2016)	REQUIRED LANES 2023	REQUIRED LANES 2036
07:30 – 08:30	NB Mainline Downstream	2	2	2	SB Mainline Downstream	2	2	2
	NB Diverge Connector	2	2	2	SB Diverge Connector	1	1	1
16:30 – 17:30	NB Mainline Downstream	2	2	2	SB Mainline Downstream	2	2	2
	NB Diverge Connector	2	2	2	SB Diverge Connector	1	1	1

Table 18. J10 Merge required number of lanes

TIME PERIOD	NORTHBOUND LINK TYPE	CURRENT LANES (2016)	REQUIRED LANES 2023	REQUIRED LANES 2036	SOUTHBOUND LINK TYPE	CURRENT LANES (2016)	REQUIRED LANES 2023	REQUIRED LANES 2036
07:30 – 08:30	NB Mainline Upstream	2	2	2	SB Mainline Upstream	2	2	2
	NB Merge Connector	1	1	1	SB Merge Connector	1	1	1
16:30 – 17:30	NB Mainline Upstream	2	2	2	SB Mainline Upstream	2	2	2
	NB Merge Connector	1	1	1	SB Merge Connector	1	1	1

Table 19. J10 Diverge required number of lanes

TIME PERIOD	NORTHBOUND LINK TYPE	CURRENT LANES (2016)	REQUIRED LANES 2023	REQUIRED LANES 2036	SOUTHBOUND LINK TYPE	CURRENT LANES (2016)	REQUIRED LANES 2023	REQUIRED LANES 2036
07:30 – 08:30	NB Mainline Downstream	2	2	2	SB Mainline Downstream	2	2	2
	NB Diverge Connector	1	2	2	SB Diverge Connector	1	1	1
16:30 – 17:30	NB Mainline Downstream	2	2	2	SB Mainline Downstream	2	2	2
	NB Diverge Connector	1	2	2	SB Diverge Connector	1	1	1

** N/A - The level of provision typically exceeds the traffic flows requirements either for reasons of design continuity with the preceding section or because actual flows are likely to be significantly below the forecast design reference flows used at the time of construction*

Appendix D – Collision Mapping

Figure 16. Crashmap accident data – M42 Junction 7a north (2015 – 2018)



Figure 17. Crashmap accident data – M42 Junction 7a south (2015 – 2018)



Figure 18. Crashmap accident data – M42 Junction 9 (2015 – 2018)

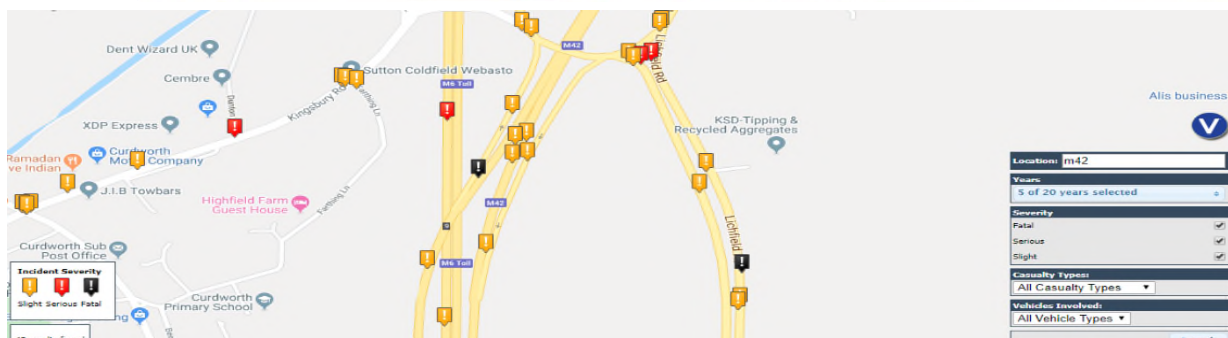
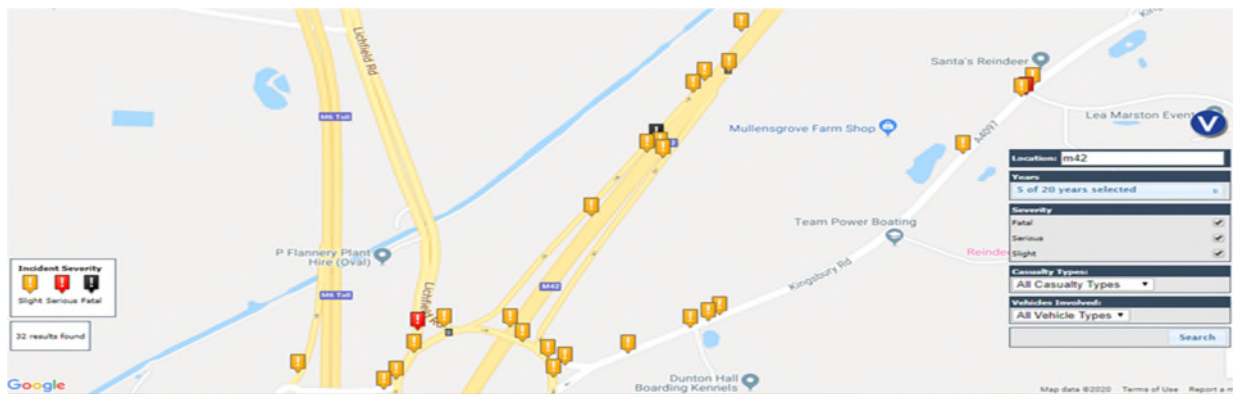
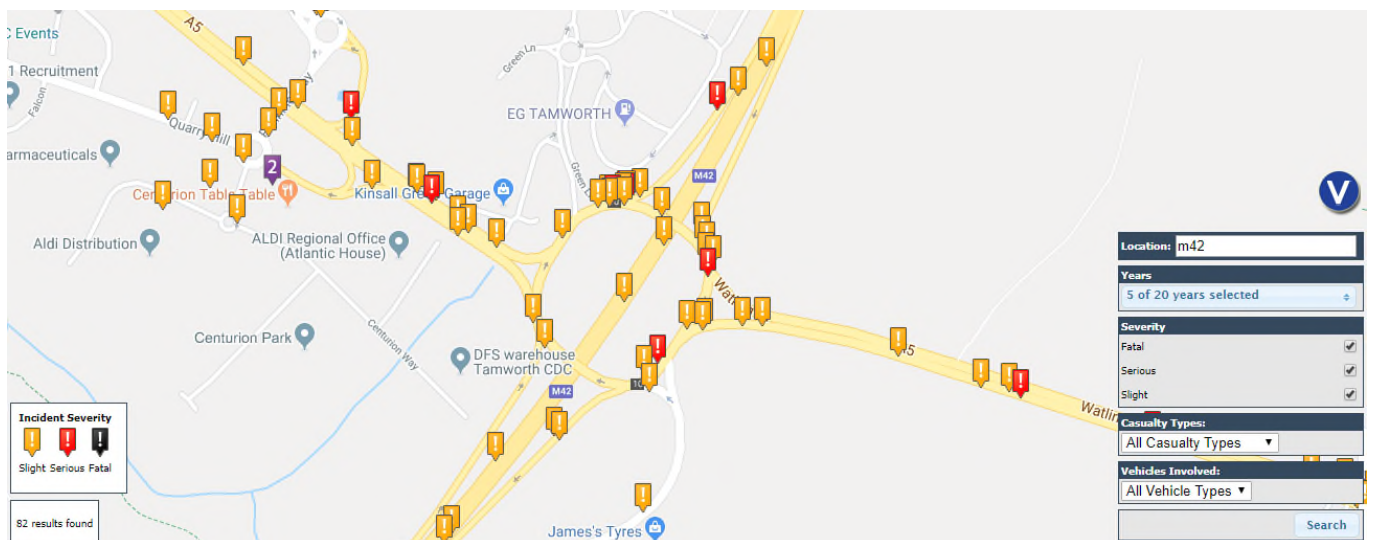


Figure 19. Crashmap accident data – M42 Junction 9 (2015 – 2018)



Appendix E – Future Year Traffic Flows

The future year traffic flow results for each link and junction connector are tabulated below in Tables 20 - 23.

Table 20. Link flows J7a Merge

DIRECTION	TIME PERIOD	LINK TYPE	2023 FLOWS	2036 FLOWS
Northbound	07:30 – 08:30	NB Mainline (M6 WB)	1140	1258
		M42 NB (Merging with M6 WB)	3591	3963
		NB Mainline	4738	5229
		NB Merge from M6 EB	1396	1541
	16:30 – 17:30	NB Mainline (M6 WB)	1659	1833
		M42 NB (Merging with M6 WB)	4493	4964
		NB Mainline	6143	6786
		NB Merge from M6 EB	2045	2259
Southbound	07:30 – 08:30	SB Mainline (M6 Toll SB)	2725	3007
		M42 SB (Merging with M6 Toll SB)	3871	4272
		SB Mainline	4699	5185
		SB Merge from M6 EB	1704	1881
	16:30 – 17:30	SB Mainline (M6 Toll SB)	1663	1837
		M42 SB (Merging with M6 Toll SB)	3487	3852
		SB Mainline	3934	4346
		SB Merge from M6 EB	1345	1486

Table 21. Link flows J7a Diverge

DIRECTION	TIME PERIOD	LINK TYPE	2023 FLOWS	2036 FLOWS
Northbound	07:30 – 08:30	NB Mainline	3591	3963
		NB Diverge to M6 EB	1072	1183
		NB Mainline	1271	1402
		NB Diverge to M42 NB	4860	5363
	16:30 – 17:30	NB Mainline	4493	4964
		NB Diverge to M6 EB	1079	1192
		NB Mainline	2471	2729
		NB Diverge to M42 NB	5712	6310
Southbound	07:30 – 08:30	SB Mainline	3871	4272
		SB Diverge to M6 WB	1749	1931
		SB Mainline	1894	2090
		SB Diverge to M6 EB	4699	5185
	16:30 – 17:30	SB Mainline	3487	3852
		SB Diverge to M6 WB	1323	1461
		SB Mainline	3934	4346
		SB Diverge to M6 EB	3073	3395

Table 22. Link flows J9 Merge

DIRECTION	TIME PERIOD	LINK TYPE	2023 FLOWS	2036 FLOWS
Northbound	07:30 – 08:30	NB Mainline Upstream (Merge)	3154	3481
		NB Merge Connector	514	567
	16:30 – 17:30	NB Mainline	3240	3580
		NB Merge	656	725
Southbound	07:30 – 08:30	SB Mainline Upstream (Merge)	3191	3521
		SB Merge Connector	2416	2666
	16:30 – 17:30	SB Mainline	3070	3391
		SB Merge	1744	1927

Figure 20. Link flows J9 Diverge

DIRECTION	TIME PERIOD	LINK TYPE	2023 FLOWS	2036 FLOWS
Northbound	07:30 – 08:30	NB Mainline Downstream (Diverge)	3154	3481
		NB Diverge Connector	1711	1888
	16:30 – 17:30	NB Mainline	3240	3580
		NB Diverge	2463	2721
Southbound	07:30 – 08:30	SB Mainline Downstream (Diverge)	3191	3521
		SB Diverge Connector	577	637
	16:30 – 17:30	SB Mainline	3070	3391
		SB Diverge	473	522

Table 23. Link flows J10 Merge

DIRECTION	TIME PERIOD	LINK TYPE	2023 FLOWS	2036 FLOWS
Northbound	07:30 – 08:30	NB Mainline Upstream (Merge)	2182	2406
		NB Merge Connector	739	816
	16:30 – 17:30	NB Mainline	2546	2812
		NB Merge	685	757
Southbound	07:30 – 08:30	SB Mainline Upstream (Merge)	2592	2860
		SB Merge Connector	1171	1292
	16:30 – 17:30	SB Mainline	2425	2678
		SB Merge	1136	1255

Figure 21. Link flows J10 Diverge

DIRECTION	TIME PERIOD	LINK TYPE	2023 FLOWS	2036 FLOWS
Northbound	07:30 – 08:30	NB Mainline Downstream (Diverge)	2182	2408
		NB Diverge Connector	1496	1651
	16:30 – 17:30	NB Mainline	2546	2812
		NB Diverge	1367	1510
Southbound	07:30 – 08:30	SB Mainline Downstream (Diverge)	2592	2860
		SB Diverge Connector	760	839
	16:30 – 17:30	SB Mainline	2425	2678
		SB Diverge	679	750

Appendix F – Full Options List and Key Issues in Assessment

Figure 22. Long list of options

M42 Junction 7 – 10 Mitigation Options		STRENGTHS	WEAKNESSES
1. Network wide - short-term solution			
1a	Review signage provision to provide more direction / warning information - Improve wider strategic signage to avoid capacity constraints within the study area - Improve local signage to better manage weaving and merge/diverge	i. A short-term solution which could be delivered whilst a more comprehensive solution is reached. ii. Low cost solution, should other schemes (HS2) impact / influence future traffic flows, resulting in fewer abortive works.	i. Additional signage may cause sign clutter that could lead to misinformation. ii. Existing road widths (lane numbers) could render additional signage ineffective. iii. Additional overhead gantries could be required to deliver an effective signing strategy. Spacing of which may be below DMRB minimum standards iv. Potentially limited benefits to driver behaviour and route choice
2. Junction 7 to 9 northbound - short-term solutions			
2a	Reassign lane capacity at M6/M42 northbound merge by dropping M6 from 3 lanes to 2 lanes prior to merge area and providing more capacity to M42 merge	i. A short-term solution which could be delivered with relatively low cost ii. M6 northbound connector has much lower traffic flows than M42 iii. Reduce weaving occurrence at and beyond the merge area	i. Involves changes to an existing non-standard merge area and likely to require a departure from standard
2b	M42 northbound diverge from M6 Toll Road. Re-assign lane allocation providing additional road space to accommodate additional lane for M42, whilst restricting two lanes ahead on Toll Road.	i. Increase capacity on M42 with little detriment to M6 Toll traffic flows. Traffic modelling demonstrates two lane requirements for Toll Road traffic flow. ii. No significant construction costs just change to signage on overhead gantries and lane markings. iii. Could be delivered in conjunction with or as a combination of Option 2a.	i. Potential safety issues with HGV movement to Toll Road. Firstly, sharing less lanes with other vehicles can lead to blocking and secondly before junction HGV's will need to weave to lane 4 (of 5 lane section) resulting in weaving manoeuvres. ii. Option does not facilitate any future changes to network operation that might result in increased traffic flow on the Toll Road. iii. Not evidently necessary in current year- Longer term issue only.

3. Junction 9 to 7 M42 southbound - Short term solutions			
3a	Re-assign lane allocation at M6 diverge from M42 to provide additional lane for M42 main line and reduce M6 diverge capacity to one lane and one shared lane (Type D1 or D2 diverge) - Sub options to explore change in diverge type to Type D1, D2, C, B1 or B2 (from current Type E over provision)	i. Increase capacity on M42 mainline with little detriment to M6 traffic flows. Traffic modelling demonstrates single lane requirement for M6 traffic flow. (once clear of junction carriageway provision can revert to two lanes before M42 overbridge). ii. No significant construction costs just change to signage on overhead gantries and lane markings. iii. Additional M42 lane will require safety assessment and consideration of interactions where it joins Toll Road, but lane gain option to be considered for third lane.	i. Alignment of additional M42 lane would be influenced by barrier separating flows from Toll Road and alignment might require departure. ii. Safety concern of reducing M6 diverge weaving area to one lane – although this may be mitigated by choosing type D options.
3b	M42 merge with Toll Road. Re-assign lane allocation providing additional road space to accommodate additional lane for M42, whilst restricting two lanes ahead on Toll Road.	iv. Increase capacity on M42 mainline with little detriment to M6 Toll traffic flows. Traffic modelling demonstrates two lane requirements for Toll Road traffic flow. v. No significant construction costs just change to signage on overhead gantries and lane markings. vi. Could be delivered in conjunction with or as a combination of Option 2a.	iv. Potential safety issues with HGV movement on Toll Road. Firstly, sharing less lanes with other vehicles can lead to blocking and secondly after junction HGV's will find themselves in lanes 2/3 resulting in weaving manoeuvres to negotiate back to appropriate lane allocations. v. Alignment of additional M42 lane would be influenced by concrete barrier separating flows from Toll Road and alignment might require departure. vi. Option does not facilitate any future changes to network operation that might result in increased traffic flow on the Toll Road.
3c	Provide additional signage in advance of merge and diverge lanes to advise drivers of correct lane allocation to reduce weaving close to junction.	i. Providing drivers with more advanced warning is a safety improvement which could be delivered as part of the current arrangements or in conjunction with either of options 2a and 2b above.	i. Additional signage may cause sign clutter that could lead to misinformation. ii. Additional overhead gantries could be required to deliver an effective signing strategy. Spacing of which may be below DMRB minimum standards.

4. M42 Junction 9 to 7 – Northbound and Southbound

Long term solutions

4a	M42 southbound merge with Toll Road Provide additional lane between / from Junction 9 and M6 diverge by means of introducing a lane gain.	i. As Option 2a but provides future proofing as the existing two lanes for M6 south are retained.	i. Notwithstanding construction costs and land acquisition this option requires widening of two railway bridges and two road bridges that carry the motorway over them and one road overbridge along with numerous gantry signage. ii. Cost could be significant.
4b	M42 diverge from M6 southbound Re-assign lane allocation providing 2 lanes for M6 main line and three lanes for M42 diverge, by removing shared lane.	i. Increase the capacity to the M42 diverge with little detriment to M6 (mainline) traffic. Traffic modelling demonstrates a two-lane requirement for M6 traffic flow. (once clear of junction M6 carriageway provision can revert to back to existing three lanes). ii. Most of the works will be changes to existing signage and road markings with some additional carriageway provision at junction	i. Removal of the shared lane moves the point at which traffic between the two motorways separate thus reducing the distance over which drivers have to decide on their lane choice. This could lead to drivers being on the wrong motorway and making illegal movements. ii. The introduction of a physical barrier may be required to address safety issues. iii. Any solution here would be non-standard due to flows
4c	M42 northbound and southbound full carriageway widening between M6 southbound merge/diverge and M6 Toll merge/diverge - Full or partial widening to provide additional lane in northbound /southbound to some / all links	i. Provides absolute increase in capacity to constrained links ii. Allows assignment of capacity to constrained M42 merge/diverges without compromise of existing provision to M6/M6 Toll mainline iii. Possible to deliver priority sections only rather than as a corridor treatment	i. Increase total weaving movements due to number of lanes and potential safety issues ii. Effective capacity gained via introduction of additional lanes in wider sections is lower than theoretical lane capacity due to weaving iii. High cost including impact on structures

4d	M42 northbound and southbound hard shoulder conversion to Smart Motorways ALR between M6 southbound merge/diverge and M6 Toll merge/diverge - Full or partial widening to provide additional lane in northbound /southbound to some / all links	i. Delivery would not adversely affect existing structures and could be considered cost effective. ii. Will provide a solution that addresses both existing and future growth scenarios for traffic flows between junctions 7 and 9.	i. SMART Motorways subject to review following safety concerns so may be an unviable solution. ii. Works will impact on traffic flows during construction with lane restrictions to one lane anticipated this will have significant impact on users and add to cost. iv. Delivered on its own, this solution would funnel traffic towards the congested areas to the north of junction 9 and should be delivered in conjunction with other solutions in that area.
5. Junction 9 northbound on slip to M42 short term solution			
5a	Provide a ramp metering system on ramp.	i. Subject to detail modelling, identification of any design constraints and ramp length assessment, ramp metering is seen as being a simple solution.	i. Solution may not be appropriate for all scenarios and part-time working (peak period only) may be considered. This can lead to inconsistencies with driver behaviour.
5b	Replace existing Type A (Option 2) merge with Type C ghost island merge slip lane	i. Little engineering works would be required to deliver the changes in design. ii. Solution would provide future proofing should decision to additional lanes between junction 9 and 10 be considered.	i. Current merge is non-compliant with DMRB standards. ii. Solution would be better delivered as part of a wider scheme proposal rather than a standalone solution.
6. Junction 9 northbound on slip to M42 long term solution			
6a	Replace existing Type A (Option 2) merge with Type D lane gain merge or Type C ghost island merge with Type E lane gain merge, dependent upon situation at the time.	i. As part of a much wider widening scheme this proposal will deliver significant benefits.	i. These types of merge can only be delivered as part of an overall widening scheme of the M42 between junction 9 and 10

7. M42 mainline improvements Junction 9 to 10 long term solution			
7a	Convert hard shoulder to running lane to provide a SMART Motorway.	iii. Delivery would not adversely affect existing structures and could be considered cost effective. iv. Will provide a solution that addresses both existing and future growth scenarios for traffic flows between junctions 9 and 10.	iii. SMART Motorways subject to review following safety concerns so may be an unviable solution. iv. Works will impact on traffic flows during construction with lane restrictions to one lane anticipated this will have significant impact on users and add to cost. v. Delivered on its own, this solution is not seen as being the ultimate solution as it will free traffic flows into the more congested areas to the south of junction 9 and should be delivered in conjunction with other solutions.
7b	Add an additional running lane in both directions by means of conventional widening	i. Will provide a solution that addresses both existing and future growth scenarios for traffic flows between junctions 9 and 10.	i. This will result in all structures between junctions 9 and 10 having to be rebuilt ii. Works will impact on traffic flows during construction with lane restrictions to one lane anticipated this will have significant impact on users and add to cost. iii. Delivered on its own, this solution is not seen as being the ultimate solution as it will free traffic flows into the more congested areas to the south of junction 9 and should be delivered in conjunction with other solutions.
7c	Add additional capacity to the network by means of providing parallel widening	i. Will provide a solution that addresses both existing and future growth scenarios for traffic flows between junctions 9 and 10. ii. By building either the north or south bound carriageway offline of the existing motorway will cause little detriment to traffic on the M42 during construction.	i. Building offline will create challenges at tie-ins with junctions 9 and 10 given current land constraints. ii. New structures will be required to cross existing roads and rivers. iii. Delivered on its own, this solution is not seen as being the ultimate solution as it will free traffic flows into the more congested areas to the south of junction 9 and should be delivered in conjunction with other solutions.

8. Junction 10 - short term solution			
8a	Junction 10 northbound on slip to M42 short term solution Review existing Type B parallel merge arrangement with a view to see if Type C ghost island merge increases capacity	i. Little engineering works would be required to deliver the changes in design.	i. Even though the works are small the actual benefit in changing the layout is to be proven and may not be cost effective.
8b	Junction 10 southbound on slip to M42 short term solution Review existing Type B parallel merge arrangement with a view to see if Type C ghost island merge increases capacity	i. Little engineering works would be required to deliver the changes in design.	i. Even though the works are small the actual benefit in changing the layout is to be proven and may not be cost effective.
9. Other Long-Term proposals			
9a	Local network improvements to investigate if solutions can be found using both SRN and Local Highway network in conjunction to direct traffic away from M42 junctions 7 to 10. - Such as improving parallel A446 route for current journeys passing through M42 Junction 9 and M6 junction 4	i. Could deliver benefits without expensive widening works to the motorway ii. Fits with wider programme and existing priorities identified by Warwickshire County Council	i. Will require Local Highway Authority support and funding. ii. Identification of scope of mitigation works could be extensive and programming such will need careful consideration.
9b	Construct new infrastructure to remove identified traffic movements away from junctions 7 to 10 for example i. Extend Toll Road to join M6 further south for northbound traffic. ii. Provide new motorway from north of junction 9 to link with M6 north which would in simple terms remove right turning vehicle movements from study area	i. Can delivered separate from other ongoing constraints such as HS2 alignment. ii. Can be delivered with minimal impact on existing motorway operation except for tie-ins.	i. Land and construction issues ii. Delivery Timescales may be excessive which does not address immediate concerns.

SYSTRA provides advice on transport, to central, regional and local government, agencies, developers, operators and financiers.

A diverse group of results-oriented people, we are part of a strong team of professionals worldwide. Through client business planning, customer research and strategy development we create solutions that work for real people in the real world.

For more information visit www.systra.co.uk

Birmingham – Newhall Street

5th Floor, Lancaster House, Newhall St,
Birmingham, B3 1NQ
T: +44 (0)121 393 4841

Birmingham – Alpha Tower

Crowne Plaza, Suffolk Street, Birmingham B1 1TT
T: +44 (0)121 393 4841

Dublin

2nd Floor, Riverview House, 21-23 City Quay
Dublin 2, Ireland
T: +353 (0) 1 566 2028

Edinburgh – Thistle Street

Prospect House, 5 Thistle Street, Edinburgh EH2 1DF
United Kingdom
T: +44 (0)131 460 1847

Edinburgh – Manor Place

37 Manor Place, Edinburgh, EH3 7EB
Telephone +44 (0)131 460 1847

Glasgow – St Vincent St

Seventh Floor, 124 St Vincent Street
Glasgow G2 5HF United Kingdom
T: +44 (0)141 468 4205

Glasgow – West George St

250 West George Street, Glasgow, G2 4QY
T: +44 (0)141 468 4205

Leeds

100 Wellington Street, Leeds, LS1 1BA
T: +44 (0)113 360 4842

London

3rd Floor, 5 Old Bailey, London EC4M 7BA United Kingdom
T: +44 (0)20 3855 0079

Manchester – 16th Floor, City Tower

16th Floor, City Tower, Piccadilly Plaza
Manchester M1 4BT United Kingdom
T: +44 (0)161 504 5026

Newcastle

Floor B, South Corridor, Milburn House, Dean Street, Newcastle, NE1 1LE
United Kingdom
T: +44 (0)191 249 3816

Perth

13 Rose Terrace, Perth PH1 5HA
T: +44 (0)131 460 1847

Reading

Soane Point, 6-8 Market Place, Reading,
Berkshire, RG1 2EG
T: +44 (0)118 206 0220

Woking

Dukes Court, Duke Street
Woking, Surrey GU21 5BH United Kingdom
T: +44 (0)1483 357705

Other locations:

France:

Bordeaux, Lille, Lyon, Marseille, Paris

Northern Europe:

Astana, Copenhagen, Kiev, London, Moscow, Riga, Wroclaw

Southern Europe & Mediterranean: Algiers, Baku, Bucharest,

Madrid, Rabat, Rome, Sofia, Tunis

Middle East:

Cairo, Dubai, Riyadh

Asia Pacific:

Bangkok, Beijing, Brisbane, Delhi, Hanoi, Hong Kong, Manila,
Seoul, Shanghai, Singapore, Shenzhen, Taipei

Africa:

Abidjan, Douala, Johannesburg, Kinshasa, Libreville, Nairobi

Latin America:

Lima, Mexico, Rio de Janeiro, Santiago, São Paulo

North America:

Little Falls, Los Angeles, Montreal, New-York, Philadelphia,
Washington