M5 Junction 10 Improvements Scheme

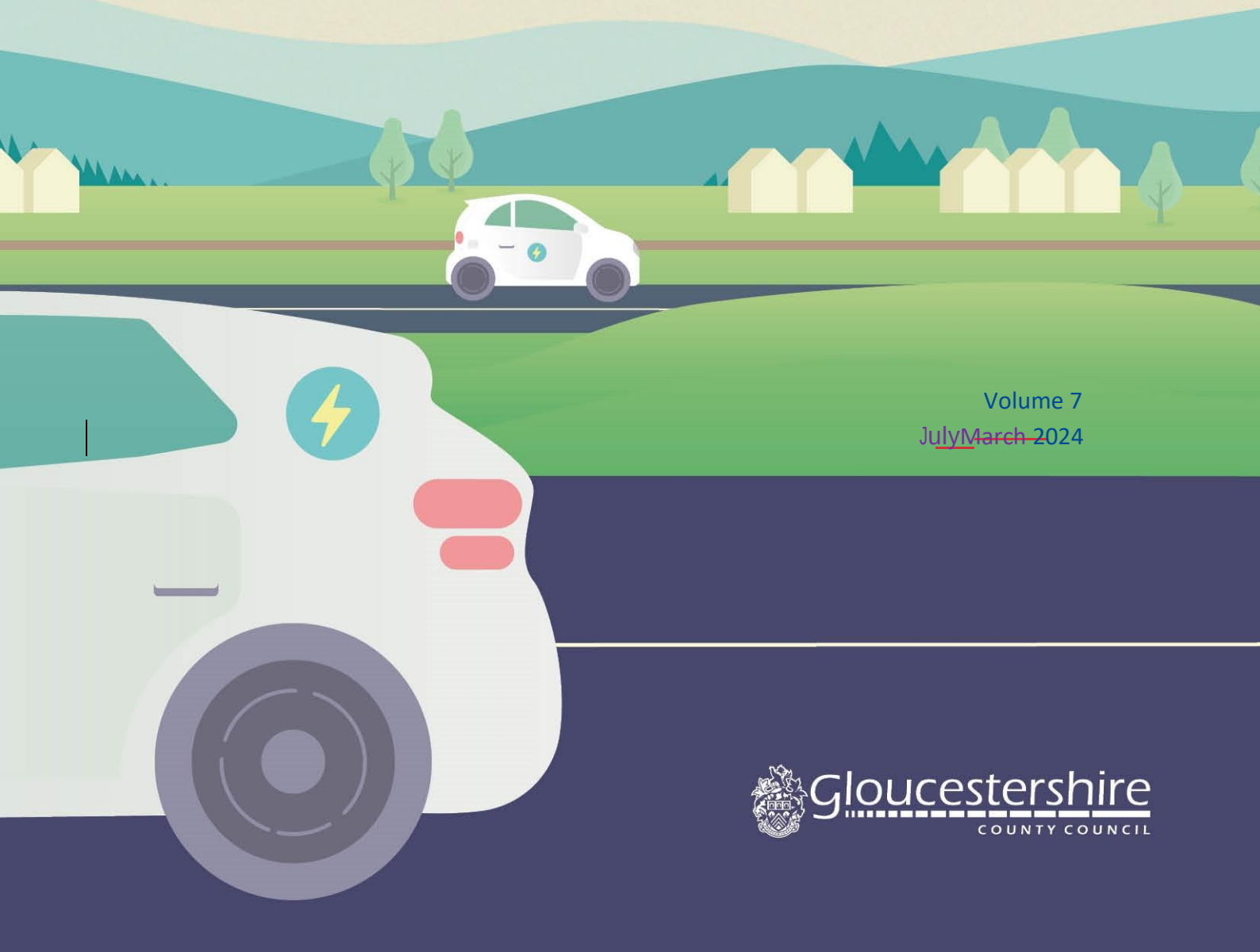
Transport Assessment (Tracked)

TR010063 – APP 7.5

Regulation 5 (2) (q)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009



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Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

M5 Junction 10 Improvements Scheme

Development Consent Order 202[x]

7.5 Transport Assessment (Tracked)

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Document accessibility

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1. Introduction

1.1.1. This Transport Assessment (TA) has been prepared to support the application by Gloucestershire County Council (GCC) for a Development Consent Order (DCO) to authorise the construction of the M5 Junction 10 Improvements Scheme (the 'Scheme').

1.2. Scheme Background

1.2.1. Gloucestershire faces significant challenges to achieve its vision for economic growth. An adopted Joint Core Strategy (JCS) – a partnership between Gloucester City Council, Cheltenham Borough Council (CBC) and Tewkesbury Borough Council (TBC) has been formed to produce a co-ordinated strategic development plan to show how the region will develop during the period 2011 - 2031. This includes a shared spatial vision targeting 35,175 new homes and 39,500 new jobs by 2031.

1.2.2. Major development of new housing (c.9,000 homes) and employment land is proposed in the JCS in strategic allocations and safeguarded land to the west and north-west of Cheltenham, much of which lies within TBC's boundary as the Local Planning Authority. This development, in turn, is linked to wider economic investment, including a government supported and nationally significant cyber business park (Cyber Central UK) adjacent to the Government Communications Headquarters (GCHQ) site in west Cheltenham, as part of the West Cheltenham allocation.

1.2.3. The existing M5 Junction 10 only provides access and egress to and from the north, with no connectivity to M5 south; this causes existing traffic to cross Cheltenham through various routes to access and leave the M5 from the south using other M5 junctions. This contributes significantly to existing traffic flows across Cheltenham, with significant congestion at peak times. To unlock the housing and job opportunities, a highway network is needed that has the capacity to accommodate the increased traffic it will generate, within a sustainable transport context.

1.2.4. Upgrading M5 Junction 10 to an all-movements junction has been identified as a key infrastructure requirement to enable the housing and economic development proposed by the Gloucestershire Local Enterprise Partnership's (GFirst LEP) Strategic Economic Plan and is central to the transport network sought by GCC in the adopted Gloucestershire Local Transport Plan. This planned housing and economic growth have been included in the adopted JCS. Improvements to the existing M5 J10 are critical to maintaining the safe and efficient operation of the junction; and enabling the planned development and economic growth around Cheltenham, Gloucester and Tewkesbury. A bid was submitted in March 2019 to Homes England to the Housing Infrastructure Fund (HIF), wherein an investment case was made for the following infrastructure improvements. Funding was successfully awarded by Homes England in March 2020:

- Element 1: Improvements to Junction 10 on the M5.
- Element 2: A new road linking Junction 10 to West Cheltenham.
- Element 3: A4019 widening, east of Junction 10.
- Element 4: A38/A4019 Junction Improvements at Coombe Hill.
- Element 5: An upgrade to Arle Court Park and Ride.

1.2.5. Elements 1, 2 and 3 comprise the M5 Junction 10 Improvements Scheme. The junction improvements at Coombe Hill (Element 4) and the upgrade to Arle Court Park and Ride (now known as the Arle Court Transport Hub) (Element 5) were included as part of the package of improvements funded by Homes England. As they do not form part of the proposed Scheme, and are located some distance from the junction, GCC has decided to take these two elements forward as separate packages of work in order to accelerate the programme for these ~~elements, and~~elements and will deliver them through separate planning strategies.

1.2.6. An application for a DCO under S.22 of the Planning Act 2008 has been submitted for carrying out works to M5 Junction 10, consisting of a new all-movements junction; the

widening of the A4019 east of the M5 J10 to the Gallagher Retail Park Junction; and a new West Cheltenham Link Road (the Link Road from the A4019 to the B4634). A small section of the A4019 will also be widened to the west of the M5 J10.

1.3. The Applicant

1.3.1. The application has been submitted by GCC and includes works to the Strategic Road Network (SRN) controlled by National Highways as well as works to the local road network managed by GCC's Highways Authority. If approved, the DCO powers will be granted to GCC, with both National Highways and GCC's Highway Authority acting as formal consultees to the Scheme.

1.4. The Designer

1.4.1. Atkins Limited has been appointed as the designer under GCC's highways framework to undertake the Preliminary Design of the Scheme. This includes responsibility for the preparation of this TA.

1.5. Need for a Transport Assessment

1.5.1. The Planning Act 2008 introduced a new planning system for determining Nationally Significant Infrastructure Projects (NSIP)s. Under the Act, the Department for Transport (DfT) which is responsible for preparing the National Policy Statement for National Networks (NN NPS), sets out government policy on the development of national road and rail networks. In establishing the general principles of assessment, Section 4.6 of NN NPS notes that applications for road and rail projects should usually be supported by a local transport model to provide sufficiently accurate detail of the impacts of a project, and the Aapplicant's assessment should include a proportionate assessment of the transport impacts on other networks as part of the application.

1.5.2. The TA will be submitted under Regulation 5(2)(q) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, as a document considered necessary to support the application.

1.5.3. The National Planning Policy Framework (NPPF) notes at Paragraph 113 that: All developments that will generate significant amounts of movement should be required to provide a Travel Plan (TP), and the application should be supported by a Transport Statement (TS) or Transport Assessment (TA) so that the likely impacts of the proposal can be assessed. As such, a TA has been prepared to accompany the DCO application for the Scheme.

1.5.4. It is important to note that the Scheme which is subject to the DCO application is a highway Sscheme. This highway Sscheme will enable the delivery of wider development, the impact of which will be assessed in a cumulative scenario and distinguished from the impact of the Scheme in isolation.

1.6. The Scheme

1.6.1. The infrastructure works under consideration in this TA comprise the following main elements which are, or are related to, changes to the strategic road network and together make up the Scheme:

- An all-movements junction at M5 Junction 10 (Scheme Element 1).
- A new West Cheltenham Link Road east of Junction 10 from the A4019 to the B4634 (Scheme Element 2).
- Widening of the A4019 to the east of Junction 10, including a bus lane on the A4019 eastbound carriageway from the West Cheltenham Fire Station to the Gallagher Junction (Scheme Element 3).

1.6.2. The locations of the proposed infrastructure elements that make up the wider M5 Junction 10 improvements are illustrated in Figure 2.

1.6.3. The improvements at Coombe Hill and extension to Arle Court Transport Hub have been progressed through planning applications. The elements can be seen in Figure 1

alongside the M5 Junction 10 Improvement Scheme. Figure 1 also illustrates the location of the major development of new housing (c.9,000 homes) and employment land proposed in the JCS in strategic allocations and safeguarded land to the west and north-west of Cheltenham.

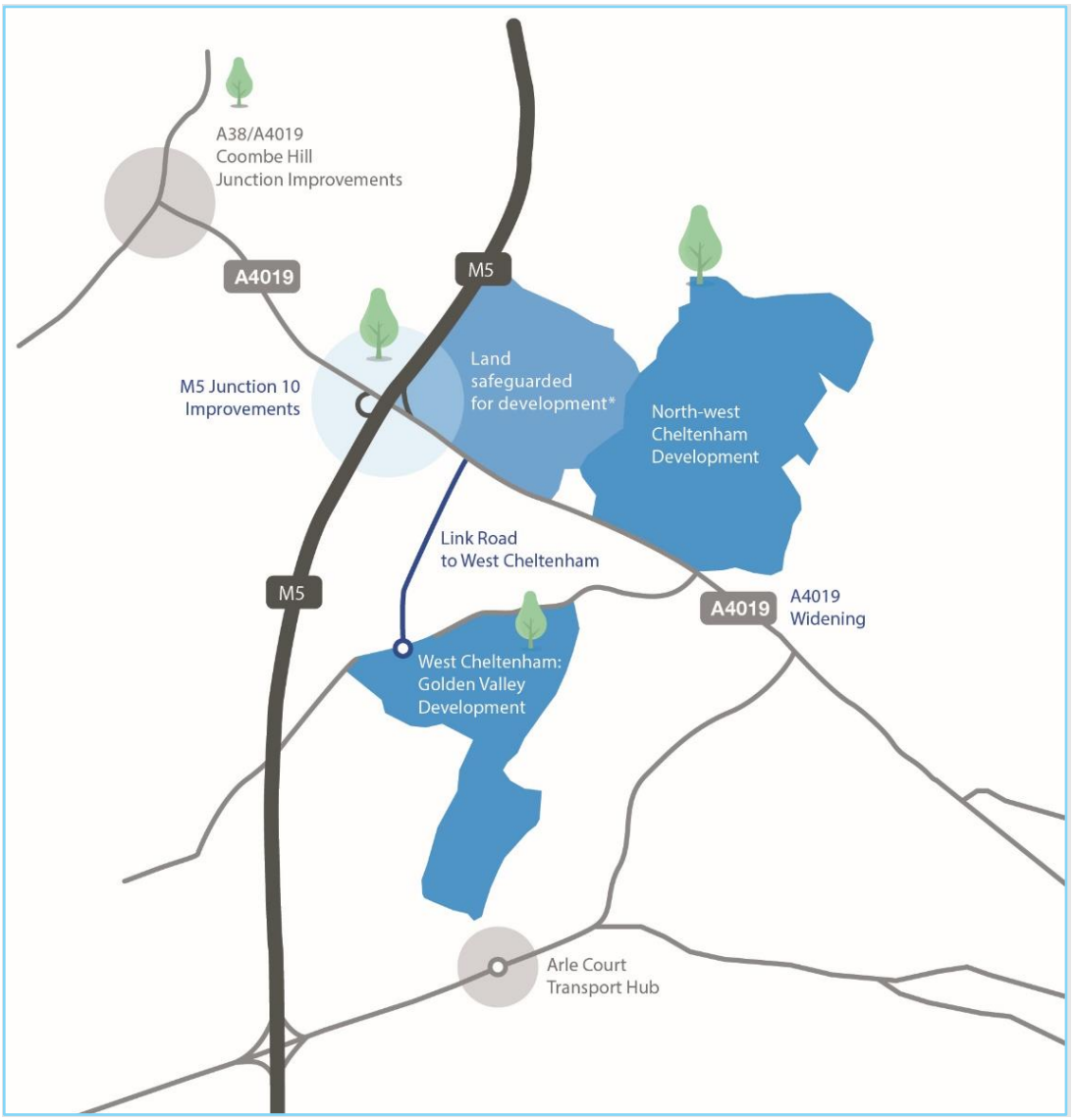


Figure 1 – North West and West Cheltenham Site Locations

1.7. Location of the Scheme

1.7.1. M5 Junction 10 is located 77km to the south of Birmingham, 8km to the south of Tewkesbury, 6km to the north-west of Cheltenham, and 13km to the north-east of Gloucester. It is the northernmost of four junctions serving the Gloucester and Cheltenham urban areas.

1.7.2. This places the junction in a strategically important location for the region, particularly as northern and western Cheltenham are the sites of ~~a number of~~several large retail parks and employment areas, and the location of planned future housing and NSIPs.

1.7.3. The locations of the proposed infrastructure improvements that make up the Scheme are illustrated in Figure 2.

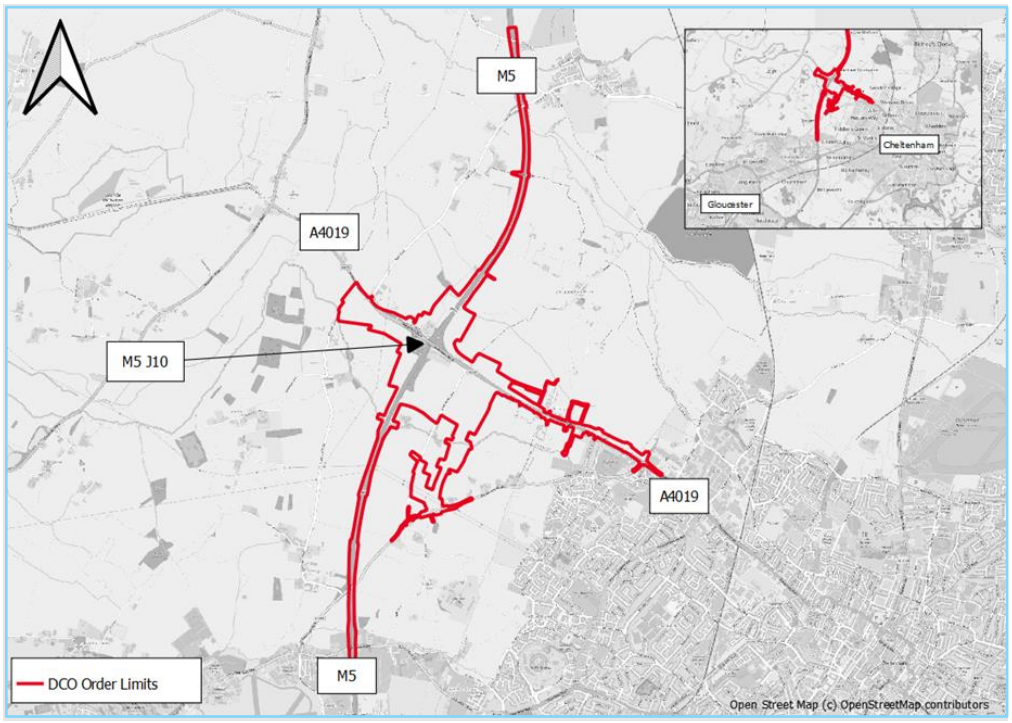


Figure 2 – Scheme Location

1.8. The Need for the Scheme

1.8.1. The need for the Scheme has been developed from the limitations of the existing M5 Junction 10, and the identification in the JCS of land for development in the vicinity of the existing junction:

- The existing M5 Junction 10 only provides access and egress to and from the north, with no connectivity to M5 south; this causes existing traffic to cross Cheltenham through various routes to access and leave the M5 from the south using other M5 junctions. This contributes significantly to existing traffic flows across Cheltenham, with significant congestion at peak times.
- Upgrading M5 Junction 10 to an all-movements junction has been identified as a key infrastructure requirement to enable the housing and economic development allocated in the JCS and proposed by the GFirst LEP Strategic Economic Plan. The Scheme is also central to the transport network sought by GCC in the adopted Gloucestershire Local Transport Plan. The provision of the Link Road will further ease congestion in the town.

1.9. Scheme Objectives

1.9.1. The objectives for the Scheme are:

1. Support economic growth and facilitate growth in jobs and housing by providing improved transport network connections in west and north-west Cheltenham.
2. Enhance the transport network in the west and north-west of Cheltenham area with the resilience to meet current and future needs.
3. Improve the connectivity between the Strategic Road Network (SRN) and the local transport network in west and north-west Cheltenham.
4. Deliver a package of measures which is in keeping with the local environment, establishes biodiversity net gain and meets climate change requirements.
5. Provide safe access to services for the local community and including for users of sustainable transport modes within and to west and north-west Cheltenham.

1.10. Purpose and Structure of the TA

1.10.1. The purpose of this TA is to evaluate the transportation aspects of the Scheme in relation to the existing highway network and sustainable transport provision within the vicinity of the Scheme. This TA has been prepared in accordance with 'Travel Plans, Transport Assessments and Statements' guidance from the Ministry of Housing, Communities & Local Government.

1.10.2. This TA includes the following sections:

- Section 2 provides a review of relevant national, regional and local planning policy.
- Section 3 describes the baseline conditions, in terms of the local highway network and multi-modal accessibility.
- Section 4 contains a detailed description of the Scheme.
- Section 5 discusses the traffic modelling.
- Section 6 summarises the Scheme assessment methodology.
- Section 7 summarises the impact of the Scheme.
- Section 8 outlines the impact of the cumulative scenarios.
- Section 9 provides details of the non-traffic assessment.
- Section 10 provides details of the assessment of the highway network during construction.
- Section 11 summarises the impact of the Scheme on the SRN.
- Section 12 provides detail on the validation of the traffic models.
- Section 13 summarises the findings and conclusions.

1.11. Amendments to the TA

1.11.1. Since the submission of the TA in December 2023, the following updates have been made:

- Further details on the validation of the traffic models following Section 51 advice;
- ~~Updates to include~~Amended references to relevant policy and guidance that has been updated since the original TA was prepared.
- Comment on the most recently reported personal injury ~~accidents~~collision data.
- Reporting on the outcomes of updated operational (Paramics) traffic modelling that has been undertaken to address refinements to the model as suggested by National Highways.
- Updates on construction trip information.
- Additional and more detailed information on the impacts of the Scheme on the Strategic Road Network (SRN).

2. Planning Policy

2.1. Introduction

2.1.1. The TA has been prepared in accordance with 'Travel Plans, Transport Assessments and Statements' guidance from the Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government.

2.1.2. This chapter provides a review of the transportation policy that is considered relevant to the ~~proposed~~ Sscheme at a national, ~~regional~~regional, and local level. The following documents have been included in this review:

- National Policy Statement for National Networks (December 2014).
- National Planning Policy Framework (NPPF) (July 2023).
- Gloucester, Cheltenham and Tewkesbury Joint Core Strategy (JCS).
- Gloucestershire's Local Transport Plan (LTP) (2020-2041).
- Cheltenham Plan (Adopted July 2020).
- Tewkesbury Borough Plan (Adopted 2022).

2.2. National Policy

National Policy Statement for National Networks (NPS NN) (December 2014)

2.2.1. The Planning Act 2008 introduced a new planning system for determining NSIPs. Under the Act, the Department for Transport (DfT) which is responsible for preparing the NN NPS which sets out government policy on the development of national road and rail networks. The Secretary of State makes decisions on applications for development consent for NSIPs based upon this policy.

2.2.2. The policy in the NN NPS aims to deliver national networks that meet the country's needs through:

- Creating networks with the capacity and connectivity to support national and local economic activity and facilitate growth.
- Creating networks which improve journey quality, reliability and safety.
- Creating networks which support the delivery of a low carbon economy.
- Creating networks which enable communities to link effectively to each other.

2.2.3. In establishing the general principles of assessment, Section 4.6 of NN NPS notes that applications for road and rail projects should usually be supported by a local transport model to provide sufficiently accurate detail of the impacts of a project.

2.2.4. The impacts of the Scheme have been assessed using the Gloucestershire Countywide Traffic Model (GCTM) The GCTM is a SATURN strategic model which has been used to test the impact of the Scheme on the wider road network.

2.2.5. The NPS NN includes details on the assessment of impacts on transport networks. It notes that for road and rail developments, if a development is subject to EIA and is likely to have significant environmental impacts arising from impacts on transport networks, the Aapplicant's Environmental Statement should describe those impacts and mitigating commitments. In all other cases the Aapplicant's assessment should include a proportionate assessment of the transport impacts on other networks as part of the application.

2.2.6. The ES for the Scheme assesses the likely significant environmental impacts arising from the Scheme, including those arising from impacts on transport networks where relevant: This TA also includes a proportionate assessment of the transport impacts on other networks.

National Planning Policy Framework (NPPF) (2023)

2.2.7. The NPPF was first published in March 2012, updated in February 2019, and revised most recently in ~~July 2021~~December 2023. It sets out the government's planning policies for England and how these are expected to be applied. The NPPF aims to make the planning system more accessible, and to promote sustainable growth.

2.2.8. The NPPF states that significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions and improve air quality and public health. However, opportunities to maximise sustainable transport solutions will vary between urban and rural areas, and this should be considered in both plan-making and decision-making (Paragraph ~~105~~109. Section 9).

2.2.9. The NPPF states that planning policies should:

- Be prepared with the active involvement of local highways authorities, other transport infrastructure providers and operators and neighbouring councils, so that strategies and investments for supporting sustainable transport and development patterns are aligned (Paragraph ~~106~~110.b. Section 9).
- Identify and protect, where there is robust evidence, sites and routes which could be critical in developing infrastructure to widen transport choice and realise opportunities for large scale development (Paragraph ~~106~~110.c. Section 9).
- Provide for high quality walking and cycling networks and supporting facilities such as cycle parking drawing on Local Cycling and Walking Infrastructure Plans (Paragraph ~~106~~110.d. Section 9).
- Provide for any large-scale transport facilities that need to be in the area, and the infrastructure and wider development required to support their operation, expansion, and contribution to the wider economy (Paragraph ~~106~~110.e. Section 9).

2.2.10. The NPPF states that in assessing sites that may be allocated for development in plans, or specific applications for development, it should be ensured that:

- Appropriate opportunities to promote sustainable transport modes can be – or have been – taken up, given the type of development and its location (Paragraph ~~110~~114.a. Section 9).
- Safe and suitable access to the site can be achieved for all users (Paragraph ~~110~~114.b. Section 9).
- The design of streets, parking areas, other transport elements and the content of associated standards reflects current national guidance, including the National Design Guide and the National Model Design Code (Paragraph ~~110~~114.c. Section 9).
- Any significant impacts from the development on the transport network (in terms of capacity and congestion), or on highway safety, can be cost effectively mitigated to an acceptable degree (Paragraph ~~110~~114.d. Section 9).

2.2.11. The NPPF also states that development should only be prevented or refused on highways grounds if there would be an unacceptable impact on highway safety, or the residual cumulative impacts on the road network would be severe (Paragraph ~~111~~115. Section 9).

2.2.12. Within this context, applications for development should:

- Give priority first to pedestrian and cycle movements, both within the Scheme and with neighbouring areas; and second–so far as possible–to facilitate access to high quality public transport, with layouts that maximise the catchment area for bus or other public transport services, and appropriate facilities that encourage public transport use (Paragraph ~~112~~116.a. Section 9).

- Address the needs of people with disabilities and reduced mobility in relation to all modes of transport (Paragraph ~~112~~116.b. Section 9).
- Create places that are safe, secure, and attractive–which minimise the scope for conflicts between pedestrians, cyclists, and vehicles, avoid unnecessary street clutter, and respond to local character and design standards (Paragraph ~~112~~116.c. Section 9).
- Allow for the efficient delivery of goods, and access by service and emergency vehicles (Paragraph ~~112~~116.d. Section 9).

2.2.13. All developments that will generate significant amounts of movement should be required to provide a travel plan, and the application should be supported by a Transport Statement or Transport Assessment so that the likely impacts of the proposal can be assessed (Paragraph ~~113~~117. Section 9).

DfT Circular 01/2022 Strategic Road Network and the delivery of sustainable development (2023)

2.2.14. National Highways ~~("the company")~~ has been appointed by the Secretary of State for Transport ~~("the Secretary of State")~~ as a strategic highways company under the provisions of the Infrastructure Act 2015. In accordance with the National Highways'~~company's~~ licence issued by the Secretary of State, it is the highway authority, traffic authority and street authority for the strategic road network (SRN)

2.2.15. DfT Circular 01/2022 was published in December 2022, replacing the previous circular 01/2013. It sets out the policy of the Secretary of State in relation to the SRN~~,~~ and is to be read in conjunction with other relevant policy such as the NPPF. The document sets out the way in which National Highways will engage with the development industry, public bodies and communities to assist the delivery of sustainable development. The circular is applicable to the whole of the SRN, comprising the trunk motorways ~~("motorways")~~ and all-purpose trunk roads ~~(APTRs)~~ in England.

2.2.16. The 01/2022 Circular notes that capacity enhancements such as modifications to existing junctions or road widening to facilitate development should be determined on a case-by-case basis. The general principle should be accepted where proposals would include measures to improve community connectivity and public transport accessibility, and this will be weighed against any negative safety, traffic flow, environmental and deliverability considerations, impacts on the permeability and attractiveness of local walking, wheeling and cycling routes, and alternative options to manage down the traffic impact of planned development or improve the local road network as a first preference.

2.2.17. In terms of decision taking, the Circular notes that where development proposals are fully in accordance with an up-to-date development plan, considerations at planning application stage in respect of impacts on the SRN will normally be limited to agreeing the final form and phasing of any supporting infrastructure (where required), measures to reduce the need to travel by private car and any relevant environmental impacts.

2.3. Regional and Local Policy

Gloucester, Cheltenham and Tewkesbury Joint Core Strategy (JCS)

2.3.1. The Joint Core Strategy (JCS) is a partnership between Gloucester City Council, CBC and TBC which sets out a strategic planning framework for the three areas. The JCS was adopted in December 2017 and is now undergoing a review as local plans are required to be reviewed every five years.

2.3.2. For now, the 2017 JCS sets out the quantum of new residential development, jobs and supporting infrastructure that is required up to 2031.

2.3.3. Within Part 2 of the 2017 strategy, a vision is provided that focusses on developing the region as highly attractive and providing accessible places to live, work and socialise. The vision makes it clear that development should be established in sustainable locations, and that residents and businesses will benefit from the improved resultant infrastructure,

including roads, public transport and services, and community facilities.

2.3.4. Within the strategy, a number of ambitions and associated strategic objectives have been provided. Those relevant to this development are as follows:

- Ambition 2 – A sustainable natural, built and historic environment
  - Strategic Objective Six – Meeting the challenges of climate change by ensuring that developments are located in sustainable locations.
- Ambition 3 – A healthy, safe and inclusive community
  - Strategic Objective Seven – Reducing the need to travel and reliance on the car by making routes more convenient, safe and attractive by improving provision of existing public transport and sustainable transport modes.
- Strategic Objective Nine – Promoting development that contributed to a healthy population by encouraging healthy lifestyles and a well society through sustainable transport, including public transport.

2.3.5. Policy INF1 specifically relates to the transport network, with the following points considered key:

- Developments should provide safe and accessible connections to the transport network to enable travel choices ensuring that connections are provided to existing network which encourage maximum use and that opportunities for sustainable travel are maximised.
- Planning permission will only be granted where the impact is not considered severe.

2.3.6. Policy SD4 relates to design requirements which states that proposals will need to clearly demonstrate how the following principles have been incorporated:

- Context, Character and Sense of Place.
- Legibility and identity.
- Amenity and space.
- Public realm and landscape.
- Safety and security.
- Inclusiveness and adaptability.
- Movement and connectivity.

2.3.7. Within the movement and connectivity principle, it states that new development should be integrated with existing development and prioritise movement by sustainable transport modes through connections to the wider movement network and use of the hierarchy of transport modes illustrated in Figure 3.

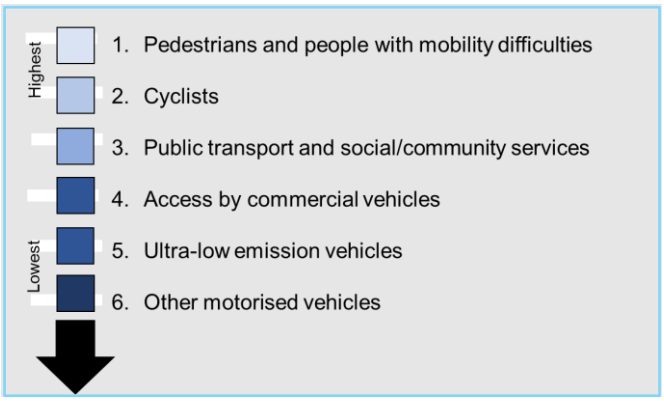


Figure 3 – Hierarchy of Transport Modes

Gloucestershire's Local Transport Plan (LTP) (2020-2041)

2.3.8. The Gloucestershire Local Transport Plan (2020-2041) sets out the long-term strategic transport vision for the County to 2041. The county's vison for transport is 'a resilient transport network that enables sustainable economic growth by providing travel choices for all, making Gloucestershire a better place to live, work and visit'.

2.3.9. The key objectives of Gloucestershire's Local Transport Plan are as follows:

- Protect and enhance the natural and built environment.
- Support sustainable economic growth.
- Enable safe and affordable community connectivity.
- Improve community health and wellbeing and promote equality of opportunity.

2.3.10. Within the Local Transport Plan there are a series of policy objectives.

2.3.11. Policy PD 0.1 – Reducing transport carbon emissions and adapting to climate change, notes that GCC will work with its partners to reduce transport carbon emissions by 2045 and improve air quality in the County by addressing travel demand, promoting the use of sustainable modes of transport and the uptake of ultra-low emission vehicles to tackle climate change. Policy proposals include:

- Ensure public availability of infrastructure required for low emission vehicles, for example a network of electric vehicle charging points or alternative technologies.
- Work towards electric vehicle charging points being provided at interchange hubs and other key locations.
- Develop and maintain a comprehensive bus network supported by interchange hubs across rural and urban areas, to improve connectivity within and across the county boundary.

2.3.12. Policy PD 0.3 – Maximising investment in a sustainable transport network, notes that GCC will work with partners to ensure the delivery of a financially sustainable transport network, through maximising opportunities for inward investment.

Tewkesbury Borough Plan (Adopted 2022)

2.3.13. The Tewkesbury Borough Plan guides where and how development will take place in the borough and provides an appropriate planning policy framework to ensure that Council policy on development is effectively implemented, that development aspirations are reasonable and that communities are protected against the built and natural environment. The Tewkesbury Borough Plan has a role to further develop the transport objectives of the Gloucestershire LTP by providing more detailed guidance on the delivery of transport infrastructure and consideration of transport as a fundamental part of the design of new developments.

2.3.14. Policy TRAC1 – pedestrian accessibility – notes that proposals which reduce pedestrian connectivity, or fail to optimise it, will be resisted. It is noted that pedestrian connectivity should be a fundamental consideration in design-led process and that pedestrian movements should be prioritised over motorised vehicles in a way that promotes pedestrian safety and convenience.

2.3.15. Policy TRAC2 – cycle networks and infrastructure – notes that the protection and enhancement of the cycle network, infrastructure and facilities across the Borough will be sought through safeguarding, developing and promoting a safe and convenient cycle route, segregated from motorised traffic where this does not detract from the pedestrian environment when where it confers an advantage to the cyclist in terms of journey directness and cycle trip experience.

2.3.16. Policy TRAC3 – Bus infrastructure – notes that strategic-scale developments should explore the potential for bus services to move through the site and that the design of developments should enable the safe, direct and convenient movement of buses including appropriate passenger facilities.

2.3.17. Policy TRAC4 – High frequency bus routes – notes that measures to improve journey times and reliability should be implemented for public transport along high frequency bus routes. Any development proposals which lead to an increase in vehicle traffic on high frequency corridors will be required to contribute towards the provision of sustainable transport and bus improvement measures to mitigate any impact and maintain the operation of the high frequency route.

Cheltenham Local Plan (Adopted 2020)

2.3.18. The Cheltenham Plan sets out a series of visions for the area and provides a planning framework to ensure that development is effectively implemented. The plan sets out a series of vision themes, these include the following:

2.3.19. Vision Theme A – to ensure Cheltenham is a place with well connected communities which are sustainable places to live and work and that they contain the necessary infrastructure to support social and cultural life. As part of this vision there are a series of objectives, these include:

- 'Design places, with a focus on connectivity, that are accessible to all and where barriers to walking and cycling are removed so that active travel and public transport are the default choices.'
- 'Improve health outcomes by promoting and prioritising active travel.'

2.3.20. Vision Theme B – to ensure Cheltenham has a prosperous economy where education, skills and employment opportunities are growing and diverse and to create an environment that supports economic growth. As part of this theme there are a series of objectives, including:

- To deliver a range of sustainable transport choices through appropriate infrastructure improvements including better links, prioritised junctions and improved public transport.

2.3.21. Vision Theme C – to ensure Cheltenham is a place where the built environment and assets are valued where tourists choose to visit and return. This vision includes to following transport related policy:

- 'Improve pedestrian and cycle connectivity and permeability throughout the town by creating a network of convenient routes which include multifunctional green spaces that link with the wider countryside, attractive and safe streets and spaces and measures which reduce the visual and environmental impact of vehicular traffic.'

2.4. Policy Summary

2.4.1. This TA has been prepared in line with the national, regional and local policy context outlined above, and in accordance with 'Travel Plans, Transport Assessments and Statements' guidance from the Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government. The subsequent sections of the TA will demonstrate how the Scheme will align with these policies.

3. Baseline Conditions

3.1. Introduction

3.1.1. This chapter of the report outlines the site location and provides details of the existing surrounding highway network and provision for sustainable travel modes, including pedestrian and cycle facilities.

3.2. Site Location

3.2.1. The site is located approximately 6km north-west of Cheltenham town centre and, 8km to the south of Tewkesbury and 13km to the north-east of Gloucester. It is the northernmost of four junctions serving the Gloucester and Cheltenham urban areas. As such the junction is in a strategically important location for the region, particularly as northern and western Cheltenham are the sites of a number of large retail parks and employment areas, and the location of planned future housing and nationally significant business development.

3.3. Local Highway Network

3.3.1. The Scheme is located on the following roads and junctions:

- M5 Junction 10.
- A4019.
- Withybridge Lane.
- Withybridge Garden.
- Stanboro Lane.
- Old Gloucester Road.

3.3.2. Figure 4 shows the local highway network.

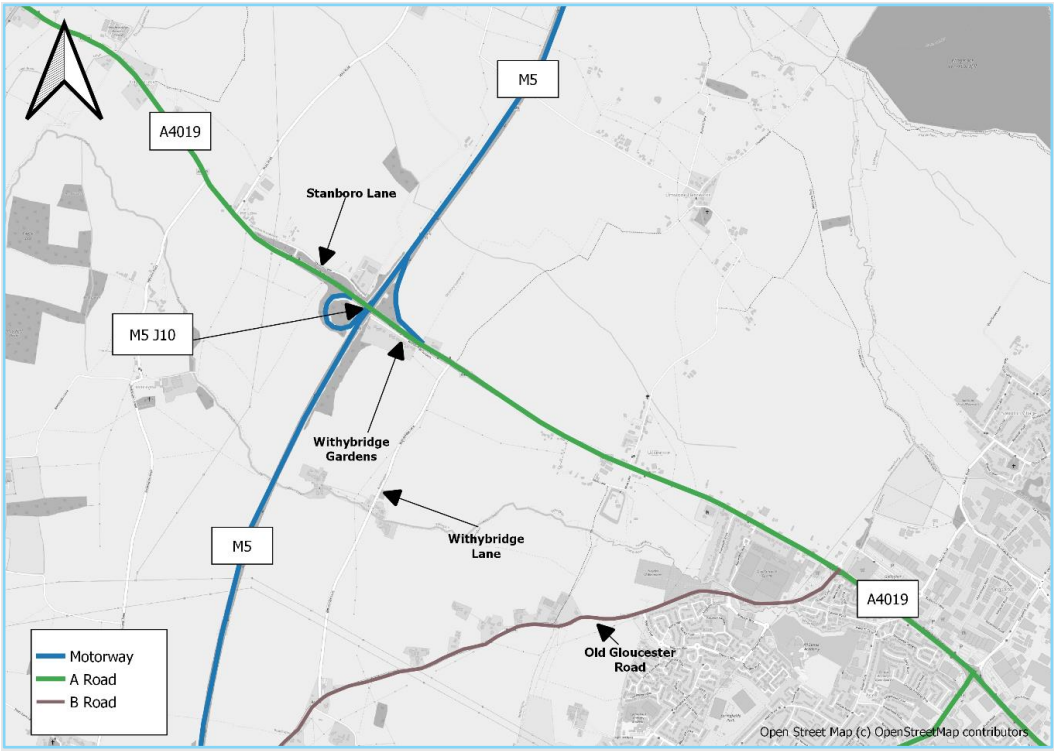


Figure 4 – Local Highway Network Plan

M5

3.3.3. The M5 is part of the Strategic Road Network (SRN) and provides a connection for the South West to the West Midlands. The M5 is subject to the national speed limit.

M5 Junction 10

3.3.4. M5 Junction 10 is a limited movement junction which only provides access to the M5 northbound and from the M5 southbound. Vehicles cannot leave the M5 northbound or join the M5 southbound. In order for traffic to travel south, traffic from Cheltenham must access the southbound M5 via Junction 11 which can be accessed from Cheltenham on the A40.

3.3.5. The section of the M5 which runs through Junction 10 has three lanes and a hard shoulder either side, an on-slip for traffic joining northbound and an off-slip for traffic leaving southbound.

A4019

3.3.6. The A4019 is a predominantly single carriageway road which runs from the Coombe Hill junction in the west where it meets the A38, to Cheltenham in the east. The A4019 provides access to the M5 northbound via junction 10 and provides an egress point for traffic on the M5 southbound, at this point the A4019 is dual carriageway and subject to a 50mph speed limit.

3.3.7. The dual carriageway section of the A4019 ends approximately 100m west of the junction with Withybridge Lane in the eastbound direction, and approximately 150m west of the junction with Stanboro Lane in the westbound direction, where the A4019 becomes a single carriageway subject to a 50mph speed limit.

3.3.8. The A4019 has sections of footway on the eastbound carriageway which runs from the west of Junction 10, up to the motorway overbridge, and then continue east of Withybridge Lane.

Withybridge Lane

3.3.9. Withybridge Lane is a two-way single carriageway road which runs from the A4019 in the north to Old Gloucester Road in the south. Withybridge Lane is subject to a 50mph speed limit and does not have any pedestrian facilities.

3.3.10. Withybridge Lane meets both the A4019 and Old Gloucester Road at priority junctions, where both the A4019 and Old Gloucester Road have priority over Withybridge Lane.

Withybridge Gardens

3.3.11. Withybridge Gardens is a two-way single carriageway road which has no through route and provides local access only with footway provision along housing frontages.

3.3.12. It meets Withybridge Lane at a priority junction.

Stanboro Lane

3.3.13. Stanboro Lane is a two-way single carriageway road with no through route which provides local access only. Stanboro Lane is subject to the national speed limit and has no pedestrian facilities with the exception of footway provision where it meets the A4019. Stanboro Lane meets the A4019 at a priority junction.

Old Gloucester Road (B4634)

3.3.14. Old Gloucester Road is single carriageway two-way road which provides a link between Cheltenham and Gloucester. Where the road interacts with the Scheme, Old Gloucester Road is subject to a 50mph speed limit and has no pedestrian facilities or street lighting.

3.4. Sustainable Transport

3.4.1. This section summarises the existing sustainable transport provision in the vicinity of the site.

Pedestrian Access

3.4.2. The A4019 is the only road within the Scheme with pedestrian facilities. Footways are present from Junction 10 on the eastbound carriageway of the A4019, these footways provide pedestrian access to the junction and a pedestrian connection towards Cheltenham. This footway provision is inconsistent with approximately 200m of the A4019 without pedestrian facilities between the M5 Junction 10 Southbound slip and the A4019 and Withy Bridge.

3.4.3. The footways are not well lit with lighting only present towards the junction with the Old Gloucester Road. In addition to this there are no formal crossing facilities present along the majority of the A4019, with signal controlled crossing points only at the junction with the Old Gloucester Road.

Cycle Access

3.4.4. There are no formal cycle facilities present along the Scheme extent, with cyclists required to use the carriageway. In addition to this, there are no crossing facilities present.

3.4.5. The closest cycle route is the National Cycle Network (NCN) 41 which runs close to M5 Junction 11.

3.5. Public Transport

3.5.1. This section summarises the bus provision in the vicinity of the site.

Bus Services

3.5.2. Figure 5 illustrates the bus stops that are located within the vicinity of the Scheme. These bus stops include:

- The Gloucester Old Spot.
- Stanboro Lodge.
- Withybridge Gardens.
- Cooks Lane.
- Moat Lane.
- The Plant Centre.

3.5.3. These bus stops are served by the following services:

- 41 – Cheltenham to Northway.
- 42 – Cheltenham to Tewkesbury.
- 43 – Cheltenham to Tewkesbury.
- 43A – Cheltenham to Tewkesbury.

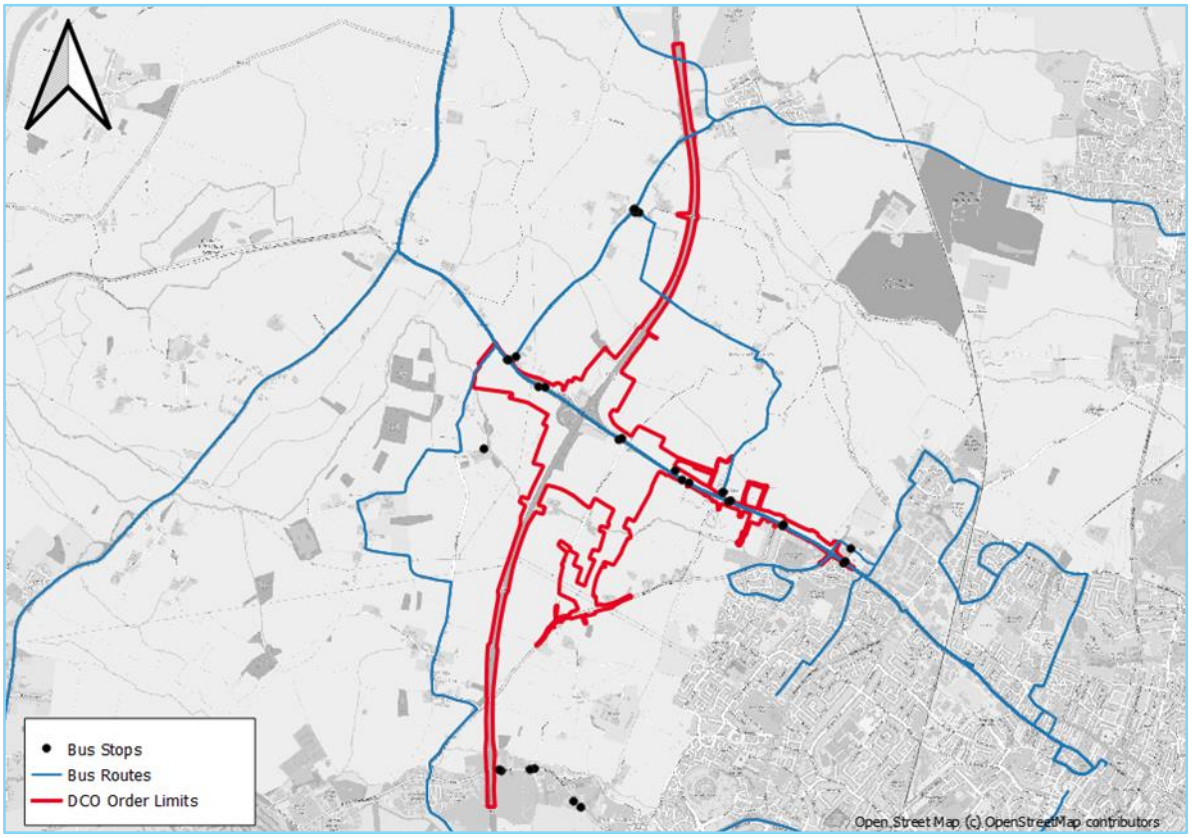


Figure 5 – Bus Stop Locations

3.6. Personal Injury Accident (PIA) Analysis

3.6.1. Personal Injury Accident (PIA) data has been obtained for the latest five-year period between 2017 and 2021. The study area covers the immediate highway network of the site and includes the following roads:

- M5.
- A4019.
- Withybridge Lane.
- Withybridge Gardens.
- Stanboro Lane.
- Old Gloucester Road.

3.6.2. Figure 6 shows the location and severity of the recorded PIAs within the study area during the five-year analysis period.

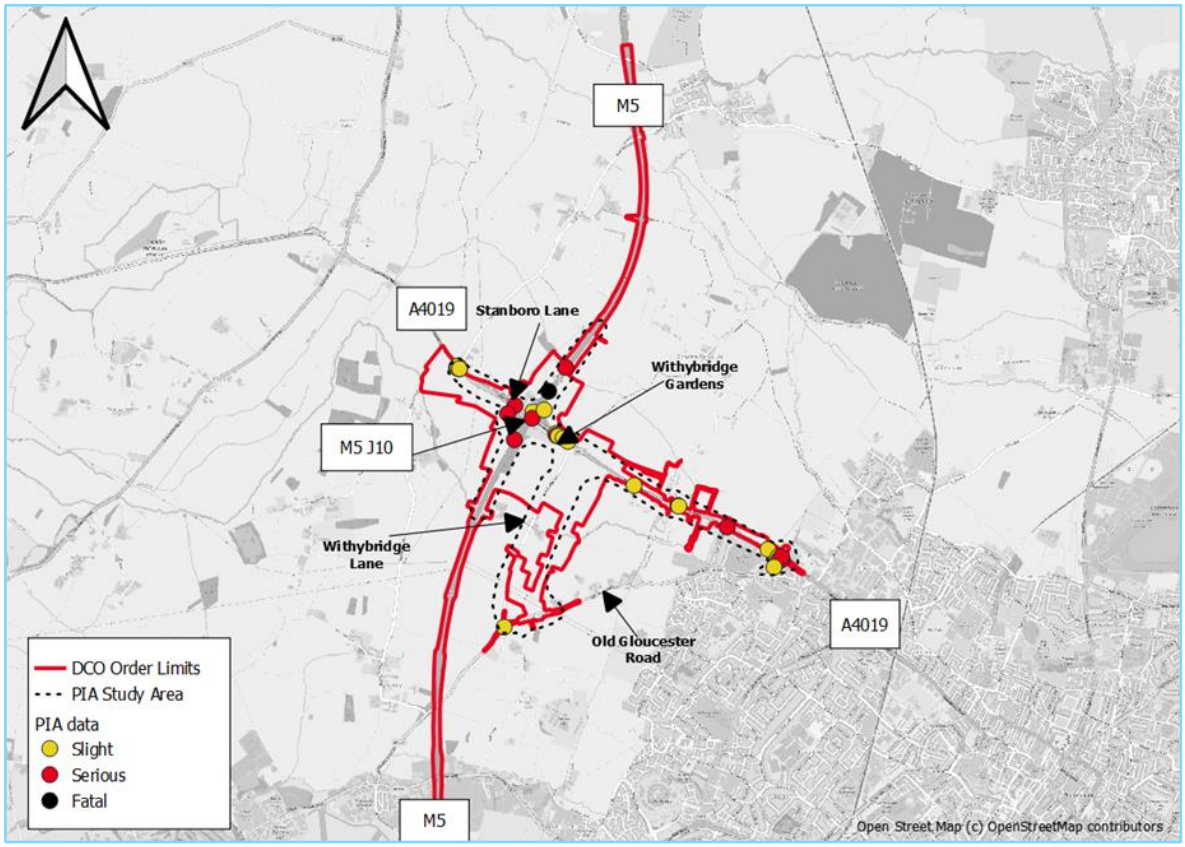


Figure 6 – Recorded PIAs – Study Area

PIA Severity

3.6.3. The Severity of a PIA is categorised as slight, serious, or fatal as defined by DfT:

- Slight – one in which at least one person is slightly injured. This includes minor injuries such as sprains, bruises, slight cuts, or shock, requiring only roadside attention.
- Serious – one in which a person is detained in hospital as an 'in-patient', or any of the following injuries whether or not they are detained in hospital: fractures, concussion, internal injuries, crushing, burns (excluding friction burns), severe cuts, severe general shock requiring medical treatment and injuries causing death 30 or more days after the accident. An injured casualty is recorded as seriously or slightly injured by the police based on information available within a short time of the accident. This generally will not reflect the results of a medical examination but may be influenced according to whether the casualty is hospitalised or not. Hospitalisation procedures will vary regionally.
- Fatal – one in which at least one person is killed, either immediately or at any time within 30 days after the accident.

PIA Severity by Year

3.6.4. The total number of slight, serious and data accidents within the study area are shown in Table 1.

Table 1 – Severity of Accidents – Study Area (2017-2021)

Severity	2017	2018	2019	2020	2021	Total
Fatal	0	0	1	0	0	1
Serious	6	2	1	0	1	10
Slight	3	7	2	5	2	19
Total	9	9	4	5	3	30

3.6.5. The table indicates that there has been one recorded fatality, 10 serious PIAs and 19 slight PIAs across the study area in the five-year study period.

PIA Severity by Location

3.6.6. The locations of the recorded accidents are outlined below separately for road links and junctions. An accident is defined as occurring at a junction when it is within 20m of a junction.

Links

3.6.7. Table 2 presents a summary of the PIAs recorded by severity at the links within the study area, these links include:

- Link 1 – M5 Southbound.
- Link 2 – M5 Northbound.
- Link 3 – M5 Southbound Slip.
- Link 4 – M5 Northbound Slip.
- Link 5 – A4019.
- Link 6 – Withybridge Lane.
- Link 7 – Withybridge Gardens.
- Link 8 – Stanboro Lane.
- Link 9 – Old Gloucester Road.
- Link 10 – Hayden Road.

Table 2 – Severity of Accidents – Per Link (2017-2021)

Severity	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Link 9	Link 10	Total
Fatal	0	1	0	0	0	0	0	0	0	0	1
Serious	0	2	0	1	2	0	0	0	0	0	5
Slight	0	0	1	0	4	0	0	0	0	1	6
Total	0	3	1	1	7	0	0	0	0	1	12

3.6.8. The table indicates that there has been one fatality across the study area in the last five years and that this was located on the M5 Northbound. In addition to this there has been five serious and six slight accidents. During post-submission discussions, National Highways noted that it has reviewed this collision data (as part of a separate planning application). They note that the fatal collision was a single vehicle at night with potential drugs/alcohol causation factor unrelated to any highway design, condition, or capacity issues.

Junctions

3.6.9. Table 3 presents a summary of the PIAs by severity at the junctions within the study area, these junctions include:

- Junction 1- A4019/The Gloucester Old Spot.
- Junction 2 - A4019/Stanboro Lane.
- Junction 3 - M5 Junction 10 Northbound Slip/M5.
- Junction 4 – M5/M5 Junction 10 Southbound Slip
- Junction 5 – M5 Junction 10 Northbound Slip/A4019.
- Junction 6 – M5 Junction 10 Southbound Slip/A4019.
- Junction 7 - A4019/Withybridge Lane.
- Junction 8 - A4019/Moat Lane.
- Junction 9 - A4019/Homecroft Drive.
- Junction 10 - A4019/Hayden Road.
- Junction 11 - Withybridge Lane/Withybridge Gardens.
- Junction 12 - Withybridge Lane/Old Gloucester Road.

Table 3 – Severity of Accidents Per Junction (2017-2021)

Severity	1	2	3	4	5	6	7	8	9	10	11	12	Total
Fatal	0	0	0	0	0	0	0	0	0	0	0	0	0
Serious	0	0	0	0	0	1	0	0	1	2	0	0	4
Slight	6	0	1	0	0	3	0	0	0	3	0	1	14
Total	6	0	1	0	0	4	0	0	1	5	0	1	18

3.6.10. The table indicates that there have been 18 PIAs at junctions across the study area with four serious and 14 slight recorded. National Highways has reviewed this collision data (as part of a separate planning application). They noted that serious collisions involved cyclists on the M5 Junction 10 southbound off-slip, and suggested that these are indicative of a potentially significant safety issue related to traffic volumes and facilities for active travel. Details of the collisions involving cyclists are outlined in Section 2.3.13 of the Walking, Cycling and Horse-riding Assessment and Review (WCHAR) included in Appendix I of this TA.

~~3.6.10.~~3.6.11. A check has been undertaken against the most recent collision data available, to understand if there have been any significant changes in collision records since the TA was originally published. The most recent validated data available covers a period up to 2022, so there is only one more year of data available since the collision analysis was undertaken. There do not appear to be any changes in collision trends, so the analysis presented above is still considered appropriate.

Summary

3.6.11. The PIA review has demonstrated that there have been 30 PIAs within the five years between 2017 and 2021, this includes one 'fatal' PIA. Given the context of the study area with strategic roads and high traffic volumes, the severity and frequency of accidents is not considered to be significantly high, and it is not considered that there are any particular locations experiencing significant accident problems.

3.7. Existing Conditions

3.7.1. To provide context on the existing traffic conditions on the local highway network, a combination of observations of typical operation and information from traffic counts has been used. Traffic count data for the development of the Paramics model (see Section 5 of the TA) was collected for both link and turning flows across the study area in November 2017. Further details of the data collected to understand baseline conditions including survey data are included in the Model Package Data Report (GCCM5J10-ATK-HTA-ZZ-RP-TR-000003 at Appendix K) The surveys were undertaken in the form of single-day Manual Classified Counts (MCC) at junctions, and two-week Automatic Traffic Counts (ATC) on links. The locations of the MCC's and ATC's are shown below in Figure 7.

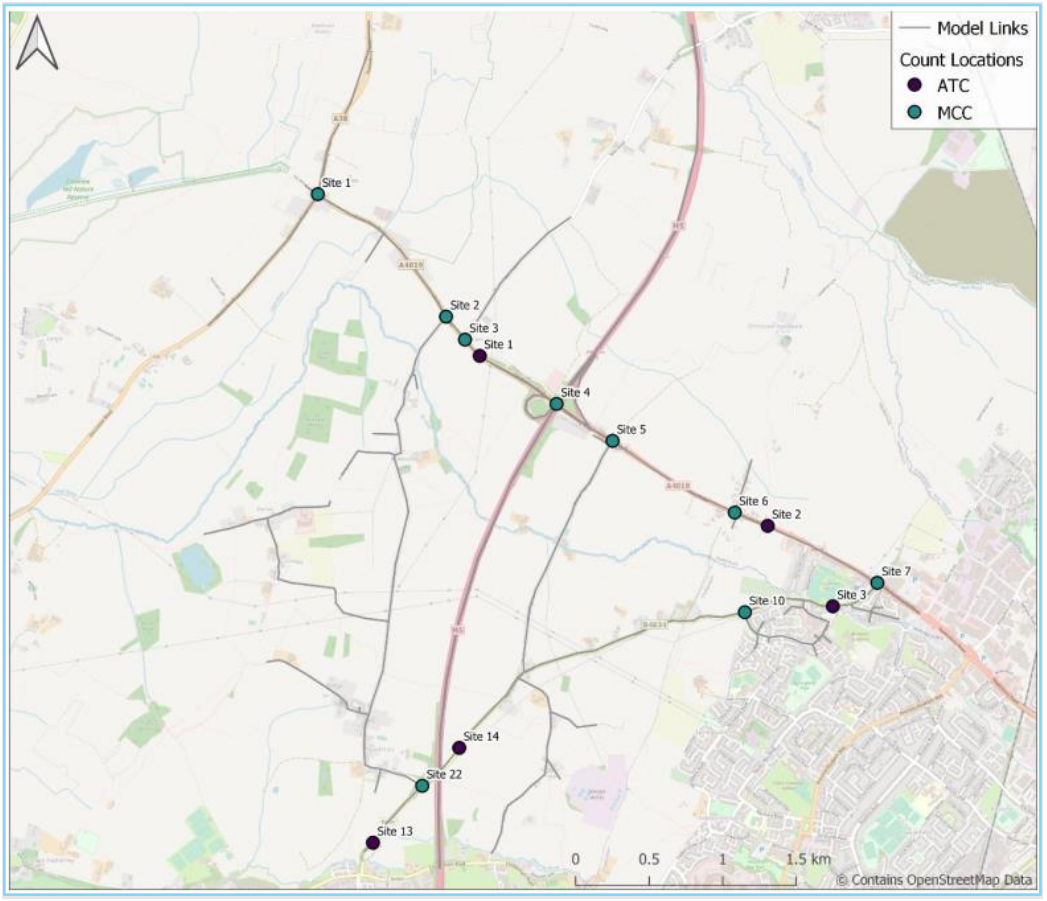


Figure 7 – Surveyed flow information

M5 Junction 10

3.7.2. M5 Junction 10 is currently a limited movement junction which only provides access to the M5 northbound and from the M5 southbound. This means traffic using M5 Junction 10 travelling to or from Gloucester and destinations to the south-west must travel through Cheltenham to Junction 11 of the M5.

3.7.3. In the AM peak, congestion has been observed on the A4019 extending back from Cheltenham to the motorway junction, resulting in instances where the southbound off-slip queue extends into the M5 mainline. No congestion issues are typically observed on the northbound on-slip.

A4019

3.7.4. The A4019 is a predominantly single carriageway road which in the 2017 AM peak carried around 1200 vehicles eastbound towards Cheltenham along with around 650 vehicles westbound towards M5 Junction 10. In the 2017 PM peak, the westbound flow towards M5 Junction 10 was around 1200 vehicles, with around 875 heading eastbound towards Cheltenham.

3.7.5. Congestion has been observed on all approaches to the A4019 ~~Tewkesbury Road~~/A4013 Princess Elizabeth Way/Kingsditch Lane roundabout in the AM peak.

3.7.6. In the PM peak, the A4019 ~~Tewkesbury Road~~/A4013 Princess Elizabeth Way/Kingsditch Lane roundabout has been observed as the main point of congestion along the A4019 corridor, with queues on all approaches and most noticeably on Kingsditch Lane and Princess Elizabeth Way arms.

4. Scheme Proposals

4.1. Introduction

4.1.1. The Scheme subject to the DCO is the proposed alterations to the existing M5 Junction 10 and the surrounding highway network. The main elements of the proposed works comprise:

- The improvements to M5 Junction 10.
- Construction of the West Cheltenham Link Road.
- Widening along the A4019 east of the junction, including a bus lane on the A4019 eastbound carriageway from the West Cheltenham Fire Station to the Gallagher Junction.

4.1.2. The Scheme aims to increase the capacity and accessibility of M5 Junction 10 whilst improving active travel provision.

4.1.3. The objectives of the Scheme are to:

- Support economic growth and facilitate growth in jobs and housing by providing improved transport network connections in West and North-West Cheltenham.
- Enhance the transport network in the West and North-West of Cheltenham area with the resilience to meet current and future needs.
- Improve the connectivity between the Strategic Road Network (SRN) and the local transport network in West and North-West Cheltenham.
- Deliver a package of measures which is in keeping with the local environment, establishes biodiversity net gain and meets climate change requirements.
- Provide safe access to services for the local community and including for users of sustainable transport modes within and to West and North-West Cheltenham.

4.1.4. It is noted that the basis of the Scheme is to 'enable' major developments, rather than to provide all the network improvement requirements for such development. Furthermore, in order to design a Scheme that had no adverse impact on the future journey times, a much larger Sscheme with notably higher cost and more importantly considerably increased impact on the environment would have been needed which would be unacceptable.

4.2. Development Description

4.2.1. The full Scheme description is outlined in Chapters 1-4 of the ES (TR010063 – APP 6.2). A summary of the works relevant to the TA are outlined below.

4.2.2. M5 Junction 10 currently only provides slip roads from the north and to the north meaning that traffic from Cheltenham must access the southbound M5 via Junction 11. As part of the Scheme, it is proposed to increase the capacity and improve the accessibility of M5 Junction 10 by removing the existing provision, and building four new slip roads onto the M5 thereby creating an all-movements signalised junction.

4.2.3. In order to create this, the existing bridge over the M5 will be demolished and replaced with a new roundabout with two bridges, a segregated cycle track and a footway.

4.2.4. The plan for the Scheme is provided in Appendix A. The main elements of the proposed works comprise:

M5 Junction 10

- A new signalised roundabout at Junction 10 with three lanes.
- Widening to three lanes westbound and two lanes eastbound on A4019 approach to Junction 10 with a cycle and pedestrian route over the motorway bridge.
- New slip road onto the M5 southbound and a slip road off the M5 northbound.
- ~~New tracks for access to farmland at a controlled access pointN~~.

West Cheltenham Link Road

- A new single carriageway link road from West Cheltenham Golden Valley Development to A4019.
- Signalised junctions on the A4019 and B4634.
- Segregated cycle track and footway on western side of the link road.

A4019 Tewkesbury Road

- Existing A4019 widened to dual carriageway.
- Bus lane on the A4019 eastbound carriageway from the West Cheltenham Fire Station to the Gallagher Junction.
- Segregated cycle track and footway.
- New tracks for access to farmland with a relocated access point incorporated into the signal-controlled junction of the A4019 with the West Cheltenham Link Road.
- Signalised junctions with pedestrian and cycle facilities.

Walking and Cycling Infrastructure

4.2.5. The Scheme provides a number of walking and cycling infrastructure improvements along the entire Scheme extent. These include pedestrian and cycle facilities alongside the A4019, formal crossing points across the A4019, and crossing facilities at M5 Junction 10.

4.2.6. A summary of these improvements is contained within the Walking, Cycling and Horse-riding Assessment and Review (WCHAR) (Included in Appendix I).

Public Transport Infrastructure

4.2.7. The Scheme will not adversely affect the existing public transport routes. Any existing bus stops that are impacted by the Scheme will be suitably replaced, and/or relocated as necessary.

4.2.8. The Scheme includes a section of bus lane on the A4019 eastbound carriageway from the West Cheltenham Fire Station to the Gallagher Junction. This is likely to provide a benefit to the existing public transport routes along the corridor.

Safety

4.2.9. The Scheme is a highways improvements Ss~~s~~cheme which aims to provide safe access to services for the local community and for users of sustainable transport modes within and to West and North West Cheltenham. The Scheme has been designed in accordance with all current standards and guidance. Therefore, it is expected that the proposed Scheme will help to improve road safety in the area.

5. Traffic Modelling

5.1. Introduction

5.1.1. This chapter summarises the traffic modelling undertaken to predict the operational impact of the Scheme on the road network. A Paramics Discovery microsimulation model has been developed to assess the impact of the Sscheme on the strategic and local highway networks surrounding the M5 J10 and A4019 corridor.

5.2. Assessment Methodology

5.2.1. The assessment methodology was outlined during scoping discussions in the TA scoping note. The Gloucestershire Countywide Traffic Model (GCTM) Version 2.3 has been used to identify the transportation impacts of the proposed development. The GCTM is a SATURN strategic model which has been used to test the impact of the M5 J10 Sscheme on the wider road network.

5.2.2. The resultant trip matrices from the GCTM were then used in the Paramics model to understand the impact of the Scheme in more detail at the junctions on the local highway network.

5.3. GCTM Scenarios

5.3.1. The GCTM 2015 base year model~~, which was updated in June 2019~~, has been developed in accordance with DfT guidelines and advice set out in the Design Manual for Roads and Bridges (DMRB) and Transport Assessment Guidance (TAG) acceptability criteria, and has achieved relevant validation standards.

5.3.2. A series of GCTM future forecast year models has been used to estimate the forecast traffic flows in future year scenarios, with and without the Scheme, and then in a cumulative scenario including the Scheme and the ~~associated~~ Joint Core Strategy (JCS) developments which are dependent on provision of the Scheme. Details of the "dead weight" (non-dependent) and dependent developments are included in the Traffic Forecasting Report.

~~resultant scenarios modelled in the GCTM were:~~

Scenario P

5.3.3. The future year scenario without the Scheme, and without the dependent development. Local improvements included in Scenario P are the Coombe Hill improvement Sscheme and upgrading Arle Court Roundabout. It represents a scenario without any improvement along the Scheme extent.

Scenario S

5.3.4. The future year scenario with the Scheme. The network is based on the Scheme, with all other elements identical to the Scenario P network. This scenario does not include the traffic associated with dependent developments. As such, it captures the impact of the Scheme in isolation.

Scenario R

5.3.5. The future year scenario with the Scheme and dependent development. This scenario includes the traffic associated with Sscheme dependent developments. It represents a cumulative scenario.

5.3.6. The purpose of the Transport Assessment is to quantify and evaluate the impacts of the Scheme reflecting realistic potential alternative scenarios. Consequently, this assessment has considered the following comparisons to evaluate the impacts of the Scheme:

- Scenario R (with the Scheme and with the dependant development) verses Scenario P (without the Scheme and without dependant development) – Core cumulative comparison
- Scenario S (with the Scheme, but without the dependant development) verses Scenario P – Comparison to isolate the impacts of the Scheme as separate to the impacts cause by the dependant development.

5.3.7. Scenario Q (without the Scheme, but with the dependant development) is a theoretical scenario, since the Joint Core Strategy (JCS) policy position is that dependant developments cannot come forward without the Scheme being implemented. Therefore, this scenario has not been subject to operational (PARAMICS) traffic modelling and is not assessed in this Transport Assessment. Nonetheless, Strategic traffic modelling of Scenario Q has been undertaken in accordance with the requirements of the Department for Transport (DfT) Transport Analysis Guidance (TAG) and the outcomes of this traffic modelling is presented in Traffic Forecasting Report which is Appendix L to this Transport Assessment.

5.4. GCTM Assessment Years

5.4.1. The GCTM was developed for the following assessment years:

- 2027 (planned opening year).
- 2042 (design year).

5.5. GCTM Modelled Periods

5.5.1. The GCTM covers the following time periods:

- AM peak period (07:00-10:00).
- PM peak period (16:00-19:00).

5.5.2. The flow information from the model is output as an average peak period flow.

5.6. GCTM Modelled Area

5.6.1. The area covered by the GCTM Version 2.3 is shown in Figure 8. The GCTM (v2.3) includes a “fully modelled area” where junctions are explicitly modelled (Simulation Area) to encompass the Scheme study area in more detail including the M6 and A46 strategic corridors south of Birmingham, recognising the potential for the Sscheme to affect wider strategic movements. The highway network outside the Simulation part of the model has been coded in the Buffer Area where they are presented as links with their speed and capacity defined.

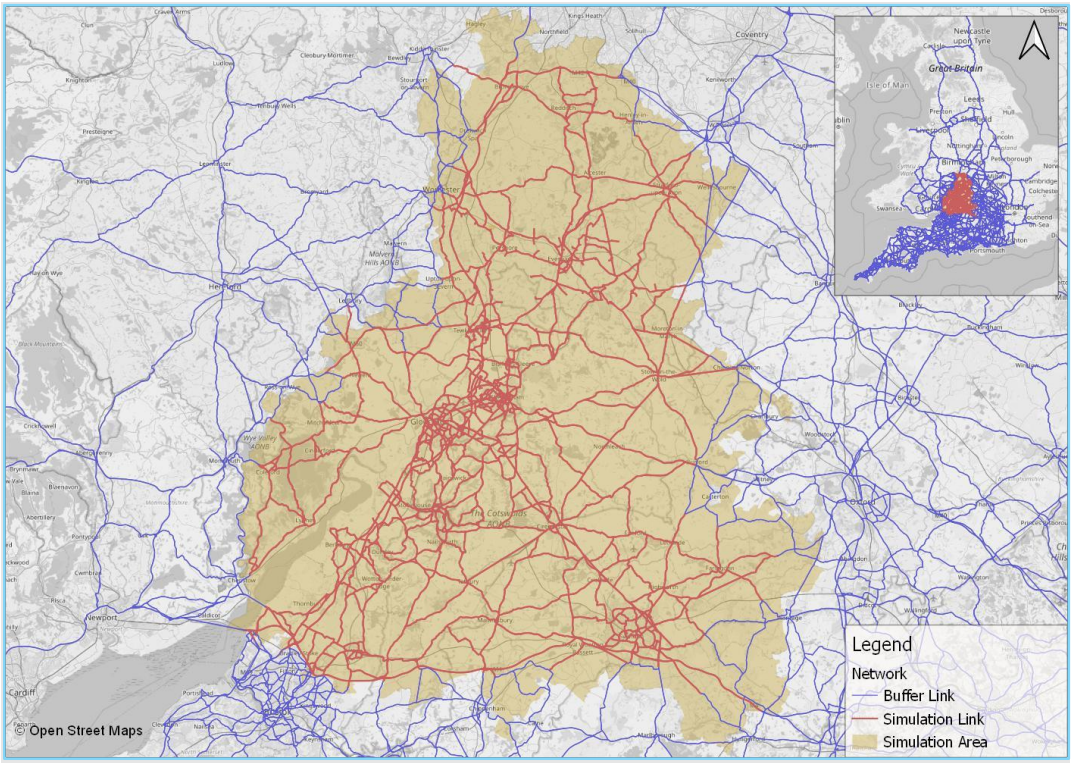


Figure 8 – GCTM Model Area

5.7. GCTM Flow Differences

5.7.1. The changes in flow between the different scenarios are illustrated in flow difference plots included in Appendix B.

5.7.2. The general summary of the flow changes predicted by the GCTM are as follows:

- Scenario P in the future with no improvements along the corridor shows a congested network.
- Comparing Scenario S to P to understand the impact of just the Scheme in isolation shows some changes to flows in the area around the Scheme. The improvements to performance from the Scheme attract a small amount of additional traffic into the area.
- Comparing Scenario R to P to understand the cumulative impact of the Scheme and the associated dependent development shows larger increases in flows. These changes are mainly as a result of the trips generated by the dependent developments and partly due to the Scheme itself.
- The differences between the R to P cumulative comparison are greater in 2042 compared to 2027, due to the amount of dependent development that is built out increasing over time.

5.8. Background for Paramics Model

5.8.1. Jacobs Consultants had previously developed a Paramics Discovery model for wider area surrounding the M5 Junction 10. This Paramics Discovery model was supplied to Atkins to use as a starting point in the development of a more context specific microsimulation model for the Scheme testing. Atkins has updated the supplied Paramics model along with a version update to 24.0.1 of the Paramics Discovery software. The updated base model has then been used to test the GCTM scenarios outlined above for both 2027 and 2042, using flow demand matrices derived from representative GCTM scenarios.

5.9. Model Layout

Model Extents

5.9.1. As the purpose of the operational modelling is to understand the detailed operation of the Scheme, enable design refinement to ensure the Scheme does not have a detrimental impact on the SRN under forecast year conditions; it was agreed with National Highways during scoping discussions that the M5 J10 operational modelling would be undertaken over a smaller localised extent. Figure 9 shows the coverage of the Paramics model, herein known as the Paramics model area.

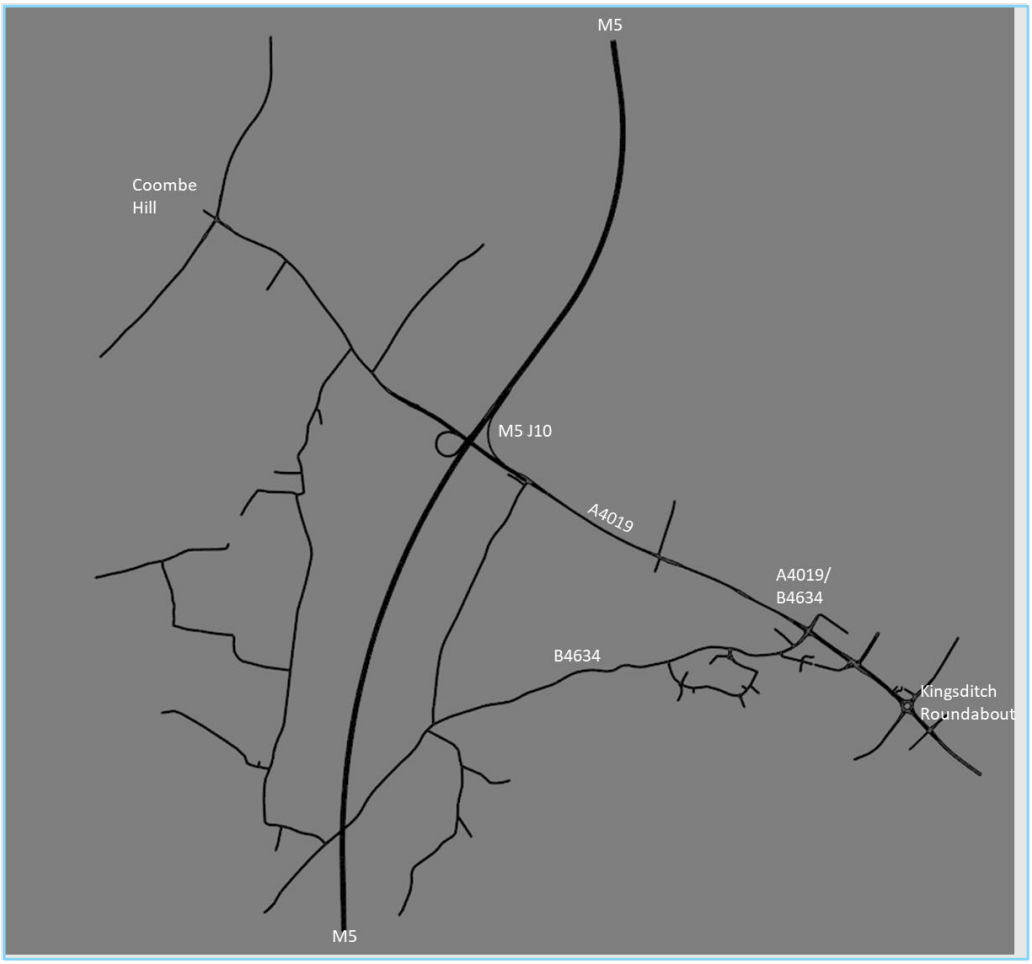


Figure 9 – M5 J10 Paramics Model Extents

Model Assignment

5.9.2. A 'dynamic' traffic assignment method is used for all the assessed scenarios. The traffic growth for Paramics models is provided by the cordoned version of the SATURN strategic model for each forecast year. Growth is then applied to t~~T~~he Paramics base year model (2017) trip matrices ~~are then growthed~~ for each forecast year in line with the growth produced by the SATURN strategic forecast models. The Paramics model runs are then undertaken based on dynamic method of assignment which means the routes between origin-destinations are not pre-determined or fixed and would vary in different time periods depending upon the travel cost in terms of time and distance.

Model Durations

5.9.3. The following time-periods for all AM and PM peak scenarios have been modelled which include an hour of 'warm-up' and 'cool-down' periods.

- 3-hour Weekday AM peak between 07:00 and 10:00

- 3-hour Weekday PM peak between 16:00 and 19:00

Vehicle Compositions

5.9.4. Atkins have used following vehicle class categories in M5 J10 Paramics Discovery model.

- User class 1 – Car,
- User class 2 – Light Goods Vehicle (LGV),
- User class 3 – Medium Good Vehicle (MGV) and Heavy Goods Vehicle (HGV).

5.9.5. Vehicle proportion for User class 3 are as below:

- AM modelled period – MGV (68%) and HGV (32%)
- PM modelled period – MGV (61%) and HGV (39%).

5.10. Base Model Calibration / Validation

5.10.1. The Paramics Discovery model was built following TAG guidance with the aim of achieving relevant validation standards to give confidence in the demand data and resulting model performance. Atkins has performed a comparison for modelled and observed traffic flows and modelled and observed journey times along selected routes.

5.10.2. The model has been validated for flows using observed traffic counts collected in November 2017 following the DfT TAG Unit M3.1 guidelines. Both modelled time periods have demonstrated a good correlation with observed flows, as more than 98% of the 68 individual link and turn counts passed the TAG criteria for the AM and PM peaks.

5.10.3. The modelled journey times also provided a reasonable representation of delay across the modelled network, with all journey time routes passing within the criteria. More details on Calibration / Validation of the base year Paramics model can be found in the Local Model Validation Report (LMVR) which is an appendix to the Model Package Report (included as Appendix J).

5.11. Modelled Scenarios

5.11.1. Table 4 provides information on various scenarios that have been modelled using the Paramics Discovery model.

Table 4 – Scenarios modelled in Paramics Discovery model

Scenario Name	Description
Scenario P 2027 AM	Uses the forecast growth from cordoned demand matrices of 2027 GCTM Scenario P model (without the Scheme) for AM and PM peak.
Scenario P 2027 PM	
Scenario S 2027 AM	Uses the forecast growth from cordoned demand matrices of 2027 GCTM Scenario S (with the Scheme) for AM and PM peak, excluding any dependent future developments in the area.
Scenario S 2027 PM	
Scenario R 2027 AM	Uses the forecast growth from cordoned demand matrices of 2027 GCTM Scenario R model (with the Scheme) for AM and PM peak, including any dependent future developments in the area completed by 2027.
Scenario R 2027 PM	
Scenario P 2042 AM	Uses the forecast growth from cordoned demand matrices of 2042 GCTM Scenario P model (without the Scheme) for AM and PM peak.
Scenario P 2042 PM	
Scenario S 2042 AM	Uses the forecast growth from cordoned demand matrices of 2042 GCTM Scenario S (with the Scheme) for AM and PM peak, excluding any dependent future developments in the area.
Scenario S 2042 PM	

Scenario Name	Description
Scenario R 2042 AM	Uses the forecast growth from cordoned demand matrices of 2042 GCTM Scenario R model (with the Scheme) for AM and PM peak, including any dependent future developments in the area completed by 2042.
Scenario R 2042 PM	

5.12. Model Assumptions

5.12.1. The forecast growth in demand for the Paramics model is derived from the strategic models. The assumptions which the SATURN models are based upon including the developments, trip generation and growth scenarios are detailed in the Traffic Forecasting Report (TFR - GCCM5J10-ATK-HTA-ZZ-RP-TR-000004 at Appendix L).

6. Scheme Assessment Methodology

6.1. Introduction

6.1.1. This section provides an overview of how the modelling results were interpreted to understand the impact of just the Scheme in isolation.

6.2. Assessment Scope

6.2.1. It is important to note that the Scheme which is subject to the DCO is a highway scheme. This highway scheme will enable the delivery of wider developments with a focus on three major developments situated along A4019 and Old Gloucester Road (shown in Figure 2), but the impact of this associated dependent development is assessed in a cumulative scenario and distinguished from the impact of the Scheme in isolation.

6.3. Assessment Scenarios

6.3.1. The Scheme is being assessed in future year scenarios (2027 and 2042) so there are associated performance impacts of traffic growth on the Paramics model area compared to existing conditions irrespective of the Scheme being implemented. Details of the changes to create the future year scenarios are outlined in the Model Package Report (included as Appendix J).

6.3.2. The interpretation of the results between Scenarios S to P has provided the findings for the Scheme assessment; it isolates just the impacts of the Scheme itself, rather than impacts of future year growth, and/or future development.

6.4. Model Result Collection

6.4.1. All the modelled scenarios are run for ~~10~~ 15 different random seed numbers to account for the daily variability of the traffic arrival pattern and network operation. The results reported in subsequent sections are an average of ~~10~~ 15 model runs for each scenario. However, to account for variations in the sample of ~~10~~ 15 model runs, the minimum and maximum values for appropriate model performance indicators are also illustrated.

6.4.2. The modelling results that will be analysed within subsequent sections include the network performance results which provide a holistic view across the network as a whole, as well as detailed journey time analysis and queue analysis.

6.5. Network Performance Results

6.5.1. The model results for all vehicles throughout the entire Paramics model area for each peak hour. The results are presented for:

- Average Journey Time (mins).
- Average Network Speed (mph).
- Total Travel Time (hours).
- Total Demand.
- Unreleased demand.

6.5.2. The average journey time is the value for the average of all of the trips within the Paramics model area, so can show general trends between assessment years (e.g., average times increasing over time indicate overall performance is deteriorating).

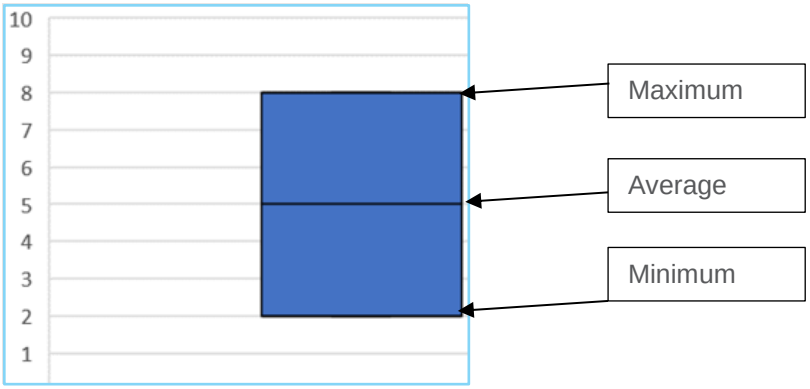
6.5.3. Average speeds are taken as an average of the average network speed for each run. In assessing the average network wide speed, variation within the ~~10~~ 15 model runs was also investigated to understand the range of average speeds within the sample.

6.5.4. Total demand is the number of vehicles trying to enter into the Paramics model area in each peak hour. Unreleased demand is the number of those vehicles that were unable to be released into the Paramics model area during the peak hour (due to congestion or queues extending back out of the modelled area).

6.6. Interpreting Variance

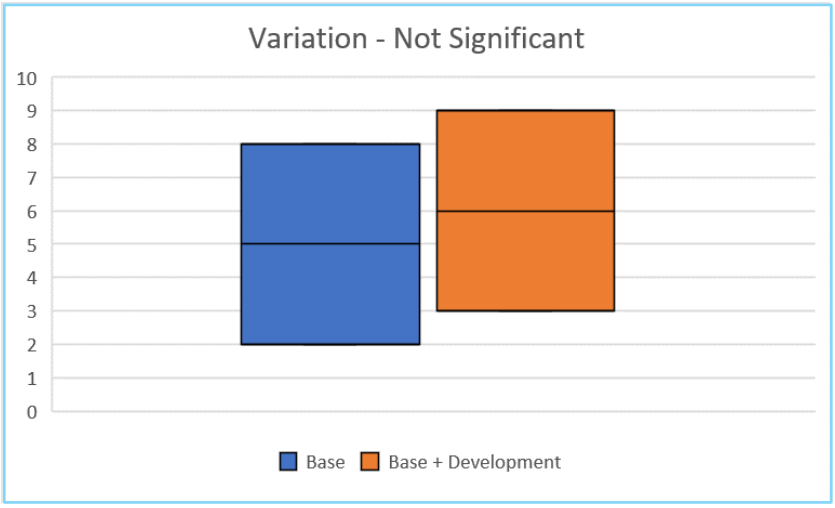
6.6.1. The model produces results for ~~10~~ 15 modelled runs which is typically averaged to produce average values. However, in order to better understand the significance of some of the differences in average results, 'box and whisker' type plots have been used to show the range of results in the sample.

6.6.2. The plots show the maximum (top of the bar) and minimum (bottom of the bar) of the sample of the results as well as the average result from the sample (the line across the bar). These have been presented to help provide context into the range of results in each scenario, rather than just the average result in isolation.



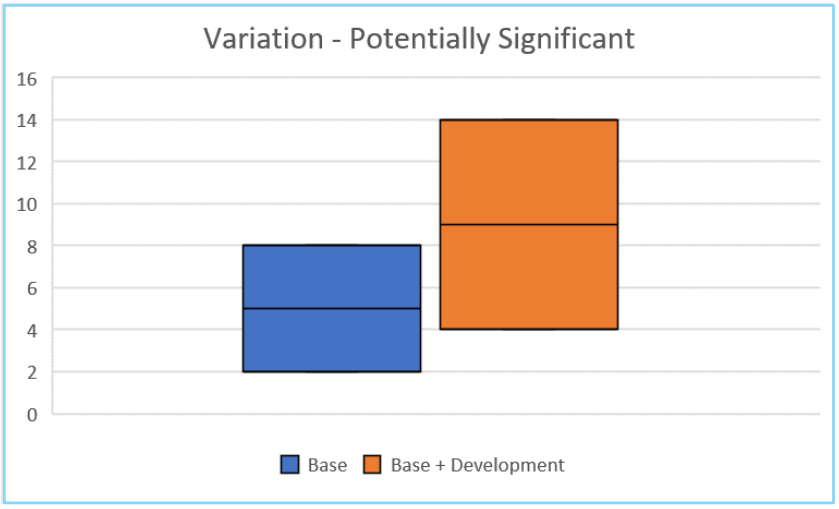
6.6.3. A general explanation of the plots, and the interpretation of the ranges is explained in the following sections.

Variation Not Considered Signficant



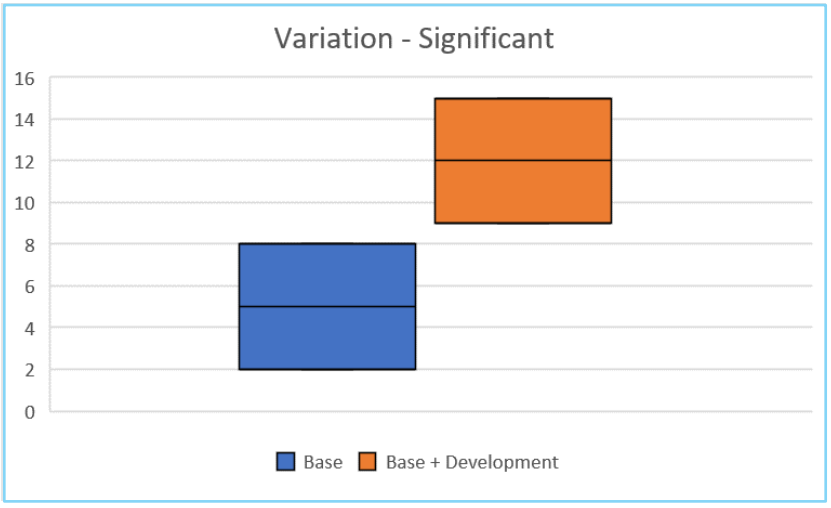
6.6.4. In this example, the results with the development have a higher average result (as shown by the higher middle line). However, when considered against the overall range, the results for the average value with the development fall well within the range of results in the base (without the development). There are model runs in the sample without the development that have similar (and higher) values than the average result in the Base + Development. Therefore, the overall average increase is not considered significant.

Variation Potentially Signficant



6.6.5. In this example, the results with the development have a higher average result (as shown by the higher middle line). This average line with the development is above the range of values in the base sample. So when considered against the overall range, the results for the average value with the development fall outside of the range of results in the base (without the development), but there are some model runs in the sample with the development that have similar (and lower) values than the average result in the Base. Therefore, the overall average increase is potentially significant, and would require further investigation.

Variation Considered Signficant



6.6.6. In this example, the results with the development have a higher average result (as shown by the higher middle line). All of the runs in the sample with the development are above the range of values in the base sample. Therefore, the overall average increase is considered significant in this instance.

6.7. Interpreting Reliability

6.7.1. The ‘box and whisker’ type plots also help provide an indication of reliability by demonstrating how big the range of results in each sample are for the various scenarios. A large range between maximum and minimum values indicate a large variation between results within a sample, indicating users could experience a range of day to day journey times.

6.7.2. A much smaller range between maximum and minimum values indicate that users are less likely to experience a range of day to day journey times, resulting in a more reliable journey.

7. Scheme Assessment

7.1. Introduction

7.1.1. This section provides an overview of how 2027 and 2042 Scenario P compares against 2027 and 2042 Scenario S in terms of traffic operation. This represents the impact of just the Scheme in isolation.

7.1.2. It is important to note that the Scheme which is subject to the DCO is a highway scheme. This highway scheme will enable the delivery of wider developments with a focus on three major developments situated along A4019 and Old Gloucester Road (shown in Figure 1), but the impact of this associated dependent development is assessed in a cumulative scenario and distinguished from the impact of the Scheme in isolation.

7.2. Traffic Flows

7.2.1. Comparing Scenario S to P to understand the impact of just the Scheme in isolation shows some changes to flows in the area around the Scheme. The improvements to performance from the Scheme attract a small amount of additional traffic into the area. The changes in flow between the different scenarios are illustrated in flow difference plots included in Appendix B.

7.3. Network Performance Results

7.3.1. The network performance results provide an overview of the performance of all vehicles within the Paramics model area as a whole and therefore give a good overall indication of the operational impacts of the proposed Scheme. They focus on the changes in key network wide results parameters including average journey time, network speed and total travel time.

Opening Year - 2027

7.3.2. Table 6 below provide a comparative summary of the network performance results for 2027 Scenario P and 2027 Scenario S for the AM and PM peak periods.

Table 5 – Network performance results – 2027 AM peak period (08:00-09:00)

Performance Indicator	Scenario P	Scenario S	% Change
Average Journey Time (mins)	~~5.42~~5.21	~~4.71~~4.66	-~~13~~11%
Average Network Speed (mph)	27	~~29~~28	4%
Total Travel Time (hours)	~~1408~~1378	~~1348~~1329	-4%
Total Demand	16589	16815	+1%
Unreleased demand	~~1011~~721	0	-

Table 6 – Network performance results – 2027 PM peak period (17:00-18:00)

Performance Indicator	Scenario P	Scenario S	% Change
Average Journey Time (mins)	~~4.65~~4.54	4.08	-~~12~~10%
Average Network Speed (mph)	~~29~~30	30	~~3~~1%
Total Travel Time (hours)	~~1231~~1199	~~1153~~1151	-~~6~~4%
Total Demand	16836	16955	+1%
Unreleased demand	~~962~~982	~~17~~12	-

7.3.3. The results for opening year 2027 indicate that the Scheme in isolation improves network-wide performance in both AM and PM peak with improved average journey times and improved average network speed across the network. Details of the variation within the ~~10~~ 15 model runs for the average network speed is included in Appendix C.

Future Year - 2042

7.3.4. Table 7~~Table 7~~ and Table 8~~Table 8~~ below provide a comparative summary of the network performance results for 2042 Scenario P and 2042 Scenario S for the AM and PM peak periods.

Table 7 – Network performance results – 2042 AM peak period (08:00-09:00)

Performance Indicator	Scenario P	Scenario S	% Change
Average Journey Time (mins)	~~5.785~~5.83	~~4.804~~4.58	-~~17~~21%
Average Network Speed (mph)	~~26~~25	28	~~10~~12%
Total Travel Time (hours)	~~1609~~1666	~~1480~~1420	-~~8~~15%
Total Demand	18051	18344	+2%
Unreleased Demand	~~1329~~915	0	-

Table 8 – Network performance results – 2042 PM peak period (17:00-18:00)

Performance Indicator	Scenario P	Scenario S	% Change
Average Journey Time (mins)	~~4.94~~4.86	~~4.15~~4.16	-~~16~~8%
Average Network Speed (mph)	28	~~30~~29	6%
Total Travel Time (hours)	~~1433~~1405	~~1280~~1286	-~~11~~8%
Total Demand	18388	18478	+1%
Unreleased Demand	~~992~~1039	0	-

7.3.5. The results for future year 2042 indicate that the Scheme in isolation improves network-wide performance in both AM and PM peak with improved journey times and average network speed across the network.

7.4. Journey Time Results

7.4.1. Various journey time counters have been set up in Paramics model to extract the journey time results for five main routes in both directions.

7.4.2. Figure 10 shows the journey times routes which have been analysed to assess the operational impact of the Scheme on travel times for the various scenarios~~-~~.

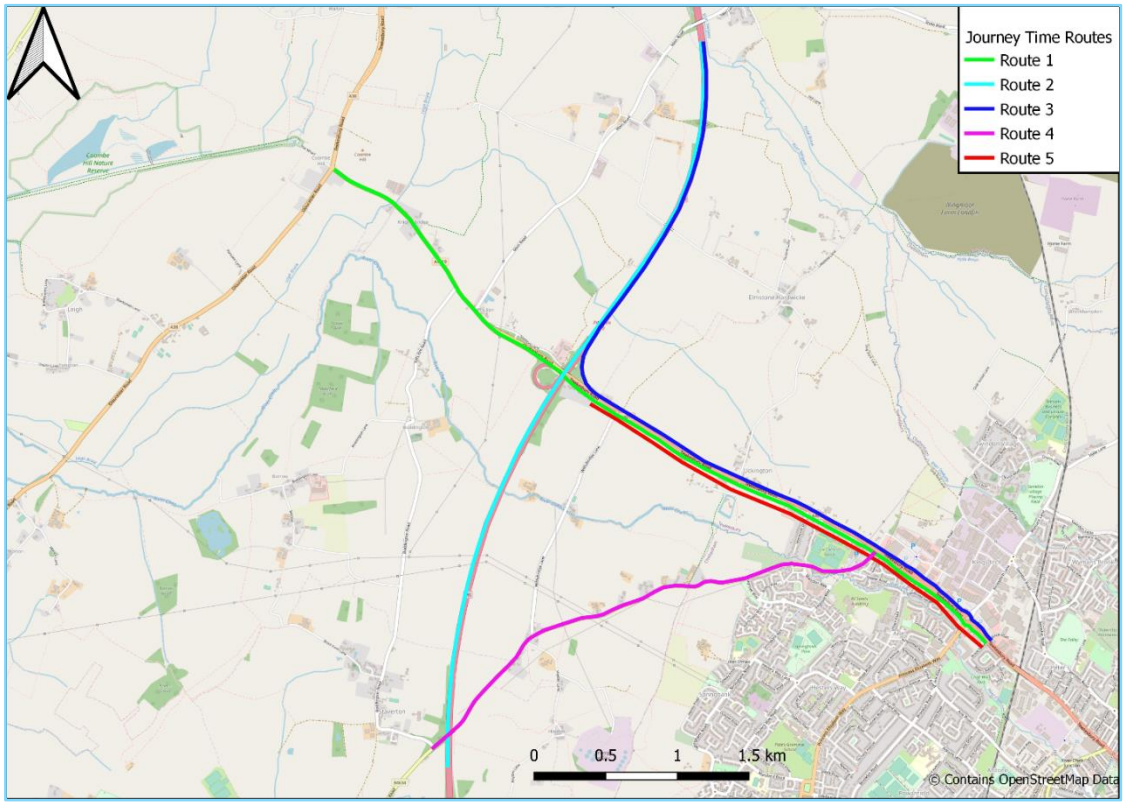


Figure 10 – M5 J10 Paramics Model Extents

Opening Year - 2027

7.4.3. Table 9~~Table 9~~ and Table 10~~Table 10~~ show the average modelled journey times for 2027 Scenario P and 2027 Scenario S for the AM and PM peak periods.

Table 9 – Modelled Journey Times – 2027 AM peak period

Route ID	Route	Modelled Journey time (hh:mm:ss)		
		Scenario P	Scenario S	% Change
R1_EB	A4019 Tewkesbury Road EB	00:12:06~~00:11:55~~	00:10:04~~00:10:17~~	-17%~~-14%~~
R1_WB	A4019 Tewkesbury Road WB	00:06:44~~00:07:05~~	00:09:18~~00:09:52~~	38%~~39%~~
R2_NB	M5 Northbound	00:03:05~~00:03:04~~	00:02:57~~00:02:58~~	-4%~~-3%~~
R2_SB	M5 Southbound	00:03:52~~00:04:36~~	00:03:22~~00:03:43~~	-13%~~-19%~~
R3_EB	M5 North to A4019 East	00:15:22~~00:17:42~~	00:09:09~~00:09:29~~	-40%~~-46%~~
R3_WB	A4019 East to M5 North	00:06:27~~00:06:49~~	00:08:07~~00:08:42~~	26%~~28%~~
R4_NB	Old Gloucester Road Northbound	00:08:20~~00:07:33~~	00:05:03~~00:05:08~~	-39%~~-32%~~
R4_SB	Old Gloucester Road Southbound	00:03:34~~00:03:36~~	00:04:02~~00:03:58~~	13%~~10%~~

Route ID	Route	Modelled Journey time (hh:mm:ss)		
		Scenario P	Scenario S	% Change
R5_EB	A4019 Eastbound	00:09:4300:09:35	00:07:2200:07:27	-24%-22%
R5_WB	A4019 Westbound	00:04:3800:05:00	00:05:5300:06:17	27%26%

Table 10 – Modelled Journey Times – 2027 PM peak period

Route ID	Route	Modelled Journey time (hh:mm:ss)		
		Scenario P	Scenario S	% Change
R1_EB	A4019 Tewkesbury Road EB	00:10:2500:11:54	00:08:3500:08:22	-18%-30%
R1_WB	A4019 Tewkesbury Road WB	00:06:1500:06:19	00:08:3600:08:18	37%31%
R2_NB	M5 Northbound	00:03:0600:03:07	00:02:5900:03:01	-4%-3%
R2_SB	M5 Southbound	00:03:1600:03:15	00:03:0700:03:09	-4%-3%
R3_EB	M5 North to A4019 East	00:10:2300:11:59	00:07:2800:07:30	-28%-37%
R3_WB	A4019 East to M5 North	00:06:0900:06:11	00:08:2200:08:01	36%30%
R4_NB	Old Gloucester Road Northbound	00:05:3100:05:48	00:04:5100:05:10	-12%-11%
R4_SB	Old Gloucester Road Southbound	00:03:3000:03:35	00:04:3100:04:29	29%25%
R5_EB	A4019 Eastbound	00:08:2900:09:58	00:05:5400:05:55	-30%-41%
R5_WB	A4019 Westbound	00:04:1900:04:21	00:06:0100:05:29	39%26%

7.4.4. The results indicate that across majority of the routes there are journey time improvements in the AM and PM peak, however there are some routes where average journey times have increased in both AM and PM peak. It is noted that the Scheme includes the provision of six additional traffic signals along relatively short corridor, which has an impact on some journey times. The largest percentage increase is in the AM PM peak on the A4019 Tewkesbury Road westbound route; an increase of around 2.8less than 2 minutes on a 7 4.3 minute journey.

7.4.5. The comparison of journey time results with variations between 10 15 runs were investigated to better understand the significance of some of the differences. Figure 11 shows the journey time variance for A4019 Tewkesbury Road westbound AM PM peak for 2027 Scenario P & S. The full outputs of variations in 2027 for all journey time routes are included in Appendix D

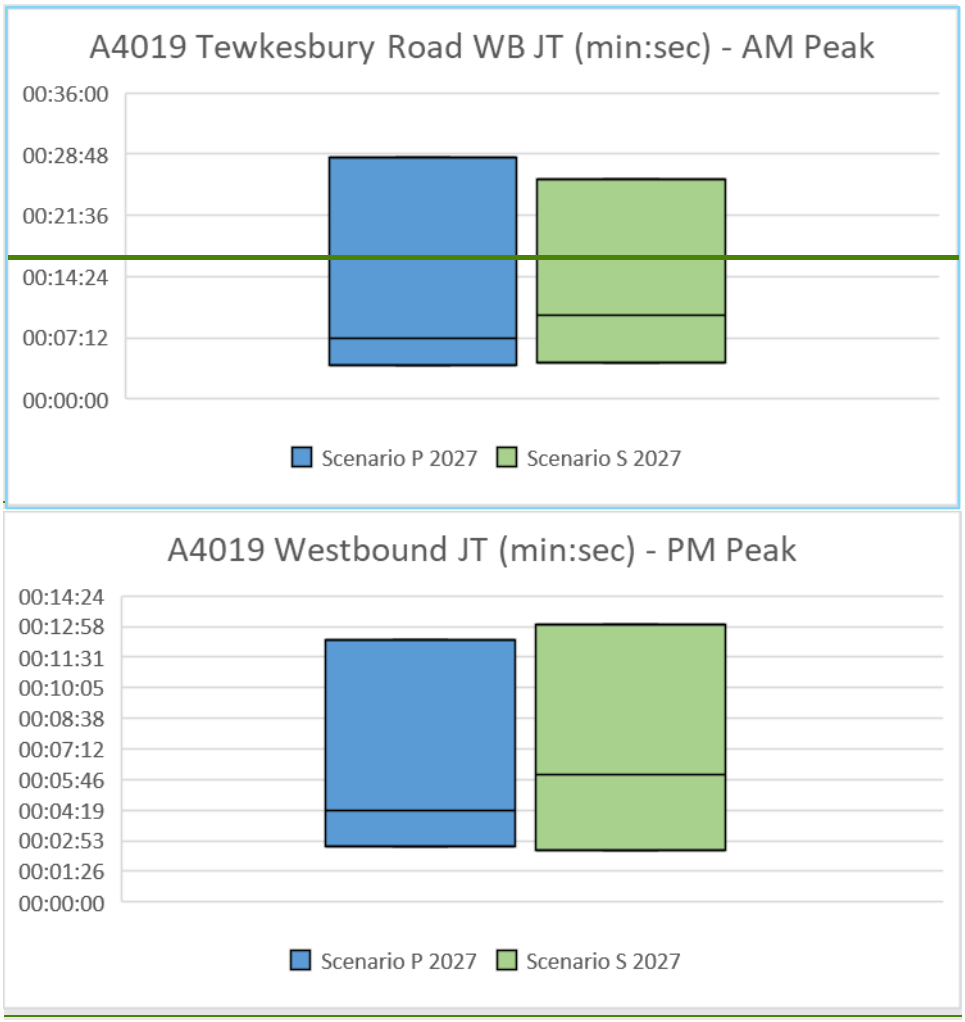
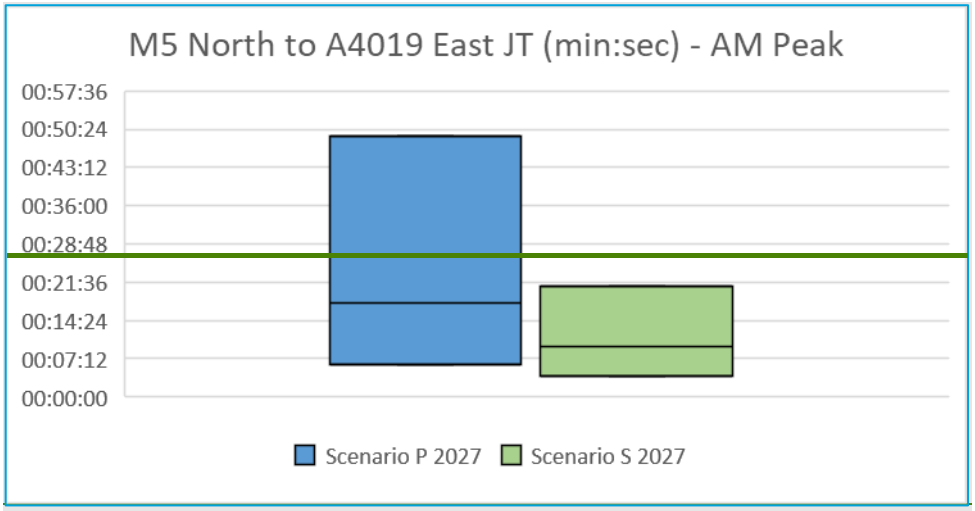


Figure 11 – Journey time variance A4019 ~~Tewkesbury Road~~ WB 2027 ~~AM~~ PM peak

7.4.6. It is clear from investigation of the variations within the ~~10~~ 15 runs, the results for the average journey time for Scenario S fall well within the range of results in the Scenario P. Therefore, the overall average journey time increase is not considered significant.

7.4.7. Considering some of the forecast improvements to journey times as a result of the Scheme, there are no routes in which the range of Scenario S results fall entirely outside of the range of Scenario P results . Figure 12 shows the journey time variance for M5 North to A4019 East in the AM peak for 2027 Scenario P & S.



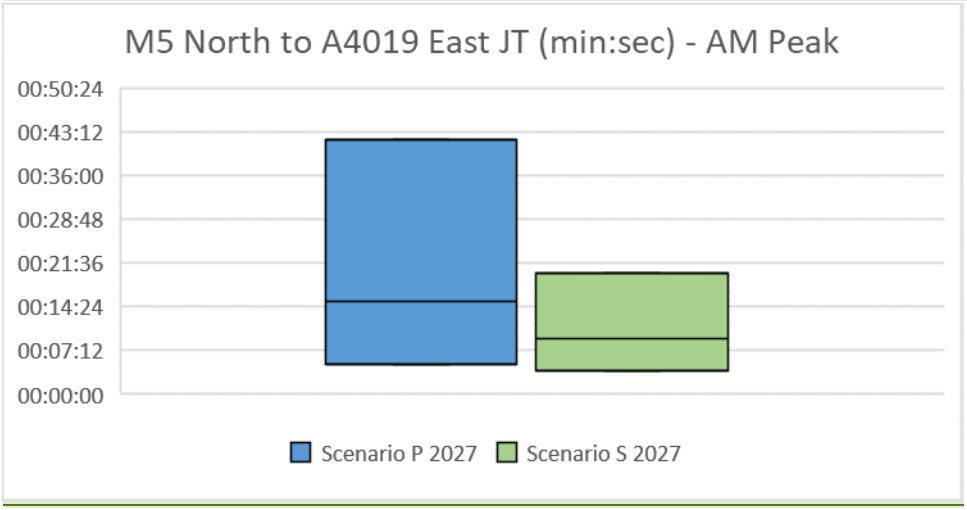


Figure 12 – Journey time variance ~~Old Gloucester Road NB~~M5 North to A4019 East 2027 AM peak

7.4.8. It is clear from investigation of the variations within the ~~10~~ 15 runs, the improved results for this average journey time for Scenario S fall at the lower end of the range of results in the Scenario P variation. However, not all Scenario S results are an improvement compared to the average of Scenario P. Therefore, this journey time improvement is not considered significant.

Future Year – 2042

7.4.9. Table 11~~Table 11~~ and Table 12~~Table 12~~ show the modelled journey times for 2042 Scenario P and 2042 Scenario S for the AM and PM peak periods.

Table 11 – Modelled Journey Times – 2042 AM peak period

Route ID	Route	Modelled Journey time (hh:mm:ss)		
		Scenario P	Scenario S	% Change
R1_EB	A4019 Tewkesbury Road EB	00:15:1900:12:22	00:10:2100:10:31	-32%-15%
R1_WB	A4019 Tewkesbury Road WB	00:10:5200:11:13	00:09:3600:09:43	-12%-13%
R2_NB	M5 Northbound	00:03:0800:03:08	00:03:0000:03:01	-4%-4%
R2_SB	M5 Southbound	00:04:2000:05:22	00:03:2300:04:09	-22%-23%
R3_EB	M5 North to A4019 East	00:20:3500:19:56	00:09:2500:09:59	-54%-50%
R3_WB	A4019 East to M5 North	00:10:3300:10:53	00:08:1900:08:31	-21%-22%
R4_NB	Old Gloucester Road Northbound	00:10:0100:08:36	00:05:2600:05:33	-46%-35%
R4_SB	Old Gloucester Road Southbound	00:04:0200:05:09	00:03:5000:04:02	-5%-22%
R5_EB	A4019 Eastbound	00:12:3100:10:15	00:07:3400:07:20	-40%-29%
R5_WB	A4019 Westbound	00:08:4200:09:02	00:06:0200:06:04	-31%-33%

Table 12 – Modelled Journey Times – 2042 PM peak period

Route ID	Route	Modelled Journey time (hh:mm:ss)		
		Scenario P	Scenario S	% Change
R1_EB	A4019 Tewkesbury Road EB	00:14:02~~00:14:08~~	00:09:19~~00:09:02~~	-34%~~-36%~~
R1_WB	A4019 Tewkesbury Road WB	00:06:31~~00:06:24~~	00:08:57~~00:08:40~~	37%~~35%~~
R2_NB	M5 Northbound	00:03:14~~00:03:12~~	00:03:05~~00:03:07~~	-5%~~-3%~~
R2_SB	M5 Southbound	00:03:26~~00:03:32~~	00:03:09~~00:03:12~~	-9%~~-9%~~
R3_EB	M5 North to A4019 East	00:15:04~~00:16:12~~	00:08:11~~00:07:56~~	-46%~~-51%~~
R3_WB	A4019 East to M5 North	00:06:24~~00:06:16~~	00:08:34~~00:08:20~~	34%~~33%~~
R4_NB	Old Gloucester Road Northbound	00:09:12~~00:08:09~~	00:06:49~~00:06:59~~	-26%~~-14%~~
R4_SB	Old Gloucester Road Southbound	00:03:37~~00:03:37~~	00:05:27~~00:05:15~~	51%~~45%~~
R5_EB	A4019 Eastbound	00:11:57~~00:12:10~~	00:06:36~~00:06:18~~	-45%~~-48%~~
R5_WB	A4019 Westbound	00:04:32~~00:04:25~~	00:06:09~~00:05:40~~	36%~~28%~~

7.4.10. The results indicate that across majority of the routes there are journey time improvements in the AM and PM peak, however there are some routes where average journey times have increased in the PM peak.

7.4.11. The largest percentage increase is in the PM peak on Old Gloucester Road southbound movements; an increase of around 1.5 minutes on a journey time of around 3.5 ~~minutes..~~minutes.

7.4.12. Figure 13 shows the journey time variance for Old Gloucester Road soutbound PM peak for 2042 Scenario P & S. The full outputs of variations in 2042 for all journey time routes are included in Appendix E.

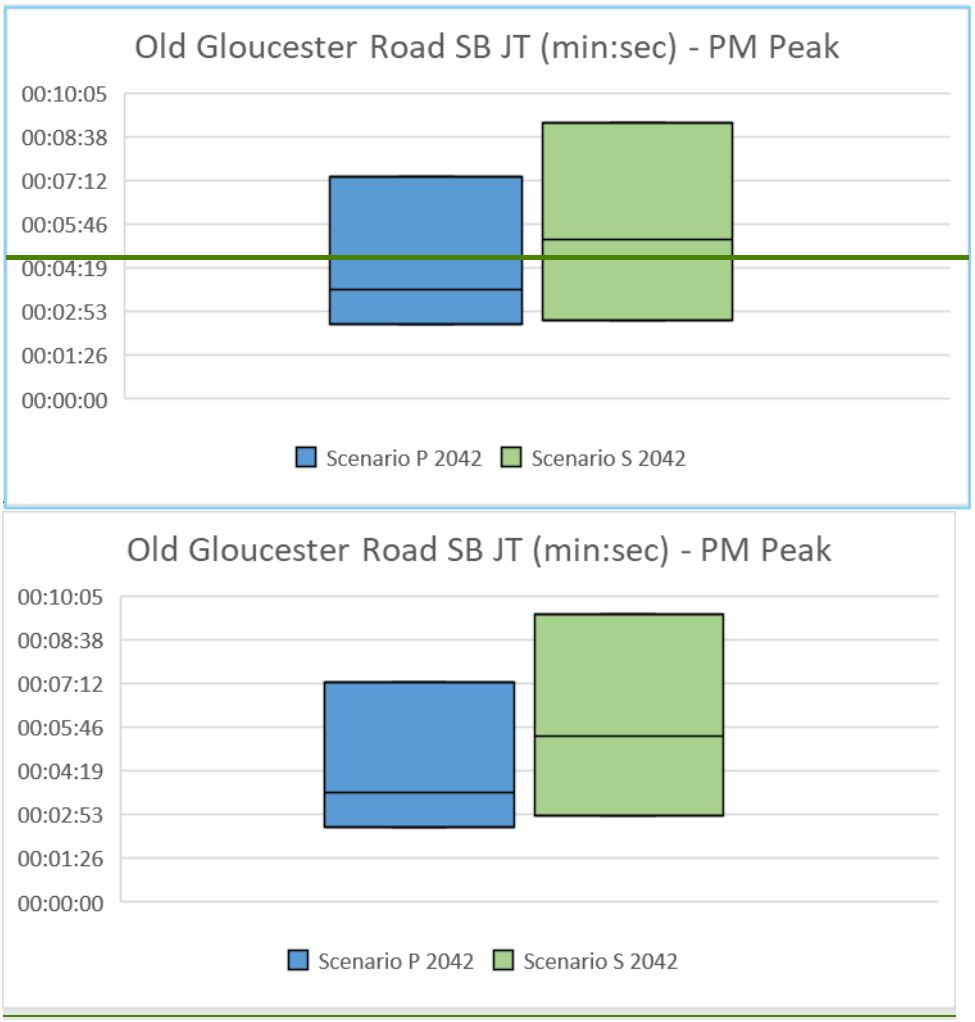


Figure 13 – Journey time variance Old Gloucester Road SB 2042 PM peak

7.4.13. It is clear from investigation of the variations within the ~~10~~ 15 runs, the results for the average journey time for Scenario S fall well within the range of results in the Scenario P. Therefore, the overall average journey time increase is not considered significant.

7.5. Queue Results

7.5.1. Details of queues at all approaches to all junctions within the Paramics model area are included in Appendix F. The table in Appendix F identifies the available queueing length for each approach and outlines the Mean-Maximum Queue lengths (MMQ) as well as average queue lengths. Where queues exceed available storage, the values are highlighted. The data is provided for Scenarios P, R and S for 2027 and 2042.

7.5.2. Across a number of currently congested junctions within the study area, MMQs are predicted to reduce as a result of the Scheme. At junctions where queues are predicted to exceed storage without the Scheme (such as the A4019 / B4634 Signalised Junction), the Scheme is predicted to reduce these queue lengths, and Scenario S results indicate that they will be contained within the storage available.

7.5.3. There are some increases in predicted queue lengths, partly as a result of introducing signalised junctions at locations where junctions were priority controlled, or no junction previously existed. The impact of these queues on journey times is captured by the reporting of journey times outlined in Section 7.~~43~~.

Queues And The Mainline Motorway

7.5.4. Queue lengths for the M5 off-slips are considered here in further detail due to the potential for queues to block mainline traffic which is a specific safety issue. Queue counters were

set up at the M5 off-slips in the Paramics model to extract the queue results for M5 J10 in detail. It is noted that in Scenario P there are no results for the northbound offslip due to its existing layout.

7.5.5. Mean-max queue (MMQ) lengths for the AM and PM peak have been plotted on aerial imagery to provide a better visual comparison of queue length changes across different scenarios.

Opening Year - 2027

7.5.6. Figures 14 and 15 show the MMQ plots for 2027 Scenario P and 2027 Scenario S for the AM and PM peak periods.

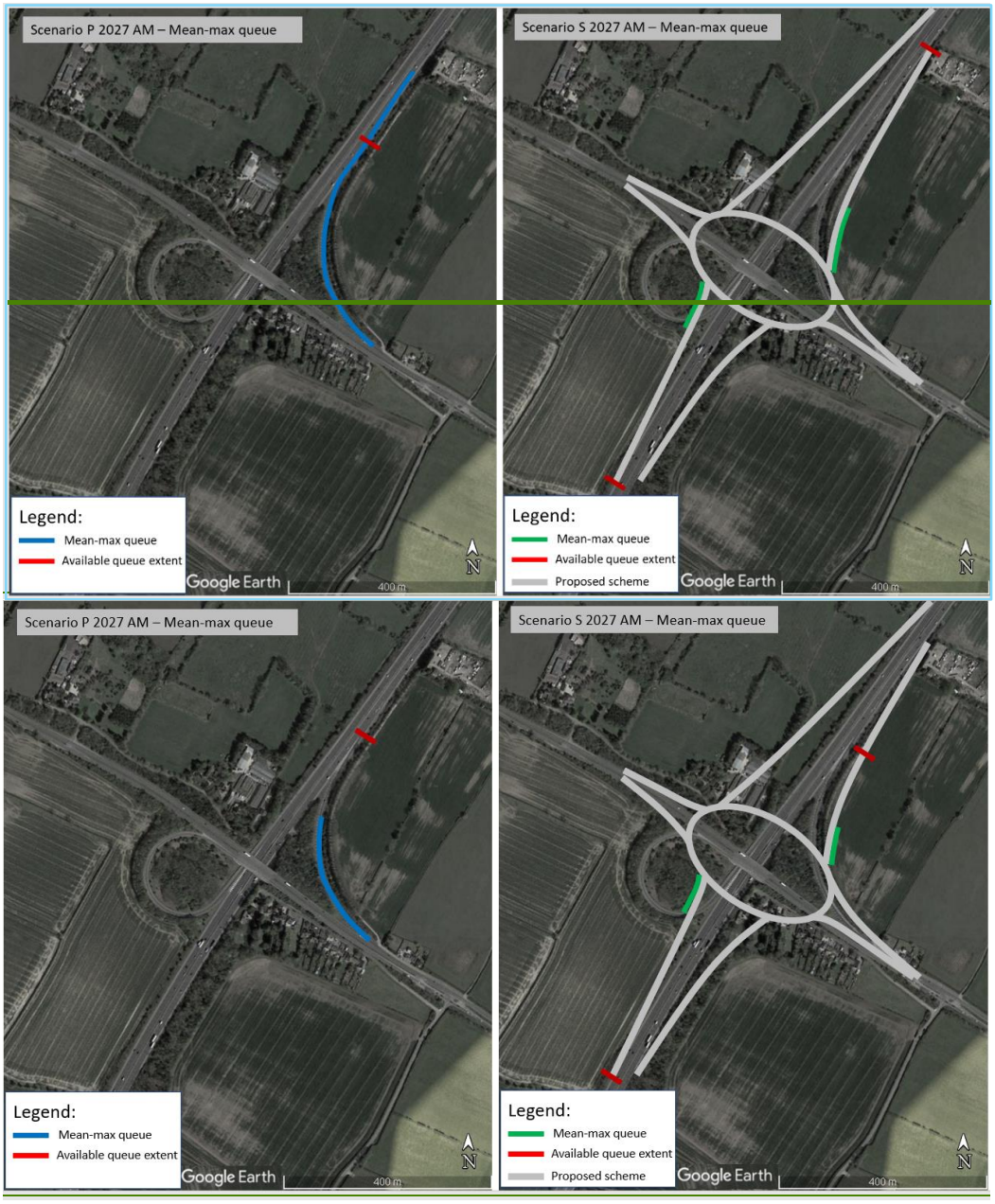


Figure 14 – Mean-max queue M5 off-slips 2027 AM Peak

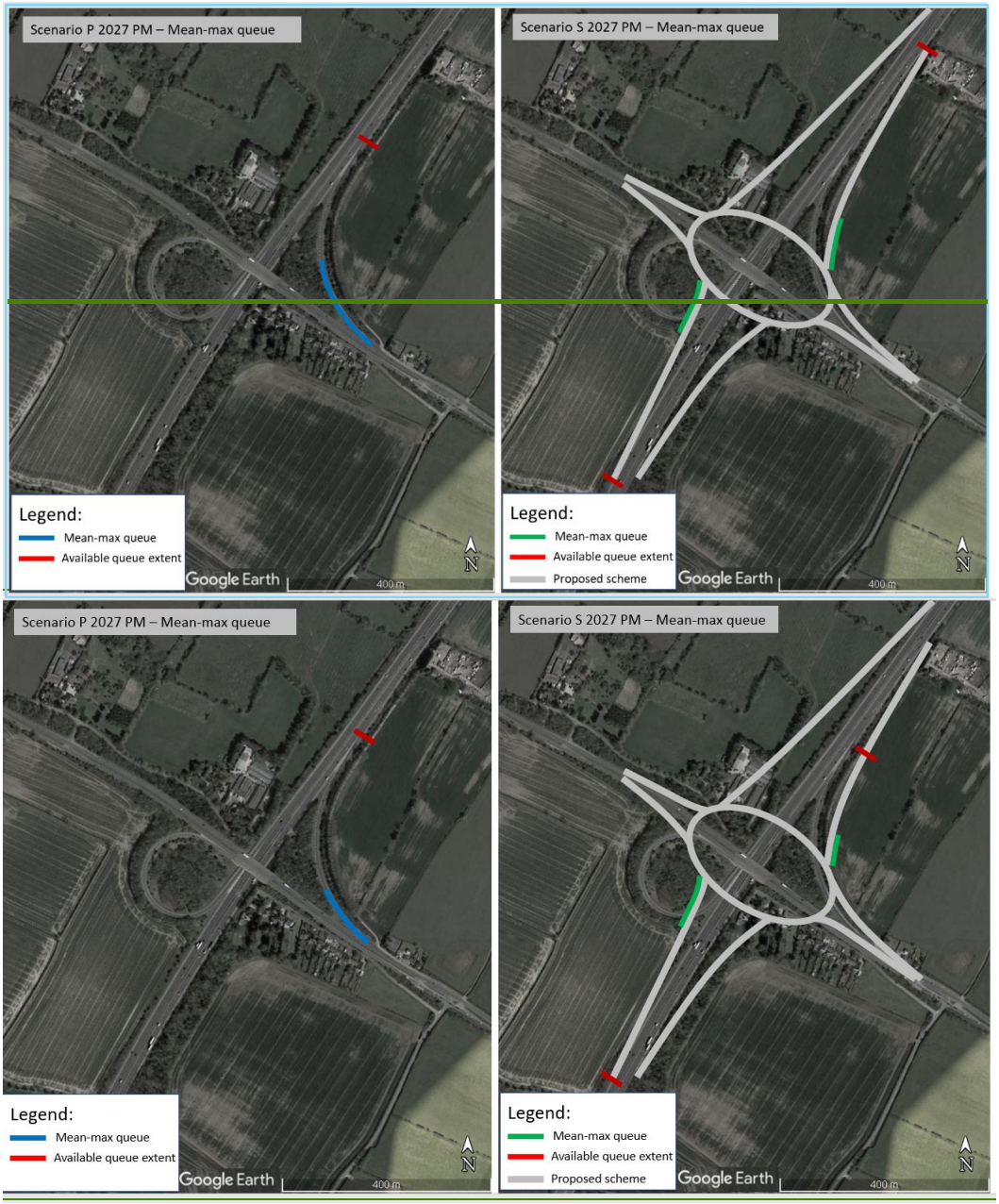


Figure 15 – Mean-max queue M5 off-slips 2027 PM Peak

7.5.7. The mean-max queue plots indicate that for opening year 2027 Scenario S reduces queue length at M5 southbound off-slip in both AM and PM peak along with minimal queues at M5 northbound off-slip. They also indicate that the Scheme prevents queuing back towards the mainline in the AM peak.

~~The mean-max queue plots indicate that for opening year 2027 Scenario S reduces queue length at M5 southbound off-slip in both AM and PM peak along with minimal queues at M5 northbound off-slip. The proposed Scheme reduces the length of the queue on the southbound off-slip, which is predicted to exceed storage and extend into the mainline in the AM peak without the Scheme.~~

Future Year - 2042

~~7.5.7.~~7.5.8. Figures 16 and 17 show the MMQ plots for 2042 Scenario P and 2042 Scenario S for the AM and PM peak periods.

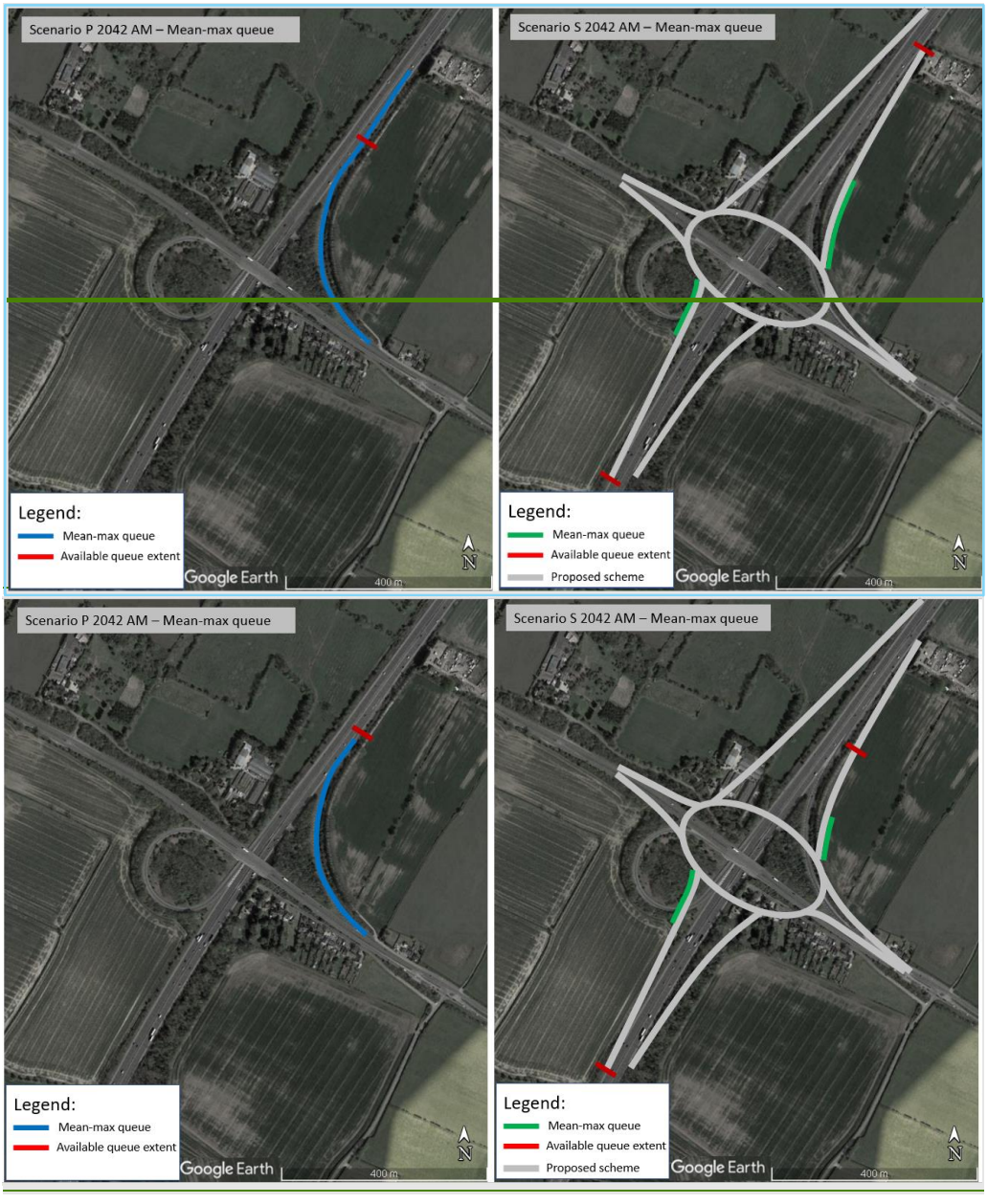


Figure 16 – Mean-max queue M5 off-slips 2042 AM Peak

Figure 17 – Mean-max queue M5 off-slips 2042 PM Peak

~~7.5.8.~~7.5.9. The mean-max queue plots indicate that for future year 2042 Scenario S reduces queue length at M5 southbound off-slip in both AM and PM peak along with minimal queues at M5 northbound off-slip. They also indicate that the Scheme prevents queuing back to the mainline in the AM peak.

7.6. Results Summary

7.6.1. The comparison of performance between Scenario S and Scenario P has demonstrated the impact of the Scheme in isolation (without any dependent development).

7.6.2. Overall, the Scheme improves average journey times and increases average speeds across the Paramics model area.

7.6.3. Considering specific journey times for routes within the model, the results indicate that across the majority of the routes there are journey time improvements. There are some routes where average journey times have increased in the AM and, or PM peak. However, investigation of the variations within the model runs demonstrate that the results for the average journey time for Scenario S fall well within the range of results in the Scenario P.

Therefore, these journey time increases are not considered significant.

7.6.4. In terms of queuing, the Scheme reduces the length of the queue on the southbound off-slip, which is predicted to exceed storage and extend into the mainline in the AM peak without the Scheme. This is considered as a safety benefit of the Scheme as queues will no longer extend back ~~onto~~ towards live lanes of motorway.

8. Cumulative Assessment

8.1. Introduction

8.1.1. This section provides an overview of how the 2027 and 2042 Scenario P (without the Scheme) compare against the 2027 & 2042 Scenario R (with the Scheme and with the dependent future development traffic) in terms of traffic operation. It represents a cumulative scenario.

8.1.2. It is noted that the basis of the Scheme is to 'enable' major developments, rather than to provide all the network improvement requirements for such development. The proposed Scheme results in 6 new signalised junctions, 5 of which are to be located along the relatively short length along the A4019 between M5 and Gallagher Junction. In order to design a Scheme that had no adverse impact on the future journey times, a much larger scheme with higher cost and considerably increased impact on the environment would have been needed which would have been unacceptable.

8.2. Traffic Flows

8.2.1. Comparing Scenario P to R to understand the cumulative impact of the Scheme and the associated dependent development shows larger increases in flows. These changes are mainly as a result of the trips generated by the dependent developments and partly due to the Scheme itself. Details of the changes to create the future year scenarios are outlined in the Model Package Report (included as Appendix J).

8.2.2. The changes in flow between the different scenarios are illustrated in flow difference plots included in Appendix B.

8.3. Network Performance Results

8.3.1. The network performance results provide an overview of the performance of all vehicles within the network as a whole and therefore give a good overall snapshot of the operational impacts of the Scheme. The results focus on the changes in key network wide results parameters including average journey time, network speed and total travel time.

Opening Year - 2027

8.3.2. Table 13~~Table 13~~ and Table 14~~Table 14~~ below provide a comparative summary of the network performance results for 2027 Scenario P and 2027 Scenario R for the AM and PM peak periods.

Table 13 – Network performance results – 2027 AM peak period (08:00-09:00)

Performance Indicator	Scenario P	Scenario R	% Change
Average Journey Time (mins)	~~5.42~~5.21	~~4.73~~4.74	~~-1~~39%
Average Network Speed (mph)	27	~~29~~28	~~4~~3%
Total Travel Time (hours)	~~1408~~1378	~~1370~~1372	~~-~~30%
Total Demand	16589	17008	+3%
Unreleased demand	~~1011~~721	0	-

Table 14 – Network performance results – 2027 PM peak period (17:00-18:00)

Performance Indicator	Scenario P	Scenario R	% Change
Average Journey Time (mins)	~~4.65~~4.54	~~4.11~~4.17	-~~8~~12%
Average Network Speed (mph)	~~29~~30	30	~~3~~1%
Total Travel Time (hours)	~~12311~~1199	~~1167~~1188	-~~5~~1%
Total Demand	16836	17087	+2%
Unreleased demand	~~962~~982	~~68~~7	-

8.3.3. The results for opening year indicate that Scenario R improves network-wide performance in both AM and PM peak with improved journey times and average network speed across the network. The level of dependent development built out at this time is lower than that in 2042.

Future Year – 2042

8.3.4. Table 15~~Table 15~~ and Table 16~~Table 16~~ below provide a comparative summary of the network performance results for 2042 Scenario P and 2042 Scenario R for the AM and PM peak periods.

Table 15 – Network performance results – 2042 AM peak period (08:00-09:00)

Performance Indicator	Scenario P	Scenario R	% Change
Average Journey Time (mins)	~~5.78~~5.83	~~6.16~~5.05	~~7~~-13%
Average Network Speed (mph)	~~26~~25	~~25~~27	~~-1~~6%
Total Travel Time (hours)	~~1609~~1666	~~21331~~1754	~~33~~5%
Total Demand	18051	20884	+16%
Unreleased demand	~~1329~~915	~~95~~31	-

Table 16 – Network performance results – 2042 PM peak period (17:00-18:00)

Performance Indicator	Scenario P	Scenario R	% Change
Average Journey Time (mins)	~~4.94~~4.86	~~4.84~~4.83	-~~2~~1%
Average Network Speed (mph)	28	28	~~0~~-1%
Total Travel Time (hours)	~~14331~~1405	~~16951~~1692	~~18~~20%
Total Demand	18388	21021	+14%
Unreleased demand	~~992~~1039	~~0~~19	-

8.3.5. The results for future year 2042 indicate that the additional dependent demand in Scenario R has an impact on performance compared to Scenario P in the 2042 AM and PM peak.

8.3.6. The total demand is predicted to increase by around 15% in both peak hours, which results in ~~a large~~an increase in total travel time throughout the Paramics model area.

8.3.7. Average journey times ~~in the AM peak increase but is~~are comparable in the AM and PM peaks. The total travel time shows an ~~significant~~ increase in both AM and PM peak which is a result of increased demand in Scenario R compared to Scenario P, as well as the impacts of the Scheme with its additional signalised junctions.

8.3.8. Average network speeds are predicted to reduce slightly in the cumulative scenario for the ~~AM~~ PM peak ~~whereas PM peak average networks speeds are comparable~~. The variations between ~~10~~ 15 runs were investigated to better understand the significance of the differences. Figure 18 shows the average network speed variance for 2042 Scenarios P & R.

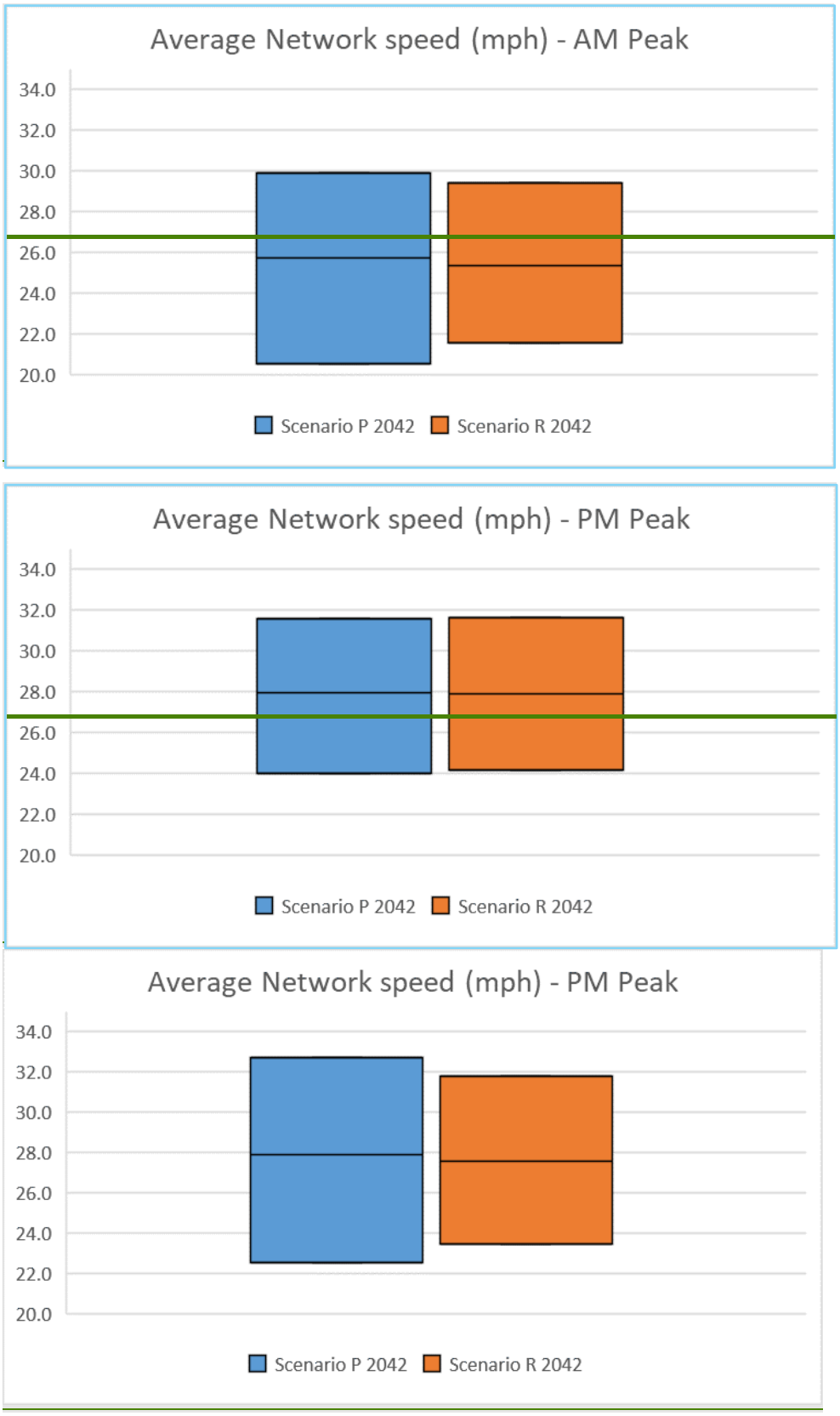


Figure 18 – Network Speed Variance 2042 ~~AM peak and~~ PM peak

8.3.9. It is clear from investigation of the variations within the ~~10~~ 15 runs, the results for the average journey time for Scenario R fall well within the range of results in the Scenario P. Therefore, the overall network speed reductions are not considered significant, nor could they be considered severe.

8.4. Journey Time Results

8.4.1. Various journey time counters have been set up in Paramics model to extract the journey time results for identified five critical routes in both directions.

8.4.2. Figure 8 shows the journey times routes which have been analysed to assess the operation impact of proposed scheme on travel times.

Opening Year – 2027

8.4.3. Table 17~~Table 17~~ and Table 18 show the modelled journey times for 2027 Scenario P and 2027 Scenario R for the AM and PM peak periods.

Table 17 – Modelled Journey Times – 2027 AM peak period

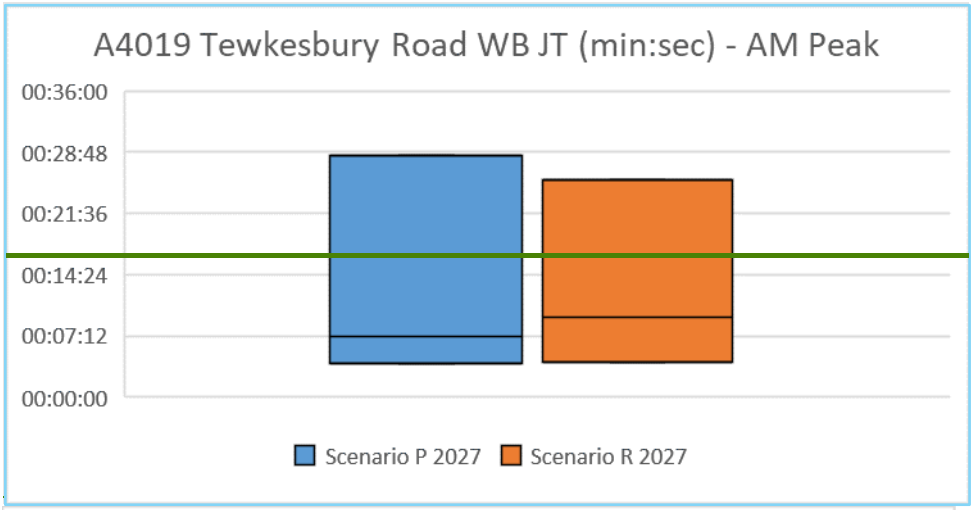
Route ID	Route	Modelled Journey time (hh:mm:ss)		
		Scenario P	Scenario R	% Change
R1_EB	A4019 Tewkesbury Road EB	00:12:0600:11:55	00:10:2000:10:14	-15%~~-14%~~
R1_WB	A4019 Tewkesbury Road WB	00:06:4400:07:05	00:09:1800:09:26	38%~~33%~~
R2_NB	M5 Northbound	00:03:0500:03:04	00:02:5700:02:58	-4%~~-3%~~
R2_SB	M5 Southbound	00:03:5200:04:36	00:03:2200:03:47	-13%~~-18%~~
R3_EB	M5 North to A4019 East	00:15:2200:17:42	00:09:1800:09:31	-39%~~-46%~~
R3_WB	A4019 East to M5 North	00:06:2700:06:49	00:08:0800:08:29	26%~~24%~~
R4_NB	Old Gloucester Road Northbound	00:08:2000:07:33	00:05:0400:05:07	-39%~~-32%~~
R4_SB	Old Gloucester Road Southbound	00:03:3400:03:36	00:04:4200:04:26	32%~~23%~~
R5_EB	A4019 Eastbound	00:09:4300:09:35	00:07:3100:07:24	-23%~~-23%~~
R5_WB	A4019 Westbound	00:04:3800:05:00	00:05:5200:06:04	27%~~21%~~

Table 18 – Modelled Journey Times – 2027 PM peak period

Route ID	Route	Modelled Journey time (hh:mm:ss)		
		Scenario P	Scenario R	% Change
R1_EB	A4019 Tewkesbury Road EB	00:10:25~~00:11:54~~	00:08:52~~00:08:27~~	-15%~~-29%~~
R1_WB	A4019 Tewkesbury Road WB	00:06:15~~00:06:19~~	00:08:39~~00:08:14~~	38%~~30%~~
R2_NB	M5 Northbound	00:03:06~~00:03:07~~	00:02:59~~00:03:01~~	-4%~~-3%~~
R2_SB	M5 Southbound	00:03:16~~00:03:15~~	00:03:07~~00:03:09~~	-5%~~-3%~~
R3_EB	M5 North to A4019 East	00:10:23~~00:11:59~~	00:07:47~~00:07:37~~	-25%~~-36%~~
R3_WB	A4019 East to M5 North	00:06:09~~00:06:11~~	00:08:27~~00:08:02~~	38%~~30%~~
R4_NB	Old Gloucester Road Northbound	00:05:31~~00:05:48~~	00:05:30~~00:05:17~~	0%~~-9%~~
R4_SB	Old Gloucester Road Southbound	00:03:30~~00:03:35~~	00:04:52~~00:04:23~~	39%~~23%~~
R5_EB	A4019 Eastbound	00:08:29~~00:09:58~~	00:06:13~~00:06:02~~	-27%~~-39%~~
R5_WB	A4019 Westbound	00:04:19~~00:04:21~~	00:06:06~~00:05:28~~	41%~~26%~~

8.4.4. The results indicate that across majority of the routes there are journey time improvements in the AM and PM peak, however, there are some routes where average journey times have increased in both AM and PM peak. This is as a result of increased demand in Scenario R compared to Scenario P, as well as the impacts of the Scheme with its additional signalised junctions. The largest percentage increase is in the ~~AM~~ PM peak on A4019 ~~Tewkesbury Road~~ westbound movements; an increase of around ~~2.32~~ minutes on a ~~7~~ 4 minute average journey time.

8.4.5. Figure 19 shows the journey time variance for A4019 ~~Tewkesbury Road~~ westbound ~~AM~~ PM peak for 2027 Scenario P & R. The full outputs of variations for all journey time routes are included in Appendix G.



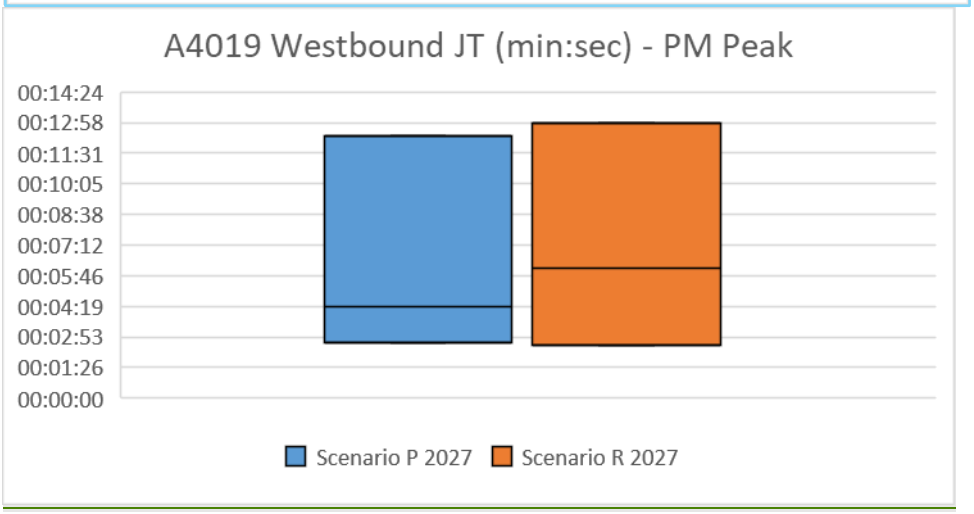


Figure 19 – Journey time variance A4019 ~~Tewkesbury Road~~ WB 2027 ~~AM~~ PM peak

8.4.6. The results for the average journey time for Scenario R fall within the range of results in the Scenario P. ~~Whilst average journey times may be higher in Scenario R, journey time reliability is improved and the maximum modelled journey time is lower in Scenario R~~. Therefore, the overall average journey time increase is not considered significant.

Future Year – 2042

8.4.7. Table 19~~Table 19~~ and Table 20~~Table 20~~ show the modelled journey times for 2042 Scenario P and 2042 Scenario R for the AM and PM peak periods.

Table 19 – Modelled Journey Times – 2042 AM peak period

Route ID	Route	Modelled Journey time (hh:mm:ss)		
		Scenario P	Scenario R	% Change
R1_EB	A4019 Tewkesbury Road EB	00:15:19~~00:12:22~~	00:11:53~~00:14:33~~	-22%~~18%~~
R1_WB	A4019 Tewkesbury Road WB	00:10:52~~00:11:13~~	00:10:04~~00:11:35~~	-7%~~3%~~
R2_NB	M5 Northbound	00:03:08~~00:03:08~~	00:03:00~~00:05:12~~	-4%~~66%~~
R2_SB	M5 Southbound	00:04:20~~00:05:22~~	00:03:31~~00:04:20~~	-19%~~-19%~~

Route ID	Route	Modelled Journey time (hh:mm:ss)		
		Scenario P	Scenario R	% Change
R3_EB	M5 North to A4019 East	00:20:3500:19:56	00:10:4400:12:37	-48%-37%
R3_WB	A4019 East to M5 North	00:10:3300:10:53	00:09:0500:11:20	-14%4%
R4_NB	Old Gloucester Road Northbound	00:10:0100:08:36	00:06:1600:06:14	-37%-28%
R4_SB	Old Gloucester Road Southbound	00:04:0200:05:09	00:05:3100:05:21	37%4%
R5_EB	A4019 Eastbound	00:12:3100:10:15	00:08:4600:09:18	-30%-9%
R5_WB	A4019 Westbound	00:08:4200:09:02	00:06:3300:06:52	-25%-24%

Table 20 – Modelled Journey Times – 2042 PM peak period

Route ID	Route	Modelled Journey time (hh:mm:ss)		
		Scenario P	Scenario R	% Change
R1_EB	A4019 Tewkesbury Road EB	00:14:0200:14:08	00:10:5600:10:43	-22%-24%
R1_WB	A4019 Tewkesbury Road WB	00:06:3100:06:24	00:09:0000:09:11	38%44%
R2_NB	M5 Northbound	00:03:1400:03:12	00:03:0400:03:37	-5%13%
R2_SB	M5 Southbound	00:03:2600:03:32	00:03:1100:03:16	-7%-7%
R3_EB	M5 North to A4019 East	00:15:0400:16:12	00:09:3900:09:24	-36%-42%
R3_WB	A4019 East to M5 North	00:06:2400:06:16	00:08:5600:09:02	40%44%
R4_NB	Old Gloucester Road Northbound	00:09:1200:08:09	00:08:1600:07:32	-10%-8%
R4_SB	Old Gloucester Road Southbound	00:03:3700:03:37	00:06:1700:06:04	74%68%
R5_EB	A4019 Eastbound	00:11:5700:12:10	00:08:0100:07:42	-33%-37%
R5_WB	A4019 Westbound	00:04:3200:04:25	00:06:1800:06:01	39%36%

8.4.8. The results indicate that more of the routes have increased average journey times in the AM and PM peak by 2042. This is as a result of increased demand in Scenario R compared to Scenario P, as well as the impacts of the Scheme with its additional signalised junctions. One of the largest percentage increase is in the AM PM peak on M5 northboundOld Gloucester Road Southbound; an increase of around 2.5 minutes on a 3.5 minute average journey time.

8.4.9. Figure 20 shows the journey time variance for ~~M5 northbound AM~~Old Gloucester Road Southbound PM peak for 2042 Scenario P & R. The full outputs of variations for all journey time routes are included in Appendix H.

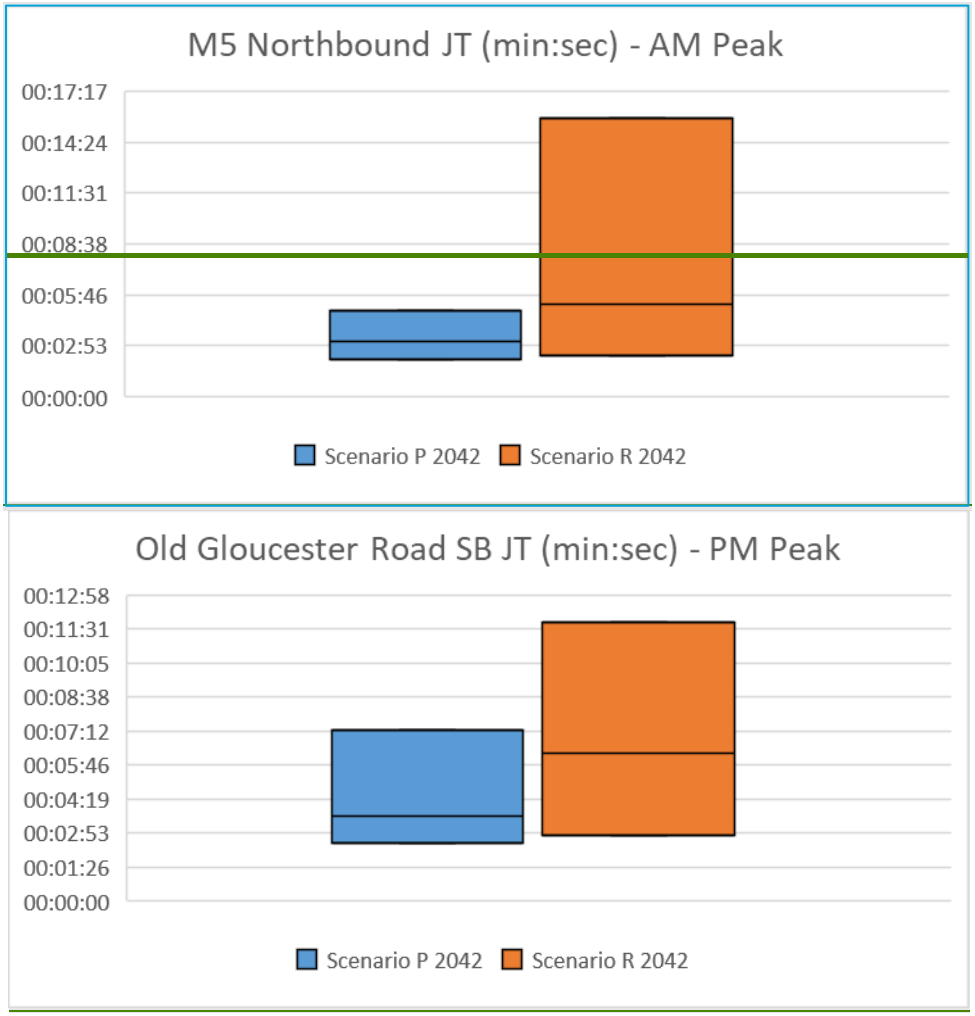
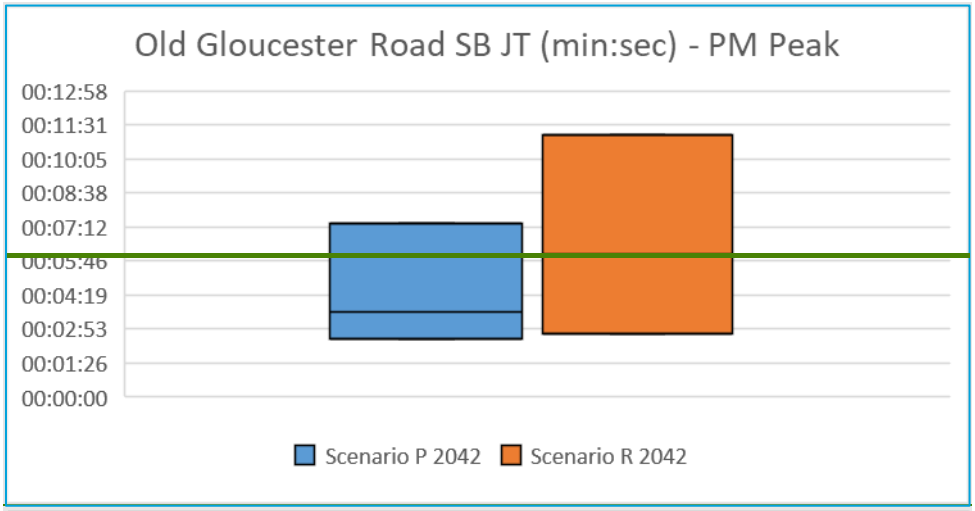


Figure 20 – Journey time variance M5 Northbound 2042 AM peak

8.4.10. The results for this average journey time for Scenario R fall just ~~above~~ within the range of results in the Scenario P, but includes a larger maximum value in the sample of model runs. This indicates that the additional dependent development traffic demand considered in Scenario R has an adverse impact on the journey times on M5 Northbound in the AM peak.

8.4.11. It is noted that the basis of the Scheme is to 'enable' major developments, which would lead to much needed new housing and notable employment opportunities. This particular impact, on this route in this peak hour, which ~~could be considered~~is not considered ~~potentially~~ significant needs to be considered in this context. ~~It is also noted that the Scheme has been designed in accordance with all current standards and guidance, and the merge and diverge has been designed in accordance with DMRB to accommodate the forecast levels of traffic.~~

8.4.12. Also, some of the other large percentage increases need consideration with respect to significance based on variation. Figure 21 shows the journey time variance for ~~Old Gloucester Road~~A4019 East to M5 North 2042 PM peak in Scenario P & R which predicts a ~~6840~~% increase.



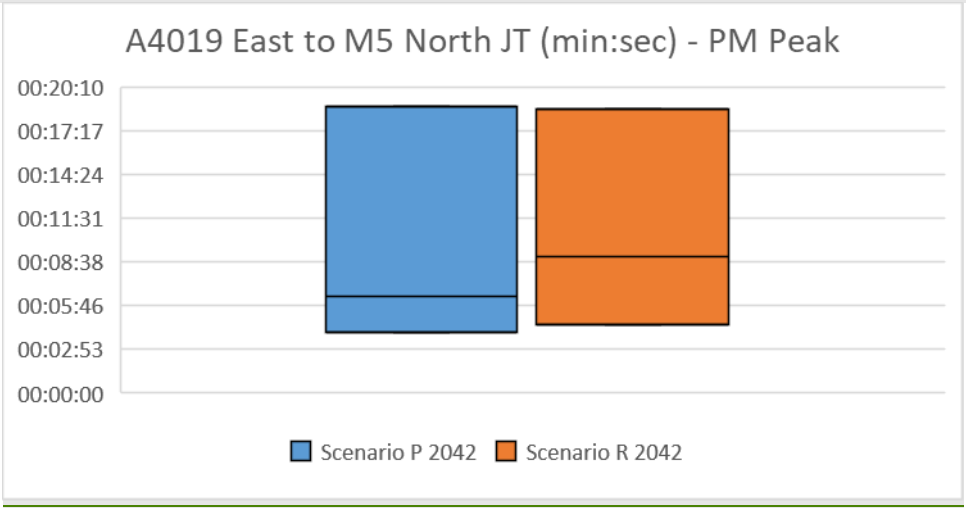
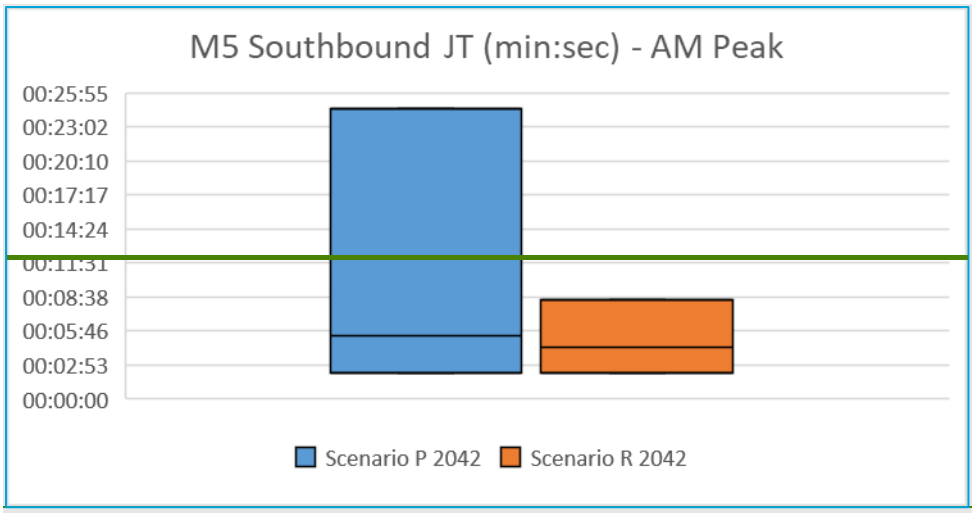


Figure 21 – Journey time variance ~~Old Gloucester Road~~A4019 East to M5 North 2042 PM peak

8.4.13. The results for the average journey time for Scenario R falls within the range of results in Scenario P. This indicates that the additional dependent development traffic demand considered in Scenario R has an insignifcant impact on the journey time on this route.

8.4.14. The adverse impacts are also balanced against journey time improvements for certain routes in the cumulative scenario. Figure 22 shows the journey time variance for M5 southbound AM peak for 2042 Scenario P & R.



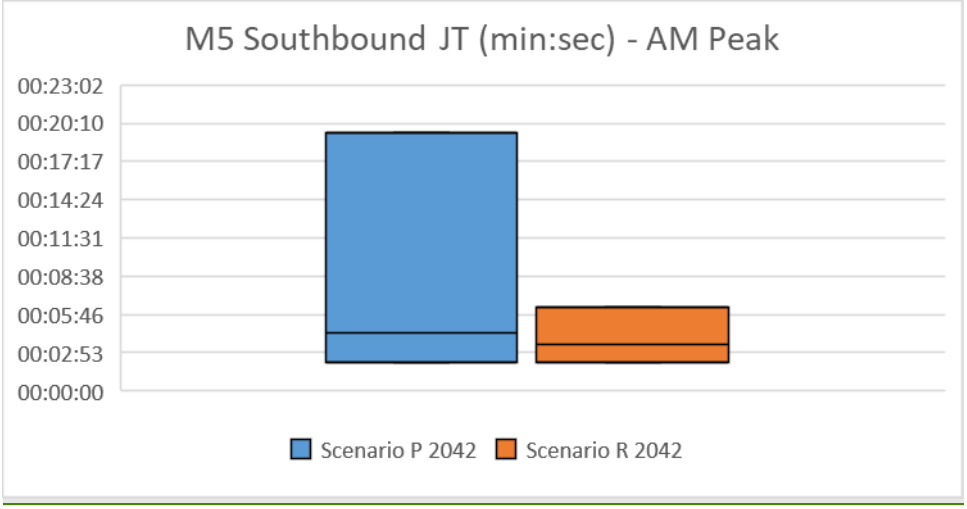


Figure 22 – Journey time variance M5 ~~N~~S~~o~~outhbound 2042 AM peak

8.4.15. The results for this average journey time for Scenario R fall towards the lower range of results in the Scenario P, and includes a much smaller maximum value in the sample of model runs. This indicates that the cumulative impacts of the Scheme and the additional dependent development traffic demand considered in Scenario R has a beneficial impact on the journey times on M5 Southbound, both in terms of averge journey time and journey time reliability.

8.5. Queue Results

8.5.1. Details of queues at all approaches to all junctions within the Paramics model area are included in Appendix F. The table in Appendix F identifies the available queueing length for each approach and outlines the Mean-Maximum Queue lengths (MMQ) as well as average queue lengths. Where queues exceed available storage, the values are highlighted. The data is provided for Scenarios P, R and S for 2027 and 2042.

8.5.2. Across a number of currently congested junctions within the study area, MMQs are predicted to reduce as a result of the Scheme and the additional dependent development traffic demand considered in Scenario R. At junctions where queues are predicted to exceed storage without the Scheme (such as the A4019 / B4634 Signalised Junction), the Scheme is predicted to reduce these queue lengths, and Scenario R results indicate that they will mostly be contained within storage.

8.5.3. There are some increases in predicted queue lengths, partly as a result of introducing signalised junctions as part of the Scheme, and also the additional dependent development traffic demand considered in Scenario R. The impact of these queues on journey times is captured by the reporting of journey times outlined in Section ~~7.3~~8.4.

Queues And The Mainline Motorway

8.5.4. Queue lengths for the M5 off-slips are considered here in further detail due to the potential for queues to block mainline traffic which is a specific safety issue. Queue counters were set up at the M5 off-slips in the Paramics model to extract the queue results for M5 J10 in detail. It is noted that in Scenario P there are no results for the northbound off-slip due to there not being a northbound off-slip ~~inthe~~in the existing layout.

Opening Year - 2027

8.5.5. Figures 23 and 24 show the MMQ plots for 2027 Scenario P and 2027 Scenario R for the AM and PM peak periods.

Figure 23 – Mean-max queue M5 off-slips 2027 AM Peak

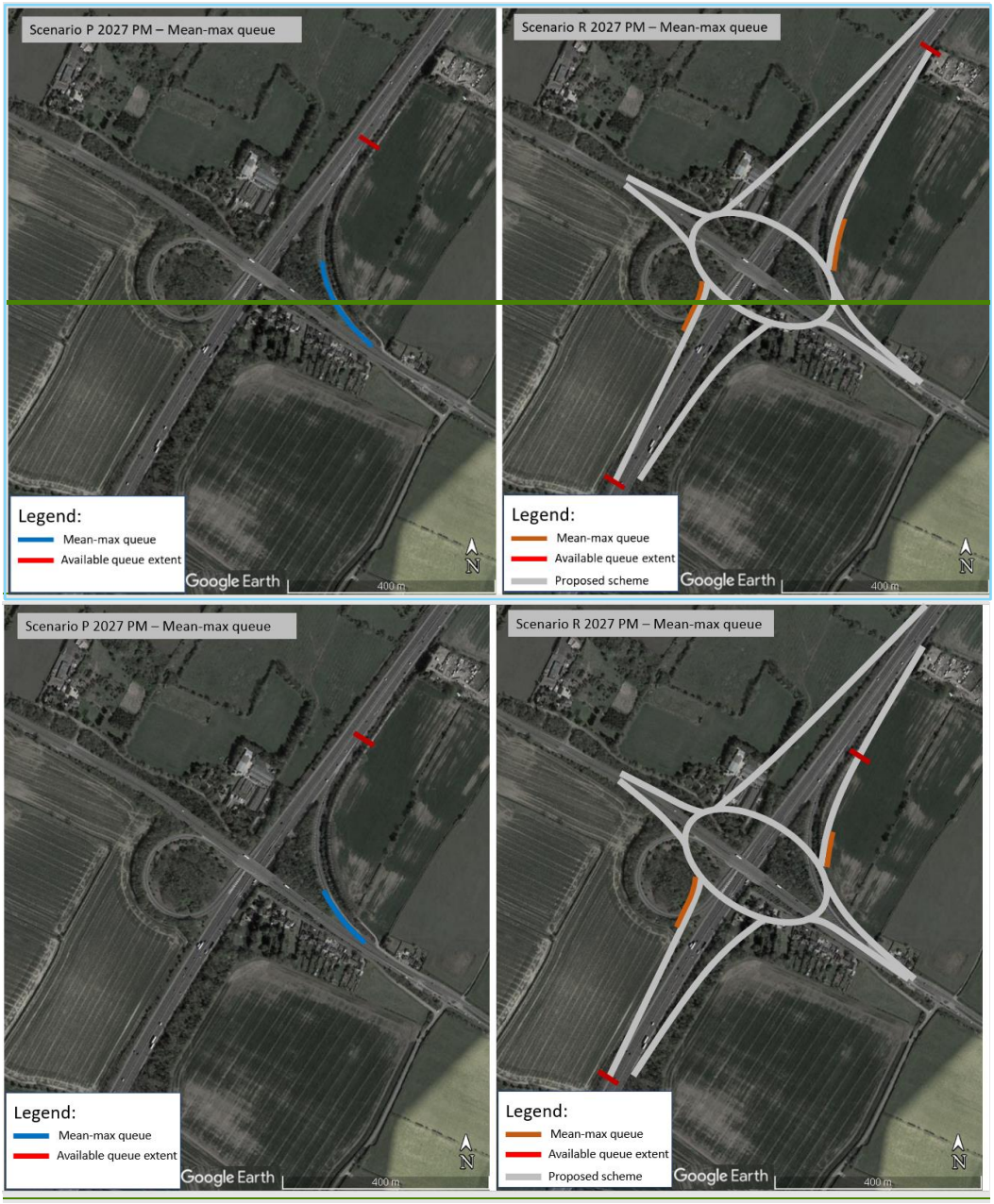


Figure 24 – Mean-max queue M5 off-slips 2027 PM Peak

8.5.6. The mean-max queue plots indicate that for opening year 2027 Scenario R reduces queue length at M5 southbound off-slip in both AM and PM peak along with minimal queues at M5 northbound off-slip With dependent development, the Scheme still reduces the length of the queue on the southbound off-slip, which is predicted to exceed storage and extend into the mainline in the AM peak without the Scheme.

Future Year - 2042

8.5.7. Figures 25 and 26 show the MMQ plots for 2042 Scenario P and 2042 Scenario R for the AM and PM peak periods.

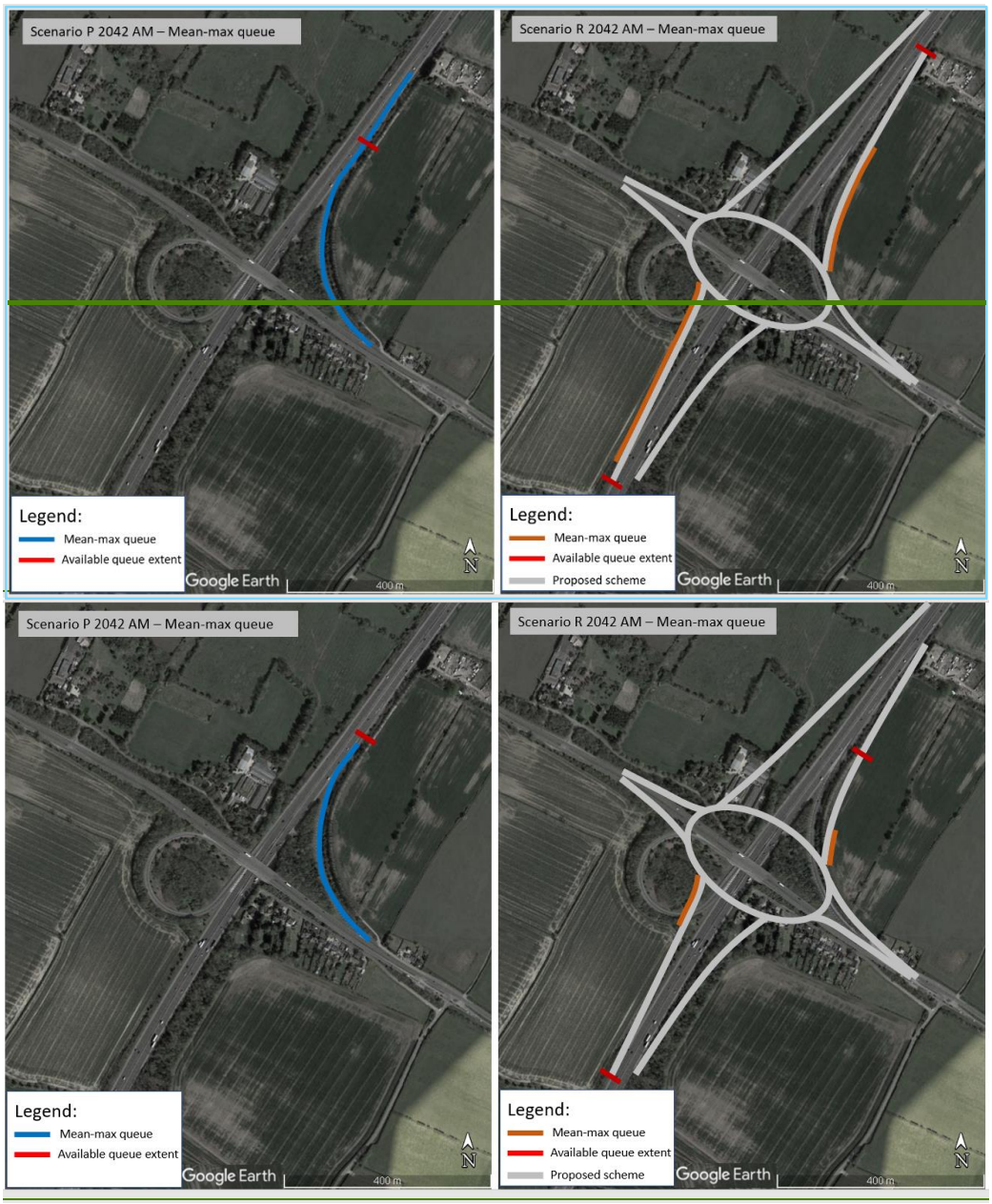


Figure 25 – Mean-max queue M5 off-slips 2042 AM Peak

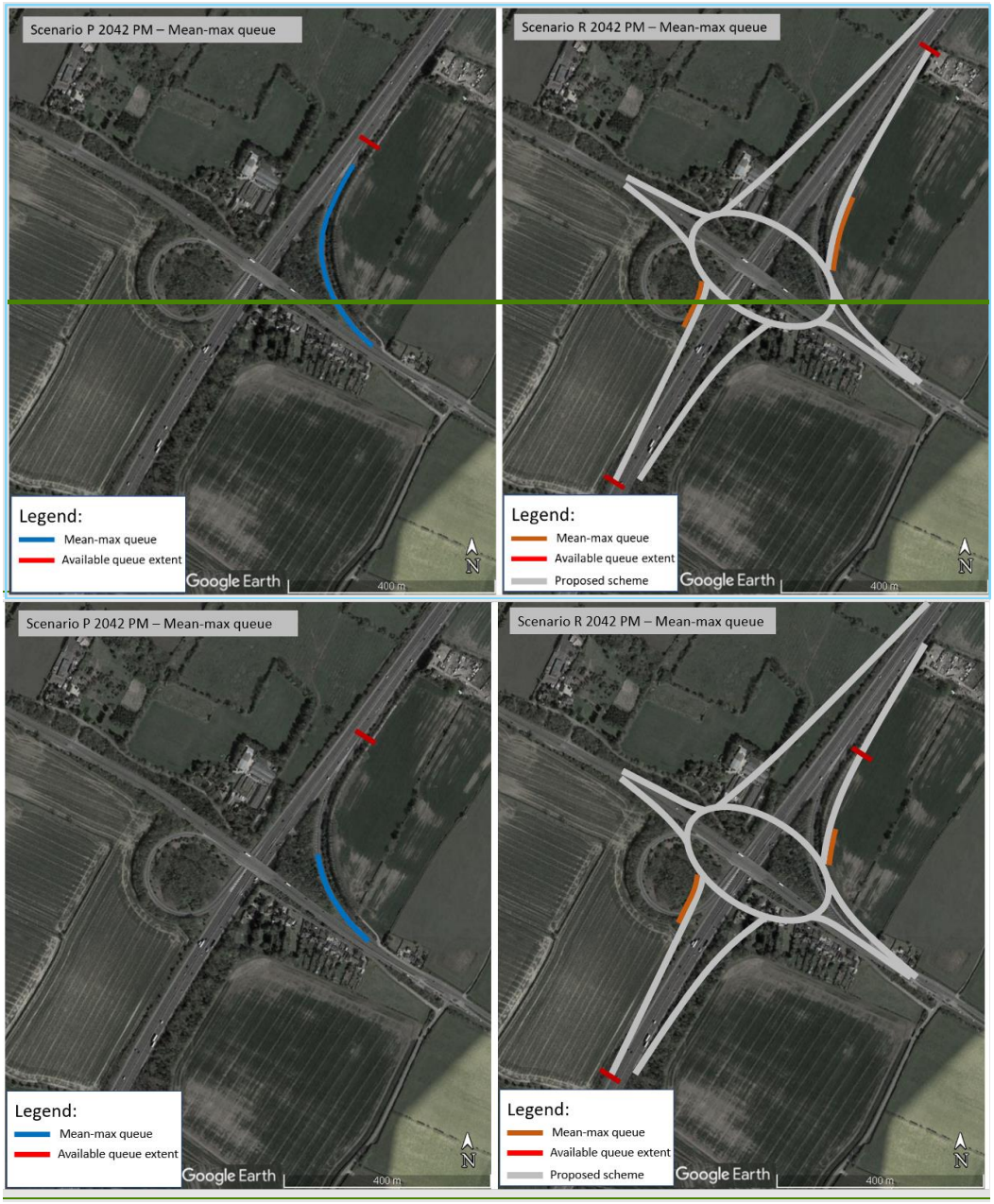


Figure 26 – Mean-max queue M5 off-slips 2042 PM Peak

8.5.8. The mean-max queue plots indicate that for future year 2042 Scenario R reduces queue length at M5 southbound off-slip in both AM and PM peak along with acceptable queues at M5 northbound off-slip. The mean-max queue on the northbound off-slip in the AM peak is not predicted to exceed available storage. With dependent development, the Scheme still reduces the length of the queue on the southbound off-slip, which is predicted to exceed storage and extend into the mainline in the AM peak without the Scheme.

8.6. Results Summary

8.6.1. The comparison of performance between Scenario S and Scenario R has demonstrated the cumulative impact of the Scheme in combination with the dependent development.

8.6.2. Overall, the results indicate that the additional dependent demand in Scenario R has an impact on performance compared to Scenario P, particularly in the 2042 future year.

8.6.3. Average network speeds are predicted to reduce in the cumulative scenario, but from investigation of the variations within the model runs, the results for the average network speed for Scenario R fall within the range of results in the Scenario P. Therefore, the

overall network speed reductions in the cumultive scenario are not considered significant, nor could they be considered severe.

8.6.4. Considering specific journey times for routes within the model, the results indicate that there are journey time improvements alongside increases to journey time caused by the demand dependent development. For these routes where average journey times have increased in the AM and, or PM peak, investigation of the variations within the model runs demonstrate that the results for almost all of the average journey time for Scenario R fall within the range of results in the Scenario P.

8.6.5. It is noted that the basis of the Scheme is to 'enable' major developments which would lead to provision of much needed new housing and notable employment opportunities and as such the Scheme enables significant additional traffic without severe impact.

8.6.6. In terms of queuing, and specifically queue lengths for the M5 off-slips due to the potential for queues to block mainline traffic, which is a safety issue, the Scheme reduces the length of the queue on the southbound off-slip, which is predicted to exceed storage and extend into the mainline in the AM peak without the Scheme. The mean-max queue on the northbound off-slip in the AM peak is not predicted to exceed available storage.

9. Non Traffic Assessments

9.1. Sustainable Transport

9.1.1. The Scheme provides a number of walking and cycling infrastructure improvements along the entire Scheme extent. These include pedestrian and cycle facilities alongside the A4019, formal crossing points across the A4019, and crossing facilities at M5 Junction 10.

9.1.2. Providing these infrastructure improvements is likely to make walking and cycling a genuine choice of transport option for users of the Scheme, including the future users from the major development of new housing (c.9,000 homes) and employment land proposed. This achieves the aims of the NPS to create networks which support the delivery of a low carbon economy, and creating networks which enable communities to link effectively to each other.

~~9.1.2.~~9.1.3. The active travel infrastructure improvements will also help reduce the likelihood of collisions between vehicles and cyclists, such as those identified in section 3.6.10 of the TA.

~~9.1.3.~~9.1.4. An assessment of these improvements is contained within the Walking, Cycling and Horse-riding Assessment and Review (WCHAR) at Appendix I.

~~9.1.4.~~9.1.5. The assessment included use of the scoring tools contained within LTN 1/20 Cycle Infrastructure Design guidance. These tools were introduced by the Department for Transport (DfT) to set minimum quality criteria for cycling infrastructure design.

~~9.1.5.~~9.1.6. An extract of the Cycling Level of Service (CLoS) assessment is replicated below.

Table 3-2 - CLoS summary comparison

Key Requirement	Maximum Score	Existing (Combined Scores)	DF 2.2 (Combined Scores)	DF 2 (Public Consultation)	DF 3 (end of prelim design)
Cohesion	6	0/1	2/1	3	3
Directness	10	6/7	5/7	4	4
Safety	16	CRITICAL (0)	11	16	16
Comfort	8	2/3	6	7	7
Attractiveness	10	1	1	5	5
Total (X/50)	50	9/12	25/26	35	35
Percentage (Pass = 70%)	100%	18%/24%	50%/52%	70%	70%

~~9.1.6.~~9.1.7. Overall, ~~the Scheme~~the Scheme meets the minimum 70% standard for the LTN 1/20 CLoS assessment, scoring strongly for safety and comfort. The WCHAR notes that safety is also a consistent strength of the junction designs within the Scheme.

~~9.1.7.~~9.1.8. In terms of public transport journey time impacts, the impact of the Scheme on journey times for all vehicles (including buses) are outlined in Sections ~~6~~7.3 and ~~7~~8.3. The results indicate that across majority of the routes there are journey time improvements. There are some routes where average journey times have increased in the AM and, or PM peak. but these journey time increases are not considered significant.

9.2. Highways Safety

9.2.1. The impact of the Scheme across the GCTM model network shown in Figure 9 above has also been assessed using the DfT COBALT software. COBALT assesses the safety

aspects of road schemes based on a comparison of accidents by severity and associated costs, across an identified network, for the 'Without-Scheme' and 'With-Scheme' forecast scenarios. The analysis is undertaken using details of the individual link and junction characteristics, their forecast traffic volumes and relevant accident rates and costs.

9.2.2. The results for the comparison between Scenario P (Without the Scheme) and Scenario S (With the Scheme but without dependent development) shows that there are accidents and casualties saved by the Scheme. Based on the outputs of GTCM v2.3, it is estimated that there will be about 195 accidents and about 250 casualties saved under this scenario over the assessment period across the GCTM highway network. The corresponding figures for the Paramics model area shown in Figure 9 above are reported as about 32 and 34 respectively.

9.2.3. The comparison between Scenario R (With the Scheme and with the dependent development) and Scenario P ~~-~~show that the accidents saved by the Scheme are offset by the additional accidents resulting from the increased demand arising from the dependent JCS developments which result in higher traffic flows across the highway network, so there are not predicted to be any accident savings in the cumulative scenario.

9.2.4. In addition to the assessment in COBALT, the Scheme addresses the specific safety issue of queues extending back from the M5 southbound off-slip onto the mainline. The modelling indicates that without the Scheme in future years the queues are predicted to extend back ~~beyond~~ towards the extents of the slip road. With the Scheme these queues are predicted to be contained within storage. In the Cumulative scenarios with the Scheme and dependent development traffic, the queues are still predicted to be contained within the off-slip storage.

9.2.5. It has been demonstrated that all reasonable steps have been taken and will be taken ~~to minimise~~to minimise the risk of road casualties arising from the ~~scheme, and~~Scheme and contribute to an overall improvement in the safety of the Strategic Road Network, as outlined in NPS NN at paragraph 4.66.

9.2.6. It is therefore considered that the Scheme achieves the NPS NN aim to deliver national networks that meet the country's needs through creating networks which improve journey quality, ~~reliability~~reliability, and safety.

10. Assessment of Highway Network During Construction

10.1. Introduction

10.1.1. This chapter summarises the traffic modelling undertaken to predict the construction phase impacts of the proposed Scheme on the road network resulting from traffic management measures such as the closure of the existing M5 J10 slip roads during the construction period, and changes to operation of sections of A4019.

10.1.2. The M5 and A4019 will remain operational for the majority of the construction of the Scheme, albeit impacted by traffic management measures. However, the closure of the two slip roads at Junction 10 will be for prolonged periods, with closure for 15 months for the northbound on-slip and ~~9~~ 5 months for the southbound off-slip, with an overlap of 5 months when both slip roads are closed. The slip road closures and impacts from the associated traffic management measures have the potential to result in significant transport impacts on the road network, so have therefore been assessed for the construction phase of the Scheme.

10.2. Assessment Assumptions

~~10.2.1. At this stage, detailed construction information such as construction worker numbers and HGV numbers for delivery of materials are not available, so the impacts associated with additional trips specifically generated by construction activities cannot be modelled. However, these impacts will be considered in subsequent stages prior to construction when more details on construction activities are known. A comprehensive Traffic Management Plan (TMP) will be in place prior to commencement of construction, to minimise their impacts on the highway network.~~

10.2.1. ~~However, t~~The impacts to general traffic on the existing road network from the major traffic management measures such as closure of the existing M5 Junction 10 slip roads have been assessed using traffic modelling at this stage.

10.2.2. A proportionate qualitative approach has been taken to assess of the impact from additional vehicle trips associated with construction activities such as deliveries of materials, and the construction workforce.~~, and the summary of the assessment results is detailed in this section of the report.~~

10.3. Construction Trips

10.3.1. The construction of the Scheme is anticipated to take 30 months to complete~~planned to commence in 2025, with the Scheme planned to be open for traffic in 2027~~. This is based on the current preliminary design (DF3) of the Scheme and will be updated by the Principal Contractor during the detailed design stage.

10.3.2. Forecast traffic generation during construction of the Scheme has been estimated from the quantities of materials and equipment required during each month of the construction programme, as well as the anticipated size of the construction workforce.

10.3.3. Construction of the Scheme is forecast to generate up to 200 materials and equipment vehicle trips per day (100 inbound and 100 outbound) during the busiest months of activity, with most of these expected to be heavy goods vehicles (HGVs). This equates to approximately up to 30 vehicle trips (15 inbound and 15 outbound) in the busiest hour of the day, which is typically mid-morning. These vehicles will be directed (but not limited) to use the preferred construction traffic routes which are as follows:

- M5 – between Junction 9 and 11.
- A4019 Tewkesbury Road and Cheltenham Road - A4013 to A38 at Coombe Hill.
- M5 Junction 10 Improvements Scheme
- A38 Gloucester Road and Jubilee Way – either side of Coombe Hill from A40 north to Tewkesbury.
- A4013 – from the A4019 to A40.
- A40 - from the A4019 to M5.
- B4634 Old Gloucester Road – B4063 to A4019.
- B4063 Cheltenham Road East – B4634 to A40.

10.3.4. In addition to these routes, construction traffic may also be redirected to sections of the official Gloucestershire diversion routes during slip road closures at M5 Junction 10 required as part of the construction works as follows:

- A438 Ashchurch Road – A38 to M5 junction 9.
- A40 Gloucester Road – A38 to M5 junction 11..

10.3.5. The usage of these preferred construction traffic routes by construction traffic will, therefore, vary depending on the different phases of construction and the associated temporary traffic management arrangements, such as temporary closures of the M5 junction 10 slip roads.

10.3.6. It is estimated that the daily workforce required to construct the Scheme will be up to 400, comprising 100 members of staff and 300 operatives, with 75% of the construction staff engaged in daytime working. The main compound, accessed from the A4019, would be the base for 200 members of the construction workforce, comprising 100 members of staff and 100 operatives. Satellite compounds would form the base for the remaining 200 members of the construction workforce.

10.3.7. The Principal Contractor will implement measures to encourage workforce commuting by sustainable modes of transport, rather than by sole occupancy private car, with the aim of minimising the workforce commuting by sole occupancy private car. This will be delivered through the Traffic Management Plan implemented by the Principal Contractor and is secured through the in the Register of Environmental Actions and Commitments (REAC) - Reference G10 (Application document TT010063 / APP 7.4).~~.~~ The sustainable measures are likely to include the following:

- Promotion of car sharing;
- Promotion of workforce commuting by public transport; and
- Consideration of a minibus service operating between the main compound and nearby public transport hubs.

10.3.8. It is forecast that the construction workforce commuting by car will generate up to approximately 185 vehicle trips during the morning and evening peak arrival and departure hours (200 arrivals in the morning peak hour and 200 departures in the evening peak hour). This is based on the following assumptions:

- 75% of workforce on day shift = 300 workers
- 80% of the workforce for day shift arrive during the busiest hour = 240 workers
- 85% of workforce commute by car (with 15% using sustainable modes of transport) = 204 workers
- 10% of workforce commuting by car car-share (average of 1.1 worker per car) = 185 cars

10.3.9. However, the peak arrival and departure times of the construction workforce are unlikely to coincide with the peak hours for traffic on the road network. This is because the workforce needs to be onsite well in advance of commencement of daily operational

construction hours, and therefore arrive earlier than the morning rush hour, and the day shift would be expected to end prior to evening rush hour. Furthermore, the peak period for arrivals and departures of the construction workforce would not coincide with the busy periods for arrivals and departures of vehicles delivering construction materials and equipment.

10.3.10. The additional construction forecast to be generated by the Scheme has not been included in the traffic modelling undertaken to establish the traffic impacts of the Scheme during construction, since information on forecast construction traffic generation was not available when this modelling was undertaken. The additional construction traffic generated by both the construction workforce and materials/equipment deliveries, will be dispersed across the road network resulting only a proportion of it using any one route.

10.3.11. On the basis that up to a third of the construction generated traffic uses any one road, e.g., the M5 north of Junction 10, the A4019 west of M5 junction 10, and the A4019 east of M5 junction 10, then the maximum number of additional vehicles on any of these roads would be approximately 60 per hour, which equates to an average of one additional vehicle per minute. Whilst this is a highly generalised assumption, in the absence of detail on the precise origin of deliveries of construction materials and equipment and the commuting workforce, then it is the most reasonable position to take.

10.3.12. Consequently, the additional generated construction traffic, now quantified, is likely to represent an insufficient proportional increase in traffic on the road network compared to background traffic volumes to materially impact ~~on~~ the operational performance of the road network, particularly during the morning and evening road network peak hours. Furthermore, the impact of temporary traffic management arrangements, such as temporary closures of the M5 Junction 10 slip roads, will have a ~~far~~ greater impact that outweighs that likely to result from the additional construction traffic. Thus, the outcomes of the traffic modelling undertaken to establish the traffic impacts of the Scheme during construction are very unlikely to be materially altered by the inclusion of construction generated traffic.

10.3.13. The volume and distribution of construction generated vehicle trips will be controlled by the Traffic Management Plan (TMP) (EMP Annex B11- (TR010063 / APP 9.12)) such that it does not, cumulatively with the construction workforce movements, exceed thresholds that would trigger significant adverse effects on noise and air quality. This calculation is based on a technical assessment of available headroom within the existing transport network (see Chapter 6 – Noise and Vibration (Application document TR010063 / APP 6.4) of the ES).

10.3.14. The mitigation of potential impacts to the environment at the construction stage will be addressed through the implementation of the Environmental Management Plan (EMP) (Application document TR010063 / APP 7.3) which is secured via requirement 3 of the dDCO. The mitigation measures implemented will include the appointment of an Environmental Clerk of Works (EnCoW) to oversee the construction activities.

~~10.3.~~10.4. M5 J10 Construction Phase Traffic Management

~~10.3.1.~~10.4.1. In order to construct the Scheme, temporary traffic management measures will be required. These include lane closures, full road closures, and temporary speed limit reductions.

~~10.3.2.~~10.4.2. Information on the predicted slip road closures associated with the construction phase of the Scheme has been taken from Chapter 2 of the Environmental Statement (ES), (TR010063 - APP 6.2) which was informed by the most recent Buildability report for the Scheme.

~~10.3.3.~~10.4.3. In addition to the closure of M5 J10 slip roads ~~at various points throughout~~during the construction phase, the current construction plan for the Scheme will also include the following traffic management changes to the surrounding highway network:

- M5 J10 mainline traffic management involving speed limit reduction on the M5 mainline on the approaches to J10 during construction period.
- A4019 traffic management - Lane closures and speed reduction on the A4019 in vicinity of the Scheme.
- Closure of Withybridge Lane junction with the A4019.
- Traffic management on the on the B4634.

~~10.3.4.~~10.4.4. In terms of full road closures at M5 J10, there are three major different closure types which occur for extended periods of time during the Scheme construction phase. These include:

- Southbound off-slip closed (northbound on-slip remains open)
- Both southbound off-slip and northbound on-slip closed.
- Northbound on-slip closed (new southbound off-slip alignment open).

~~10.3.5.~~10.4.5. The sequence of the traffic management and slip road closures are outlined in Table 21.

Table 21 – Traffic Management Timings

~~Date~~Construction Month	Description
5	M5 Junction 10 Motorway works commence – traffic management starts
11	Southbound off-slip closed
15	Northbound on-slip closed
20	New Southbound off-slip opened
30	New Northbound on-slip opened
30	M5 Junction 10 Motorway works complete – traffic management ends

~~10.4.~~10.5. Assessment Methodology

~~10.4.1.~~10.5.1. As with the operational phase assessment reported in previous sections of this report, the Gloucestershire Countywide Traffic Model (GCTM) has been used to identify transportation impacts on the highway network. The GCTM is a SATURN strategic model which has been used to test the impacts of traffic management measures such as the slip road closures at M5 J10 on the wider road network during the construction phase.

~~10.4.2.~~10.5.2. The GCTM is considered to be the most appropriate modelling tool to understand traffic reassignment, which is the main ~~impact on~~impact on traffic that results from closing the M5 J10 slip roads and other major traffic management measures detailed above. As identified in Section 10.2, the construction phase assessment considers the impact of the slip road closures and traffic management measures on the road network. The impacts associated with additional trips from construction workers and materials will be covered in the Traffic Management Plan, when the details are known prior to construction commencing.

~~10.4.3.~~10.5.3. There will be signed diversion routes directing traffic along specified routes during slip road closures, It is acknowledged that some of the regular users of the slip roads who are likely to be familiar with the local road network, will find alternative routes along non-signed diversion routes during the construction phase, The modelling has therefore assumed a reasonable worst case scenario where traffic has free choice over routes, rather than assessing an unrealistic scenario whereby all affected traffic only uses the signed diversion routes.

~~10.5.~~10.6. GCTM Assessment Year for Construction Phase

~~10.5.1.~~10.6.1. The GCTM was developed for an assessment year of 2024 to correspond to the planned start of construction. This was done by developing a forecast 2024 model by interpolating the 2015 Base Year and 2027 Scenario P (without the Scheme) models. It is noted that since the construction phase assessment was undertaken, the assumption on construction start date has changed. However, a change to the construction start date is not likely to have a material impact to the modelling results, nor the conclusions drawn from the modelling, given that the focus of the assessment is on the relative difference between scenarios.

~~10.6.~~10.7. GCTM Construction Assessment Scenarios

~~10.6.1.~~10.7.1. A series of GCTM future forecast year (2024) models has been used to forecast traffic conditions in the future year construction phase scenarios, with and without the different slip road closures and other major traffic management measures.

~~10.6.2.~~10.7.2. The resultant scenarios modelled in the GCTM are detailed in Table 22 below.

Table 22 – Construction Phase Scenarios

Construction ~~Phase Scenario~~Phase Scenario Reference	Description of Construction Phase Scenario
Do-Minimum (DM)	• Model with the M5 J10 current layout (both slip roads open). • Includes the local schemes for Coombe Hill improvement scheme and upgrading Arle Court Roundabout. • No changes to highway networks associated with construction of the M5 J10 Scheme.
Do-Something 1 (DS1)	• M5 J10 slip roads open. • Speed limit reduction on the M5 mainline on approaches to J10. • Lane closure and speed limit reductions along sections of the A4019. • Withybridge Lane junction with A4019 open. • Other elements the same as DM scenario.
Do-Something 2 (DS2)	• M5 J10 southbound off-slip closed. • Speed limit reduction on the M5 mainline on approaches to J10. • Lane closure and speed limit reductions along sections of the A4019. • Withybridge Lane junction with A4019 closed. • Other elements the same as DM scenario.
Do-Something 3(DS3)	• M5 J10 southbound off-slip and northbound on-slip closed. • ~~Speed limit~~Speed limit reduction on the M5 mainline on approaches to J10. • Lane closure and speed limit reductions along sections of the A4019. • Withybridge Lane junction with A4019 closed. • Other elements the same as DM Scenario.

Construction ~~Phase Scenario~~Phase Scenario Reference	Description of Construction Phase Scenario
Do-Something 4 (DS4)	• M5 J10 northbound on-slip closed. • M5 J10 southbound off-slip open (using new alignment, but operation same as existing priority controlled off-slip). • ~~Speed limit~~Speed limit reduction on the M5 mainline on approaches to J10. • Lane closure and speed limit reductions along sections of the A4019. • Withybridge Lane junction with A4019 closed. • Other elements the same as DM Scenario.

~~10.6.3.~~10.7.3. A summary of the network operation in the GCTM scenarios are detailed in Table 23 below.

Table 23 – GCTM Network Coding Summary

Scenario Reference	M5 mainline Traffic Management (speed limit reduction)	A019 Traffic Management (lane closure and speed limit reduction)	Withybridge Lane / A4019 Junction closure	M5 J10 Slip Road operation	
				SB off-slip	NB on-slip
DM				Open	Open
DS1	y	y		Open	Open
DS2	y	y	y	Closed	Open
DS3	y	y	y	Closed	Closed
DS4	y	y	y	Open	Closed

~~10.7.~~10.8. GCTM Construction Phase Modelled Periods

~~10.7.1.~~10.8.1. The GCTM covers the following time periods for the construction phase scenarios:

- Average AM peak period (07:00-10:00).
- Average Interpeak (IP) period (10:00-16:00).
- Average PM peak period (16:00-19:00).

~~10.8.~~10.9. GCTM Construction Assessment Modelled Area

~~10.8.1.~~10.9.1. The area covered by the GCTM Version 2.3 is shown in Figure 8 of Chapter 5.

~~10.9.~~10.10. Flow Differences

~~10.9.1.~~10.10.1. The changes in traffic flows between the different construction phase scenarios are illustrated in traffic flow difference plots included in Appendix M for the three modelled periods. The plots have been used to show the general trends in flow changes (blue representing reductions, green increases, and the size of the bar relating to the relative scale of the change) but the plots in Appendix M also include the difference in numbers of vehicles plotted alongside the affected links.

~~10.9.2.~~10.10.2. The general summary of the flow changes predicted by the GCTM for the impacts associated with the traffic management measures during the construction phase are

described in the following paragraphs.

~~10.9.3.~~10.10.3. To understand the potential general extent of the impact of the slip road closures during the construction phase, the scenario where both of the M5 J10 slip roads will be closed (DS3) was investigated. This represents the most significant impact and can be considered as the 'worst case scenario'. It was investigated to identify the extent of large traffic flow changes across the highway network.

~~10.9.4.~~10.10.4. Figure 27 is a diagrammatic output from the GCTM which shows the general pattern of traffic flow differences between Do Minimum (DM) and Do Something Scenario 3 (DS3) for the AM peak period, although similar trends in terms of extents occur in the other modelled periods.

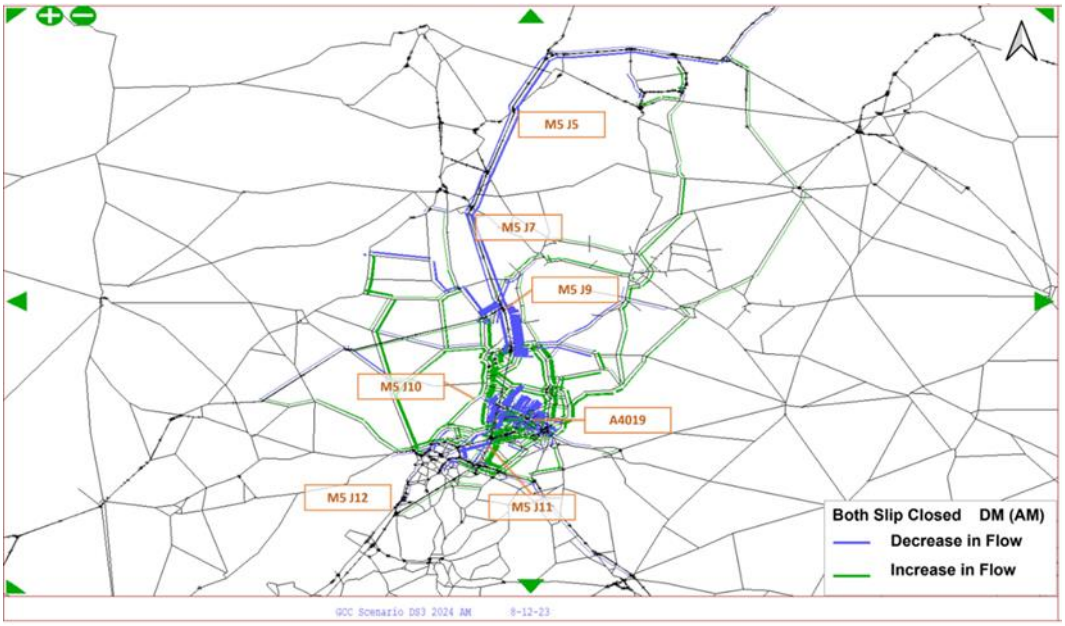


Figure 27 – GCTM Extent of Construction Assessment Impact

~~10.9.5.~~10.10.5. Figure 27 demonstrates that whilst there are some small flow differences predicted as far north as M5 J5, the main impact is focused on the area of the network between M5 J9 and M5 J11. The focus of the assessment therefore covers the area of road network between M5 J9 and M5 J11, including the adjacent local road network.

~~10.9.6.~~10.10.6. There are two main factors impacting on performance of the road network during the construction period; Firstly, the traffic management measures such as lane closures on the A4019 and speed limit reductions, and secondly the full road closures of the M5 J10 slip roads.

Traffic Management Impacts with Both M5 J10 Slip Roads Open

~~10.9.7.~~10.10.7. Comparing the traffic flow difference plots included in Appendix M for DM to DS1 scenario to understand the impact of the traffic management and speed limit restrictions to general traffic shows that there would be, as expected, some reduction in traffic flows along the M5 mainline and the A4019. The traffic management measures on the mainline (such as the speed limit reduction) act as a 'bottleneck' to flow when compared to DM conditions, meaning that slightly fewer vehicles are able to complete their journeys within the modelled period. These vehicles are likely to be delayed by the traffic management measures on the M5 mainline, particularly in the AM peak. A similar pattern of traffic flow reduction is predicted on the A4019 as a result of the traffic management measures. There is evidence of localised rerouting (such as through Boddington and Staverton). This is likely to be the result of vehicles avoiding the constricted A4019, and rerouting to reach the north of Cheltenham via Old Gloucester Road. The general patterns of flow differences are comparable in all modelled periods.

~~10.9.8.~~10.10.8. The changes to flows from just the traffic management measures when the slip roads are open are considered to be minor, with forecast increase on local roads around 60 to 70 vehicles in the AM peak hour, although similar magnitudes of flow changes are seen in other peaks. This roughly equates to an additional 1 vehicle every minute per hour in the peak periods, which is unlikely to result in severe impacts to network operation. The impact of traffic management combined with the M5 J10 slip road closures is assessed below.

Traffic Management Impacts with only M5 J10 Southbound Off-slip Closed

~~10.9.9.~~10.10.9. Comparing the traffic flow difference plots included in Appendix M for DM to DS2 reveals that the impact of closing the southbound off-slip to general traffic, which includes some changes to flows in the surrounding area of the M5 J10 where vehicles are predicted to choose alternative routes (in addition to the reductions in flow from the traffic management). The vehicles choosing alternative routes comprise the current users of the southbound off-slip who will not be able to choose the route which includes the slip ~~road ,~~road, and other general traffic choosing different routes due to the knock on impacts of those slip road users on the highway network.

~~10.9.10.~~10.10.10. In the 2024 DM scenario, there are predicted to be 886 users of the southbound off-slip in the AM peak, 548 in the Interpeak, and 479 in the PM peak. Further detailed assessment of the impact to these users is included in Section 10.11.

~~10.9.11.~~10.10.11. The assessment shows that the general reassigned traffic (slip road users, and general traffic) would disperse across multiple different routes towards Cheltenham, including the A38 to the west of the M5 and the A435 to the east of the M5. There are also some increases on the M5 southbound south of M5 J10 with trips using the A40 from M5 J11 towards Cheltenham, and on the A46 from the M5 J11a towards Cheltenham. The combined increases in flows along these routes which carry the diverted traffic are broadly comparable to the number of current slip road users, indicating that the flow changes are mainly (but not exclusively) from slip road users diverting to alternative routes. There are similar patterns in the flow differences for all modelled periods.

Traffic Management Impacts with Both M5 J10 Slip Roads Closed

~~10.9.12.~~10.10.12. Comparing the traffic flow difference plots included in Appendix M for DM to DS3 provides an insight to the impact of closing both slip roads at the M5 J10 which represents the maximum of the impacts among the construction phase scenarios considered.

~~10.9.13.~~10.10.13. In the 2024 DM scenario, there are predicted to be 354 users of the northbound on-slip in the AM peak, 383 in the Interpeak, and 687 in the PM peak. Further detailed assessment of the impact to these users is included in Section 10.11.

~~10.9.14.~~10.10.14. The DS3 to DM comparison shows further general reassignment of trips (slip road users and general traffic) onto other routes in the highway network compared to DS2 where only southbound off-slip is closed. There are increases in traffic flows from Cheltenham along the A40 towards M5 J11. As with the other flow difference plots, there are similar patterns across all modelled periods. Figure 28 shows the patterns of differences in traffic flows in the AM peak for DS3 scenario, which as stated previously is the scenario when the largest impact is likely to occur from the closure of both the M5 J10 slip roads during construction phase.

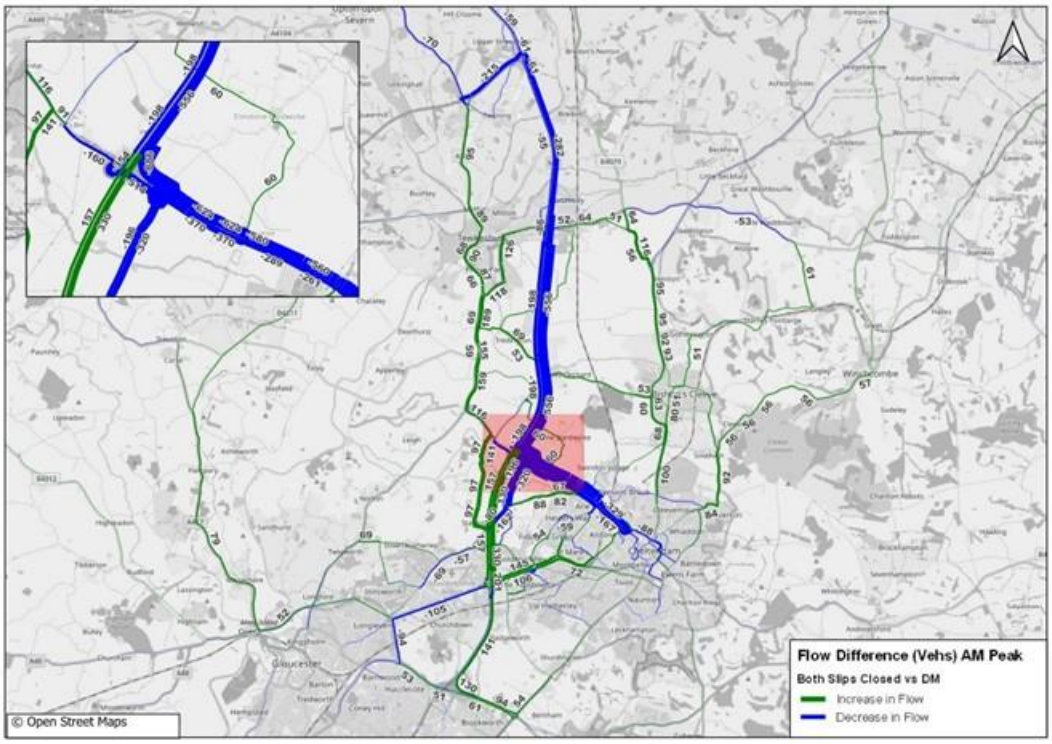


Figure 28 – Flow differences during closure of both slip roads at M5 J10

Traffic Management Impacts with Only M5 J10 Northbound On-slip Closed

~~10.9.15.~~10.10.15. Finally, the comparison of the traffic flow difference plots included in Appendix M for DM to DS4 scenario shows the impact on traffic flows from closure of the M5 J10 northbound on-slip with the new southbound off-slip open. Under this scenario it can be seen that there would be increases in flows from Cheltenham along the A40 to M5 J11. There are also the same impacts to flows resulting from the traffic management measures, although the reduction in flows along the M5 and A4019 is lower because the southbound off-slip has reopened.

Traffic Flow Changes Summary

~~10.9.16.~~10.10.16. The magnitude of change in traffic flows on some of the local roads for most of the slip road closure scenarios is predicted to be in the region of increases around the tens of vehicles to below 200 in the modelled peak hours. For example, in the DS3 AM peak scenario where both the M5 J10 slip roads are closed (representing the maximum impact on the affected highway network during the construction phase), there are predicted to be increases in flow northbound on the A38 south of Tewkesbury of 69 vehicles, and southbound increases of 189 vehicles. The road through Staverton and Boddington is predicted to carry an additional 97 and 157 vehicles in the northbound and southbound directions respectively in the AM ~~peak during~~peak during the period when both M5 J10 slip roads are closed. These increases equate to an additional 1 to 3 vehicles every minute per hour in the peak periods, which is unlikely to result in severe impacts. It is acknowledged that whilst these predicted flow changes from the traffic management measures during the construction phase are not likely to result in severe transport impacts, they may have noise and air quality impacts; these are covered separately in Chapter 6 of the ES (TR010063 – APP 6.4.)

~~10.9.17.~~10.10.17. In order to understand if these flow changes are likely to result in severe impacts to the operation of the road network during the construction phase, further interrogation of the GCTM has been undertaken to investigate changes to the predicted levels of congestion.

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~~10.10.~~10.11. Volume Over Capacity

~~10.10.1.~~10.11.1. In order to understand the impact of the slip road closures on the road network in terms of congestion, volume over capacity ratios for links have been interrogated in the GCTM model runs. Volume over capacity (V/C) ratios identify when predicted volumes of traffic approach the theoretical capacity of the link, with a V/C over 100% indicating that congestion may occur along the link.

~~10.10.2.~~10.11.2. The V/C ratios have been grouped into ~~categories, and~~categories and illustrated for the different construction phase scenarios in plots included in Appendix M for the three modelled periods. It is important to note that V/C is a modelling concept, so a link that experiences a V/C over 100% isn't 'full'. It can still take more traffic flow, but the chances of the link experiencing congestion and delay increases. As such, V/C is being used as a proxy to identify potential congestion increases in more detail compared to just considering flow differences.

~~10.10.3.~~10.11.3. A general summary of the congestion on the network predicted by the GCTM is provided below.

~~10.10.4.~~10.11.4. The 2024 DM Scenario in the future before construction of the Scheme commences shows some congestion on local roads with V/Cs over 100% (shown in red), and other roads approaching their capacity (between 85% and 100% shown in amber). Links with V/C below 85% are colour coded ~~green, and~~green and are generally predicted to operate within capacity. The signed diversion routes for the slip road closures are predicted to be operating with V/C below 85%.

~~10.10.5.~~10.11.5. With the traffic management in place but the M5 J10 slip roads open (Scenario DS1), there is no change to congestion category levels predicted by the model compared to DM Scenario. Whilst V/C values may increase slightly due to flow increases, the change is not at a level to push the links into the next category, and so is unlikely to lead to significant increases in congestion on the road network.

~~10.10.6.~~10.11.6. With the closure of the M5 J10 southbound off-slip in DS2, there is very little change to congestion category levels predicted by the model. The reassignment caused by closure of the southbound off-slip results in some links that were previously approaching their capacity now being more likely to experience congestion (around Bishops Cleave), but this is mainly observed just in the AM peak, with the majority of links staying in the same categories as the DM scenario in the Interpeak and PM peak.

~~10.10.7.~~10.11.7. For the DS3 scenario where both M5 J10 slip roads are closed, the same patterns of V/C category changes are observed as those for the scenario with just the southbound off-slip closed. The small number of links that are predicted to experience congestion are those that were already approaching their capacity in the DM scenario, and the changes are largely only observed during the AM peak period, with modest changes to congestion categories in the other modelled periods. The local roads such as the route through Staverton and Boddington is predicted to remain in the 'green' category with V/C below 85% and unlikely to experience congestion for all slip road closure scenarios in all modelled peak periods.

~~10.10.8.~~10.11.8. For the DS4 scenario with just the M5 J10 northbound on-slip closed and the new southbound off-slip open, there do not appear to be any significant changes to V/C levels, with no links changing category as defined in the plots (V/C less than 85%; between 85% and 100% and over 100~~%) in~~%) in any of the modelled periods.

~~10.10.9.~~10.11.9. The general trends observed to V/C resulting from the slip road closures indicate that there are no significant increases in the V/C ratios and links which are predicted to experience congestion were already predicted to be operating close to their capacity prior to construction commencing.

~~10.11.~~10.12. Impact on Journey Times During Construction Phase

~~10.11.1.~~10.12.1. The potential impacts on journey lengths and journey times resulting from the M5 J10 slip road closures on the affected highway road network during the construction phase have been investigated using the outputs from GCTM. This has been investigated

for current users of the M5 J10 slip roads, and the M5 mainline users between M5 J9 and J11.

Impact on M5 J10 Slip Road Users

~~10.11.2.~~10.12.2. Select Link Analysis (SLA) has been undertaken to identify the Origins and Destinations of trips that use the southbound off-slip and northbound on-slip in the DM scenario when the slip roads are open.

~~10.11.3.~~10.12.3. Figure 29 and Figure 30 show the SLA for the two slip roads. It is clear that the majority of current southbound off-slip users originate from destinations to the north travelling along the M5 towards destinations in central Cheltenham.

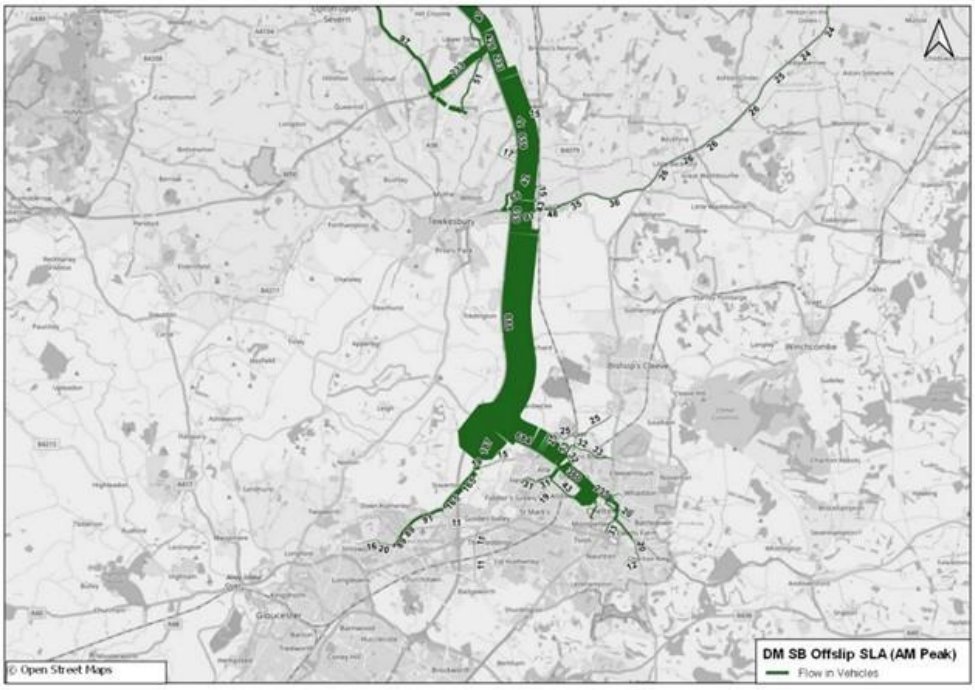


Figure 29 – M5 J10 southbound off-slip Select Link Analysis

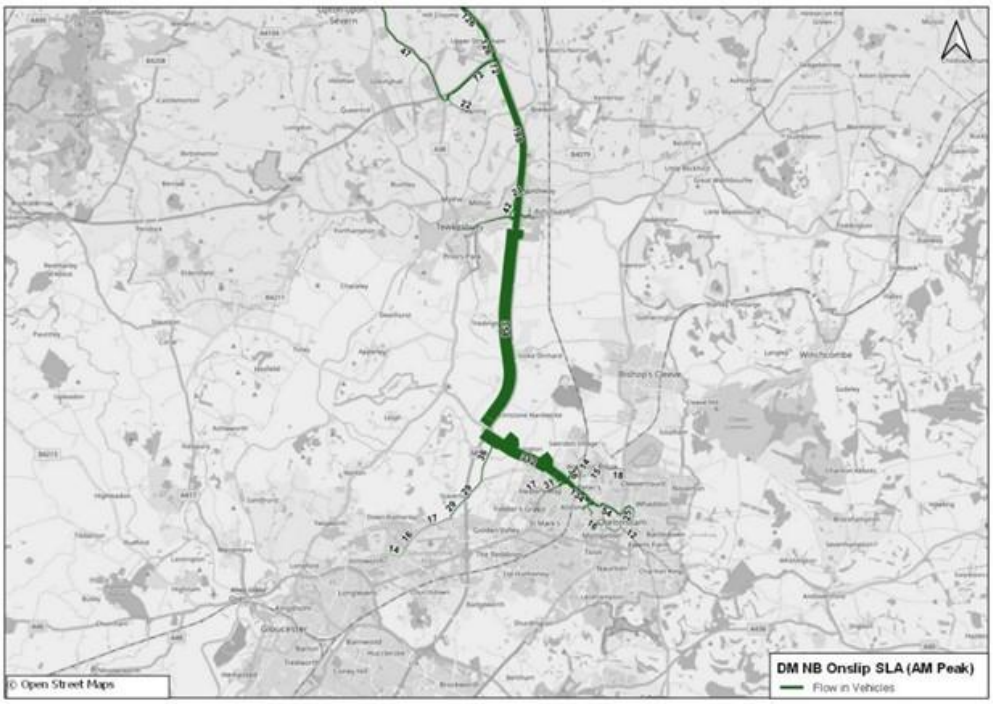


Figure 30 – M5 J10 northbound on-slip Select Link Analysis

~~10.11.4.~~10.12.4. The current northbound on-slip road users are predominantly from origins in central Cheltenham who are heading towards the M5 northbound mainline.

~~10.11.5.~~10.12.5. In order to understand the routes that the slip road users are reassigning to during the construction phase, the trips to and from the same OD ~~pairs as~~pairs as contained in the SLA matrices were assigned onto the highway networks with the M5 J10 slip road closures.

~~10.11.6.~~10.12.6. Figure 31 and Figure 32 show the alternative routes used by the M5 J10 slip

roads users.

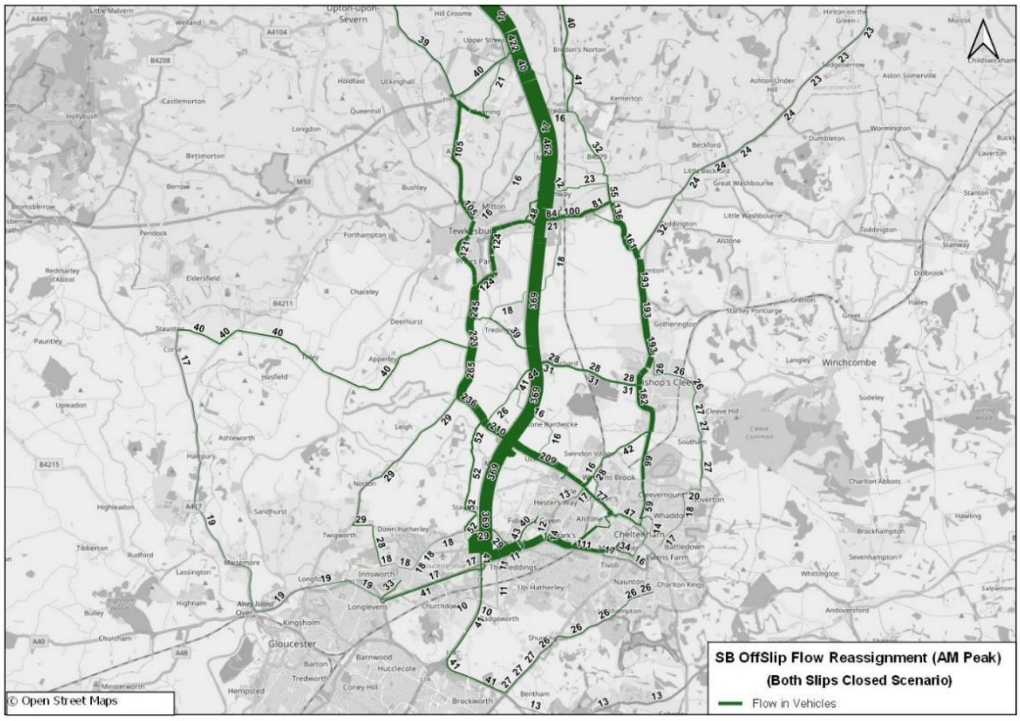


Figure 31 – M5 J10 southbound off-slip Alternative Routes

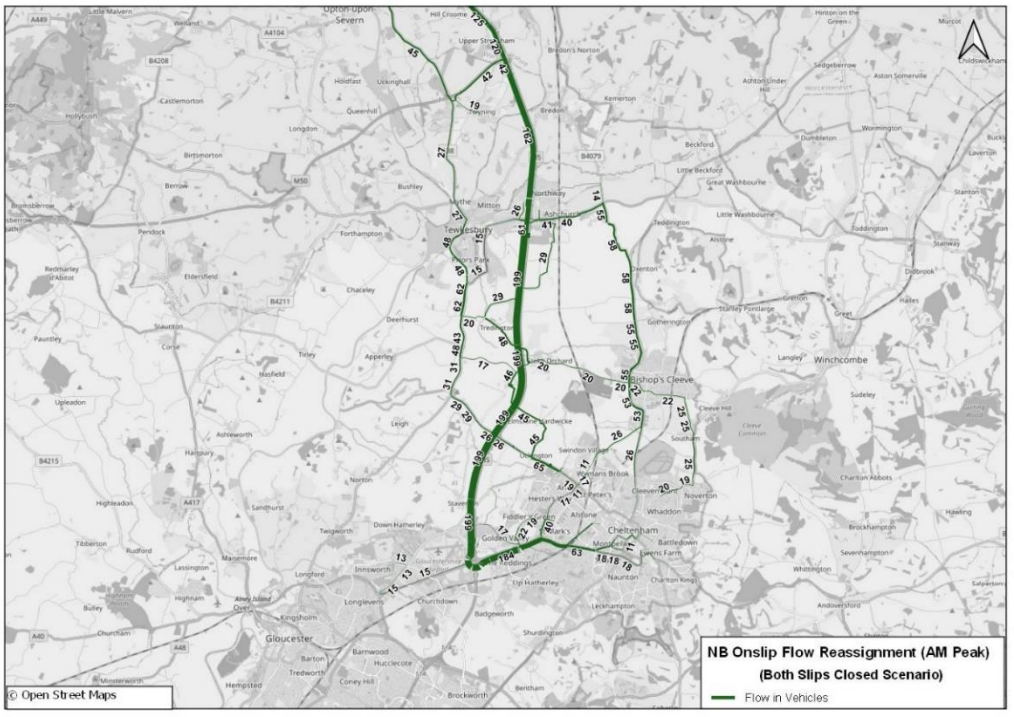


Figure 32 – M5 J10 northbound on-slip Alternative Routes

~~10.11.7.~~10.12.7. The alternative routes used by the M5 J10 slip roads users show additional trips on the similar routes to those that were illustrated in the general flow difference plots, indicating that the majority of flow changes on the network are from the diverted traffic from closure of the slip roads, rather than significant rerouting of general network traffic. The numbers of vehicles taking these alternative routes are shown in Figures included in Appendix M.

~~10.11.8.~~10.12.8. It is acknowledged that although there may be signed diversion routes directing traffic along specified routes during slip roads closures, some of the regular users of the slip roads who are likely to be familiar with the local road network, can find alternative routes along non-signed diversion routes during the construction phase, Given the relatively low number of the total diverted traffic from the slip roads, the impact of a small number of drivers who may use the non-signed diversion on operation of the highway network is thought to be negligible. However, through good traffic management practices and continued liaison with the residents of the affected areas during construction phase, appropriate additional mitigation measures would be implemented to minimise excessive impact of non-signed diversion routes.

~~10.11.9.~~10.12.9. In order to understand the changes to journey lengths and journey times for the slip road users, an OD pair was selected from the SLA trip matrices to represent a typical journey that currently uses the M5 J10 slip roads. The changes for these 'typical' OD pairs have then been calculated in the various DS scenarios when one or both slip roads are closed i.e Scenarios DS2, DS3 and DS4. It is worth noting that M5 J10 slip roads are both open in DS1 during construction phase. The typical southbound OD pair represent trips from a zone north of Worcester to a zone in central Cheltenham (zone 90059 to 23009), and the northbound pair are the return from Cheltenham to Worcester (zone 23009 to 90059).

~~10.11.10.~~10.12.10. Table 24 presents the results of the journey distance and journey time analysis for ~~the~~ 'the 'typical' current slip road users.

Table 24 – Journey time changes – typical M5 J10 slip road user trips

		AM Peak		Interpeak		PM Peak	
		Dist (km)	Time (mins)	Dist (km)	Time (mins)	Dist (km)	Time (mins)
DM	NB OD pair	45.5	38	45.5	39	45.2	42
	SB OD Pair	44.9	42	45.1	38	44.9	39
DS2 (SB off-slip closed)	NB OD pair	48.8	39	48.8	38	48.8	42
	SB OD Pair	48.6	46	48.6	38	48.6	39
DS3 (both slip roads closed)	NB OD pair	48.8	39	48.8	39	48.8	43
	SB OD Pair	48.6	46	48.6	38	48.6	39
DS4 (NB on-slip closed, SB off-slip re-open)	NB OD pair	48.8	39	48.8	39	48.8	43
	SB OD Pair	44.9	44	48.6	38	48.6	39

~~10.11.11.~~10.12.11. Table 24 demonstrates that the change to the distance travelled for typical current southbound off-slip road users who will divert to other available routes during the construction phase in the DS2 and DS3 scenarios is approximately an additional 3.7 km. For the current northbound on-slip road users, the change to the distance travelled is approximately an additional 3.3km.

~~10.11.12.~~10.12.12. The corresponding increases in journey time are largest, as expected, in the southbound journey during the AM peak with both M5 J10 slip roads closed as assessed in DS3, with an increase of around 4 minutes to a current journey time of 42 minutes, which is equivalent to an increase of 10% predicted to occur over a route of over 45 km long. The changes to southbound journeys in the interpeak and PM peak are much ~~lower~~

~~with~~lower with increases of less than a minute.

~~10.11.13.~~10.12.13. For all the slip roads closure scenarios, the current typical users of the northbound slip road experience journey time increases which are much lower than the southbound slip road users at reported as usually less than a minute which is equivalent to around 2% in all the modelled periods.

~~10.11.14.~~10.12.14. It is therefore considered that the majority of impacts to journey times for typical users of the M5 slip roads during construction phase are not considered severe, and any larger impacts will be monitored and considered in mitigation.

M5 Mainline Users

~~10.11.15.~~10.12.15. In terms of M5 mainline journey time changes, the journey times for trips between M5 J9 to M5 J11 have been analysed for all the modelled periods in each of the slip road closure scenarios. Full details of all journey times for the modelled scenarios as reported by GCTM for the M5 mainline between Junctions 9 and 11 are included in Appendix M.

~~10.11.16.~~10.12.16. The highest increase in M5 mainline journey times along the northbound section between J11 to J9 is reported by the GCTM as about 30 seconds (27 seconds in the AM peak in DS4 where the northbound on-slip is closed).

~~10.11.17.~~10.12.17. The increase in the M5 mainline journey times along the southbound section between J9 and J11 are reported to be below 30 seconds, with the greatest increase of 29 seconds in the Interpeak in DS4 when the northbound on-slip is closed, and the southbound off-slip has reopened along the new alignment.

~~10.11.18.~~10.12.18. The increases in journey times along the M5 mainline between J9 and J11 are, as expected, impacted by both the traffic management measures such as the reduction to speed limits during the construction phase, and also the changes in flow due to traffic rerouting. For the southbound journey times, the reduction of flows along the mainline from rerouting when the southbound off-slip is closed help with journey times to remain largely unaffected, and as such offset the impacts of the reduction in speed limit.

~~10.11.19.~~10.12.19. The predicted increases in journey times along the M5 mainline between J9 and J11 for all modelled scenarios and time periods during the construction phase are all predicted to be less than 30 seconds, and as such are not considered to be severe.

~~10.12.~~10.13. Non Traffic Impacts of M5 J10 Construction Phase

~~10.12.1.~~10.13.1. It is recognised that the traffic management measures implemented during the construction phase of the Scheme also have the potential to impact on non-~~vehicle users~~vehicle users of the road network such as pedestrians, cyclists and public transport users.

~~10.12.2.~~10.13.2. The Traffic Management Plan will outline the detailed closures of footways throughout the construction ~~phase, and~~phase and will ensure that the impact to pedestrians will be considered in all traffic management measures.

~~10.12.3.~~10.13.3. The A4019 will remain operational throughout construction (albeit with lane closures) so bus routes along the corridor will not be subject to significant impacts such as route diversions.

~~10.12.4.~~10.13.4. A detailed assessment of the impacts of the construction phase to walking and cycling routes is outlined in Chapter 13 of the ES (TR010063 – APP 6.11) It is noted that mitigation measures proposed as part of the construction phase of the Scheme will ensure that there will be safe access for pedestrians and cyclists through areas under traffic management. It is therefore concluded that there is unlikely to be any unacceptable impacts to these users.

~~10.13.~~10.14. Mitigation of Construction Phase Impacts

~~10.13.1.~~10.14.1. A Traffic Management Plan (TMP) will be in place prior to commencement of construction, to mitigate severe construction phase impacts.

~~10.13.2.~~10.14.2. The TMP is likely to include measures such as advanced notice of roadworks

using signage, which will enable existing users at this location to plan their regular journeys to avoid or minimise potential delays, such as those predicted to be experienced by the current southbound off-slip users in the AM peak.

~~10.13.3.~~10.14.3. It is also considered that good management of construction traffic and diversion routes in the local area, through the use of the Traffic Management Plan, onto the signed diversion routes would lead to fewer roads being affected by increases in traffic during the closures of the slip roads. However, it is not possible to make traffic use the signed diversion routes, so this measure has not been included in the assessment. Notwithstanding this fact the Applicant is committed to reducing the effects of the construction phase as far as is reasonably practicable. As such it is proposed to include the signed diversion routes as an additional mitigation measure, during the construction stage, to help reduce some of the impacts on local routes.

~~10.13.4.~~10.14.4. The TMP will also include details of traffic management measures for all road users (including walking and cycling) to ensure that there are no unacceptable safety impacts as a result of construction activities.

~~10.14.~~10.15. Summary of Highway Impacts during the Construction Phase

~~10.14.1.~~10.15.1. In order to construct the Scheme, there will be a requirement for traffic management and slip road closures at M5 J10. The M5 and A4019 will remain operational for the majority of the construction of the Scheme, albeit impacted by traffic management measures. However, the closure of the two slip roads at Junction 10 will be for prolonged periods, with closure for 15 months for the northbound on-slip and 9 months for the southbound off-slip, with an overlap of 5 months when both slip roads are closed. The GCTM has been used to assess the impacts of these slip road closures as well as other major changes on the operation of the highway network.

~~10.14.2.~~10.15.2. The construction phase traffic modelling has demonstrated that there are likely to be changes in traffic flows on the road network in the vicinity of the Scheme resulting from both the implementation of traffic management measures, and the M5 J10 slip road closures. The modelling results show that the general magnitude of flow changes on the local road network is unlikely to result in severe traffic impacts.

~~10.14.3.~~10.15.3. The GCTM has also been used to understand the impacts of the slip roads closures on the capacity and level of potential congestion across the affected network which are reported as Volume over Capacity (V/C) ratios. The general trends observed from changes to V/C categories resulting from the slip road closures indicate that the increases in V/C categories are modest and consistent with the pattern of reassigned traffic, and as such are not considered to be severe.

~~10.14.4.~~10.15.4. Select Link Analysis has been used to identify the current M5 J10 slip road users in terms of numbers, trip origins and destinations, and changes to the routes of diverted traffic when the slip roads are closed.

~~10.14.5.~~10.15.5. Changes in journey distances and time have been assessed for the typical current users of the slip roads. These changes for the majority of the modelled peak periods and scenarios are not considered to be severe, and any larger impacts would be subject to mitigation measures that would be outlined in the TMP. The predicted changes in journey times along the M5 mainline between J9 and J11 for any of the scenarios in any of the modelled time periods are all predicted to be less than 30 seconds, and as such they are not considered to be severe.

~~10.14.6.~~10.15.6. It is therefore concluded that during the construction phase of the Scheme there would not be an unacceptable impact on highway safety, and that the residual cumulative impacts on the road network would not be severe, in accordance with paragraph 111 of the NPPF.

11. Strategic Road Network Assessment

11.1. Introduction

11.1.1. This chapter provides a more detailed assessment of the impact of the Scheme on the Strategic Road Network (SRN). National Highways, as the highway authority for the SRN have requested that more detailed information is provided to understand the impact of the Scheme, in particular at M5 Junction 11 and Elmbridge Court roundabout on the A40.

11.2. Assessment Scope

11.2.1. It is important to note that the Scheme which is subject to the DCO is a highway scheme intended to unlock development on the JCS sites. ~~This highway scheme will enable the delivery of wider developments, but~~T~~ t~~he impact of this associated dependent development is assessed in a cumulative scenario (Scenario R vs Scenario P) and distinguished from the impact of the Scheme in isolation (Scenario S vs Scenario P).

11.3. Assessment Methodology

11.3.1. The detailed assessment of the impacts of the Scheme has been undertaken by examining the GCTM information produced to assess the operational phase, as described in Chapter 5. The GCTM outputs from the same scenarios have been used to identify the transportation impacts on the SRN.

11.3.2. The GCTM is a SATURN strategic model which has been used to test the impact of the Scheme on the wider road network, including the SRN.

11.3.3. The Paramics model used to assess the Scheme in detail does not extend as far as the M5 Junction 11 or Elmbridge Court roundabout. The purpose of the Paramics modelling was to inform the Scheme design and understand ~~the detailed~~its operational performance in detail. ~~operation of the Scheme~~. It was agreed with National Highways during scoping discussions that the M5 J10 operational modelling would be undertaken over a smaller localised ~~extent~~area.

11.3.4. Flow difference, V/C and queue outputs have been used to assess the impact of the Scheme on the SRN.

11.4. Flow Differences

11.4.1. Flow differences for the wider network are included in Appendix B, but a more detailed illustration of differences have been produced for the SRN area. These are included in Appendix N.

11.4.2. The differences between Scenario S (with the Scheme, but without dependant developments) and Scenario P (without the Scheme and without dependant developments) have been illustrated for AM and PM peak periods for both 2027 and 2042.

11.4.3. Figure 33 provides the 2042 AM peak S vs P comparison. It demonstrates that the impact of the Scheme on the SRN varies from location to location.

11.4.4. To the north of the Scheme at M5 Junction 9, there are predicted to be flow reductions, as well as flow reductions along the M5 mainline between Junctions 9 and 10.

11.4.5. Between the Scheme and M5 Junction 11 there are flow increases along the mainline in both directions.

11.4.6. At M5 Junction 11, there are a mixture of flow increases and flow decreases. There are increases in flows on the north facing slips (southbound off-slip and northbound on-slip), but comparable reductions on the south facing slips (southbound on-slip and northbound off-slip). A similar trend is seen on the A40 approaches, with increases on the west facing slips and comparable reductions on the east facing slips.

11.4.7. At the Elmbridge Court roundabout, the largest increases are on the A40 between the roundabout and M5 Junction 11.

11.4.8. These general flow difference trends are replicated in the PM peak, and in both 2027 and 2042.

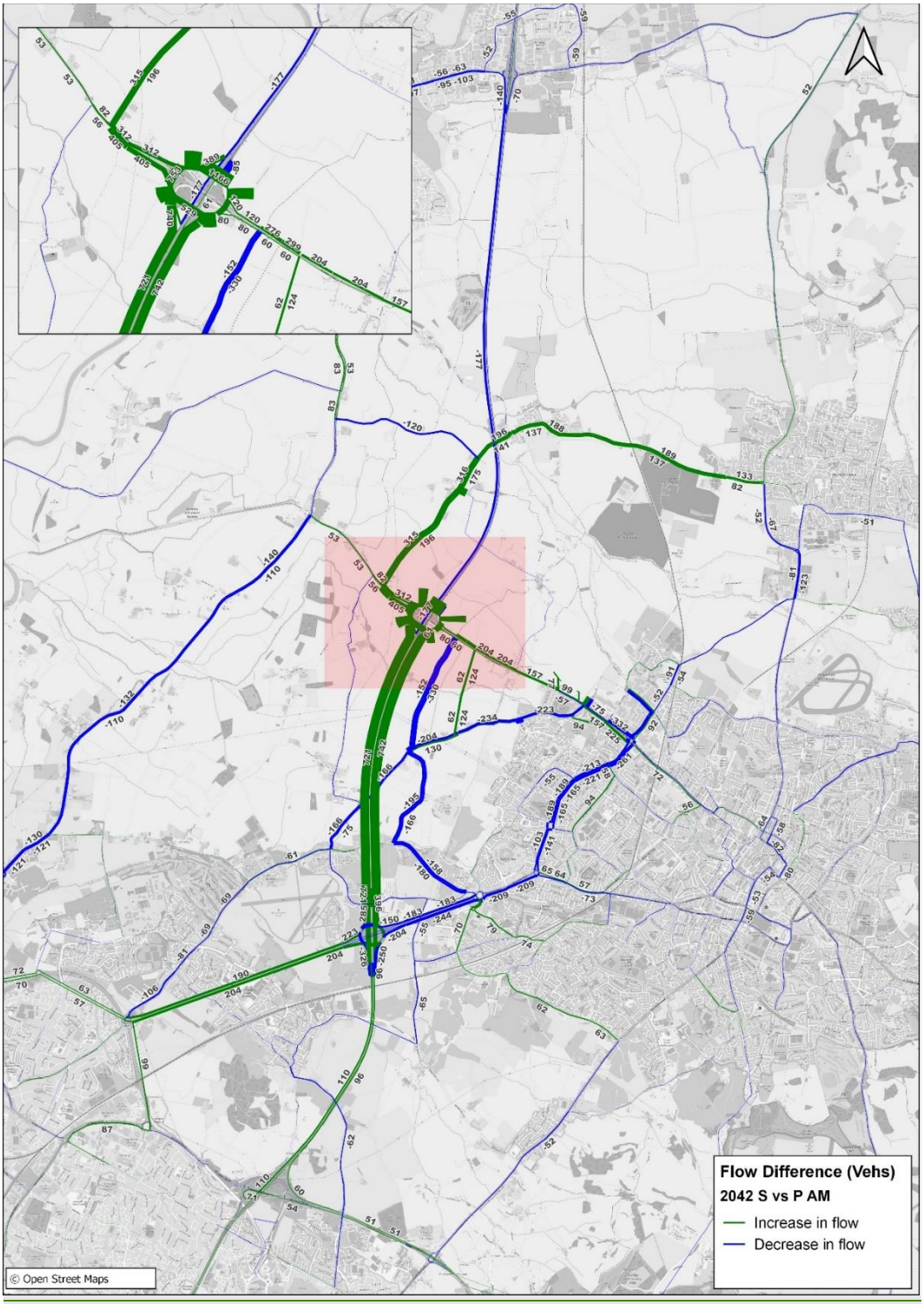


Figure 33 – SRN flow differences, 2042 AM Peak Scenario S vs Scenario P

11.4.9. For completeness, plots for comparison between Scenario R vs Scenario P have been included in Appendix N. They show the impact of the Scheme and the dependent development in terms of a cumulative impact. ~~It is acknowledged that the Scheme will enable this associated development, but the development itself will still require approval through the planning process. At that point, the impacts of the development on the road network (including the SRN) will require detailed assessment. Any significant impacts from the development on the transport network (in terms of capacity and congestion), or~~

~~on highway safety, would be mitigated to an acceptable degree to ensure there would not be an unacceptable impact on highway safety, and the residual cumulative impacts on the road network would not be severe~~

11.4.10. The flow difference plots comparing Scenario S to Scenario P indicate there is unlikely to be an adverse impact on the operation of the SRN at Junction 9 as a result of the Scheme, due to the reductions in flows.

11.4.11. However, in order to understand the impacts of the ~~flow increases and differences~~changes in flows on the SRN due to ~~as a result of~~ the Scheme ~~on the SRN~~, V/C outputs have been investigated.

11.5. Volume Over Capacity and Queues

11.5.1. In order to understand the impact of the flow changes caused by the Scheme on the SRN, volume over capacity ratios for links have been interrogated in the GCTM model runs. Volume over capacity (V/C) ratios identify when predicted volumes of traffic approach the theoretical capacity of the link, with a V/C over 100% indicating that congestion may occur along the link.

11.5.2. The V/C ratios have been grouped into categories and illustrated for the different scenarios in plots included in Appendix O for the AM and PM peak periods. It is important to note that V/C is a modelling concept, so a link that experiences a V/C over 100% isn't 'full'. It can still take more traffic flow, but the chances of the link experiencing congestion and delay increases. As such, V/C is being used as a proxy to identify potential congestion increases in more detail compared to just considering flow differences.

11.5.3. The full flow difference, V/C outputs, and queue length outputs in tabulated format is included in Appendix P, to enable greater detailed understanding of the changes beyond illustrative category changes.

11.5.4. As well as the V/C plots for each scenario, progression plots have been created which show how V/C category changes evolve between the different scenarios. These demonstrate when the changes to V/C category occur to understand if they are a result of the Scheme, or the dependent development.

2042 AM Peak

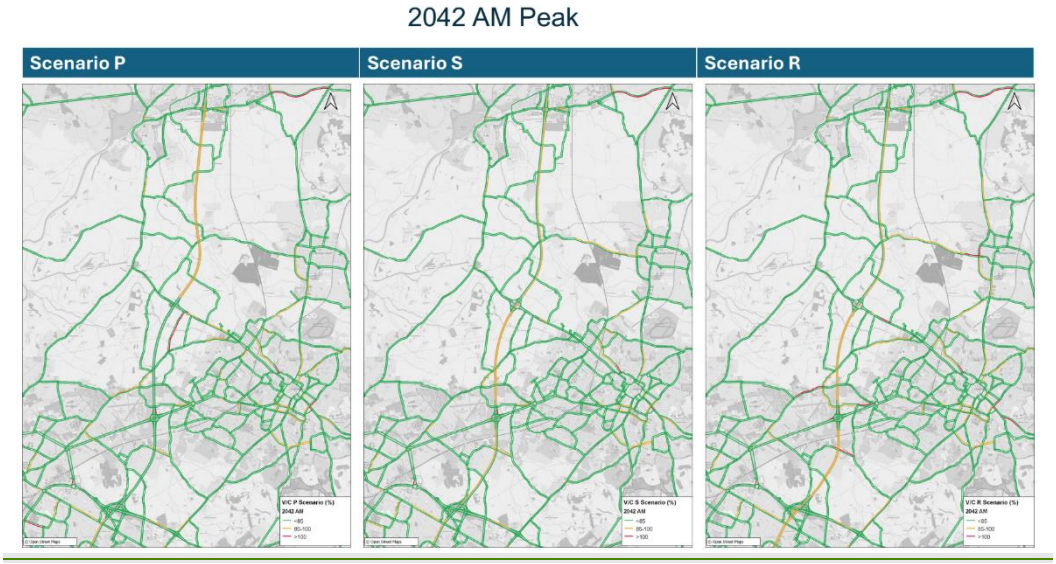


Figure 34 – SRN V/C Progression, 2042 AM Peak

11.5.5. Figure 34 presents the 2042 AM peak V/C progression plot. It demonstrates that there are links with V/C over 85% (amber) and over 100% (red) in the 2042 Scenario P network. This~~,~~ indicates~~ing~~ that there are links that are likely to experience congestion in the future ~~before~~without the Scheme.

11.5.6. At M5 Junction 11, the southbound motorway off-slip is predicted to operate with a V/C of

108% in the 2042 Scenario P AM peak, this reduces to a V/C of 102% in Scenario S, and then returns to 107% in Scenario R. These values indicates that ~~for this slip road, the~~ Scheme, including dependant development, does not have an adverse impact, ~~and also that when the associated development trips are included, the approach operates at similar levels of congestion to that before the Scheme~~on this slip road.

11.5.7. On the M5 Junction 11 northbound motorway off-slip there is a change from green to amber category in the 2042 AM peak as a result of the Scheme. The V/C in Scenario P is 79% which rises to 93% in Scenario S. There is a decrease in predicted flow as a result of the Scheme, but the capacity element of the V/C on the slip road is calculated based on the associated node performance, and there is predicted to be an increase in flow circulating past the approach arm, hence the reduction in capacity and the increased V/C. ~~A review of the associated queue increases notes that t~~This modest increase in V/C increases queue lengths by 2m, which is not considered severe. The V/C increases further as a result of the dependent development, with a V/C of 98%, and an additional increase in queue. These increases do not ~~suggest~~represent a severe impact.~~, and are also without any potential mitigation that may be delivered by the development to ensure residual cumulative impacts are not severe.~~

11.5.8. On the A40 eastbound off-slip at M5 Junction 11 in the 2042 AM peak, there is predicted to be a change from amber category to red category in the cumulative scenario (Scenario R) as a result of the associate development trips (although it is noted that there is no change in category as a result of the Scheme in isolation – Scenario S). The Scenario P V/C of 90% increases to 95% with the inclusion of the Scheme, but this increase results in a minor increase in queue of around 8m. The Scenario R V/C increases to 102% and an increase in queue of around 90m compared to Scenario S. A review of queue lengths indicate that this level of queueing ~~could~~can be accommodated within slip road ~~storage~~and would not extend back onto the A40 mainline carriageway. Therefore, ~~which do not suggest~~this does not represent a severe impact, although it is noted that the GCTM can only provide high level indications of operational performance. ~~also associated~~dependants

11.5.9. At the Elmbridge Court Roundabout, there are no changes to V/C category caused by either the Scheme, or the Scheme in conjunction with dependent development. The predicted flow changes do not result in significant changes in V/C, and whilst there may be slight increase, the associated queue changes are minor, and not considered severe.

2042 PM Peak

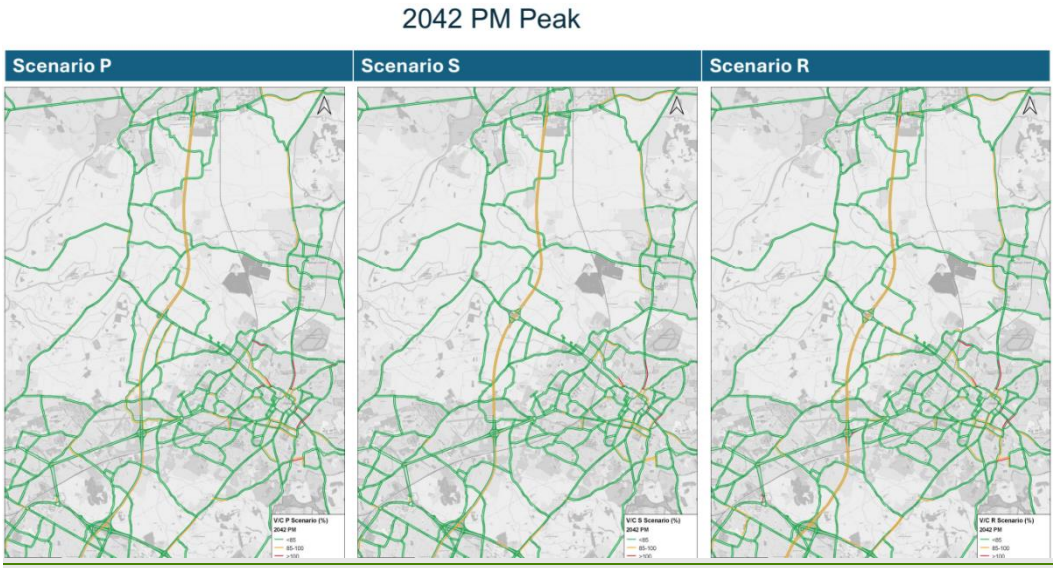


Figure 35 – SRN V/C Progression, 2042 PM Peak

11.5.10. Figure 35 presents the 2042 PM peak V/C progression plot. Similar ~~pattern~~impacts to those in the AM peak are observed in the PM peak ~~impacts~~, with small increases resulting from the Scheme, and further increases as a result of the dependent development it

enables.

11.5.11. On the M5 Junction 11 northbound motorway off-slip there is a change from green to amber category in the 2042 PM peak as a result of the Scheme. The V/C in Scenario P is 84% which rises to 98% in Scenario S. There is again a decrease in predicted flow as a result of the Scheme, and despite the increase in V/C there is predicted to be a slight reduction in the associated queue, which is not considered severe.

11.5.12. The V/C on the northbound off-slip increases further as a result of the dependent development, with a V/C of 101% in Scenario R, and an increase in queue of 7m compared to Scenario P. These increases do not suggest a severe impact,~~dependant s~~.

11.5.13. The southbound motorway off-slip at M5 Junction 11 is predicted to experience less congestion than the AM peak, with the Scenario S V/C of 87%. This amber category reduces to green category with the inclusion of the Scheme (V/C of 82% in Scenario P), and remains at green (V/C of 85%) in Scenario R with the cumulative impacts of the dependent development.

11.5.14. The V/C category o~~O~~n the A40 westbound approach~~es~~ to M5 Junction 11 in the PM peak is predicted to change due to the Scheme and the dependant development~~, the change in V/C category is predicted on the westbound approach~~, with the amber category in Scenario P (97%) and Scenario S (96%) changing to a red category in Scenario R (V/C of 102%). This increase in congestion is not as a result of the Scheme, but from the dependent development. The resulting increase in queues is around 90-m compared to that in Scenario S. ~~It is likely to~~to the forecast queue can be accommodated within slip road storage, and any potential impacts would be on the local road network (as opposed to the SRN). These increases do not suggest a severe impact~~, dependant s~~.

11.5.15. In the 2042 PM peak, as with the AM peak, there are not predicted to be any adverse impacts at the Elmbridge Court Roundabout. There are no changes to V/C categories~~y~~ caused by either the Scheme, or the dependent development. The predicted flow changes do not result in significant changes in V/C, and whilst there may be slight increase, the associated queue changes are minor, and not considered severe.

11.6. Summary of SRN Assessment

11.6.1. The investigation of the impacts of the Scheme on the SRN has demonstrated that the Scheme is not considered likely to have severe adverse impacts on the wider SRN. Whilst the Scheme and dependent development it enables is predicted to have larger impacts, these increases do not ~~suggest~~represent a severe impact.~~dependant s~~.

12. Validation of the Traffic Model

12.1.1. Through Section 51 Advice, the Examining Authority (ExA) recommended, in November 2023, that the current traffic model is assessed against present day (2023) observed traffic data to confirm that it remains valid in light of the impact of the COVID-19 pandemic on travel patterns.

12.1.2. The ExA also suggested that this Transport Assessment (TA) is updated to include the current year (2023) assessments so that the future operational performance of the modelled road network can be considered against current operational performance.

12.1.3. The supplementary report (TR010063/APP/9.17), submitted alongside this updated TA, provides the results of the traffic modelling work undertaken to address the ExA's comments regarding the potential impact of the COVID-19 on the validity of the current forecast models.

12.1.4. The work reported in the Transport Assessment Ssupplementary Rreport (TR010063 / APP 9.17) includes the development of two 2023 forecast models, namely 'with' and 'without' COVID-19 adjustments and their comparisons against 2023 observed data, which include journey time and traffic counts data obtained from Gloucestershire County Council (GCC), National Highways (NH) and Department for Transport (DfT).

12.1.5. The results of this work show that both the 2023 models, with and without COVID-19 adjustment factors, correlate with observed traffic data within acceptable TAG validation tolerances. This demonstrates that the differences in the modelled traffic demand between the two models fall within the range of acceptable validation tolerances for strategic traffic models.

12.1.1. Interrogation of the two models shows that the modelled traffic flows on the road network are consistently higher for the without COVID adjustment model compared to the with COVID adjustment model, but in both cases the variation from the 2023 observed data is within acceptable validation tolerances. This confirms that the traffic model is performing as expected in response to changes in traffic demand. It also indicates that, overall, the with COVID-19 adjustment model compares marginally better with observed traffic flow data. I

12.1.2. ~~When considering t~~The findings of the supplementary report ~~the results~~ demonstrate that the 2015 base used in the traffic modelling submitted for the DCO application remains valid ~~despite its 2015 base when 2023 forecast is compared to the current (2023) traffic flows~~ and is ~~therefore~~ fit for purpose in assessing the proposed Scheme.

~~12.~~13. Summary and Conclusion

~~12.1.~~13.1. Summary

~~12.1.1.~~13.1.1. Having been validated against present day (2023) observed traffic data, and through the application of COVID-19 adjustments factors, ~~T~~this document ~~has provided~~provides a review of the existing transport conditions within the vicinity of the Scheme. This has highlighted poor existing walking, cycling and public transport facilities in the vicinity of the Scheme. The area benefits from access to bus routes and some pedestrian facilities on the A4019, but poor access to cycle facilities. A review of local accident data indicates that there has been 30 PIAs in the last five years, including one 'fatal' PIA.

~~12.1.2.~~13.1.2. Additionally, the TA has outlined the Scheme proposals, including details of the improvements to pedestrian and cycle facilities. The Scheme proposes to provide an upgrade to pedestrian and cycle facilities. These will provide an improvement compared to the existing situation for pedestrian and cycle users.

~~12.1.3.~~13.1.3. The predicted impact of the Scheme on the local road network has been identified using the GCTM, the GCC strategic SATURN model. The GCTM has predicted the change in flows on the road network in a number of assessment years using the following scenarios:

- Scenario P – Without dependent development and without the Scheme.
- Scenario S – Without dependent development and with the Scheme.
- Scenario R – With dependent development and with the Scheme.

~~12.1.4.~~13.1.4. The GCTM predicts that the proposed Scheme in isolation (the difference between Scenario S and Scenario P) will result in some minor reassignment of existing traffic through the Scheme.

~~12.1.5.~~13.1.5. For the cumulative scenario (the difference between Scenario R and Scenario P) the GCTM predicts much larger increases in flows in the Scheme area. These are mainly as a result of the trips generated by the dependent development rather than Scheme itself.

~~12.1.6.~~13.1.6. Detailed microsimulation modelling has been undertaken using a Paramics Discovery model in the study area around the Scheme, to understand the impact of the Scheme at these junctions in more detail.

~~12.1.7.~~13.1.7. The comparison of performance between Scenario S and Scenario P has demonstrated the impact of the Scheme in isolation (without any dependent development). Overall, the Scheme improves average journey times and increases average speeds across the Paramics model area. Considering specific journey times for routes within the model, the results indicate that across majority of the routes there are journey time improvements. In terms of queuing, and specifically queue lengths for the M5 off-slips due to the potential for queues to block mainline traffic, which is a safety issue, the proposed Scheme reduces the length of the queue on the southbound off-slip, which is predicted to ~~exceed~~ approach storage and extend ~~into~~ towards the mainline in the AM peak without the Scheme and is therefore a safety benefit.

~~12.1.8.~~13.1.8. The comparison of performance between Scenario R and Scenario P has demonstrated the cumulative impact of the Scheme in combination with the dependent development. Overall, the results indicate that the additional dependent demand in Scenario R has an impact on performance compared to Scenario P, particularly in the 2042 future year.

~~12.1.9.~~13.1.9. Average network speeds are predicted to reduce in the cumulative scenario, but from investigation of the variations within the model runs, the results for the average network speed for Scenario R fall within the range of results in the Scenario P. Therefore, the overall network speed reductions in the cumulative scenario are not considered significant and represent a broadly neutral, or nil-detriment impact.~~, nor could they be considered sev~~ere.

~~12.1.10.~~13.1.10. Considering specific journey times for routes within the model, the results indicate that there are journey time improvements, alongside increases to journey time caused by the demand dependent development. For these routes where average journey times have increased in the AM and, or PM peak, investigation of the variations within the model runs demonstrate that the results for ~~almost~~ all of the average journey time for Scenario R fall within the range of results in the Scenario P.

~~12.1.11.~~13.1.11. It is noted that the basis of the Scheme is to 'enable' major developments, which would lead to provision of much needed new housing and notable employment opportunities, and as such the proposed Scheme accommodates the additional traffic forecast to be generated by the dependant development in the most appropriate and least impactful way by alleviating the most severe impacts on the road network that would otherwise occur~~enables significant additional traffic without severe impact~~.

~~12.1.12.~~13.1.12. In terms of queuing, the Scheme reduces the length of the queue on the southbound off-slip, which is predicted to ~~exceed~~ approach storage and extend ~~into~~ towards the mainline in the AM peak without the Scheme. The mean-max queue on the northbound off-slip in the AM peak is not predicted to exceed available storage.

~~12.1.13.~~13.1.13. The Scheme provides a number of walking and cycling infrastructure improvements along the entire Scheme extent. Overall, the M5 Junction 10 Improvement Scheme meets the minimum 70% standard for the LTN 1/20 CLoS assessment, scoring strongly for safety and comfort. Safety is also a consistent strength of the junction designs within the Scheme.

13.1.14. The impacts resulting from construction traffic trips and traffic management measures during the construction phase of the Scheme have been assessed. These measures which include lane closures, reduction in speed limit, and full road closure of the M5 J10 slip roads have been modelled in the GCTM, to understand their impacts on the affected highway network in terms of flow changes, congestion, ~~journey distance~~journey distance and journey times. The results of the assessment show that the impacts from these traffic management measures are not by and large considered to be severe, and mitigation measures such as a TMP will be in place prior to commencement of construction, to ensure that there are no severe residual cumulative impacts.

13.1.15. An investigation of the impacts of the Scheme on the SRN has demonstrated that the Scheme is not considered likely to have severe adverse impacts on the wider SRN. Whilst the Scheme and dependent development it enables is predicted to have larger impacts, these increases do not ~~suggest~~represent a severe impact.~~dependant s~~.

~~12.1.14.~~13.1.16. It is concluded that there would not be an unacceptable impact on highway safety, and that the residual cumulative impacts on the road network would not be severe for all stages of the Scheme, so accords with the NPPF and NPS NN.

~~12.1.15.~~13.1.17. It has been demonstrated that the Scheme creates networks with the capacity and connectivity to support national and local economic activity and facilitate growth. The modelling demonstrates that the Scheme creates networks which improve journey quality, ~~reliability~~reliability, and safety.

~~12.1.16.~~13.1.18. The sustainable transport infrastructure improvements in the Scheme achieve the aims of the NPS to create networks which support the delivery of a low carbon ~~economy, and~~economy and create networks which enable communities to link effectively to each other.

~~12.1.17.~~13.1.19. It is therefore concluded that the Scheme accords with the aims of the National Policy Statement for National Networks.

Appendix A. Masterplan

NOTE:

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE DEVELOPMENT CONSENT ORDER AND OTHER APPLICATION PLANS.

KEY:

DEVELOPMENT CONSENT ORDER (DCO) LIMITS

1 IN 40000 SCALE ORDNANCE RASTER DATA

1 IN 25000 SCALE ORDNANCE VECTOR DATA

REFER TO INSET A FOR SCHEME DETAIL

M5 JUNCTION 10

INSET A

CHELTENHAM

GLOUCESTER

TEWKESBURY

Scale 1:25000
500m 0m 500m 1000m 1500m

Scale 1:40000
500m 0m 500m 1000m 1500m 2000m

Description						
Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
Description						
Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
Description						
Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
Description						
Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
Description	FIRST SUBMISSION					
Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
A1	C01	NKRP	CJ	HC	BM	18/10/23

Drawing Suitability: APPROVED - PUBLISHED — Status: A1

Project Title: M5 Junction 10 Improvements Scheme

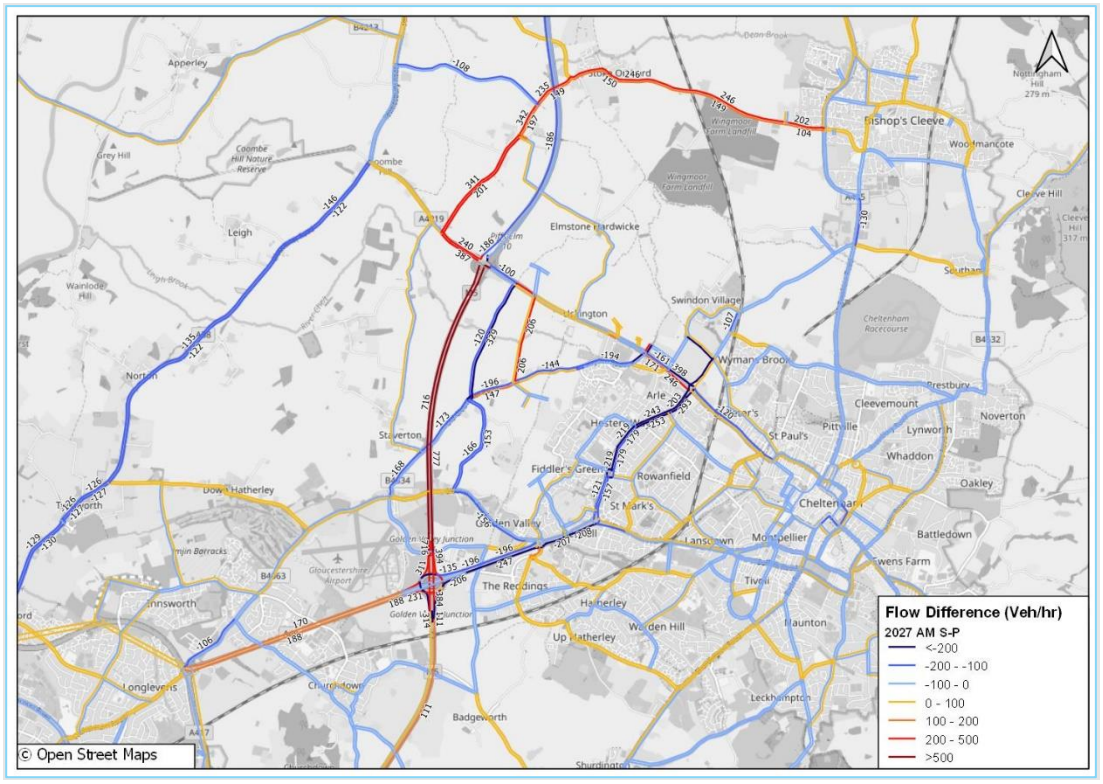
Drawing Title: LOCATION PLAN REGULATION 5(2)(o)

Drawing Number: TR010063/APP/2.1

Original Size:	Scale:	Project Ref. No:	Sheet:	Rev:
A1	AS SHOWN	5197035	1 of 1	C01

This Drawing is saved on ProjectWise as Drawing No.GCCM5J10-ATK-HGN-ZZ-DR-CH-001000 Plotted: 19/10/2023 15:22:27 By: CHAU8495

Appendix B. GCTM Flow Difference Plots


Flow Difference (Veh/hr)
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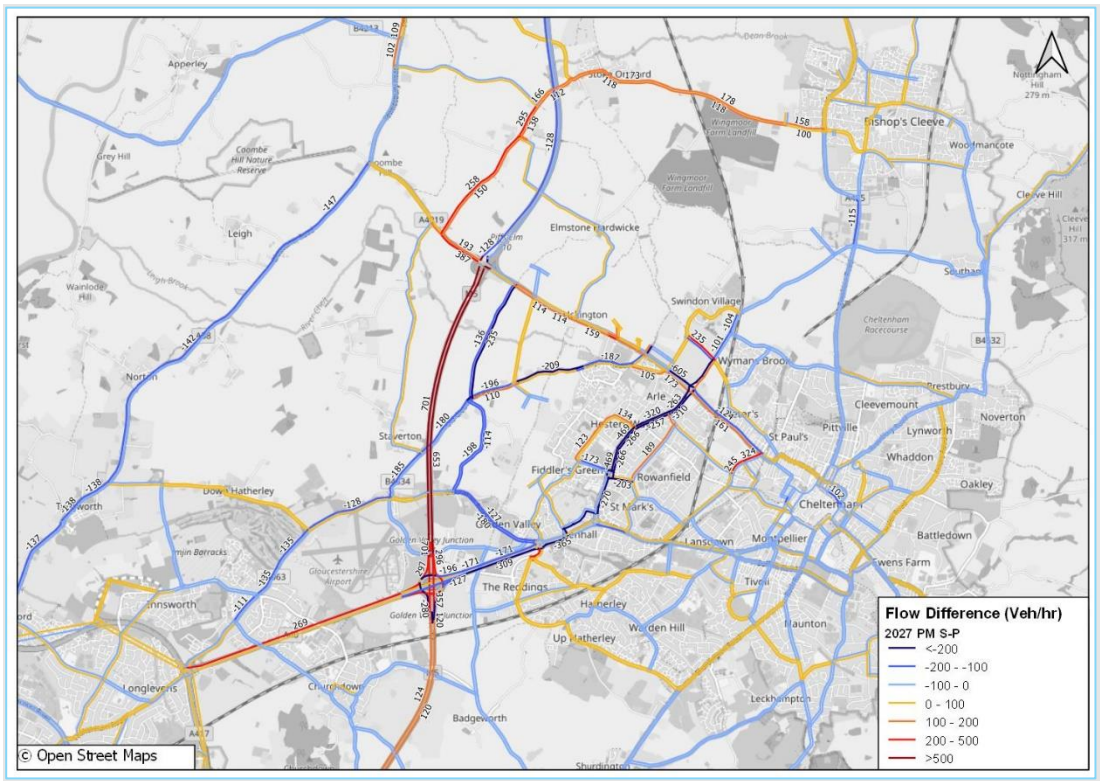
-100 - 0
0 - 100
100 - 200
200 - 500
>500
© Open Street Maps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0 - 100
100 - 200
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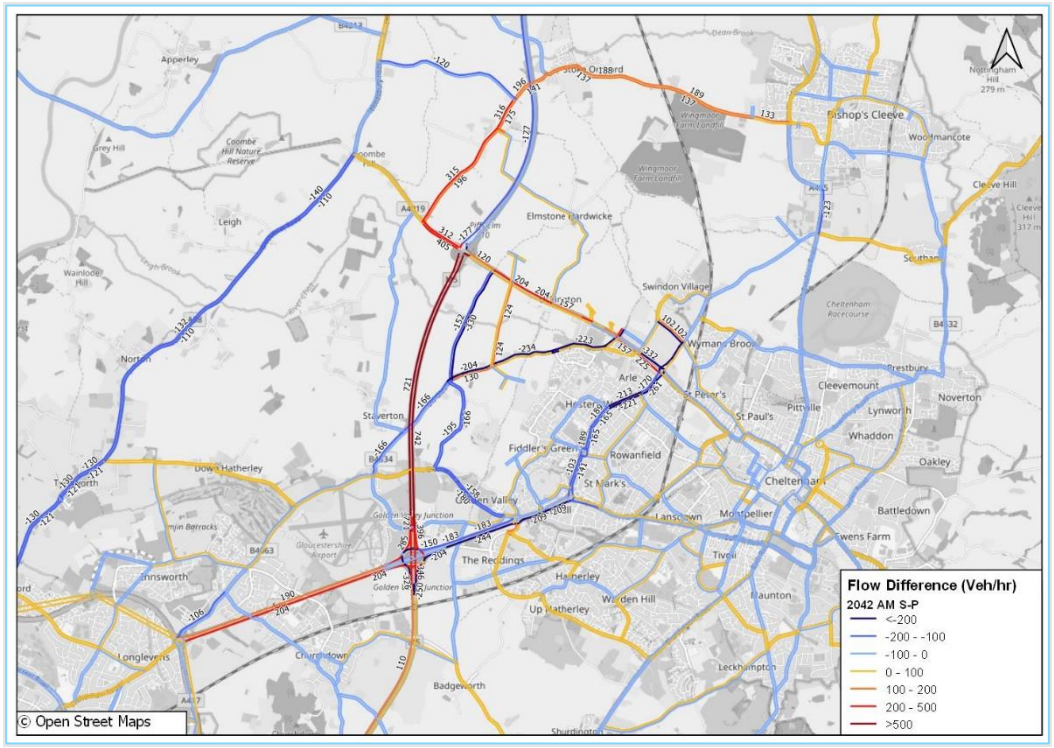
© Open Street Maps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0 - 100
100 - 200
200 - 500
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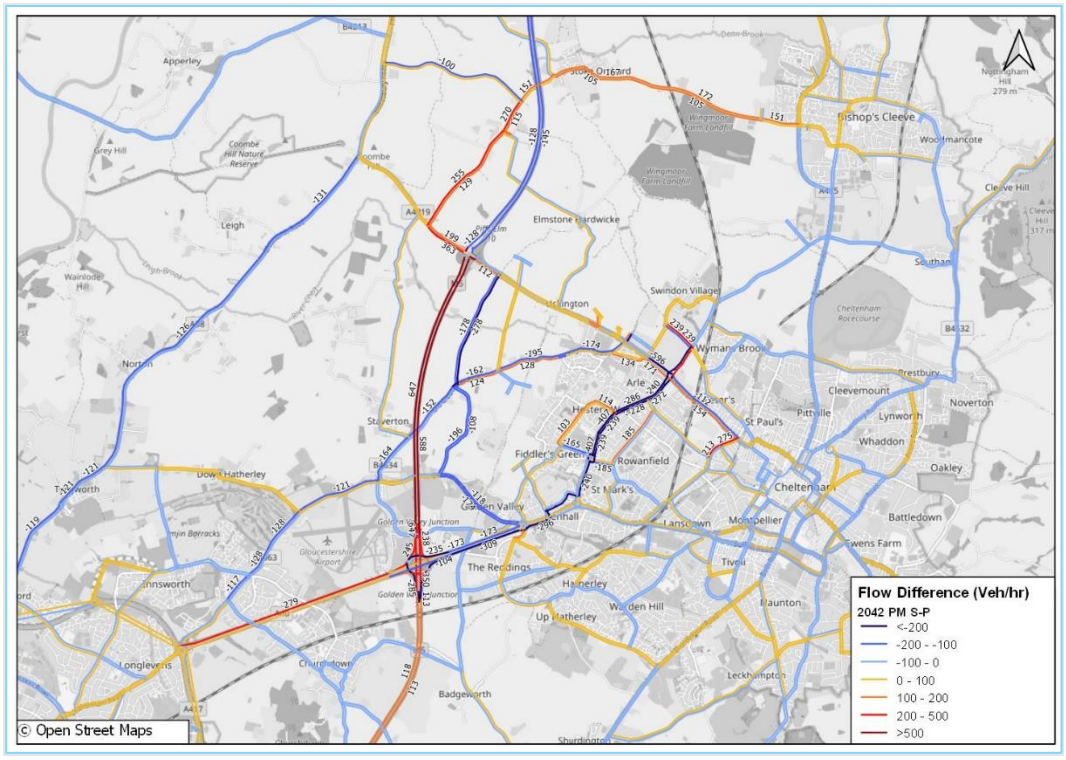
© Open Street Maps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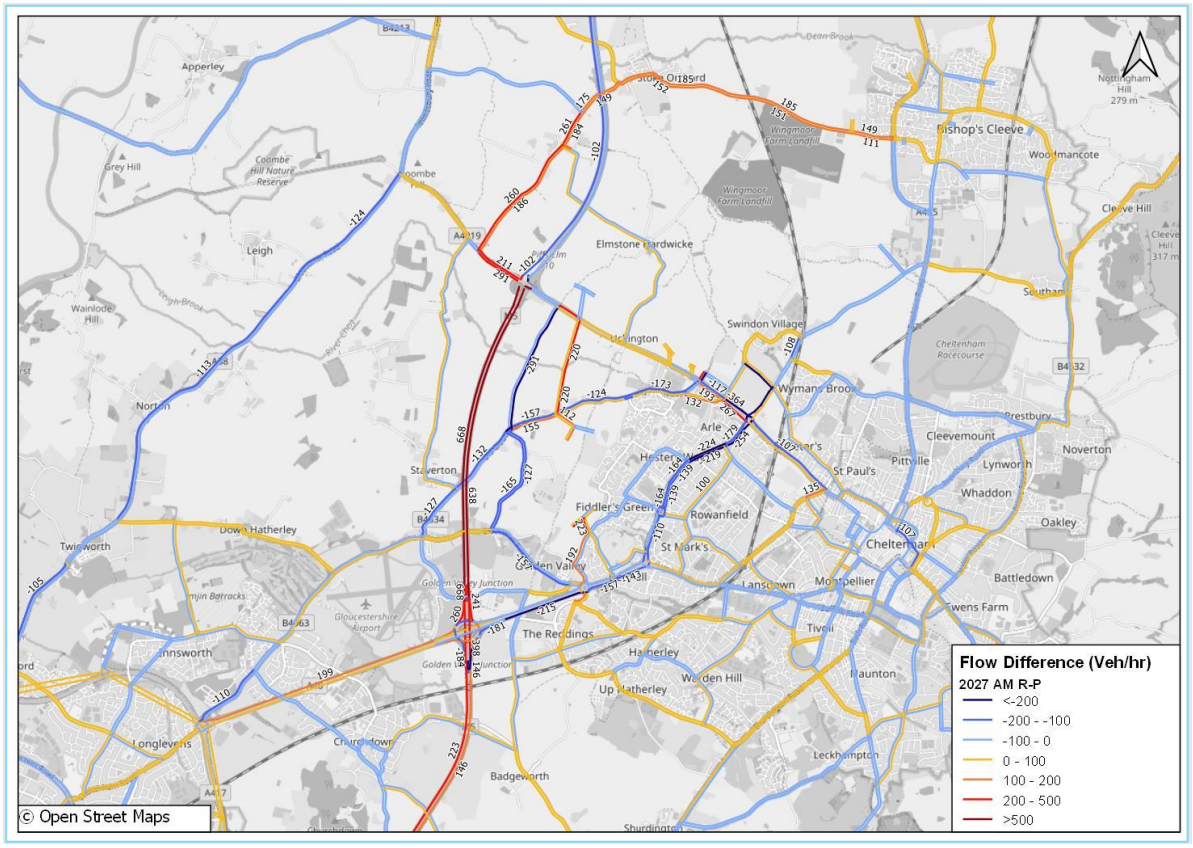
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0 - 100
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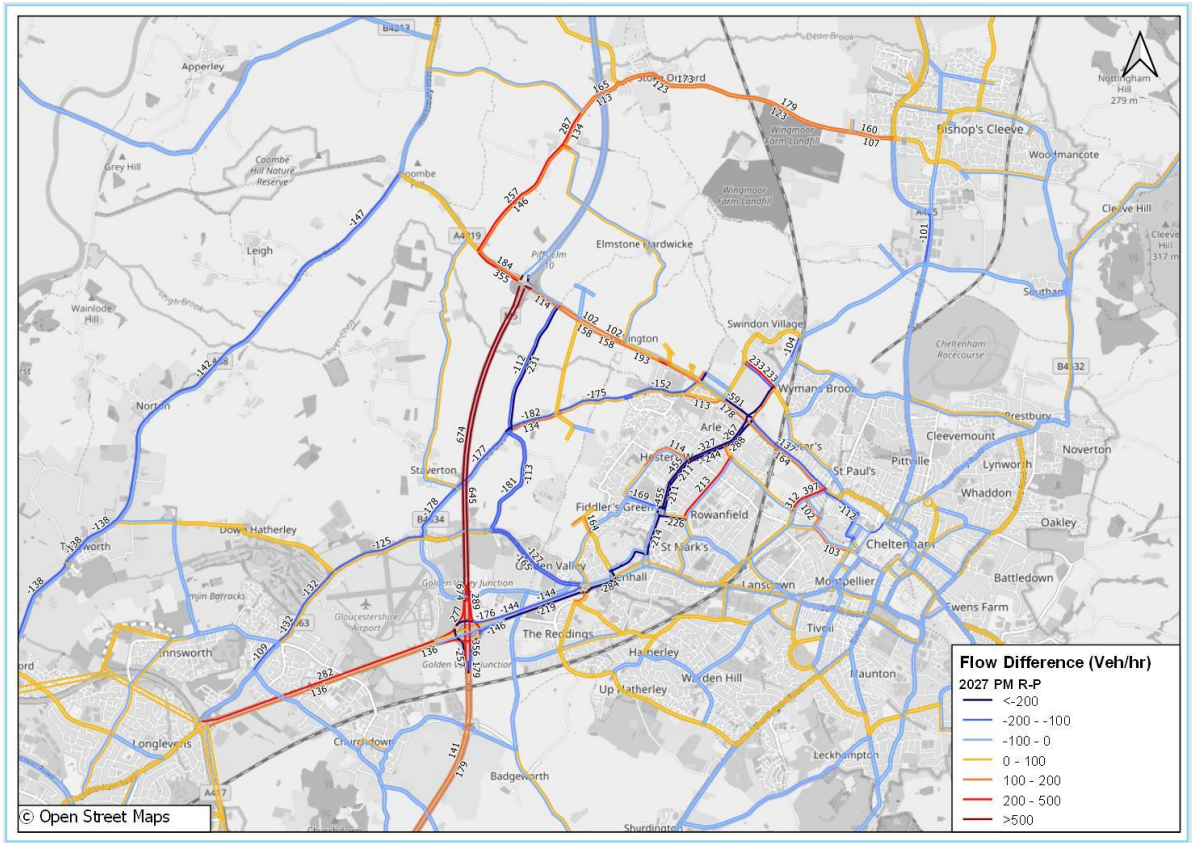
© Open Street Maps


Flow Difference (Veh/hr)
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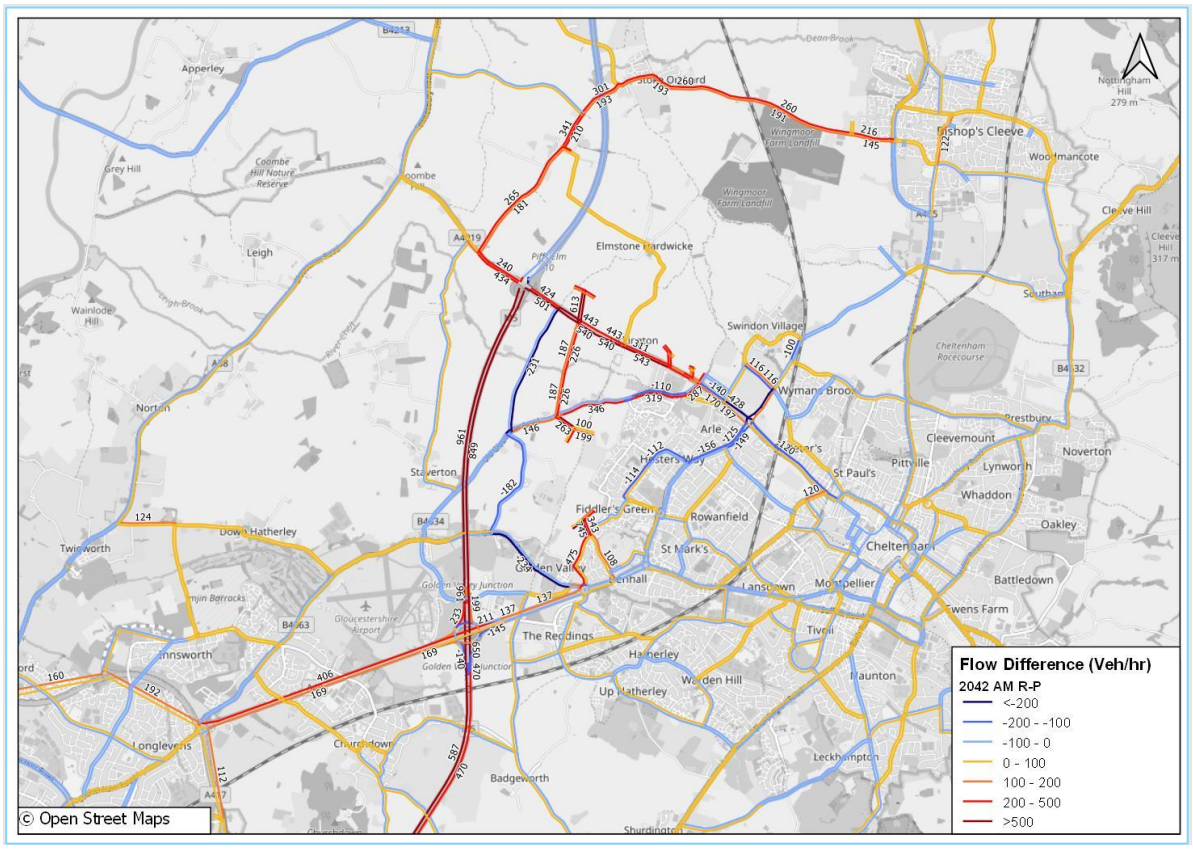
Flow Difference (Veh/hr)
2042 AM R-P
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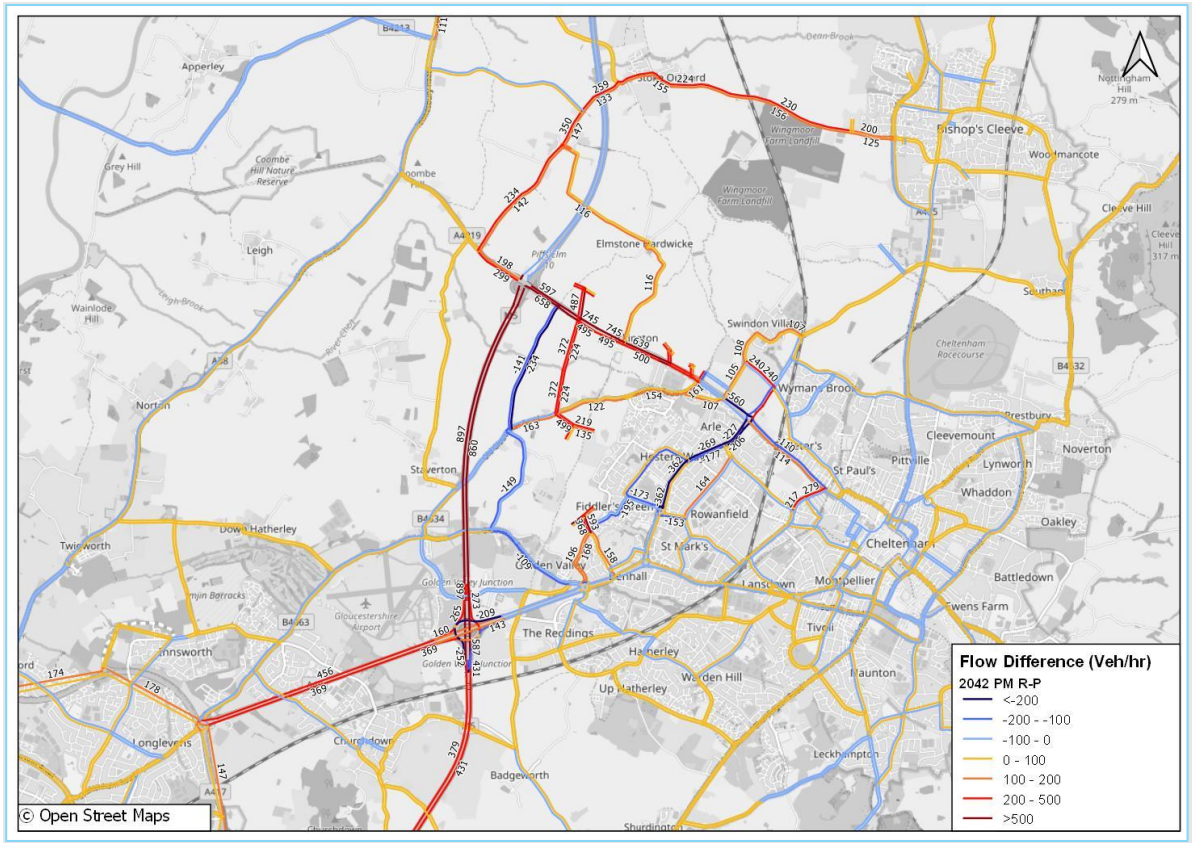
© Open Street Maps

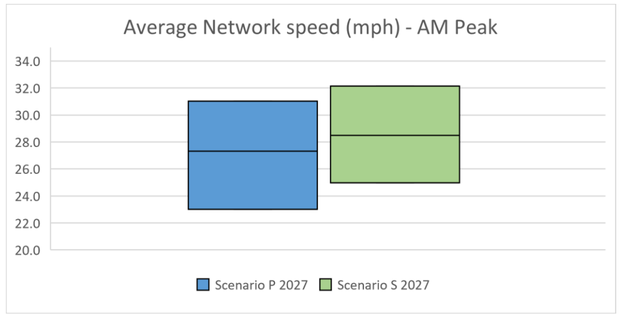

Flow Difference (Veh/hr)
2042 PM R-P
<-200
-200 - -100
-100 - 0
0 - 100
100 - 200
200 - 500
>500
© Open Street Maps

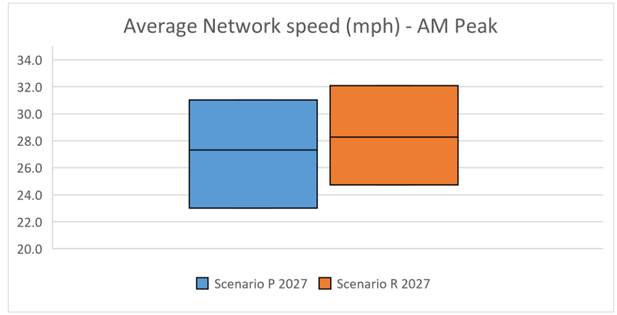
Appendix C. Overall network performance speed variance graphs

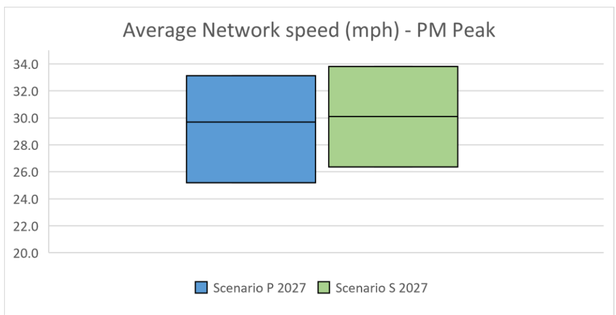
Average Network Speed Performance Indicator - 2027

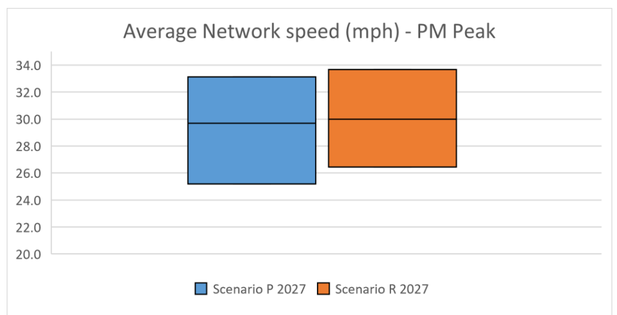
Average Network Speed			
Average Network Speed (mph)	Avg	Min	Max
Scenario P 2027	27.31	23.01	31.02
Scenario R 2027	28.27	24.72	32.08
Scenario S 2027	28.49	24.97	32.14

Average Network Speed			
Average Network Speed (mph)	Avg	Min	Max
Scenario P 2027	29.69	25.19	33.13
Scenario R 2027	29.98	26.44	33.68
Scenario S 2027	30.09	26.37	33.80





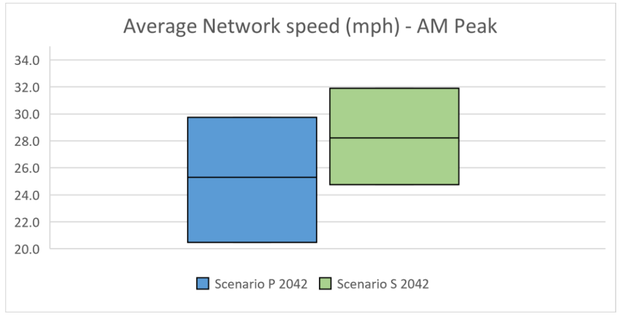


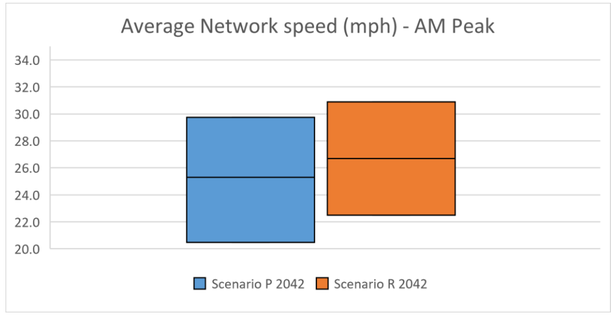


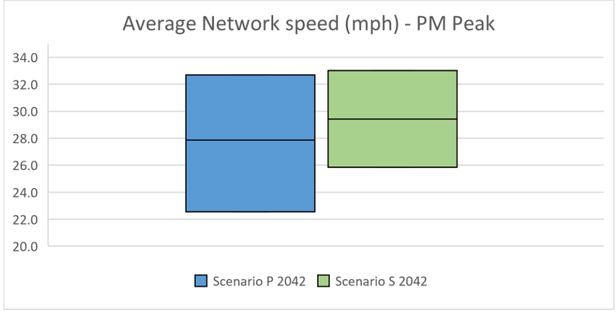
Average Network Speed Performance Indicator - 2042

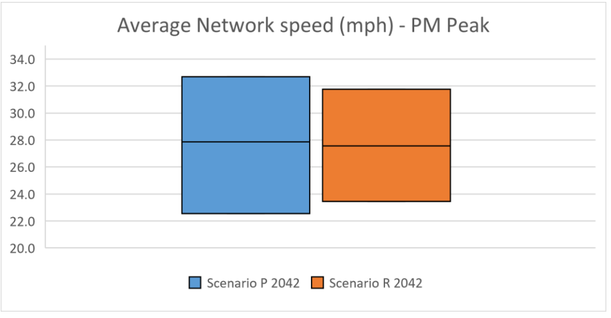
Average Network Speed			
Average Network Speed (mph)	Avg	Min	Max
Scenario P 2042	25.29	20.46	29.75
Scenario R 2042	26.69	22.48	30.90
Scenario S 2042	28.21	24.76	31.90

Average Network Speed			
Average Network Speed (mph)	Avg	Min	Max
Scenario P 2042	27.87	22.54	32.70
Scenario R 2042	27.56	23.45	31.77
Scenario S 2042	29.42	25.84	33.03



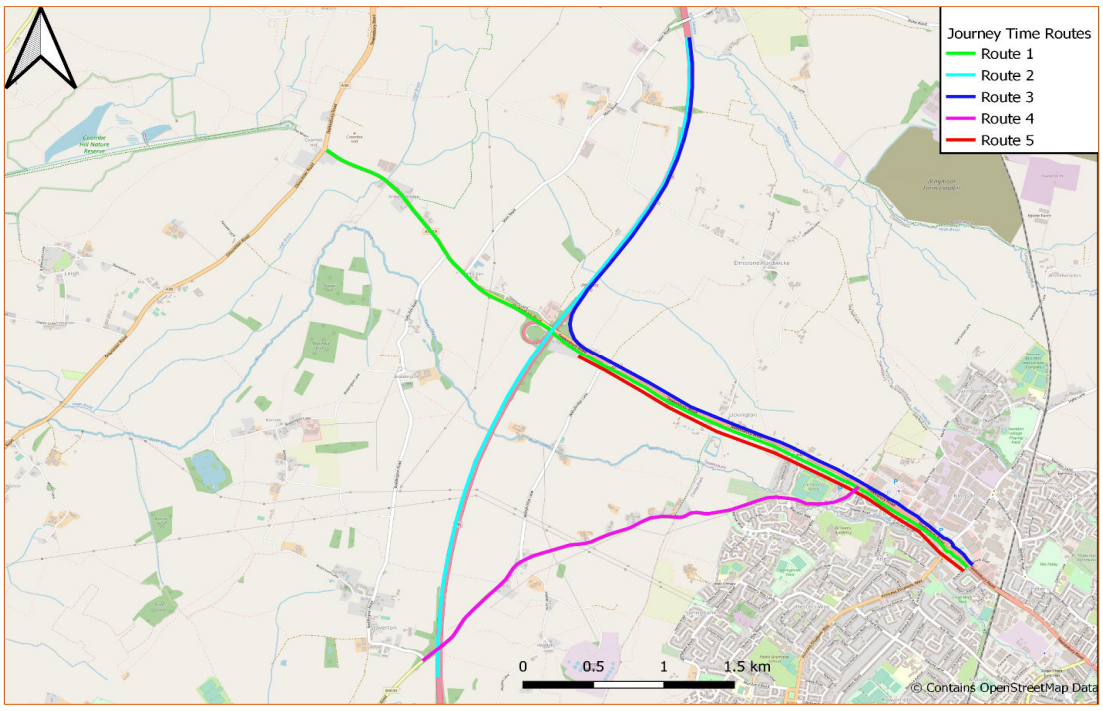






Appendix D. Journey Time graphs – P& S 2027

Journey Time Results



Route 1	A4019 Tewkesbury Road EB - AM Peak			
	R1_EB	Avg	Min	Max
	Scenario P 2027	00:12:06	00:05:16	00:27:05
	Scenario S 2027	00:10:04	00:04:26	00:22:13

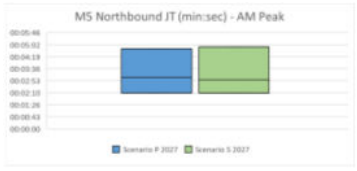
A4019 Tewkesbury Road EB - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:10:25	00:05:19	00:23:43
Scenario S 2027	00:08:35	00:04:15	00:19:18

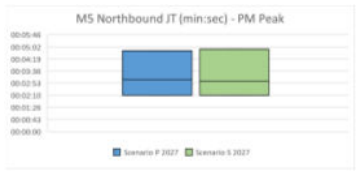
A4019 Tewkesbury Road WB - AM Peak			
R1_WB	Avg	Min	Max
Scenario P 2027	00:06:44	00:04:00	00:26:37
Scenario S 2027	00:09:18	00:04:13	00:24:16

A4019 Tewkesbury Road WB - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:06:15	00:04:00	00:16:16
Scenario S 2027	00:08:36	00:04:06	00:18:55

Route 2	M5 Northbound - AM Peak			
	R2_NB	Avg	Min	Max
	Scenario P 2027	00:03:05	00:02:08	00:04:47
	Scenario S 2027	00:02:57	00:02:08	00:04:54

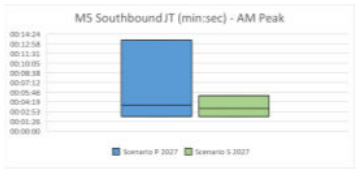
M5 Northbound - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:03:06	00:02:10	00:04:48
Scenario S 2027	00:02:59	00:02:09	00:04:54





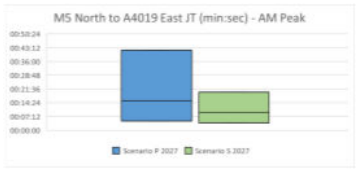
M5 Southbound - AM Peak			
R2_SB	Avg	Min	Max
Scenario P 2027	00:03:52	00:02:08	00:13:29
Scenario S 2027	00:03:22	00:02:09	00:05:15

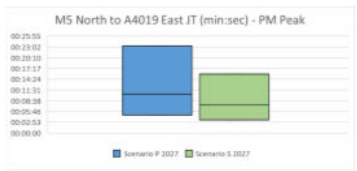
M5 Southbound - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:03:16	00:02:08	00:04:57
Scenario S 2027	00:03:07	00:02:08	00:04:59



Route 3	M5 North to A4019 East - AM Peak			
	R3_EB	Avg	Min	Max
	Scenario P 2027	00:15:22	00:04:53	00:41:51
	Scenario S 2027	00:09:09	00:03:44	00:19:55

M5 North to A4019 East - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:10:23	00:04:50	00:23:16
Scenario S 2027	00:07:28	00:03:32	00:15:46





A4019 East to M5 North - AM Peak			
R3_WB	Avg	Min	Max
Scenario P 2027	00:06:27	00:03:56	00:24:44
Scenario S 2027	00:08:07	00:04:04	00:20:11

A4019 East to M5 North - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:06:09	00:03:57	00:14:57
Scenario S 2027	00:08:22	00:03:58	00:16:55

Route 4	Old Gloucester Road NB - AM Peak			
	R4_NB	Avg	Min	Max
	Scenario P 2027	00:08:20	00:02:46	00:17:02
	Scenario S 2027	00:05:03	00:02:29	00:11:55

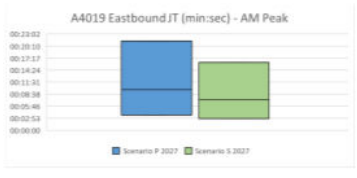
Old Gloucester Road NB - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:05:31	00:02:46	00:11:56
Scenario S 2027	00:04:51	00:02:30	00:11:49

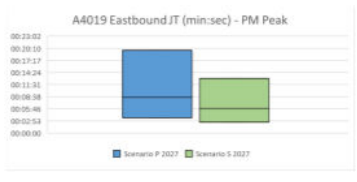
Old Gloucester Road SB - AM Peak			
R4_SB	Avg	Min	Max
Scenario P 2027	00:03:34	00:02:28	00:07:11
Scenario S 2027	00:04:02	00:02:31	00:07:23

Old Gloucester Road SB - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:03:30	00:02:28	00:06:33
Scenario S 2027	00:04:31	00:02:31	00:08:30

Route 5	A4019 Eastbound - AM Peak			
	R5_EB	Avg	Min	Max
	Scenario P 2027	00:09:43	00:03:38	00:21:21
	Scenario S 2027	00:07:22	00:02:46	00:16:14

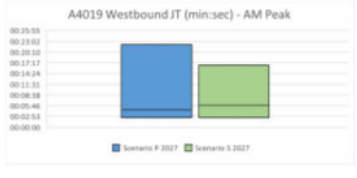
A4019 Eastbound - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:08:29	00:03:41	00:19:39
Scenario S 2027	00:05:54	00:02:35	00:13:02





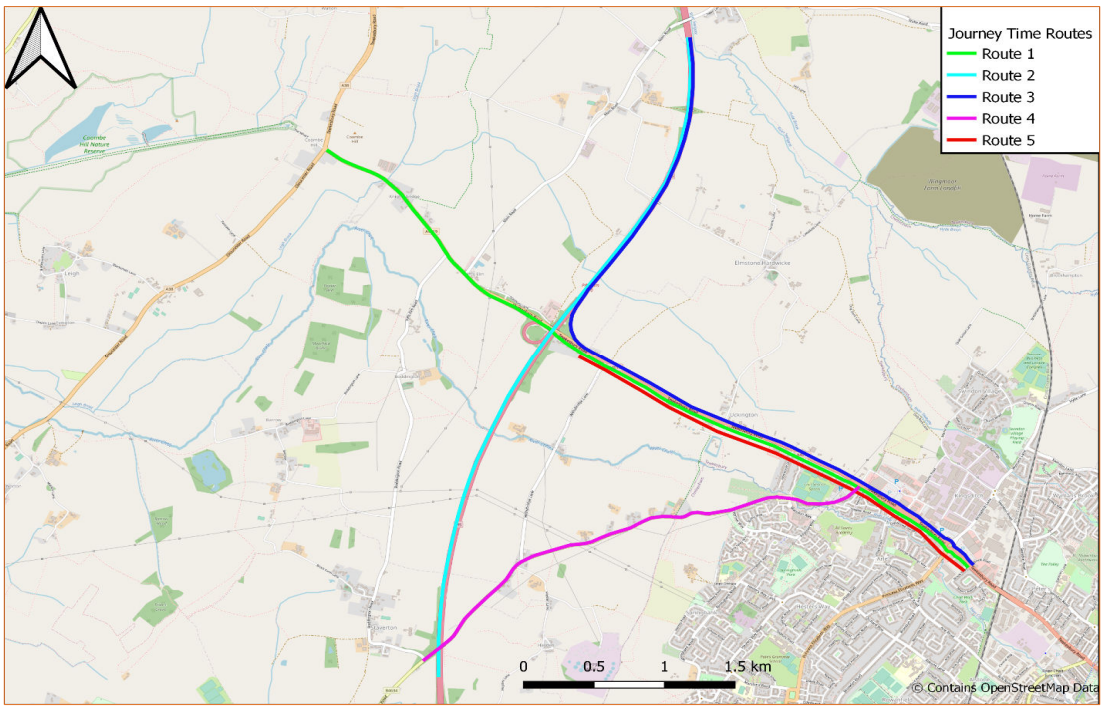
A4019 Westbound - AM Peak			
R5_WB	Avg	Min	Max
Scenario P 2027	00:04:38	00:02:35	00:22:10
Scenario S 2027	00:05:53	00:02:33	00:16:35

A4019 Westbound - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:04:19	00:02:35	00:12:20
Scenario S 2027	00:06:01	00:02:27	00:13:05



Appendix E. Journey Time graphs – P& S 2042

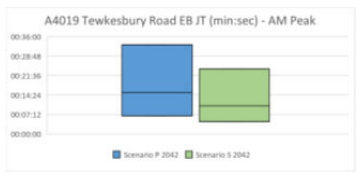
Journey Time Results

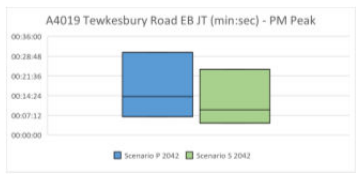


Route 1

A4019 Tewkesbury Road EB - AM Peak			
R1_EB	Avg	Min	Max
Scenario P 2042	00:15:19	00:06:41	00:33:03
Scenario S 2042	00:10:21	00:04:29	00:24:01

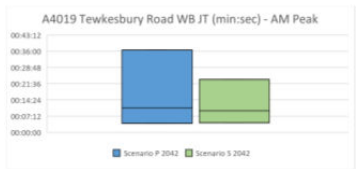
A4019 Tewkesbury Road EB - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:14:02	00:06:40	00:30:13
Scenario S 2042	00:09:19	00:04:18	00:24:02

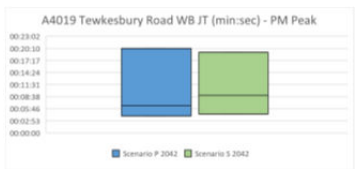




A4019 Tewkesbury Road WB - AM Peak			
R1_WB	Avg	Min	Max
Scenario P 2042	00:10:52	00:04:02	00:36:41
Scenario S 2042	00:09:36	00:04:12	00:23:29

A4019 Tewkesbury Road WB - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:06:31	00:04:00	00:20:07
Scenario S 2042	00:08:57	00:04:28	00:19:12

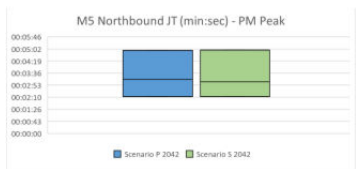




Route 2

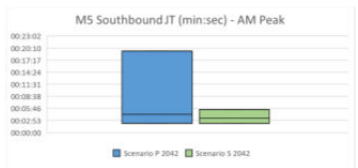
M5 Northbound - AM Peak			
R2_NB	Avg	Min	Max
Scenario P 2042	00:03:08	00:02:09	00:04:45
Scenario S 2042	00:03:00	00:02:09	00:04:56

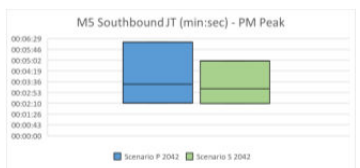
M5 Northbound - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:03:14	00:02:12	00:04:58
Scenario S 2042	00:03:05	00:02:12	00:04:58



M5 Southbound - AM Peak			
R2_SB	Avg	Min	Max
Scenario P 2042	00:04:20	00:02:10	00:19:27
Scenario S 2042	00:03:23	00:02:09	00:05:28

M5 Southbound - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:03:26	00:02:10	00:06:15
Scenario S 2042	00:03:09	00:02:10	00:05:00

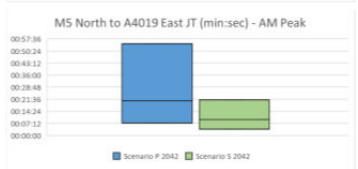


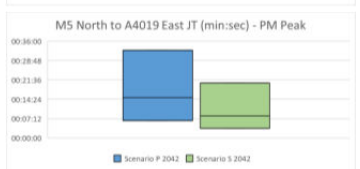


Route 3

M5 North to A4019 East - AM Peak			
R3_EB	Avg	Min	Max
Scenario P 2042	00:20:35	00:07:25	00:54:50
Scenario S 2042	00:09:25	00:03:46	00:21:07

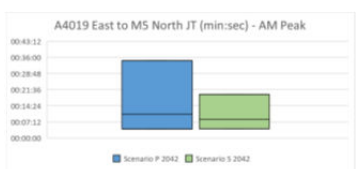
M5 North to A4019 East - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:15:04	00:06:28	00:32:42
Scenario S 2042	00:08:11	00:03:36	00:20:25





A4019 East to M5 North - AM Peak			
R3_WB	Avg	Min	Max
Scenario P 2042	00:10:33	00:03:57	00:34:37
Scenario S 2042	00:08:19	00:04:04	00:19:27

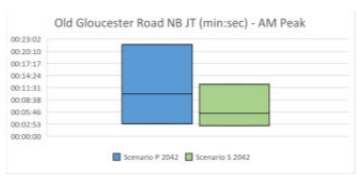
A4019 East to M5 North - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:06:24	00:03:58	00:18:54
Scenario S 2042	00:08:34	00:04:23	00:17:03

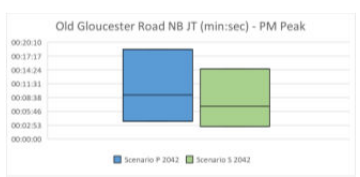


Route 4

Old Gloucester Road NB - AM Peak			
R4_NB	Avg	Min	Max
Scenario P 2042	00:10:01	00:02:59	00:21:45
Scenario S 2042	00:05:26	00:02:30	00:12:18

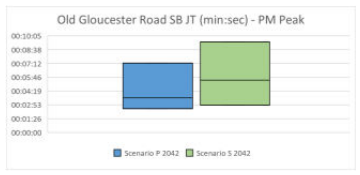
Old Gloucester Road NB - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:09:12	00:03:40	00:18:42
Scenario S 2042	00:06:49	00:02:37	00:14:38





Old Gloucester Road SB - AM Peak			
R4_SB	Avg	Min	Max
Scenario P 2042	00:04:02	00:02:28	00:09:08
Scenario S 2042	00:03:50	00:02:30	00:06:29

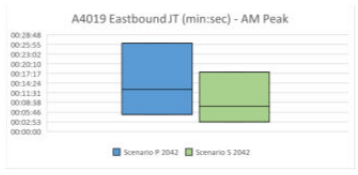
Old Gloucester Road SB - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:03:37	00:02:28	00:07:15
Scenario S 2042	00:05:27	00:02:51	00:09:28

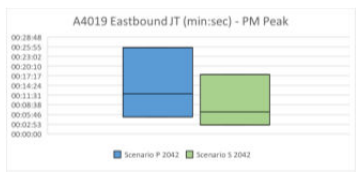


Route 5

A4019 Eastbound - AM Peak			
R5_EB	Avg	Min	Max
Scenario P 2042	00:12:31	00:05:02	00:26:18
Scenario S 2042	00:07:34	00:02:48	00:17:41

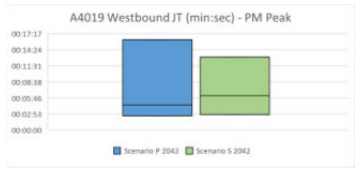
A4019 Eastbound - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:11:57	00:05:02	00:25:44
Scenario S 2042	00:06:36	00:02:38	00:17:40





A4019 Westbound - AM Peak			
R5_WB	Avg	Min	Max
Scenario P 2042	00:08:42	00:02:36	00:32:03
Scenario S 2042	00:06:02	00:02:31	00:15:42

A4019 Westbound - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:04:32	00:02:35	00:16:14
Scenario S 2042	00:06:09	00:02:50	00:13:05



Appendix F. Queue Data

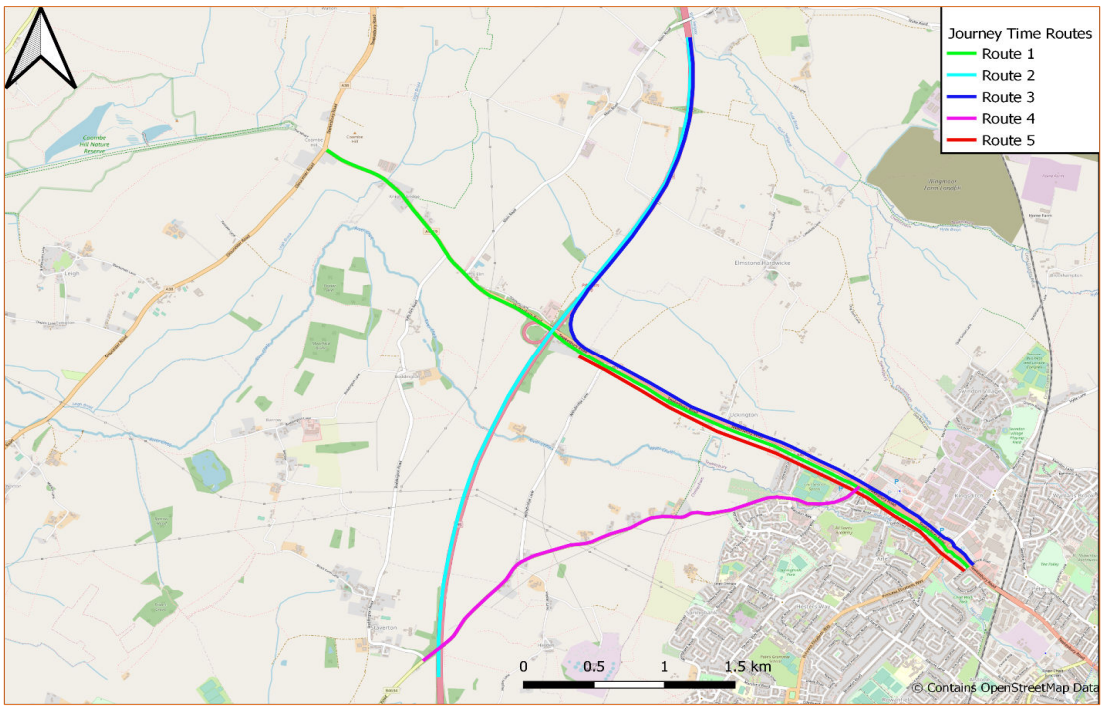
DCO

Where Queues are 0, it means it's N/A

Ref No.	Junctions	Route Name Scenario P 2027	Route Name Scenario P 2042	Route Name Scenario S & R 2027	Route Name Scenario S & R 2042	Available Queuing Length (m)	Available Queuing Length (m)	Available Queuing Length (m)	P_2027				S_2027				R_2027				P_2042				S_2042				R_2042			
									AM		PM		AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
									P_2027_AM		P_2027_PM		S_2027_AM		S_2027_PM		R_2027_AM		R_2027_PM		P_2042_AM		P_2042_PM		S_2042_AM		S_2042_PM		R_2042_AM		R_2042_PM	
						A	DM	DS	MMQ	Avg	MMQ	Avg	MMQ	Avg	MMQ	Avg	MMQ	Avg	MMQ	Avg	MMQ	Avg	MMQ	Avg	MMQ	Avg	MMQ	Avg	MMQ	Avg	MMQ	Avg
1	**Coombe Hill Junction**																															
	A38 North Approach (SB)	10B	10B	10B	10B	1700	1700	1700	49	1	49	0	46	1	41	0	47	1	40	0	48	1	47	1	51	1	44	0	54	1	51	1
	A4019 East Approach (WB)	10C	10C	10C	10C	503	503	503	46	2	49	3	64	3	53	3	73	4	54	3	55	2	44	2	68	3	61	3	56	3	51	3
	A38 South Approach (NB)	10D	10D	10D	10D	1155	1155	1155	52	29	39	15	43	17	37	10	44	19	36	10	49	26	40	15	44	20	37	11	50	25	37	12
2	**M5 Junction 10**																															
	A4019 West Approach (EB)	11A	11A	11G	11G	1048/657	1048	657	119	3	61	0	64	32	61	30	66	33	60	29	74	2	67	1	66	31	63	32	72	34	71	38
	M5 North Approach (SB)	11B	11B	11B	11B	582/488	582	388	270	158	53	12	43	17	38	11	43	18	38	11	366	234	122	56	46	21	39	11	56	27	43	16
	A4019 East Approach (WB)	11D		11J	11J	520/344	520	344	0	0	0	0	40	7	57	10	42	8	56	10	0	0	0	0	46	11	55	11	53	17	54	17
	M5 South Approach (NB)	11E		11M	11M	470	470	371	0	0	0	0	40	10	45	17	39	9	45	16	0	0	0	0	41	10	42	15	41	9	43	13
3	**A4019 / Link Road Junction : Access A**																															
	A4019 West Approach (EB)	22A	22A	22A	22A	236	236	236	0	0	0	0	56	22	43	16	59	24	43	16	0	0	0	0	74	31	58	23	93	56	102	75
	A4019 West Approach (EB) Right Turn	22D		22D	22D	162	162	162	0	0	0	0	43	18	39	10	49	26	38	11	0	0	0	0	55	30	47	17	63	44	66	50
	North Approach (SB)	22B	22B	22B	22B	360	360	360	21	0	0	0	33	0	31	0	34	0	33	0	142	128	148	125	36	1	38	2	225	225	154	151
	North Approach Left Turn (SB)	22E		22E	22E	129	129	129	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0	27	0	33	8	39	15
	A4019 East Approach (WB)	22C	22C	22C	22C	733	733	733	0	0	0	0	53	3	99	2	48	3	106	2	0	0	0	0	60	1	115	1	84	1	115	2
	West Cheltenham Link Road (NB)	22G		22G	22G	1300	1300	1300	0	0	0	0	52	18	44	14	51	25	47	19	0	0	0	0	50	23	50	23	104	103	133	99
4	**A4019 / Green Junction**																															
	A4019 West Approach (EB)	12A	12A	12A	12A	733	733	733	0	0	0	0	97	57	57	29	103	62	56	28	0	0	0	0	99	57	62	32	122	69	114	61
	The Green Approach (SB)	12B	12B	12B	12B	368	368	368	237	223	19	0	326	294	36	7	308	274	44	13	160	127	23	1	359	331	60	30	406	385	408	398
	A4019 East Approach (WB)	12C	12C	12C	12C	537	537	537	181	9	0	0	40	13	58	20	41	16	67	33	188	36	79	2	41	12	63	32	53	24	64	32
	Moat Ln (NB)	12D	12D	12D	12D	60	60	60	21	1	22	0	33	1	33	3	32	1	34	2	23	3	25	3	32	1	34	3	32	1	34	2
5	**A4019 / Development Site Junction : Access B1**																															
	A4019 West Approach (EB)	13A	13A	13A	13A	537	537	537	0	0	0	0	41	11	36	10	41	11	33	7	0	0	0	0	39	8	36	8	86	44	69	31
	Development Site Approach Link	13B	13B	13B	13B	255	255	255	0	0	0	0	41	10	41	7	41	7	40	4	0	0	0	0	43	11	41	7	54	28	51	23
	A4019 East Approach (WB)	13C	13C	13C	13C	376	376	376	0	0	0	0	0	0	40	0	0	0	39	0	0	0	0	0	38	0	40	0	40	0	0	0
	A4019 East Approach (WB) Right turn	13D	13D	13D	13D	137	137	137	0	0	0	0	24	2	24	1	24	1	24	1	0	0	0	0	25	2	26	2	30	8	29	8
6	**A4019/ Development Site Junction : Access B2**																															
	A4019 West Approach (EB)	14A	14A	14A	14A	376	376	376	0	0	0	0	68	26	39	6	68	25	49	14	0	0	0	0	76	12	55	6	70	14	55	8
	Development Site Approach Link	14B	14B	14B	14B	300	300	300	0	0	0	0	28	0	33	0	31	0	33	0	0	0	0	0	43	0	47	0	50	0	49	0
	A4019 East Approach (WB)	14C	14C	14C	14C	166	166	166	0	0	0	0	0	0	26	0	0	0	26	0	0	0	0	0	0	0	25	0	29	0	28	0
	Homecroft Dr	14E		14E	14E	50	50	50	0	0	0	0	29	5	27	0	30	5	27	0	0	0	0	0	32	8	29	0	31	7	28	0
7	**A4019 / B4634 Signalised Junction (Gallagher) : Access B3**																															
	A4019 West Approach (EB)	15A	15A	15A	15A	1079/166	1079	166	554	60	743	96	64	20	46	17	60	19	44	19	668	103	830	199	67	28	46	21	57	27	48	25
	Gallagher Retail Park Approach	15B	15B	15B	15B	340	340	340	88	64	219	162	152	0	117	0	147	0	95	0	83	54	211	151	115	0	94	0	102	0	209	0
	A4019 East Approach (WB)	15C	15C	15C	15C	334	334	334	34	6	41	15	62	31	68	29	61	29	57	22	37	9	40	14	70	33	69	29	69	34	73	35
	B4634 Approach (NB)	15D	15D	15D	15D	555	555	555	200	154	125	87	107	77	100	67	108	79	133	93	185	134	168	117	104	76	143	108	146	106	187	123
8	**A4019/ Manor Road Junction**																															
	A4019 West Approach (EB)	16A	16A	16A	16A	334	334	334	85	54	110	79	76	45	47	22	78	46	52	30	98	62	135	96	77	46	61	37	66	37	54	29
	Manor Road	16B	16B	16B	16B	240	240	240	216	214	188	170	66	48	82	63	154	140	166	143	207	199	217	202	68	52	92	72	70	52	205	176
	A4019 East Approach (WB)	16C	16C	16C	16C	387	387	387	26	7	37	15	41	23	46	19	41	23	47	21	28	7	36	14	40	22	46	20	38	18	43	16
	Hayden Road	16D	16D	16D	16D	255	255	255	129	107	116	97	82	57	104	86	87	62	90	70	132	110	118	100	97	73	74	51	90	66	72	50
9	**Kingsditch Roundabout**																															
	A4019 West Approach (EB)	17A	17A	17A	17A	387	387	387	76	44	69	38	55	21	45	7	56	22	44	7	76	43	68	36	56	22	46	7	55	21	46	7
	Kingsditch Lane	17B	17B	17B	17B	520	520	520	110	55	135	61	79	42	41	14	80	43	41	14	118	57	133	62	78	44	43	16	90	44	47	20
	A4019 East Approach (WB)	17C	17C	17C	17C	195	195	195	55	27	43	21	54	28	43	15	50	27	43	15	53	30	46	23	56	29	43	15	56	28	44	16
	Princess Elizabeth Way	17D	17D	17D	17D	470	470	470	88	46	72	39	71	39	39	8	66	35	39	8	88	46	71	39	70	38	39	8	63	32	43	12
10	**A4019 / Brook Road Junction**																															
	A4019 West Approach (EB)	18A	18A	18A	18A	140	140	140	69	27	50	16	76	30	54	18	76	30	52	17	69	27	52	16	78	31	54	18	74	29	54	17
	Brook Road North Approach (SB)	18B	18B	18B	18B	150	150	150	48	4	45	9	45	5	45	8	45	6	45	8	46	6	45	8	49	5	45	8	47	5	44	8
	A4019 East Approach (WB)	18C	18C	18C	18C	433	433	433	41	12	44	15	46	15	49	17	46	15	49	17	45	14	45	15	49	17	49	18	47	16	48	17
	Brook Road South Approach (NB)	18D	18D	18D	18D	180	180	180	42	2	41	2	41	2	43	2	40	2	42	2	41	2	43	2	41	2	40	3	41	2	41	3
11	**New Link Rd / B4634 Junction : Development Site Access C**																															
	B4634 West Approach (EB)	24A	24A	24A	24A	313	313	313	16	0	17	0	50	16	51	15	51	16	51	15	24	0	16	0	54	19	58	24	56	20	64	28
	Development Site Approach Link North (SB)	24B	24B	24B	24B	1300	1300	1300	0	0	0	0	61	40	44	17	61	43	44	16	0	0	0	0	53	24	44	12	61	36	46	19
	B4634 EAST Approach (WB)	24C	24C	24C	24C	1267	1267	1267	58	0	0	0	48	15	49	13	53	17	49	13	0	0	0	0	48	16	58	23	81	35	61	25
	Development Site Approach Link South (NB)	24D	24D	24D	24D	254	254	254	16	0	17	0	44	0	44	3	43	1	47	12	18	0	18	0	44	2	44	5	61	33	80	49
12	**A4019/Hardwicke junction**																															
	A4019 East Approach (WB)	21C	21C	21C	21C	65	65	65	21	1	16	0	79	14	37	4	80	14	36	4	19	0	25	0	79	14	35	4	87	17	44	5
	Stoke Road (SB)	21B	21B	21B	21B				26	1	21	0	202	114	44	9	221	133	47	9	29	1	22	0	157	77	44	8	268	172	50	12

Appendix G. Journey Time graphs – P& R 2027

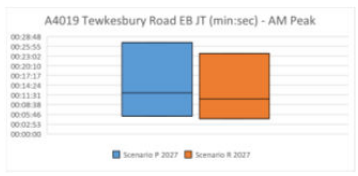
Journey Time Results

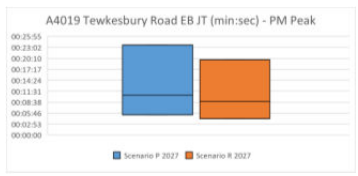


Route 1

A4019 Tewkesbury Road EB - AM Peak			
R1_EB	Avg	Min	Max
Scenario P 2027	00:12:06	00:05:16	00:27:05
Scenario R 2027	00:10:20	00:04:29	00:23:51

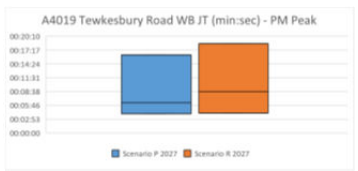
A4019 Tewkesbury Road EB - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:10:25	00:05:19	00:23:43
Scenario R 2027	00:08:52	00:04:16	00:19:46





A4019 Tewkesbury Road WB - AM Peak			
R1_WB	Avg	Min	Max
Scenario P 2027	00:06:44	00:04:00	00:26:37
Scenario R 2027	00:09:18	00:04:10	00:23:56

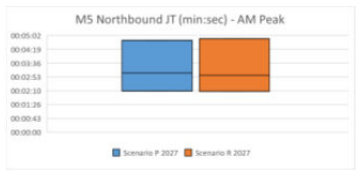
A4019 Tewkesbury Road WB - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:06:15	00:04:00	00:16:16
Scenario R 2027	00:08:39	00:04:10	00:18:37

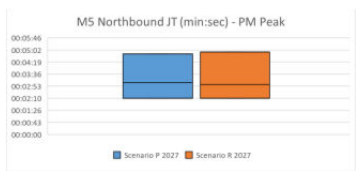


Route 2

M5 Northbound - AM Peak			
R2_NB	Avg	Min	Max
Scenario P 2027	00:03:05	00:02:08	00:04:47
Scenario R 2027	00:02:57	00:02:07	00:04:53

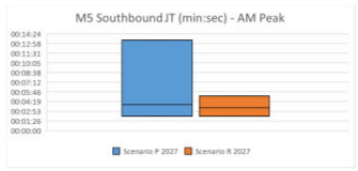
M5 Northbound - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:03:06	00:02:10	00:04:48
Scenario R 2027	00:02:59	00:02:10	00:04:55

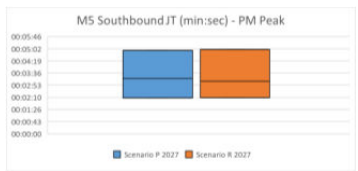




M5 Southbound - AM Peak			
R2_SB	Avg	Min	Max
Scenario P 2027	00:03:52	00:02:08	00:13:29
Scenario R 2027	00:03:22	00:02:08	00:05:10

M5 Southbound - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:03:16	00:02:08	00:04:57
Scenario R 2027	00:03:07	00:02:09	00:05:00

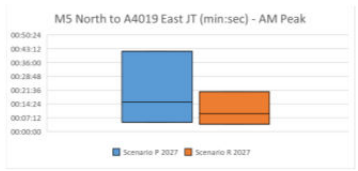


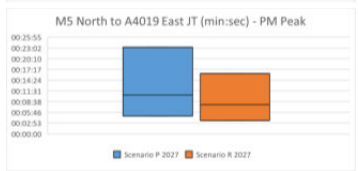


Route 3

M5 North to A4019 East - AM Peak			
R3_EB	Avg	Min	Max
Scenario P 2027	00:15:22	00:04:53	00:41:51
Scenario R 2027	00:09:18	00:03:46	00:20:44

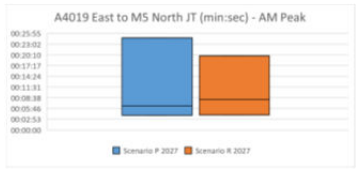
M5 North to A4019 East - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:10:23	00:04:50	00:23:16
Scenario R 2027	00:07:47	00:03:33	00:16:09

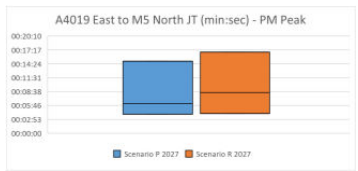




A4019 East to M5 North - AM Peak			
R3_WB	Avg	Min	Max
Scenario P 2027	00:06:27	00:03:56	00:24:44
Scenario R 2027	00:08:08	00:04:01	00:19:54

A4019 East to M5 North - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:06:09	00:03:57	00:14:57
Scenario R 2027	00:08:27	00:04:02	00:16:48





Route 4

Old Gloucester Road NB - AM Peak			
R4_NB	Avg	Min	Max
Scenario P 2027	00:08:20	00:02:46	00:17:02
Scenario R 2027	00:05:04	00:02:30	00:12:02

Old Gloucester Road NB - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:05:31	00:02:46	00:11:56
Scenario R 2027	00:05:30	00:02:30	00:12:52

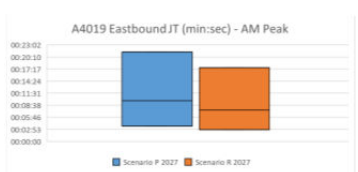
Old Gloucester Road SB - AM Peak			
R4_SB	Avg	Min	Max
Scenario P 2027	00:03:34	00:02:28	00:07:11
Scenario R 2027	00:04:42	00:02:31	00:08:44

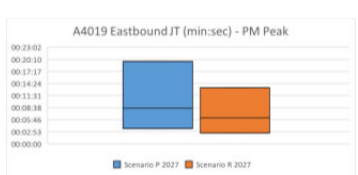
Old Gloucester Road SB - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:03:30	00:02:28	00:06:33
Scenario R 2027	00:04:52	00:02:33	00:09:03

Route 5

A4019 Eastbound - AM Peak			
R5_EB	Avg	Min	Max
Scenario P 2027	00:09:43	00:03:38	00:21:21
Scenario R 2027	00:07:31	00:02:48	00:17:37

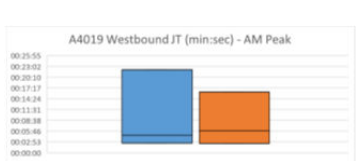
A4019 Eastbound - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:08:29	00:03:41	00:19:39
Scenario R 2027	00:06:13	00:02:36	00:13:26

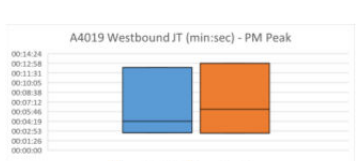




A4019 Westbound - AM Peak			
R5_WB	Avg	Min	Max
Scenario P 2027	00:04:38	00:02:35	00:22:10
Scenario R 2027	00:05:52	00:02:30	00:16:10

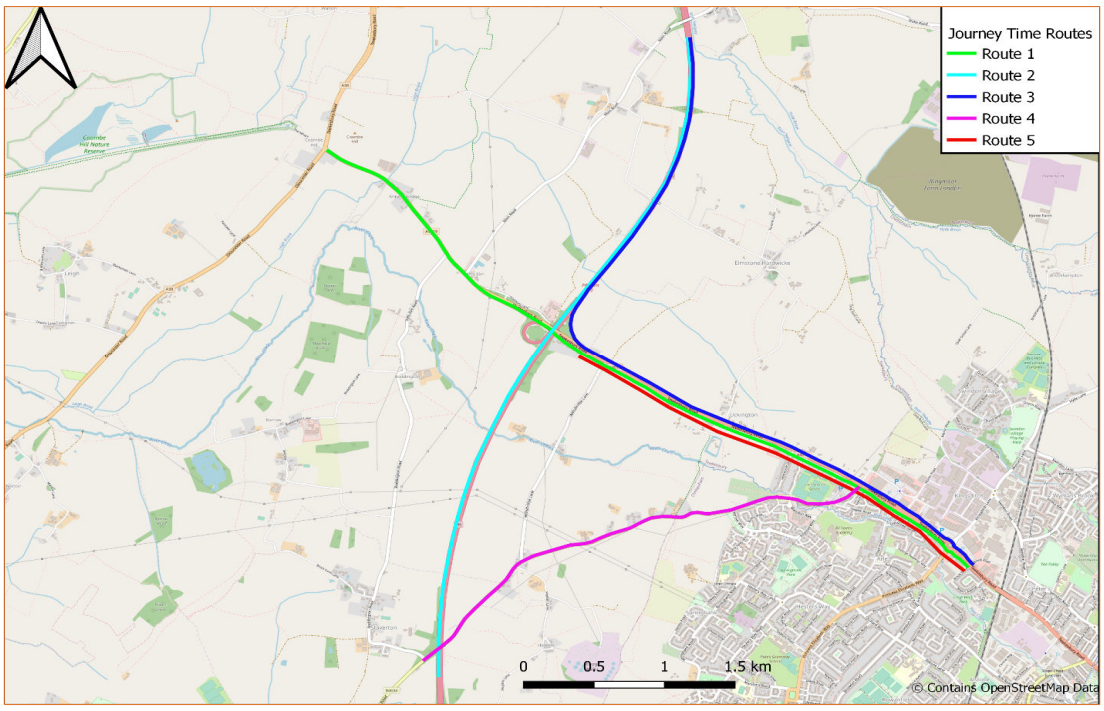
A4019 Westbound - PM Peak			
	Avg	Min	Max
Scenario P 2027	00:04:19	00:02:35	00:12:20
Scenario R 2027	00:06:06	00:02:31	00:12:58





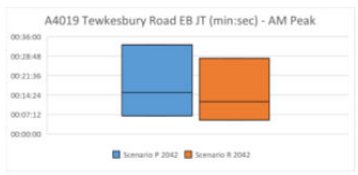
Appendix H. Journey Time graphs – P& R 2042

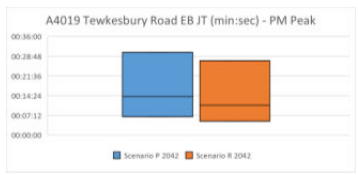
Journey Time Results



Route 1	A4019 Tewkesbury Road EB - AM Peak			
	R1_EB	Avg	Min	Max
	Scenario P 2042	00:15:19	00:06:41	00:33:03
	Scenario R 2042	00:11:53	00:05:07	00:28:03

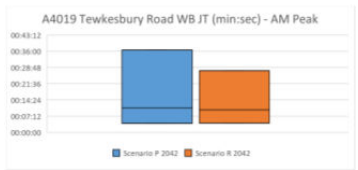
A4019 Tewkesbury Road EB - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:14:02	00:06:40	00:30:13
Scenario R 2042	00:10:56	00:05:03	00:27:10

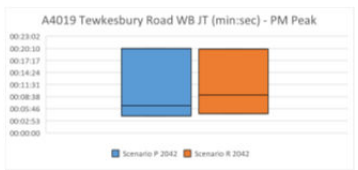




A4019 Tewkesbury Road WB - AM Peak			
R1_WB	Avg	Min	Max
Scenario P 2042	00:10:52	00:04:02	00:36:41
Scenario R 2042	00:10:04	00:04:10	00:27:21

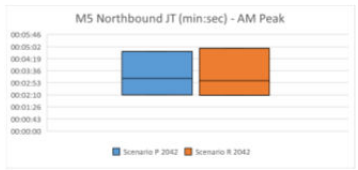
A4019 Tewkesbury Road WB - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:06:31	00:04:00	00:20:07
Scenario R 2042	00:09:00	00:04:34	00:19:57

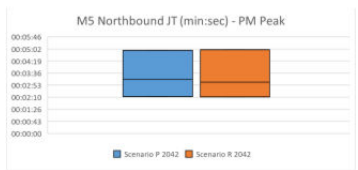




Route 2	M5 Northbound - AM Peak			
	R2_NB	Avg	Min	Max
	Scenario P 2042	00:03:08	00:02:09	00:04:45
	Scenario R 2042	00:03:00	00:02:09	00:04:57

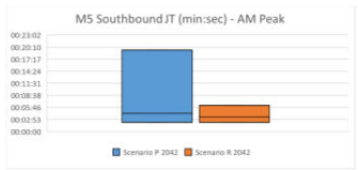
M5 Northbound - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:03:14	00:02:12	00:04:58
Scenario R 2042	00:03:04	00:02:11	00:05:00

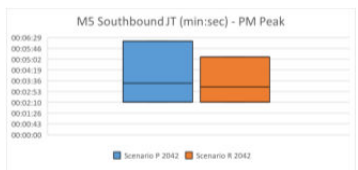




M5 Southbound - AM Peak			
R2_SB	Avg	Min	Max
Scenario P 2042	00:04:20	00:02:10	00:19:27
Scenario R 2042	00:03:31	00:02:10	00:06:16

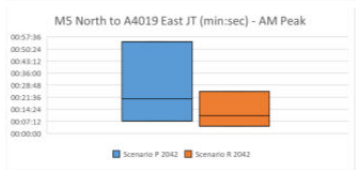
M5 Southbound - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:03:26	00:02:10	00:06:15
Scenario R 2042	00:03:11	00:02:10	00:05:11

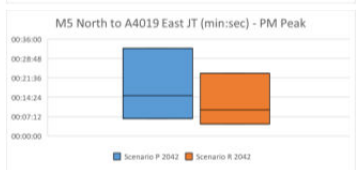




Route 3	M5 North to A4019 East - AM Peak			
	R3_EB	Avg	Min	Max
	Scenario P 2042	00:20:35	00:07:25	00:54:50
	Scenario R 2042	00:10:44	00:04:25	00:25:03

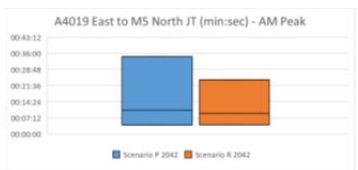
M5 North to A4019 East - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:15:04	00:06:28	00:32:42
Scenario R 2042	00:09:39	00:04:20	00:23:17

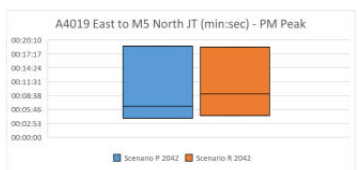




A4019 East to M5 North - AM Peak			
R3_WB	Avg	Min	Max
Scenario P 2042	00:10:33	00:03:57	00:34:37
Scenario R 2042	00:09:05	00:04:04	00:24:18

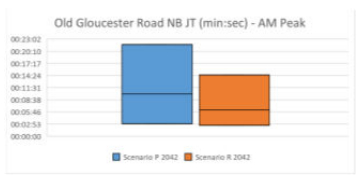
A4019 East to M5 North - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:06:24	00:03:58	00:18:54
Scenario R 2042	00:08:56	00:04:29	00:18:43

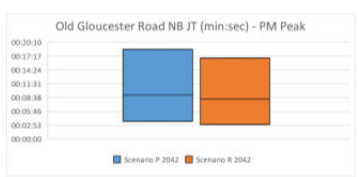




Route 4	Old Gloucester Road NB - AM Peak			
	R4_NB	Avg	Min	Max
	Scenario P 2042	00:10:01	00:02:59	00:21:45
	Scenario R 2042	00:06:16	00:02:36	00:14:31

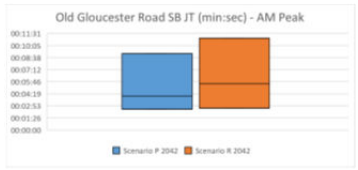
Old Gloucester Road NB - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:09:12	00:03:40	00:18:42
Scenario R 2042	00:08:16	00:02:58	00:16:54

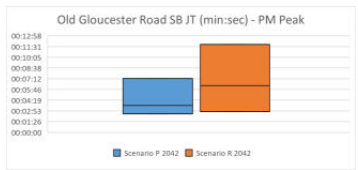




Old Gloucester Road SB - AM Peak			
R4_SB	Avg	Min	Max
Scenario P 2042	00:04:02	00:02:28	00:09:08
Scenario R 2042	00:05:31	00:02:37	00:10:56

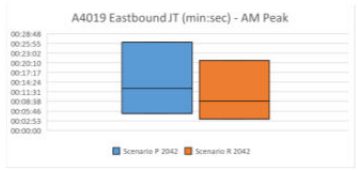
Old Gloucester Road SB - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:03:37	00:02:28	00:07:15
Scenario R 2042	00:06:17	00:02:47	00:11:49

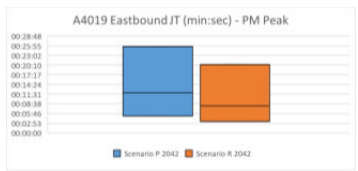




Route 5	A4019 Eastbound - AM Peak			
	R5_EB	Avg	Min	Max
	Scenario P 2042	00:12:31	00:05:02	00:26:18
	Scenario R 2042	00:08:46	00:03:27	00:20:51

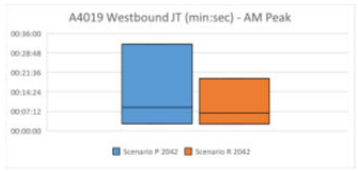
A4019 Eastbound - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:11:57	00:05:02	00:25:44
Scenario R 2042	00:08:01	00:03:22	00:20:24

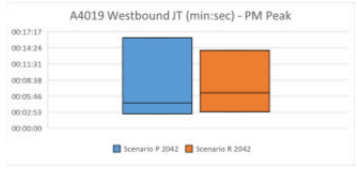




A4019 Westbound - AM Peak			
R5_WB	Avg	Min	Max
Scenario P 2042	00:08:42	00:02:36	00:32:03
Scenario R 2042	00:06:33	00:02:29	00:19:24

A4019 Westbound - PM Peak			
	Avg	Min	Max
Scenario P 2042	00:04:32	00:02:35	00:16:14
Scenario R 2042	00:06:18	00:02:55	00:13:56





Appendix I. WCHAR

Appendix I –Walking, Cycling and Horse-Riding Assessment is provided as a separate document (application document TR010063 – APP 7.5).

Appendix J. Transport Model Package Report

Appendix J –Transport Model Package Report is provided as a separate document (application document TR010063 – APP 7.5).

Appendix K. Model Package Data Report

Appendix K –Model Package Data Report is provided as a separate document (application document TR010063 – APP 7.5).

Appendix L. Traffic Forecasting Report

Appendix L –Traffic Forecasting Report is provided as a separate document (application document TR010063 – APP 7.5).

Appendix M. Construction Phase Figures

Appendix M – Construction Phase Figures are provided as a separate document (application document TR010063 – APP 7.5).

Appendix N. SRN Flow Difference Plots

Appendix N – SRN Flow Difference Plots is provided as a separate document (application document TR010063 – APP 9.57).

Appendix O. SRN Volume Over Capacity Plots

Appendix O – SRN V/C Plots is provided as a separate document (application document TR010063 – APP 9.58).

Appendix P. SRN Impact Results

Appendix P – SRN Impact Results is provided as a separate document (application document TR010063 – APP 9.59).

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