A417 Missing Link
TR010056

7.10 Transport Report

Planning Act 2008

APFP Regulation 5(2)(q)
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Volume 7

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

A417 Missing Link

Development Consent Order 202[x]

7.10 Transport Report

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Executive summary

The section of the A417 in Gloucestershire between Cowley roundabout and Brockworth bypass is called the Missing Link. This section of road experiences congestion, delays throughout the year, with poor journey time reliability and a poor safety record. The route needs improvement to meet Highways England's objectives of maintaining the smooth flow of traffic, making the network safer and supporting economic growth.

The scheme would provide 3.4 miles (5.5km) of new, rural all-purpose dual carriageway for the A417. The scheme would connect the existing dual carriageway A417 Brockworth bypass with the existing dual carriageway A417 south of Cowley. The scheme would provide safe crossing points for the Cotswold Way National Trail and Gloucestershire Way along with the other walking, cycling and horse riding (WCH) infrastructure. The scheme would improve the existing route network and improve safety by removing the requirement for users and Public Rights of Way (PRoW) from crossing the A417 carriageways.

The existing single carriageway alignment of the A417, with its steep gradients, junctions and private accesses reduces vehicle speeds. These all contribute towards longer journey times and poor journey time reliability for road users. The characteristics of the existing road alignment, traffic flows and poor forward visibility all have a negative effect on road safety. They contribute toward the poor safety record when compared to the national average for a single carriageway road. In the period from July 2014 to June 2019 there were 42 collisions. These collisions resulted in eight fatalities and a further 21 seriously injured casualties.

Traffic modelling has been undertaken to assess the impact of the scheme on the local and wider road network. The scheme traffic model is based on the South West Regional Traffic Model (SWRTM). The SWRTM has been enhanced in Gloucestershire and surrounding areas to better represent the local area around the scheme. The scheme base traffic model has undergone a calibration and validation process to ensure the required standards set out by the Department for Transport (DfT) in its Transport Appraisal Guidance (TAG) are met. By meeting the requirements of the DfT, the scheme traffic model is deemed to be representative of the real world.

Using the scheme base traffic model, scheme forecast traffic models have been developed for the opening year, in 2026 and the design year in 2041. Additionally, two other forecast years were developed. All of the forecast scheme traffic models have been used to inform the design of the scheme. The scheme traffic models have also informed the environmental assessment and economic appraisal of the scheme.

The economic appraisal has assessed the scheme in relation to both user and environmental impacts. The impacts assessed include transport user benefits, accidents, construction and maintenance, noise, air quality and greenhouse gases, journey time reliability and wider economic benefits. The result of the appraisal is a Benefit Cost Ratio of 2.51. This represents a medium value for money.

1 Introduction

1.1 Purpose of this document

1.1.1 As a Nationally Significant Infrastructure Project (NSIP), the scheme requires an application for a DCO to be submitted to the Planning Inspectorate, acting on behalf of the Secretary of State (SoS). This report forms part of Volume 7 of the application for a DCO authorising Highways England to construct and operate the scheme.

1.1.2 The purpose of this report is to provide a description of the existing transport features in the locality, the policy context, a summary of the transport modelling work undertaken and describes the transport impacts of the scheme and the economic appraisal of the scheme. The purpose of these works has been to:

- quantify the impacts of the scheme on the highway network, in terms of expected levels of congestion with and without the scheme in place
- provide traffic flow inputs to the design of the new road and its junctions
- provide traffic flow inputs to the Environmental Impact Assessment (EIA) of the scheme
- provide inputs to the value for money assessment for the scheme, in terms of the costs and benefits arising from the scheme for road users
- assess the existing provision of WCH facilities identify potential opportunities for improvement and integration with the local and national network(s) throughout the design process.

1.1.3 The scheme traffic model is a strategic highway model that assesses the impact of the scheme at a local level and a wider regional area. The scheme traffic model has a detailed study area that covers from Worcester in the north, to Bristol in the south, to Hereford in the west and Swindon to the east. The wider study area includes the major routes between the south coast and the Midlands, namely the M40, M42 and A34.

1.1.4 Full details of the transport planning works completed in support of the DCO Application are set out in the Combined Modelling and Appraisal (ComMA) Report (Document Reference 7.6).

1.2 Scheme overview

1.2.1 The A417/A419 is a strategic route between Gloucester and Swindon that provides an important link between the Midlands/North and South of England. The route is an alternative to the M5/M4 route via Bristol. The section of the A417 near Birdlip, known as the 'Missing Link', forms the only section of single carriageway along the route and is located in the Cotswolds Area of Outstanding Natural Beauty (AONB).

1.2.2 In 2014, the DfT announced its five-year investment programme for making improvements to the strategic road network (SRN) across England. This scheme is one of more than 100 schemes identified as part of the first Road Investment Strategy (RIS1) 2015-2020[1]. Funding for delivery of the scheme has been

[1] Department for Transport (March 2015), Road investment strategy: 2015 to 2020, accessed 29 January 2020, https://www.gov.uk/government/publications/road-investment-strategy-for-the-2015-to-2020-road-period

confirmed within the second Road Investment Strategy (RIS2)[2], which covers the period between 2020 and 2025 and was published on 11 March 2020.

1.2.3 This scheme to upgrade this section of the A417 to dual carriageway, in a way that is sensitive to the surrounding AONB, would help unlock Gloucestershire's potential for growth, support regional plans for more homes and jobs, and improve life in local communities.

1.3 Scheme vision and objectives

1.3.1 The scheme vision is for a landscape-led highways improvement scheme that will deliver a safe and resilient free-flowing road whilst conserving and enhancing the special character of the Cotswolds AONB; reconnecting landscape and ecology; bringing about landscape, wildlife and heritage benefits, including enhanced visitors' enjoyment of the area; improving local communities' quality of life; and contributing to the health of the economy and local businesses.

1.3.2 In order to deliver this vision, the following scheme objectives have been set:

- Safe, resilient and efficient network: to create a high-quality resilient route that helps to resolve traffic problems and achieves reliable journey times between the Thames Valley and West Midlands as well as providing appropriate connections to the local road network.
- Improving the natural environment and heritage: to maximise opportunities for landscape, historic and natural environment enhancement within the Cotswolds AONB and to reduce negative impacts of the proposed scheme on the surrounding environment.
- Community & access: to enhance the quality of life for local residents and visitors by reducing traffic intrusion and pollution, discouraging rat-running through villages and substantially improving public access for the enjoyment of the countryside.
- Supporting economic growth: to facilitate economic growth, benefit local businesses and improve prosperity by the provision of a free-flowing road giving people more reliable local and strategic journeys.

1.4 Scheme description

1.4.1 The scheme would provide 3.4 miles (5.5km) of new, rural all-purpose dual carriageway for the A417. The new dual carriageway would connect the existing A417 Brockworth bypass with the existing dual carriageway A417 south of Cowley. The new dual carriageway would be completed in-line with current trunk road design standards. The section to the west of the existing Air Balloon roundabout would follow the existing A417 corridor, but to the south and east of the Air Balloon roundabout, the corridor would be offline, away from the existing road corridor.

1.4.2 The scheme would include a new crossing near Emma's Grove for walkers, cyclists and horse riders including disabled users, which would accommodate the Cotswold Way National Trail. A new junction would be incorporated at Shab Hill, providing a link from the A417 to the A436 (towards the A40 and Oxford), and to the B4070 (for Birdlip and other local destinations).

[2] Department for Transport (March 2020), Road investment strategy: 2020 to 2025, accessed 11 March 2020, https://www.gov.uk/government/publications/road-investment-strategy-2-ris2-2020-to-2025

1.4.3 A new 37m wide multi-purpose crossing would provide essential mitigation for bats and enhancement opportunity of ecology and landscape integration. The public would also further benefit as the crossing would accommodate the Gloucestershire Way and provide an improved visitor experience.

1.4.4 A new junction would be included near Cowley, replacing the existing Cowley roundabout, making use of an existing underbridge to provide access to local destinations. The use of the existing underbridge would allow for all directions of travel to be made.

1.4.5 The current A417 between the existing ‘Air Balloon roundabout’ and ‘Cowley roundabout’ would be detrunked for its entire length. Some lengths of the existing road would be converted into a route for walkers, cyclists and horse riders including disabled users. Other sections would be retained as lower-class public roads, maintaining local access for residents. Some of the route would provide Common Land.

2 Policy context

2.1 Overview

2.1.1 To support the preparation of the scheme traffic model and economic appraisal, it is necessary to review National and Local Planning Policy and how this has informed the overall approach. An assessment of the scheme's compliance with relevant policies is provided in the Case for the Scheme (Document Ref 7.1).

2.2 National Policy Statement for National Networks (December 2014)

2.2.1 The National Policy Statement for National Networks (NPSNN) sets the Government's policy against which the SoS will make decisions on applications for development consent for nationally significant infrastructure projects on road, rail and strategic rail freight interchange developments[3]. Specifically, Paragraph 1.1 states that the purpose of the NPSNN is to establish:

"the need for, and Government's policies to deliver, development of nationally significant infrastructure projects (NSIPs) on the national road and rail networks in England. It provides planning guidance for promoters of nationally significant infrastructure projects on the road and rail networks, and the basis for the examination by the Examining Authority and decisions by the Secretary of State."

Drivers of Need for development on the National Road Network

2.2.2 The NPSNN sets out the 'vision and strategic objectives for the national networks'. This recognises that there is a critical need to provide safe, expeditious and resilient networks that better support social and economic activity, and to provide a transport network that is capable of supporting economic growth and rebalancing the economy.

"Government's vision and strategic objectives for the national networks.

The Government will deliver national networks that meet the country's long-term needs; supporting a prosperous and competitive economy and improving overall quality of life, as part of a wider transport system." This means:

- *Networks with the capacity and connectivity and resilience to support national and local economic activity and facilitate growth and create jobs.*
- *Networks which support and improve journey quality, reliability and safety.*
- *Networks which support the delivery of environmental goals and the move to a low carbon economy.*
- *Networks which join up our communities and link effectively to each other.[4]"*

2.2.3 Whilst the NPSNN is not scheme specific, it provides a decision-making framework for applications on the strategic highway network. It does however state that in some cases, it will not be sufficient to simply expand capacity on the existing network, through factors such as junction improvements or new slips roads, implementing 'smart motorways' or improving trunk roads. In these

[3] National Networks National Policy Statement (Paragraph 1.1)
[4] National Networks National Policy Statement (Vision)

circumstances "*new road alignments and corresponding links… may be needed to support increased capacity and connectivity*"[5].

Assessment Principles

2.2.4 As set out in Chapter 1 of the Case for the Scheme (Document Reference 7.1), the NPSNN is the relevant National Policy Statement (NPS) for this scheme and is the primary policy document against which the scheme must be determined by the SoS, in accordance with section 104 of the Act.

2.2.5 Accordingly, Paragraph 1.2 of the NPSNN states that*:*

"The Secretary of State will use this NPS as the primary basis for making decisions on development consent applications for national networks nationally significant infrastructure projects in England. Other NPSs may also be relevant to decisions on national networks nationally significant infrastructure projects. Under section 104 of the Planning Act the Secretary of State must decide an application for a national networks nationally significant infrastructure project in accordance with this NPS unless he/she is satisfied that to do so would:

- *lead to the UK being in breach of its international obligations*
- *be unlawful*
- *lead to the Secretary of State being in breach of any duty imposed by or under any legislation*
- *result in adverse impacts of the development outweighing its benefits*
- *be contrary to legislation about how the decisions are to be taken."*

2.2.6 Paragraph 4.2 of the NPSNN sets out that subject to the detailed policies and protections in the NPS, and the legal constraints set out in the Act, there is a presumption in favour of granting development consent for national networks NSIPs that fall within the need for infrastructure established in the NPSNN. In considering a scheme, and weighing adverse impacts against benefits, Paragraph 4.3 sets out how the SoS should take into account:

- its potential benefits, including the facilitation of economic development, including job creation, housing and environmental improvement, and any long-term or wider benefits
- its potential adverse impacts, including any longer-term and cumulative adverse impacts, as well as any measures to avoid, reduce or compensate for any adverse impacts.

2.2.7 Within this context, the NPSNN requires that environmental, safety, social and economic benefits, and adverse impacts, should be considered at national, regional and local levels.

2.3 National Planning Policy Framework

Role of the National Planning Policy Framework and NPS

2.3.1 The National Planning Policy Framework (NPPF), (first published March 2012, and most recently amended in June 2019), sets out the Government's planning policies for England and how they are expected to be applied. Policies set out in the NPPF are based upon a 'presumption in favour of sustainable development',

[5] National Networks National Policy Statement (Paragraph 2.27)

conveyed through social, environmental and economic policies. To achieve sustainable development, plans and decisions need to represent and consider the local context.

2.3.2 The NPPF does not contain any specific policies relating to NSIPs. Paragraph 5 states that:

"The Framework does not contain specific policies for nationally significant infrastructure projects. These are determined in accordance with the decision-making framework in the Planning Act 2008 (as amended) and relevant national policy statements for major infrastructure, as well as any other matters that are relevant (which may include the National Planning Policy Framework). National policy statements form part of the overall framework of national planning policy, and may be a material consideration in preparing plans and making decisions on planning applications".

2.3.3 Paragraph 1.17 of the NPSNN states that the overall strategic aims of the NPS and the NPPF are consistent, however, the two documents have differing but equally important roles. Paragraph 1.17 of the NPSNN states that the NPPF will be an important and relevant consideration 'but only to the extent relevant to [the] project'.

2.3.4 Further details are provided in the Case for the Scheme (Document Ref 7.1).

2.4 Local planning policy

2.4.1 Although an application for a DCO is not subject to Section 38 (6) of the Planning and Compulsory Purchase Act 2004, Local Development Plans are a material consideration in determining applications.

Development plans relevant to the scheme

2.4.2 At the local level, the scheme has been considered against the following adopted development plans:

- Minerals Local Plan for Gloucestershire (2018-2032) (Adopted 2020)
- Gloucestershire County Council Waste Core Strategy (Adopted 2012)
- Gloucestershire County Council Waste Local Plan 2002 - 2012[6] Saved Policies (Adopted 2004)
- Gloucestershire County Council Local Transport Plan 2015 – 2031 (Adopted 2017)
- Gloucestershire Highways Biodiversity Guidance (Adopted December 2019)[7]
- Cotswolds District Council Local Plan (Adopted 2018)
- Joint Core Strategy (Adopted 2017)
- Tewkesbury Borough Council Local Plan 2006 – 2011 Saved Policies (Adopted 2006)

2.4.3 The Joint Core Strategy[8] adopted in 2017 by three local authorities – Gloucester City Council, Cheltenham Borough Council and Tewkesbury Borough Council (with the support of Gloucestershire County Council) – sets out the strategic growth objectives for the wider area. It identifies the need for over 35,000 new

[8] https://www.cheltenham.gov.uk/downloads/file/7211/jcs

homes to be delivered across the three authorities by 2031. The need for increased capacity, reduced congestion and safer journeys on the A417 is therefore situated within this context of significant planned economic and housing growth to the surrounding settlements within the Joint Core Strategy plan area.

2.4.4 The Gloucestershire County Council Local Transport Plan[9] identifies the A417 Missing Link project as a priority scheme for 'maintaining a functioning highways network' in the county, within the context of the Plan seeking to create a 'fit for purpose, reliable and efficient transport network that connects communities, employment and services, with minimal congestion and competitive journey times.'

2.4.5 Furthermore, the scheme is identified in three Infrastructure Delivery Plans (IDP) in the region: the Joint Core Strategy IDP (covering Tewkesbury Borough Council, Cotswold District Council and Gloucester City Council authorities)[10]; the Gloucester City IDP[11]; and, the Cotswold District Council IDP[12]. The latter identifies the A417 as a piece of critical infrastructure required to enable the delivery of growth within the district.

2.4.6 More details on local planning policy and the scheme are in the Case for the Scheme (Document Reference 7.1).

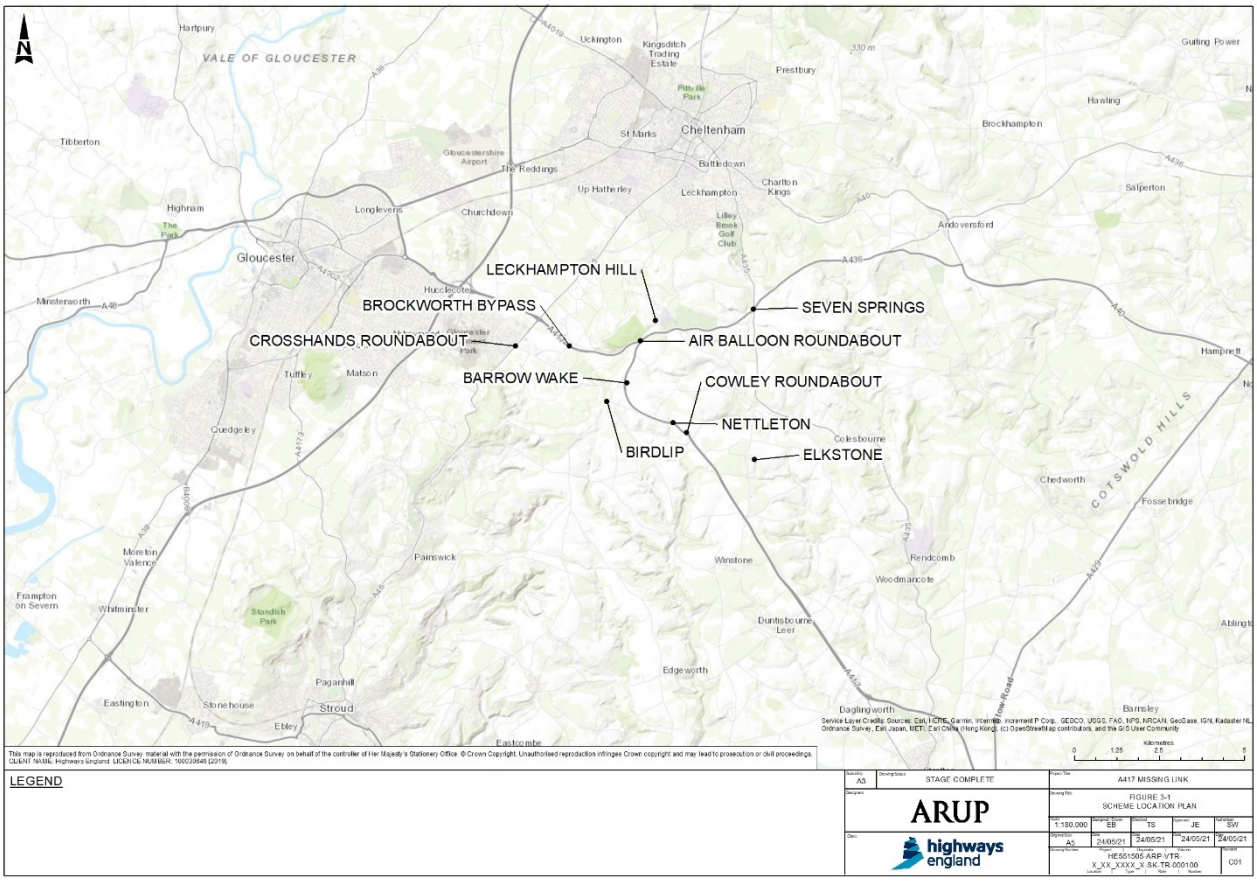
[9] https://www.gloucestershire.gov.uk/media/2227/11-pd-4-highways-nov-2017.pdf
[10] https://www.gloucester.gov.uk/media/1122/jcs_infrastructure_delivery_plan_full_document_august_2014.pdf
[11] https://www.gloucester.gov.uk/media/3775/gloucester-city-idp_final_26-sept-2019-for-upload-v2.pdf
[12] https://www.cotswold.gov.uk/media/21ajkejk/6302-infrastructure-delivery-plan-2016-update-apr-2016.pdf

3 Existing conditions

3.1 Overview of the existing highway network

3.1.1 Together, the A417 and A419 make up one of the south-west's most important road corridors, helping people to travel for work, business, and leisure. They link two of the region's top growth areas, the M5 at Gloucester (junction 11A) to the M4 at Swindon (junction 15). They help south-west businesses connect with markets and opportunities in the midlands and the north, and they attract investment for Gloucestershire and its neighbours by linking them to London and the south-east.

3.1.2 Most of the A417/A419 route is dual carriageway, but there is one section that is not. Known as the A417 Missing Link, this stretch of around 3.4 miles (5.5km) of single-carriageway on the A417 between the Brockworth bypass and Cowley roundabout (see Figure 3-1) restricts the flow of traffic causing pollution and congestion. Delays of 20 minutes or more are not unusual, and nor is the sight of queuing traffic or the sound and smell of idling engines. This results in some motorists diverting onto local roads to avoid tailbacks, causing difficulties for neighbouring communities. Poor visibility and challenging gradients also contribute to the disproportionately high number of serious and fatal accidents that are seen along this stretch of road.

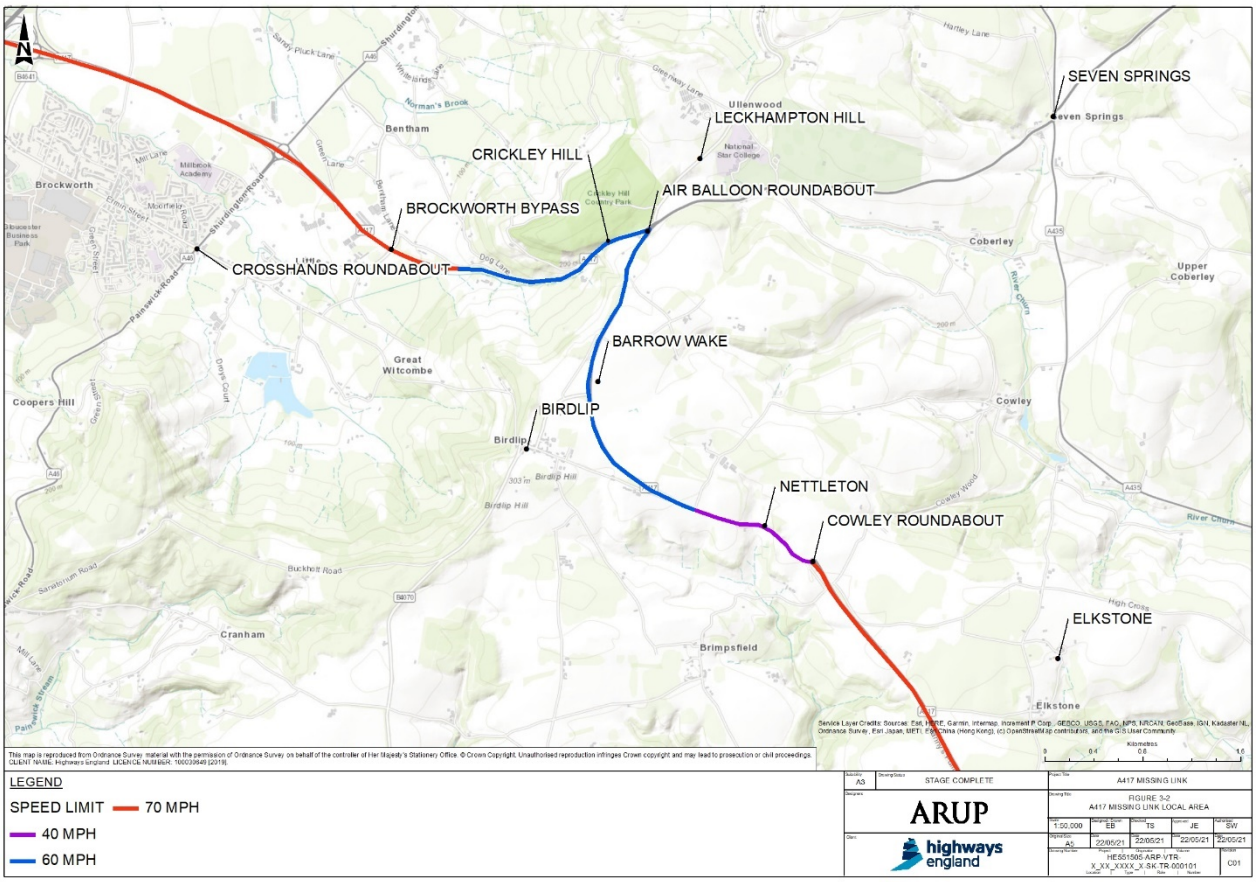


Source: Highways England

Figure 3-1 Scheme location plan

3.1.3 The A417/A419 route between junction 11a of the M5 and junction 15 of the M4 is part of the SRN.

3.1.4 The 3.4 mile (5.5km) Existing A417 between Brockworth bypass and Cowley roundabout is the only remaining single-carriageway section on the 32 mile (52km) length of the A417/A419 between the M5 and M4. Figure 3-2 identifies key local points of interest.



Source: Highways England

Figure 3-2 A417 Missing Link local area

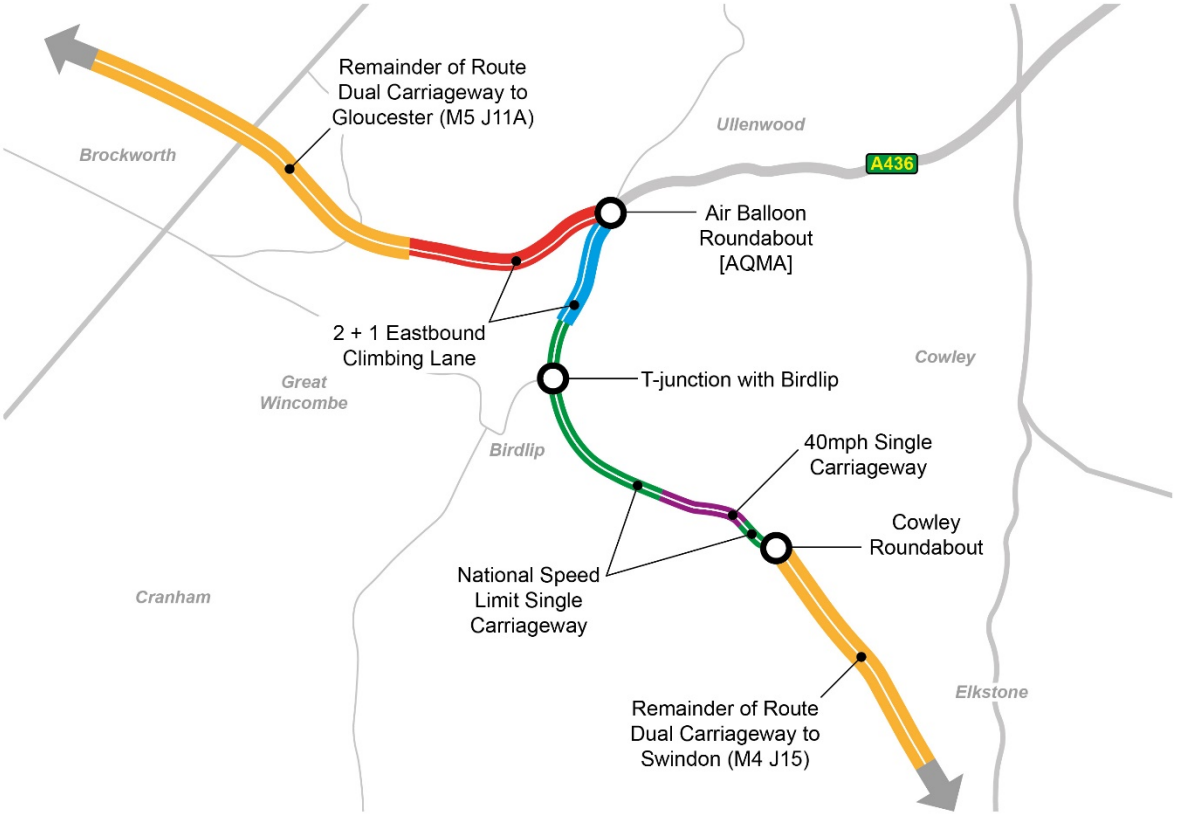
3.1.5 This section of theA417 crosses the Cotswolds escarpment at Crickley Hill and the alignment of the existing route does not meet current standards with steep gradients (up to 10% on Crickley Hill) present along most of the A417 Missing Link.

3.1.6 There is a major junction with the A436 at the Air Balloon roundabout which, along with other junctions and private means of access along the route, all constrain traffic flow.

Highway alignment and junction arrangements

3.1.7 As shown in Figure 3-3, the Existing A417 includes 1.5 miles (2.4 kilometres) of single carriageway between Cowley Roundabout and a T-junction with the B4070 at Birdlip, and 2 miles (3.2 kilometres) of single-carriageway with an additional eastbound climbing lane.

3.1.8 The majority of the Existing A417 is covered by the national speed limit, with a 0.5 mile (0.8 kilometres) section of 40mph limit through Nettleton Bottom, to the north of the Cowley roundabout.



Source: Highways England

Figure 3-3 A417 Missing Link

3.1.9 The standard of the Existing A417 is highly inconsistent with the rest of the A417/A419 route. While the remainder of the route provides separation between A417/A419 traffic and local road traffic and priority to traffic already on the A417/A419, there are a number of issues with the Existing A417 which limit the effectiveness of the whole route, these being:

- single carriageway layouts
- junctions between the A417 and other roads, including the Cowley and Air Balloon roundabouts where traffic on the SRN may be required to give way
- a section subject to a 40mph speed limit

3.1.10 This section of the route includes long sections with gradients exceeding the desirable maximum gradient of 6% for all purpose single carriageway roads[13].

3.1.11 Steep gradients on the SRN can lead to significant problems, including frustration for drivers following slow moving heavy vehicles, breakdowns and bottlenecks which can lead to traffic congestion. On sections of single carriageway with an additional lane in one direction, such as Crickley Hill, bottlenecks form due to inefficient lane usage.

3.1.12 For the majority of the Existing A417, forward visibility is below the desirable minimum for a road of this type[14]. Ordinarily, a single carriageway road with a

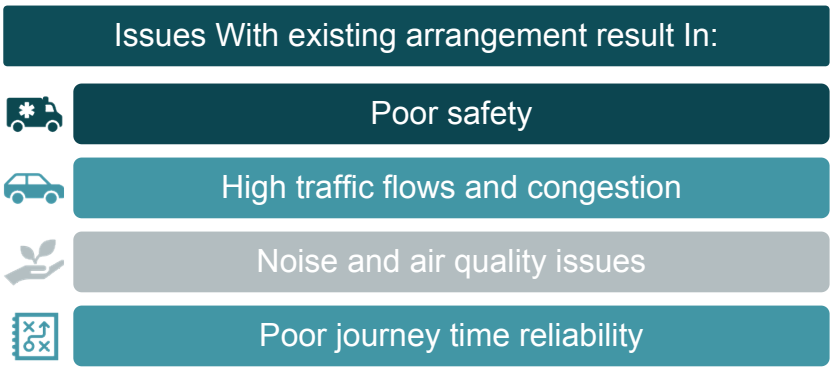
[13] The desirable maximum gradients are in DMRB Volume 6 Section 1, chapter 4 Vertical Alignment (Part 1 TD9/93). 6% is considered to be the desirable maximum, while 8% is allowable within design standards

[14] The desirable minimum stopping sight distances are in DMRB Volume 6 Section 1 Part 1, chapter 1 Design Speed (TD9/93).

60mph speed limit would have 215m of forward visibility to allow drivers to slow and stop. The existing road has visibility as low as 120m in places.

3.1.13 There are four priority junctions and 11 private property accesses directly along the Existing A417. All these junctions and access points are unrestricted, which means that all turning movements are allowed, including right turns off and on to the Existing A417.

3.1.14 Overall, these issues with the existing alignment result in a range of wider issues on the Existing A417.



Key junctions

3.1.15 There are three key junctions between the Cowley roundabout and the Brockworth bypass, in addition to Cowley roundabout.

3.1.16 At the eastern extent of the scheme is Cowley roundabout and this connects the existing A417 and provides access to Cowley, Brimpsfield, Birdlip and other local communities.

3.1.17 The three key junctions between Cowley roundabout and Brockworth bypass are:

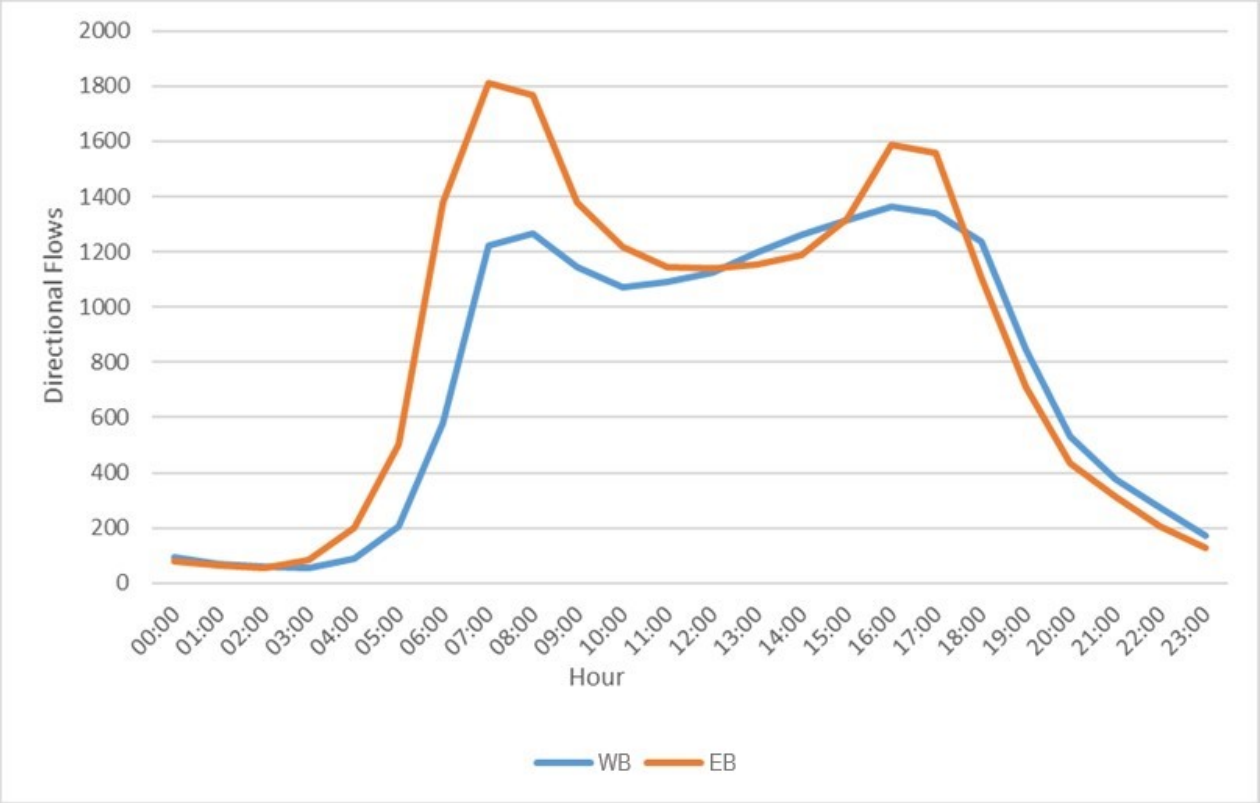
- Air Balloon roundabout which connects the A417 and A436
- Approximately 70m to the east of the Air Balloon roundabout, the A436 forms the major arms at a T-junction with Leckhampton Hill. Leckhampton Hill provides access to the south of Cheltenham from the A436 and A417
- Approximately 0.9 miles (1.5km) to the south of Air Balloon the A417 forms a T-junction with the B4070. The B4070 provides access to Birdlip village and connects Stroud with the A417

3.2 Observed traffic flows

3.2.1 Average daily traffic flows on the Existing A417 are around 37,000 vehicles on Crickley Hill and around 30,000 vehicles south of the Air Balloon roundabout. These volumes are already well in excess of recommended flows for new single carriageway roads[15].

3.2.2 Figure 3-4 shows the hourly weekday traffic flows, by direction, in February 2016 on the A417 Crickley Hill.

[15] Design Manual for Roads and Bridges

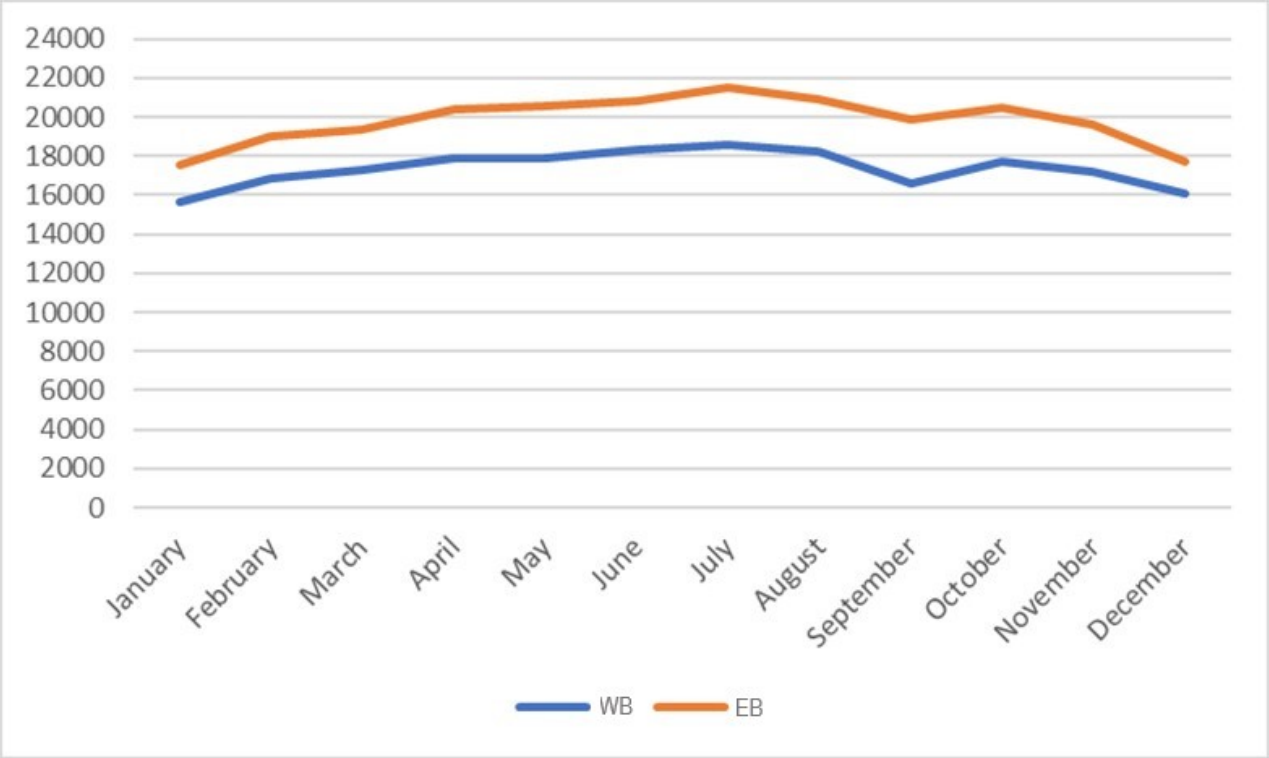


Source: Highways England

Figure 3-4 A417 Crickley Hill hourly traffic flows, by direction (February 2016)

3.2.3 Figure 3-4 clearly identifies morning and evening peak periods for eastbound traffic, but the peaks for westbound traffic are far less pronounced with relatively little variation in flows in the 12-hours between 07:00 and 19:00. Peak period traffic volumes in the westbound direction are also lower than in the eastbound direction, particularly in the morning peak period. This is likely to be reflective of a lack of westbound capacity, particularly at the Air Balloon roundabout and on Crickley Hill, which restricts the volumes of traffic travelling westbound on this section of the A417 throughout the day.

3.2.4 Figure 3-5 shows the distribution of eastbound (EB) and westbound (WB) daily traffic volumes on the A417 Crickley Hill across the year (between November 2015 and October 2016). The data presented is the seven-day average daily flow and is derived from all days of the year (i.e. with no dates, such as school or bank holidays, excluded).



Source: Highways England

Figure 3-5 A417 Crickley Hill daily traffic flows, by direction

3.2.5 At the daily level, westbound flows on the A417 in this area are typically 10-15% lower than the eastbound direction. The variation in directional flows is reflective of congestion along this section of the A417 route. Westbound traffic on the A417 experiences delays for much of the day, while eastbound traffic typically experiences less delay, and journey times are more consistent throughout the day.

3.3 Seasonal variation

3.3.1 As can be seen from Figure 3-5 the flow across the year is consistent and there is no indication of seasonal variation in the traffic flows. Both the eastbound and westbound daily flows peak in July, but there is a general increase in traffic through the first park of the year peaking in July and then decreasing to the end of the year. There is no large increase in July/August that would be indicative of an increase in traffic in the summer months.

3.3.2 The westbound daily traffic flow is between generally 16,000 and 18,000 vehicles and the eastbound daily traffic flow is generally between 18,000 and 22,000.

3.4 Observed journey times

3.4.1 The majority of the A417/A419 route between M5 J11A and Cirencester is a dual carriageway with the national speed limit of 70mph. However, as shown in Table 3-1, average traffic speeds across this section are as low as 49mph during both the AM and PM peak periods. Given the high standard of most of the route, it is clear that the Existing A417 is the source of these reduced speeds.

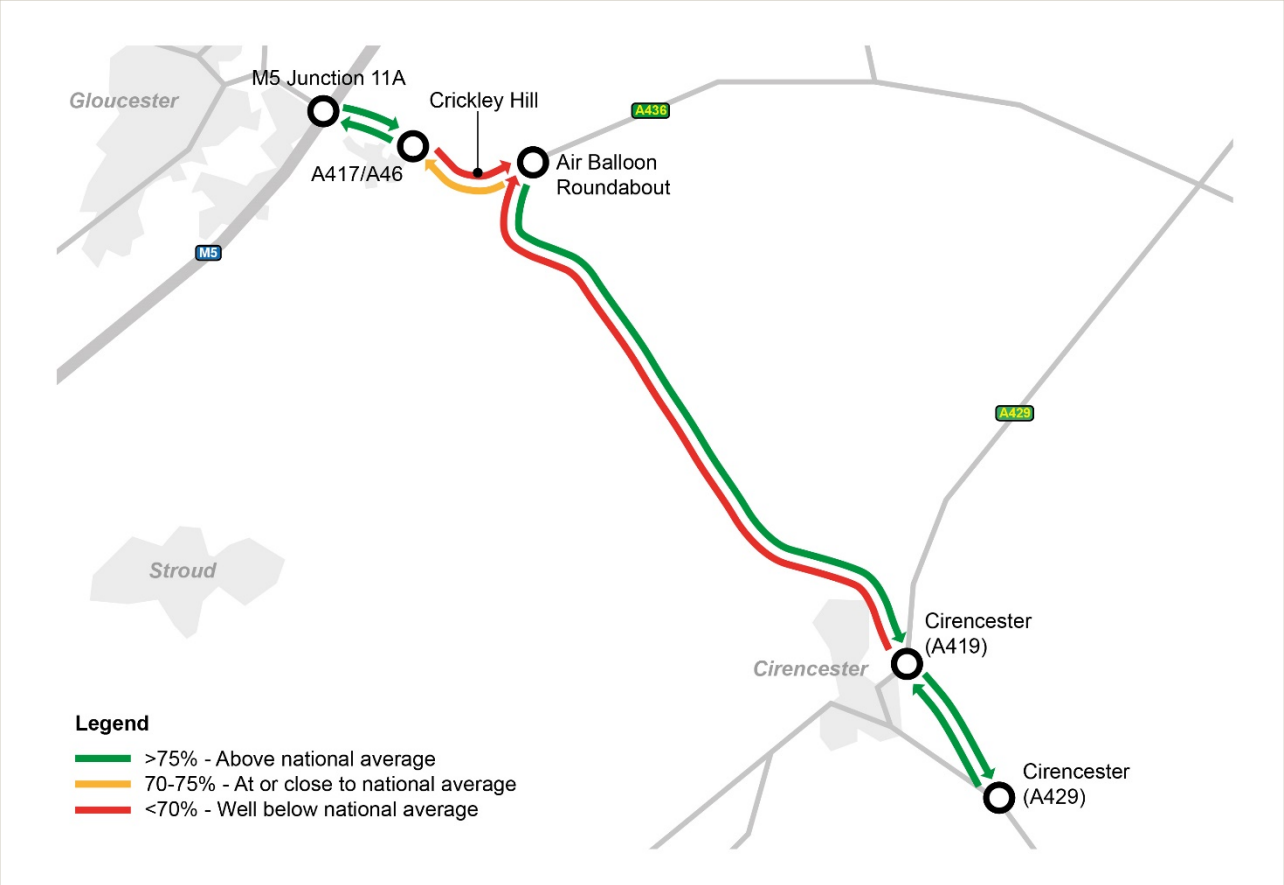
Table 3-1 Average journey times and vehicle speeds on the A417 between Cirencester and M5 J11a[16]

Year	AM peak		IP		PM peak	
	Time (mm:ss)	Average speed (mph)	Time (mm:ss)	Average speed (mph)	Time (mm:ss)	Average speed (mph)
Cirencester (A417/A429 junction) to M5 Junction 11a [westbound]						
2015	17:33	49	17:12	50	18:25	47
M5 Junction 11a to Cirencester (A417/A429 junction) [eastbound]						
2015	15:38	56	14:42	59	15:03	58

Source: Highways England

3.4.2 Reliable journey times are essential to a functioning road network. It is important to both businesses and freight providers to know how long specific journeys will take so that they can plan efficiently and economically.

3.4.3 Average 2015 journey time reliability statistics, collected by the Highways Agency (now Highways England), indicate the percentage of journey times on each section of the SRN that are considered to be completed 'on time'. The statistics for the A417 between Cirencester and M5 Junction 11a for the period April 2014 to March 2015 are presented, by section in Figure 3-6.



Source: Highways England

Figure 3-6 A417 Journey time reliability

[16] Journey time forecasts extracted from the Preliminary Design ComMA Report

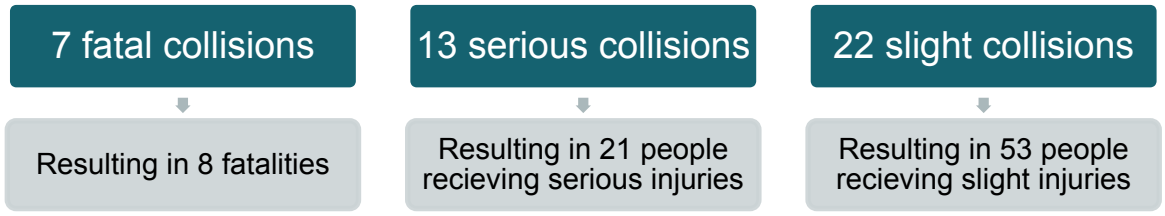
3.4.4 As shown in Figure 3-6 journey time reliability on key sections of the A417 is as low as 60-70%. The average reliability for the full A417/A419 route was 77% during the same period, while the average for all A roads on the SRN in England was 75%.

3.4.5 Poor journey time reliability is an issue throughout the year and does not vary seasonally. The Air Balloon roundabout and Crickley Hill are two major causes of the issue. Eastbound (uphill) journey time reliability on Crickley Hill is considerably worse than the reverse direction, 67.8% of 'uphill' compared to 74.0% of 'downhill' of journeys are completed on time. This is reflective of the impact of slow-moving vehicles ascending Crickley Hill and delays approaching Air Balloon roundabout.

3.5 Road safety

3.5.1 The high volumes of traffic, poor forward visibility and challenging gradients also contribute towards a particularly poor safety record on the existing single-carriageway section of the A417.

3.5.2 The Existing A417 is an accident cluster site, with 42 collisions involving personal injury of 82 people over the 5-year period between July 2014 and June 2019 (inclusive)[17].



3.5.3 The fatal and serious casualty rates observed on the A417 are significantly higher than the national average for single-carriageway roads. This is summarised in Figure 3-7 which presents the observed casualty rates per Personal Injury Accident (PIA) on the A417 against the national average for equivalent road types.

[17] Causation information is not readily available for this period.

sSource: Highways England

Figure 3-7 Number of casualties per PIA

3.5.4 Table 3-2 provides a comparison of the observed number of casualties against a national average equivalent. The national average number of casualties shown in the table are based on the same number of observed accidents (42) but assuming national average casualty rates.

Table 3-2 Casualty rates per PIA by severity – local and national comparison

	Total PIAs	Casualties			
		Fatal	Serious	Slight	Total
Observations (July 2014 – June 2019)	42	8	21	53	82
National Average	42	2	10	55	66

Source: Highways England
Notes: numbers may not sum due to rounding

3.6 Sustainable transport

Bus

3.6.1 There are direct bus services linking Swindon, Cirencester, and Cheltenham, but not Gloucester and Swindon. The Swindon to Cheltenham (via Cirencester) services generally operates with an hourly frequency, with total journey times approaching two hours.

Rail

3.6.2 The railway line between Swindon and Gloucester/Cheltenham, known as the Golden Valley Line, provides a public transport option for people travelling on this corridor. Direct rail services are available between Swindon and Gloucester and Cheltenham Spa. These services generally operate with one service per hour in each direction, with journey times from Swindon of around 55 minutes to Gloucester and 70 minutes to Cheltenham Spa. The line is also used by direct services operating between Gloucester/Cheltenham and London Paddington.

3.6.3 Cheltenham Spa railway station is situated on the main line between Birmingham and Bristol, with journey times of 45 minutes and 100 minutes to each city respectively.

3.6.4 Trains between Cheltenham and Gloucester themselves are frequent, with four services an hour in each direction throughout most of the day. Journey times vary but are usually around 10 minutes.

Walking, cycling and horse-riding

3.6.5 Environmental statement (ES) Figure 12.2 Public rights of way and local routes (Document Reference 6.3) shows PRoW and local routes including unclassified roads which carry public rights. This has been drawn from published data and consultation feedback.

3.6.6 The majority of PRoW in the study area involve footpaths, whilst there are also bridleway and restricted byway connections valued by local people and visitors. The PRoW that are potentially directly affected by the scheme have been identified through examination of the Definitive Maps and site walkover work undertaken by the consultant team, complemented by stakeholder engagement. The scheme would affect the Cotswold Way National Trail, Gloucestershire Way long distance footpath, and more than 20 footpaths, bridleways and restricted byways.

3.6.7 Some of the identified routes, in particular the Cotswold National Trail and Gloucestershire Way long distance footpath currently cross the A417 at grade. With the road being used daily by more than 34,000 vehicles it is considered that this may supress usage of these routes.

3.6.8 PRoW that intersect with the scheme are shown on ES Figure 12.2 Public rights of Way and local routes (Document Reference 6.3) and are summarised in Table 12-6 of ES Chapter 12 Population and Human Health (Document Reference 6.2).

3.6.9 PRoW located within the study area that do not interact with the scheme have also been reviewed in order to assess the potential for effects on these routes and their users. Many of the PRoW within Table 12-16 of ES Chapter 12 Population and Human Health (Document Reference 6.2) are located within 250 metres of the scheme and are likely to experience a direct effect as part of construction and/or operation. Those PRoW within the wider 500 metre study area would not experience any direct effects as a result of the scheme and would therefore remain unchanged during both construction and operation.

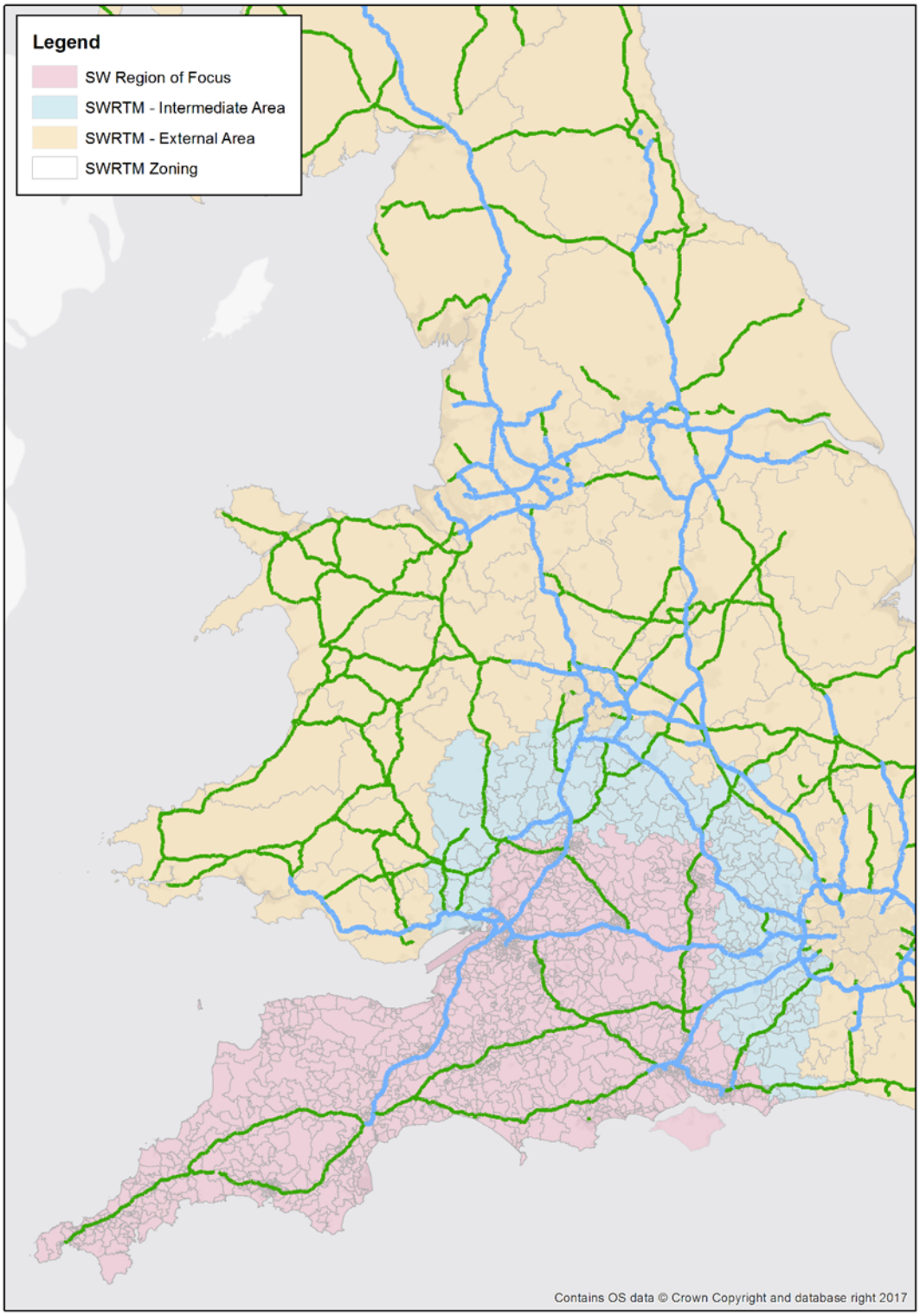
3.6.10 More details on the existing PRoW and local routes are in ES Chapter 12 Population and Human Health (Document Reference 6.2) and details on usage of these are in ES Appendix 12.2 Walking, Cycling and Horse-riding including Disabled Users Review at Preliminary Design (Document Reference 6.4).

4 Base year scheme traffic model development

4.1 Overview of scheme traffic model

4.1.1 Highways England have developed five 'regional' traffic models (RTMs) to provide the basis for the development and appraisal of the Road Investment Strategy (RIS) and Road Investment Programme (RIP) schemes. The RTM base traffic models are intended to be representative of an average weekday in March 2015.

4.1.2 The scheme is a RIS scheme within the South-West Regional Traffic Model (SWRTM) and has used the software package Simulation and Assignment of Traffic to Urban Road Networks (SATURN). The coverage of the SWRTM is illustrated in Figure 4-1, which identifies the various modelled areas that are defined below.



Source: Highways England – SWRTM MVR. This map is based upon Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Highways England 100030649 2016.

Figure 4-1 SWRTM network coverage

4.1.3 The SWRTM is most detailed around the former South-West Government Office region but this detailed area extends further east to include Oxfordshire, West Berkshire and Hampshire, or parts thereof. This area is referred to as the SWRTM Region of Focus (RoF). The SWRTM RoF includes all motorways, A-roads, B-roads and any minor roads that have an important role in enabling

strategic traffic movements within the scheme traffic model. Whilst the SWRTM RoF is fully simulated in the most part, it contains 'islands' of fixed speed coding covering large urban areas.

4.1.4 Outside of the SWRTM RoF, the 'external area' is modelled as fixed speed network and does not include travel time responses to variations in flow. The network within this area is also skeletal in form, covering motorways and roads.

4.1.5 The SWRTM also includes an 'intermediate area', the purpose of which is to feed the RoF, providing a transition between the external and internal areas. The intermediate area is modelled as fixed speed, but with a more detailed network compared to the external area.

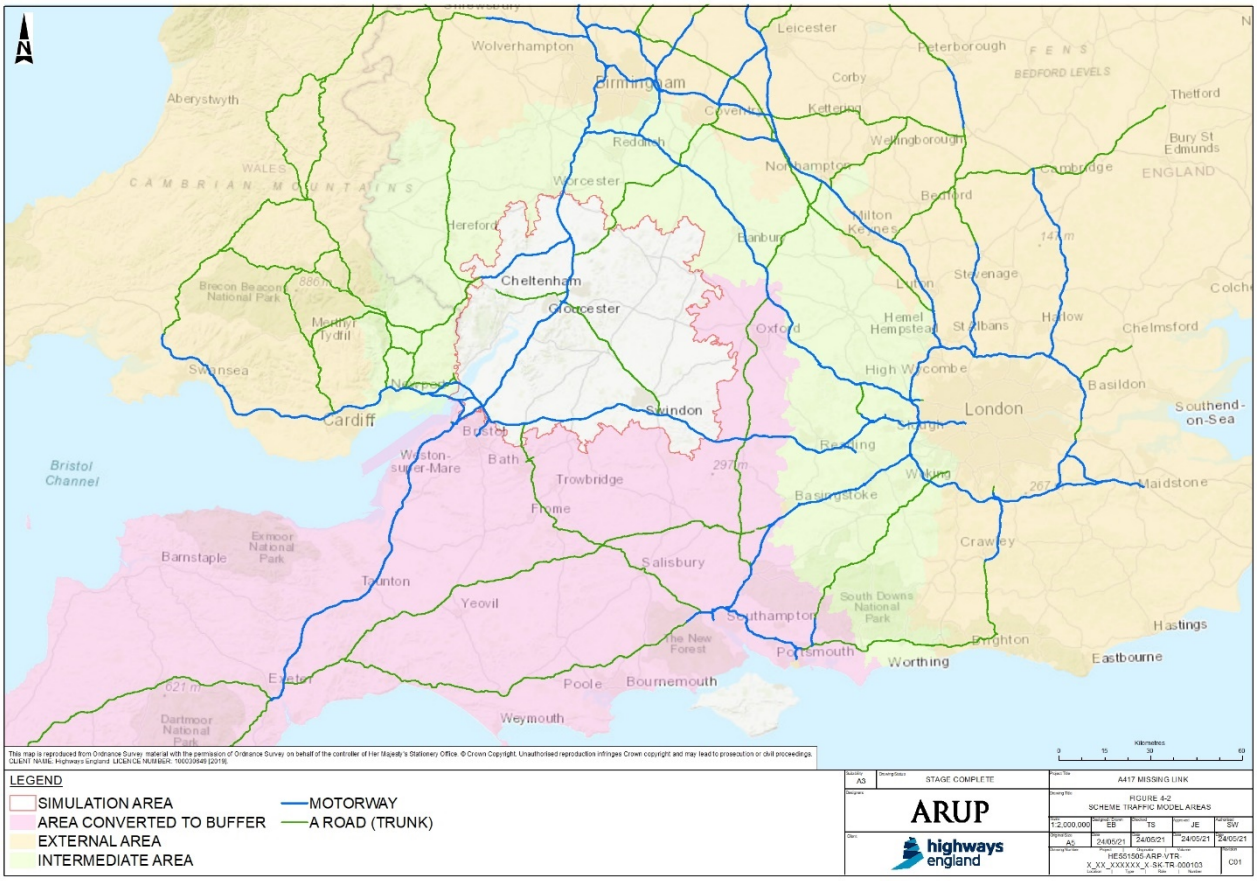
Scheme study area

4.1.6 The scheme is expected to result in a range of local, sub regional and regional impacts and this was shown to be the case in the forecasts undertaken at previous stages.

4.1.7 With the range of impacts expected from the scheme, four main areas in the scheme traffic model have been defined based on the expected impact of the scheme. The scheme traffic model detail within these areas decreases as the distance from the scheme increases and the expected impact decreases. The four areas are:

- Simulation area – this is the area over which the proposed intervention has its main strategic and local impact. The network within this area consists of fully simulated links and nodes, in addition to some fixed speed links within Swindon.
- Area converted to buffer – this comprises of the network within the SWRTM RoF but outside of the scheme traffic model simulation area. This area of the network has detailed coverage as it still contains all the links, nodes and zones included in the SWRTM, but these have been converted to buffer network with fixed speeds.
- Intermediate area – this is the same as the intermediate area defined in the SWRTM. It is adjacent to the area converted to buffer and has more detailed network coverage than that of the external area.
- External area – this is the same as the external area defined in the SWRTM.

4.1.8 The scheme traffic model areas described above are shown in Figure 4-2.



Source: Highways England

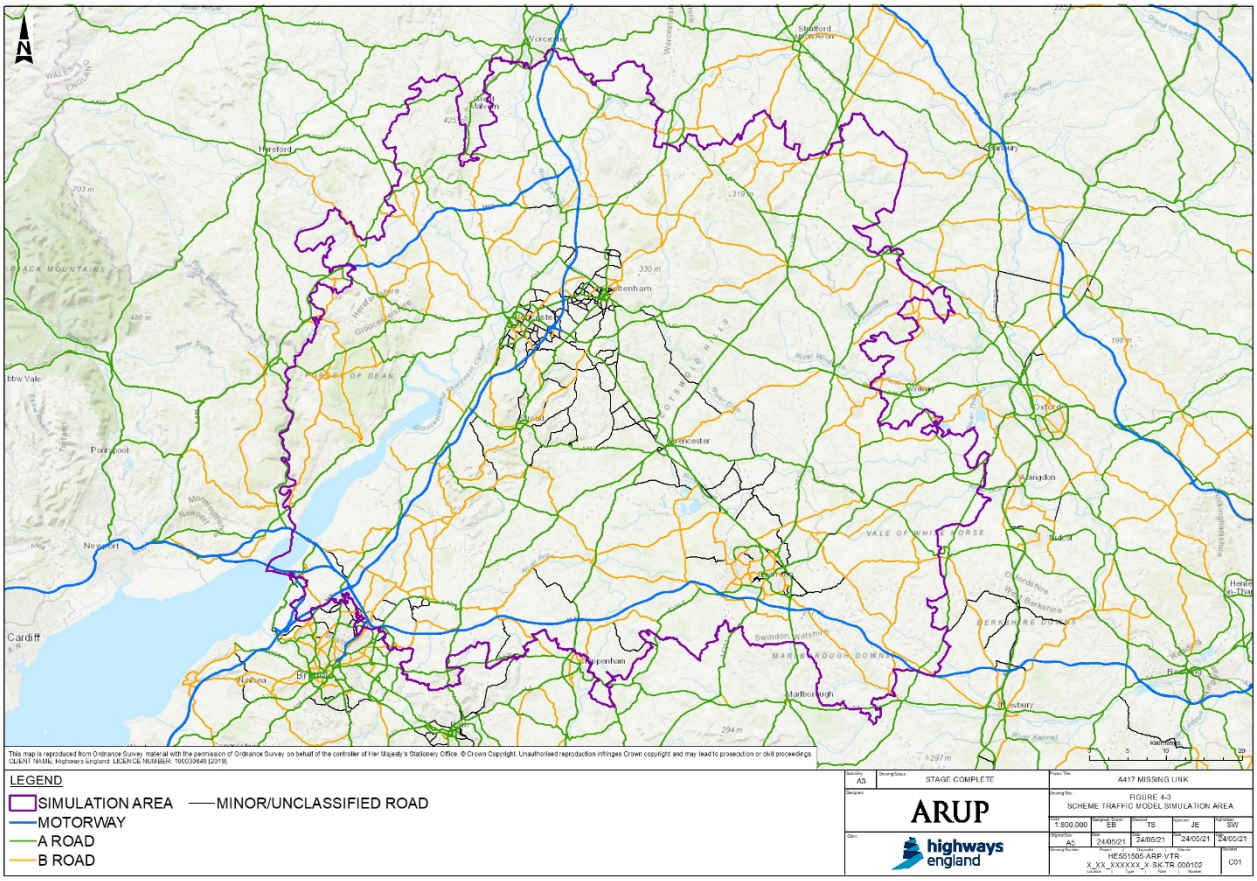
Figure 4-2 Scheme traffic model areas

4.1.9 From the option testing stage forecast assignments it was noted that, in addition to local rerouting from existing rat-runs onto the A417, the main forecast strategic effect of the scheme was rerouting onto the A417 from the long distance alternative routes of the M40/A34 and, to a lesser extent, the M5/M4.

4.1.10 Whilst the affected M4/M5 sections are included within the SWRTM RoF and were retained within the simulated area in the A417 at the option testing stage, the length of the M40/A34 alternative route over which re-routing is anticipated to occur is primarily coded in buffer and lies outside the SWRTM RoF. At the option testing stage, it was necessary to retain the M40/A34 route as fixed speed/buffer coding and to accept that journey time benefits arising from a reduction in traffic on this route would not be captured in the appraisal. It was considered that such benefits would only lead to marginal improvements in the economic appraisal of the scheme.

4.1.11 Due to the length of this alternative route, its relative remoteness from the main modelled area and the substantial data requirements, the M40/A34 route has not been included within the simulation network in the current scheme traffic model. However, in order to improve the responsiveness of this route to changes in demand, information in relation to speed and road capacity have been introduced along its length (see Section 4.4).

4.1.12 Figure 4-3 illustrates the extent of the scheme traffic model simulation area.



Source: Highways England

Figure 4-3 Scheme traffic model simulation area

4.1.13 More details on the scheme traffic model can be found in Section 6 of the ComMA Report (Document Reference 7.6).

4.2 Scheme traffic model time periods

4.2.1 The scheme traffic models cover a single average hour across four time-periods on a March weekday. The modelled time periods are:

- AM average hour (07:00 to 10:00)
- Inter-peak (IP) average hour (10:00 to 16:00)
- PM average hour (16:00 to 19:00)
- Off peak (OP) average hour (19:00 to 07:00)

4.2.2 Only the three daytime periods are subject to checks between observed and data from the scheme traffic model (referred to as modelled data) as described in later sections of this report. The OP scheme traffic model is not subject to these checks as it is simply an alternative method to factoring from modelled periods to daily levels.

4.3 Scheme traffic model user classes

4.3.1 The following assignment vehicle and purpose classes are included in the scheme traffic models:

- Car – Employers' business
- Car – Commuting
- Car – Other

- Light goods vehicles (LGV)
- Heavy goods vehicles (HGV)
- Rail – Employers' Business
- Rail – Commuting
- Rail – Other

4.3.2 The employers' business and other trips were also split into home-based and non-home-based purposes.

4.3.3 In accordance with the SWRTM, LGV demand is assumed to be a mix of freight and personal business trips based on the average proportions outlined in the TAG databook. HGV demand assumptions are also identical to those used in the SWRTM.

4.3.4 Rail segments are included within the demand to allow the effects of mode choice between highway and rail to be represented in forecasting.

4.4 Network development

4.4.1 The network development process is described in Section 7.2 of the ComMA Report (Document Reference 7.6).

Network enhancements

4.4.2 Network enhancements were made to the SWRTM network to better represent delay and route choice in the study area. More details on the network enhancements made to the SWRTM network are detailed in Section 7.2 of the ComMA Report (Document Reference 7.6).

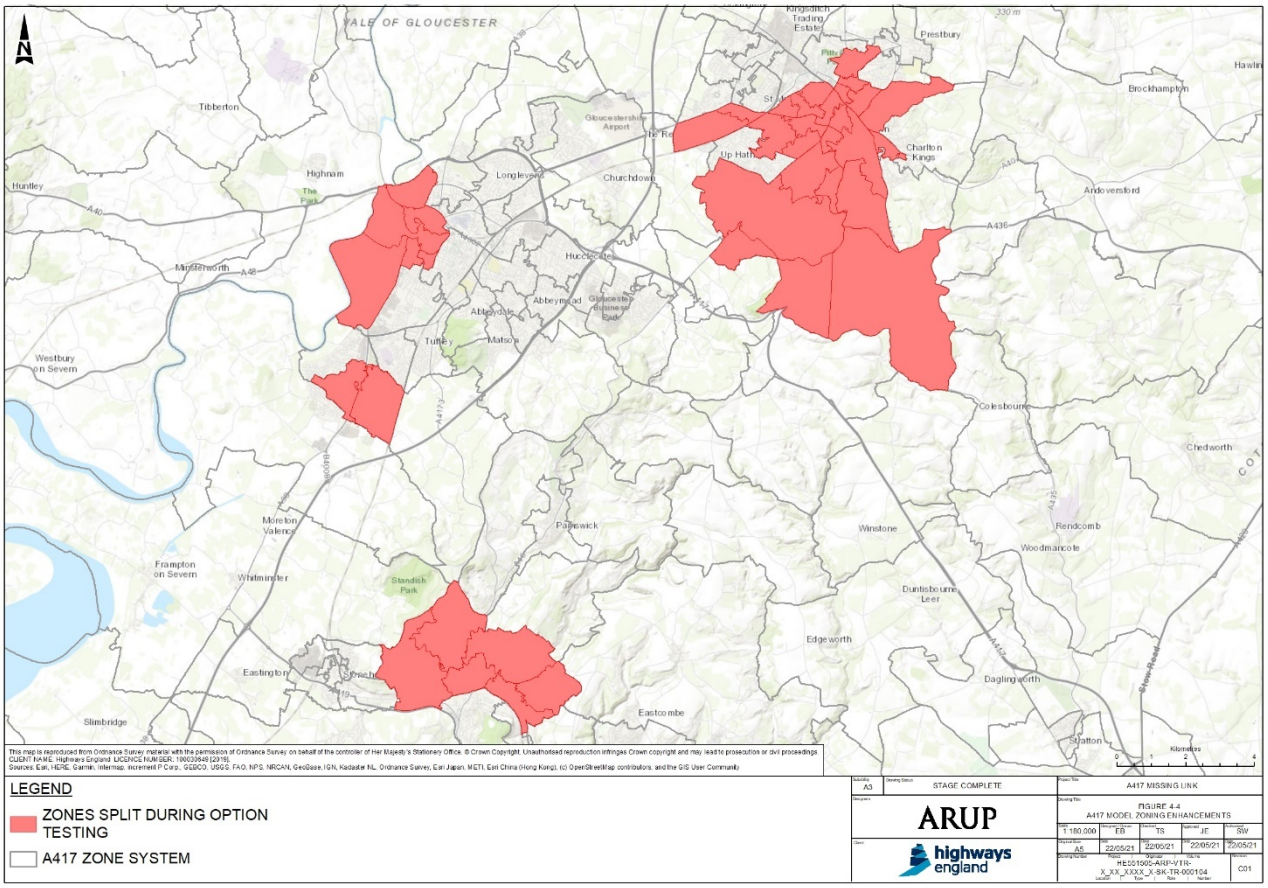
4.5 Trip matrix development

Zoning system

4.5.1 The SWRTM has a number of zones which has been designed to provide sufficient detail to allow representative routes from origins and destinations over a wide area. These zones have been designed to take account of administrative boundaries so that reports at district, county and regional levels are possible. In total, there 1,901 zones in the SWRTM.

4.5.2 The zone system from SWRTM has been the basis for the development of the scheme traffic model. The simulation area has been further refined to add more detail in the study area. This has been undertaken primarily around the urban areas of Cheltenham, Gloucester and Stroud. The refinements allow trip origins and destinations to be more precisely located within these areas which are close to the scheme.

4.5.3 The scheme traffic model now has 1,940 zones, an increase of 39 zones over the SWRTM. The location of the zones which have been split in the option testing stage are shown in Figure 4-4.



Source: Highways England

Figure 4-4 Option testing stage zoning enhancements

Trip matrix building

4.5.4 The development of the SWRTM car trip matrices was based primarily on mobile phone data (MPD) supplied through Highways England's Trip Information System (TIS).

4.5.5 The development of the SWRTM LGV and HGV matrices were based on DfT's TrafficMaster dataset and the DfT's base year freight matrices (BYFM) respectively.

4.5.6 The scheme traffic model matrices remain unchanged from the SWRTM matrices in terms of the total number of trips and origin/destination of those trips. As discussed in paragraph 4.5.2, some local zones have been split to improve the scheme traffic model detail in the urban areas of Cheltenham, Gloucester and Stroud.

4.5.7 Full details of how the trip matrices were developed are included in Section 7.3 of the ComMA Report (Document Ref 7.6).

4.6 Scheme traffic model calibration

4.6.1 To test the scheme traffic model is representative of the real world, the base scheme traffic model undergoes a calibration and validation process. This process compares modelled traffic flows and journey times to observed traffic count data and journey time data to ensure that the results from the scheme traffic model are within acceptable limits of the observed data.

4.6.2 The validation criteria and acceptability guidelines for each of these measures, as defined by the Department for Transport (DfT), are presented in Table 4-1.

Table 4-1 TAG validation criteria

Criteria	Description of criteria	Acceptability guidelines
Screenline flow validation criterion and acceptability guidelines		
	Difference between modelled flows and counts should be less than 5% of the counts	All or nearly all screenlines
Link flow and turning movement validation criterion and acceptability guidelines		
1	Individual flows within100 vph for flows < 700 vph	>85% of cases
	Individual flows within 15% for flows 700-2700 vph	
	Individual flows within 400 vph for flows > 2700 vph	
2	GEH < 5 for individual flows:	>85% of cases
Journey time validation criterion and acceptability guidelines		
	Modelled journey times along routes should be within 15% of surveyed times (or 1 minute, if higher than 15%)	>85% of routes

Source: TAG unit M3.1, Table 2

Network Calibration

4.6.3 Network calibration was driven by aiming to achieve a good fit between the modelled and observed journey times and link flows/turning movements at junctions. As part of this calibration, junctions with unrealistic delays were checked and modified where necessary to achieve realistic journey times.

4.6.4 Modifications made to the network included changes to turn saturation flows, number of approaching lanes at junctions, signal timings in each time period, roundabout parameters and revisions to the speed and capacity/fixed speeds for achieving the observed link journey times. Such enhancements to the network coding were undertaken throughout the A417 simulation area.

4.6.5 Full details of the Network Calibration process are included in Section 8.3 of the ComMA Report (Document Reference 7.6).

Trip matrices

4.6.6 The trip matrices were calibrated using a process called matrix estimation (ME). ME attempts to improve the matrix to achieve a better fit between modelled traffic flows and observed traffic flows. Similarly, as per checks made in the Network Calibration, checks were made on the changes to the trip matrices during the ME process in line with DfT's TAG criteria.

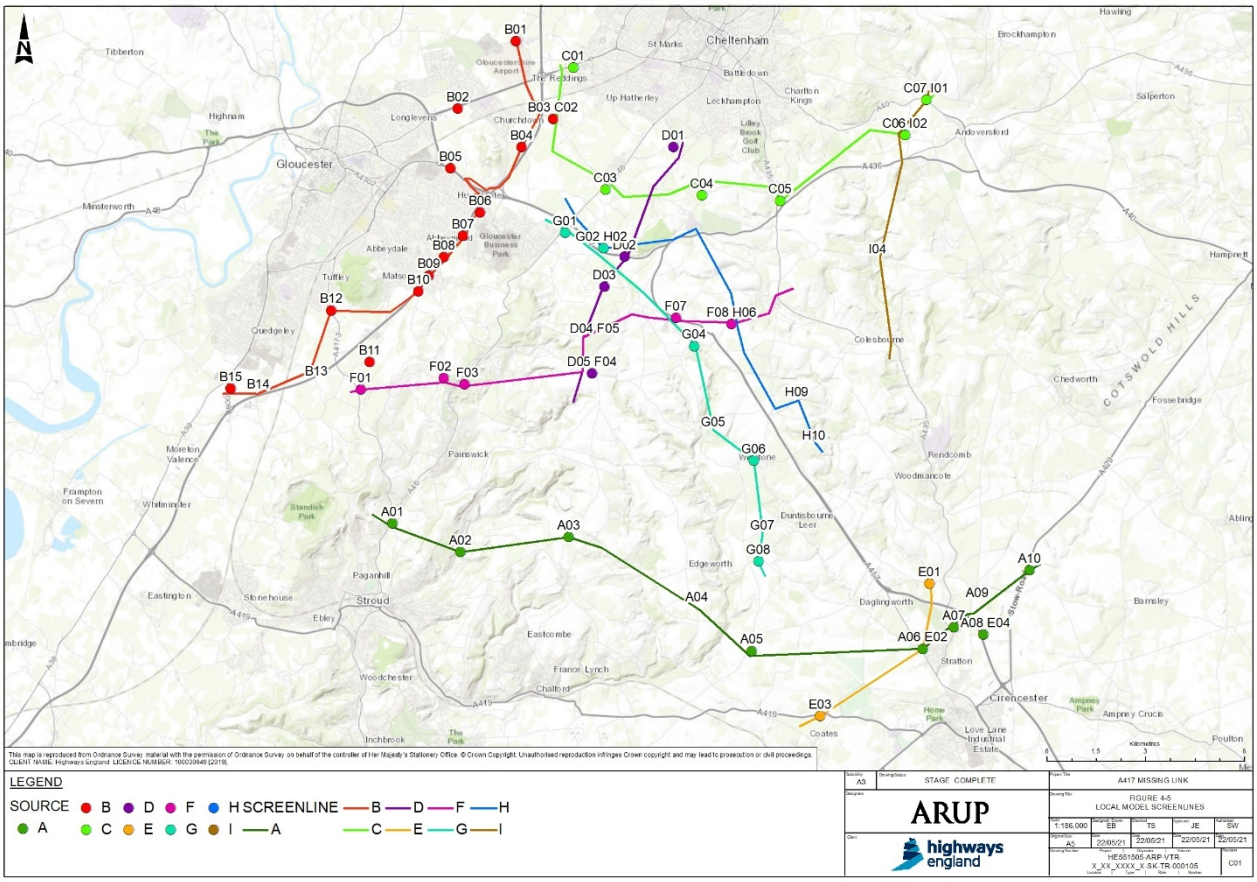
4.6.7 More details on the ME methodology are in Section 8.5 of the ComMA Report (Document Reference 7.6) and more details on the results of the ME are in Section 8.6 of the ComMA Report (Document Reference 7.6).

4.6.8 Overall, the ME changes are within the TAG criteria and so the changes to the prior matrices as a result of ME are acceptable.

Link flows and screenlines

4.6.9 In accordance with TAG criteria, the modelled flows were compared to observed traffic counts at a number of calibration screenlines and validation screenlines. The location of these screenlines are shown in Figure 4-5.

4.6.10 Further details of the screenlines used in the scheme traffic model calibration and validation process are included in Section 8.3 of the ComMA Report (Document Reference 7.6).



Source: Highways England

Figure 4-5 Local scheme traffic model screenlines

4.6.11 The TAG validation criteria set out in Table 4-1 were used to assess the screenline/link flows and journey times in the scheme traffic model. Table 4-2 summarises these results.

Table 4-2 Scheme traffic model performance summary

	TAG criteria		AM	IP	PM
Screenlines within 5%	All or nearly all	Calibration	100%	100%	95%
Screenlines GEH <4	(no longer included in TAG)	Calibration	100%	100%	100%
Links and turns passing GEH or flow criteria	>85%	Calibration	93%	97%	94%

Source: Highways England

4.6.12 The calibration results of screenlines and link flows all meet the relevant TAG criteria. Full details of the scheme traffic model calibration, including all of the

results, are included in Section 9 of the ComMA Report (Document Reference 7.6).

4.7 Scheme traffic model validation

4.7.1 A set of independent validation data, not used in the calibration process, was used to validate the scheme traffic model. A map of the validation counts is given in Section 4.6 and further details on the split between calibration and validation is in Section 8.3 of the ComMA Report (Document Reference 7.6).

Network

4.7.2 Throughout the validation process, various network checks were carried out as described in Section 4.6. The journey times through the network show a good match with the observed journey time data provided by TrafficMaster, which shows that the network coding is sufficiently accurate and the scheme traffic model is capable of accurately reflecting realistic journey times through the study area.

4.7.3 In addition to various network checks, reviews of routing within the scheme traffic model were undertaken, with focus given to routes that travel through the Air Balloon roundabout, or known rat run alternative routes. This was undertaken to ensure that the scheme traffic model routed traffic on logical routes through the study area. A detailed breakdown of this analysis is provided in Appendix D of the ComMA Report (Document Reference 7.6).

Matrices

4.7.4 The SWRTM matrices were mainly created using mobile phone data. During the building of the SWRTM, demand comparisons were undertaken between the SWRTM demand and independent observed data sources, primarily involving the National Travel Survey (NTS) and the 2011 Census.

4.7.5 Various analysis has been carried out on the changes produced by the matrix estimation process on the prior matrices. Details and results of these tests are given in Section 8.6 of the ComMA Report (Document Reference 7.6).

Scheme traffic model Convergence

4.7.6 Model convergence is required in order to provide stable, consistent and robust model results and to differentiate between real changes and those associated with differing degrees of convergence. The convergence of the scheme traffic model assignments for each modelled time period must meet the criteria set out in Table 4 of TAG unit M3.1.[18], Table 7-4 of the ComMA Report (Document Reference 7.6) provides a summary of the convergence measures that need to be achieved.

4.7.7 The results show that the scheme traffic model is very well converged in all time periods, Table 9-1 of the ComMA Report (Document Reference 7.6) contains details on the convergence of the base scheme traffic model.

[18] Department for Transport (2014) TAG unit M3.1 – Highway Assignment Modelling [Online]. Available at: (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427124/webtag-tag-unit-m3-1-highway-assignment-modelling.pdf)

Link flows and screenlines

4.7.8 The TAG validation criteria set out in Table 4-1 were used to assess the screenline/link flows and journey times in the scheme traffic model. Table 4-3 summarises these results.

Table 4-3 Scheme traffic model validation summary

	TAG criteria		AM	IP	PM
Screenlines within 5%	All or nearly all	Validation	100%	100%	83%
Screenlines GEH <4	(no longer included in TAG)	Validation	100%	100%	100%
Links and turns passing GEH or flow criteria	>85%	Validation	96%	100%	100%
Journey time routes within 15%	>85%		100%	100%	100%

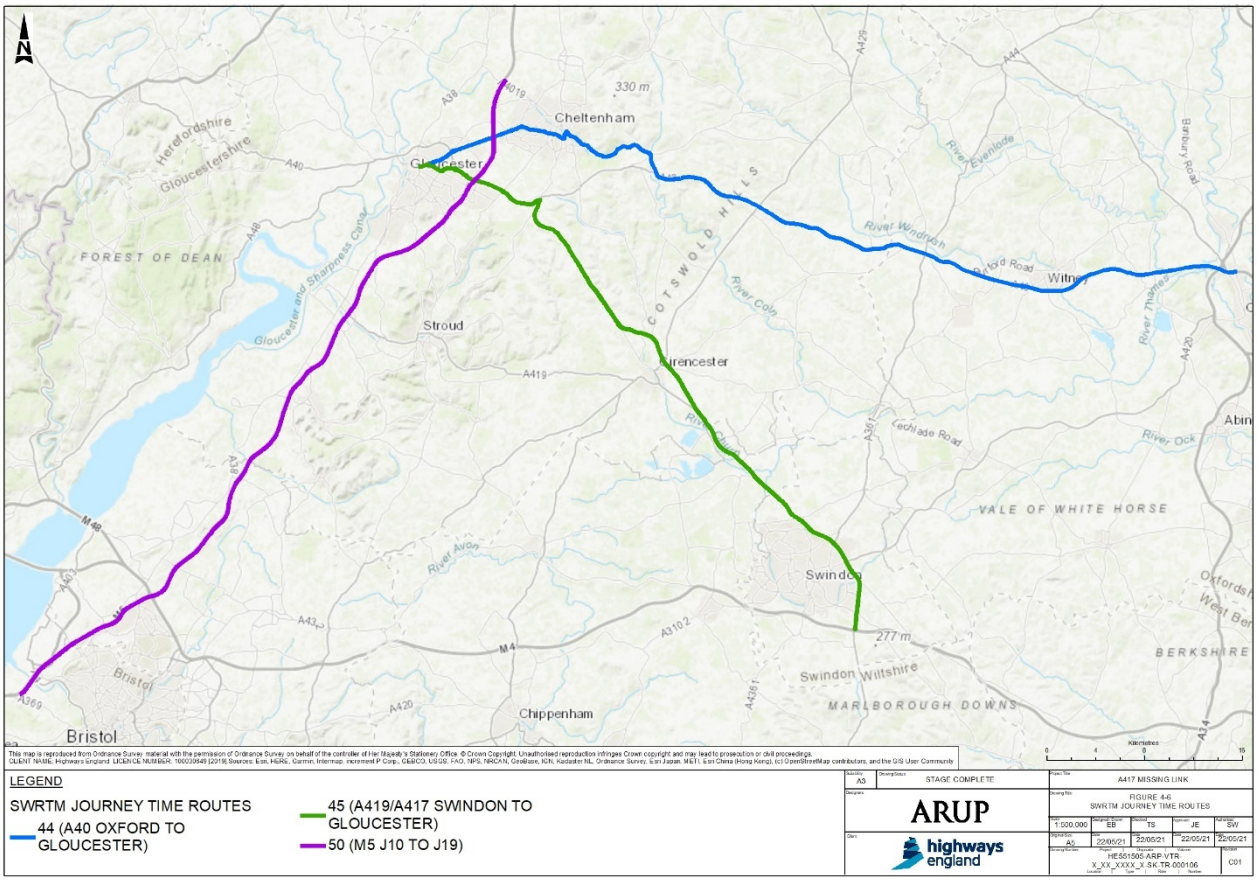
Source: Highways England

4.7.9 The validation results of screenlines and link flows all meet the relevant TAG criteria. More details on the screenline and link flow performance are in Section 9.5 of the ComMA Report (Document Reference 7.6).

Journey times

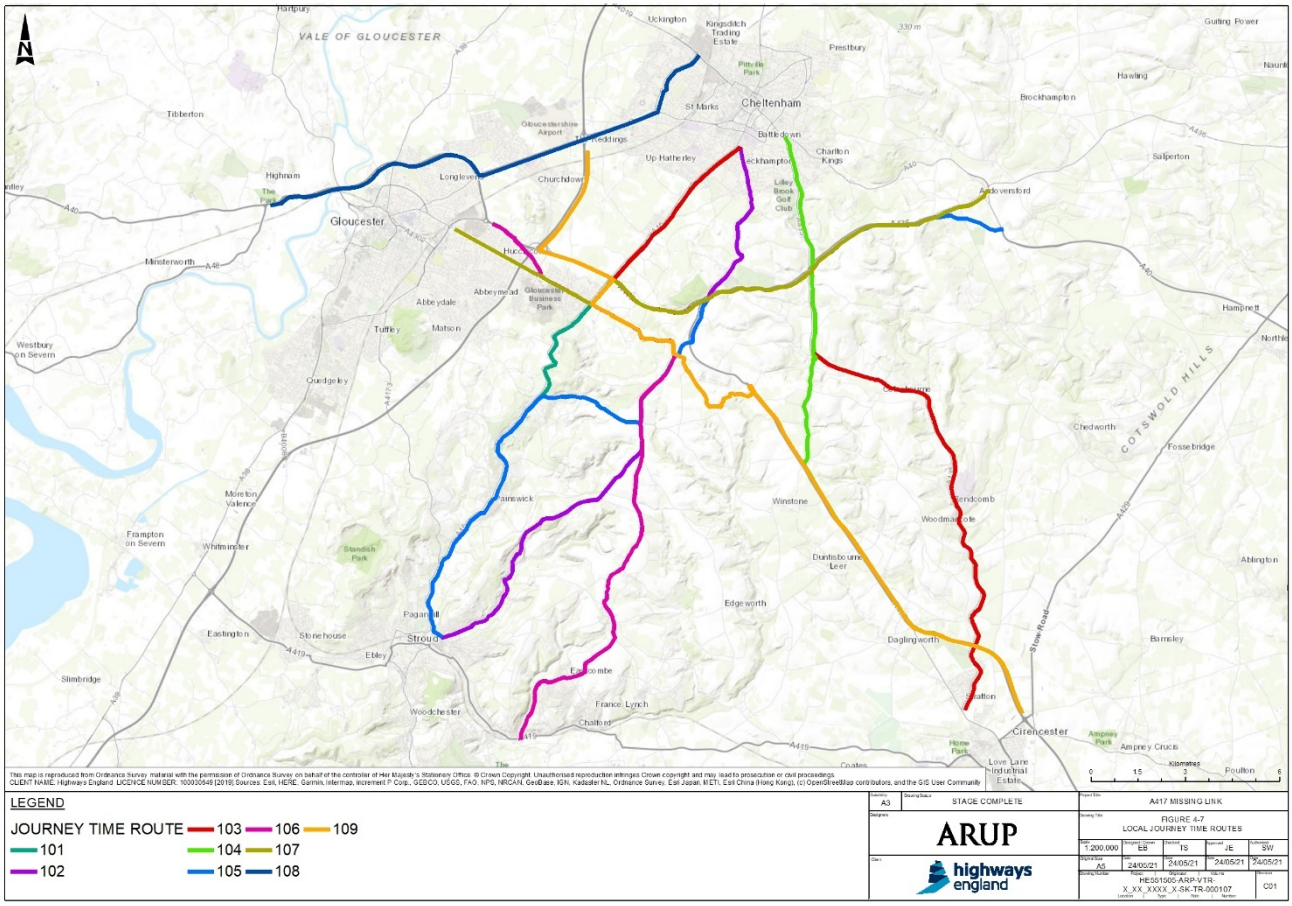
4.7.10 It is important that journey times are accurately modelled for the purposes of the economic analysis and so the modelled journey times must meet the criteria set out in Table 3 of TAG unit M3.1.[19] Journey time routes used in the validation of the scheme traffic model can be seen in Figure 4-6 and Figure 4-7.

[19] Department for Transport (2014) TAG unit M3.1 – Highway Assignment Modelling [Online]. Available at: (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427124/webtag-tag-unit-m3-1-highway-assignment-modelling.pdf)



Source: Highways England

Figure 4-6 SWRTM journey time routes



Source: Highways England

Figure 4-7 Local journey time routes

4.7.11 The journey time performance of the scheme traffic model is good, with all routes in all time periods meeting the TAG criteria and this can be seen in Table 4-3.

4.7.12 More details on the journey time performance can be seen in Section 9.5 of the ComMA Report (Document Reference 7.6).

Turning counts

4.7.13 Turning counts at key junctions have been used in the calibration and validation of the base scheme traffic model. A comparison between the observed and modelled turning counts is summarised in Table 4-4. This shows that there is an excellent match between the observed and modelled turning movements at the key junctions.

Table 4-4 Turning counts meeting flow criteria

Junction	Site Ref.	Turns meeting flow criteria		
		AM	IP	PM
A417/A436 Air Balloon roundabout	12*	All	All	All
A417/B4070 Barrow Wake	13	All	All	All
A436/Leckhampton Hill	12*	All	All	All
A436/Seven Springs	4	All	All	All
A417/A46 Shurdington Road Interchange	1	All	All	All

Junction	Site	Turns meeting flow criteria		
B4070/Birdlip Hill (Birdlip village)	9	All	All	All

Source: Highways England

5 Forecast year Do-Minimum scenario scheme traffic model summary

5.1 Approach

Overview of demand forecasting approach

5.1.1 The current estimated opening year for the scheme is 2026, and the scheme design year is 2041. Two additional forecast years, consisting of an intermediate year of 2031 and a final forecast year of 2051, have also been used to support the economic appraisal of the scheme. The interim year of 2031 and the final forecast year of 2051 are not reported on in this report.

5.1.2 The traffic forecasts account for future proposed residential and employment developments in the local area, as well as proposed transport network changes. The forecast scenarios comprise the following:

- a set of transport network changes
- assumptions about changes in values of time and vehicle operating costs over time
- a specific set of development assumptions
- application of National Trip End Model (NTEM) growth factors as a constraint on trip growth for cars and rail
- application of growth of freight traffic from DfT Road Traffic Forecasts 2018 (RTF18)
- application of forecast traffic growth at the primary airports and seaports within the south-west region.

5.1.3 The transport supply and development assumptions have been determined through a process of identifying potential transport improvements and development proposals and undertaking an assessment of the likelihood of each of these proposals coming forward. Further details can be found in Section 10.3 and Section 10.5 of the ComMA Report (Document Reference 7.6).

5.1.4 The following demand forecasts have been produced for each forecast year:

- Do-Minimum (DM) forecasts – these use forecast year trip matrices and the future transport network that excludes the scheme
- Do-Something (DS) forecasts – these use forecast year trip matrices and the future transport network changes, including the scheme

National Transport Model and National Trip End Model

5.1.5 Trip growth factors for LGVs and HGVs have been derived using RTF18 data, which is based on output from the DfT's National Transport Model (NTM).

5.1.6 Trip growth factors for cars have been derived from the NTEM. These trip growth factors have been applied to individual developments and across the wider scheme traffic model area.

5.1.7 Full details on how the NTM and NTEM have been applied in the development of the forecast matrices is included in Section 10.5 of the ComMA Report (Document Reference 7.6).

5.2 Development assumptions included in forecasts

Developments

5.2.1 An uncertainty log has been developed which identifies potential major developments within the study area of the scheme traffic model and categorises them according to their likelihood in accordance with DfT TAG unit M4 'Forecasting and Uncertainty'.

5.2.2 The A417 uncertainty log was originally developed from the wider SWRTM, with proposed new developments within the local planning authorities of Cheltenham, Cotswolds, City of Gloucester, Stroud and Tewkesbury included.

5.2.3 This uncertainty log was updated for use in the scheme traffic model following liaison with Gloucestershire County Council and using information originated from the above local planning authorities.

5.2.4 The phasing for each development has been taken from information provided within planning application documentation, or in the absence of this has been assumed based on the type and scale of the development.

5.2.5 The level of certainty for each development has been assigned taking advice from Gloucestershire County Council and in accordance with the definitions of uncertainty contained in TAG unit M4, which are reproduced in Table 5-1.

Table 5-1 Development certainty classification

Probability	Status
Near certain: The outcome would happen or there is a high probability that it would happen.	Intent announced by proponent of regulatory agencies. Approved development proposals. Projects under construction.
More than likely: The outcome is likely to happen but there is some uncertainty.	Submission of planning or consent application imminent. Development application within the consent process.
Reasonably foreseeable: The outcome may happen, but there is significant uncertainty.	Identified within a development plan. Not directly associated with the transport strategy/scheme, but may occur if the strategy/scheme is implemented. Development conditional upon the transport strategy/scheme proceeding. Or, a committed policy goal, subject to tests (e.g. of deliverability) whose outcomes are subject to significant uncertainty.
Hypothetical: There is considerable uncertainty whether the outcome would ever happen.	Conjecture based upon currently available information. Discussed on a conceptual basis. One of a number of possible inputs in an initial consultation process. Or, a policy aspiration.

Source: TAG unit M4

5.2.6 A total of 85 developments have been identified as being either 'Near certain' or 'More than likely' and, in accordance with TAG guidance, these are considered in more detail within the forecasts. Full details of these developments including the site name, Local Authority area and number of houses/dwellings is provided in Section 10.6 of the ComMA Report (Document Reference 7.6).

Trip generation

5.2.7 Full details of how the number of trips travelling to and from development sites in the scheme traffic model forecast year scenarios are calculated is presented in Section 10.5 of the ComMA Report (Document Reference 7.6).

Trip distribution

5.2.8 Full details on the trip distribution (where trips from development sites travel to and from) methodology are in Section 10.5 of the ComMA Report (Document Reference 7.6).

Demand forecasting using RTF18

5.2.9 The growth factors for LGVs and HGVs have been derived using RTF18 data, which is based on output from the DfT's NTM.

5.2.10 Full details of the growth factors, and how they have been applied, are included in Section 10.5 of the ComMA Report (Document Reference 7.6).

Reference case matrices

5.2.11 The approach for the running the forecast scheme traffic models is the same for the DM and DS scenario with the same matrices used as the starting point, these are referred to as the reference case matrices. This ensures that any changes to traffic routing are due to the scheme alone and not an external parameter impacting on the assignment of traffic. This means that the same level of growth is used for both the DM and DS scenarios.

5.2.12 Table 5-2 shows the reference case forecast matrix totals for 2026 and 2041 compared to the base scheme traffic model (2015) totals.

Table 5-2 Reference case forecast matrix totals

Scenario	UC1	UC2	UC3	UC4	UC5	TOTAL	Total % Increase from 2015
2015							
AM	378,031	1,971,610	2,113,898	634,384	306,644	5,404,564	
IP	362,207	854,309	2,765,240	605,710	294,415	4,881,881	
PM	343,836	1,904,973	3,102,707	512,589	192,191	6,056,295	
2026							
AM	413,799	2,113,249	2,364,391	745,289	306,102	5,942,830	10%
IP	394,698	915,854	3,091,134	711,827	293,884	5,407,397	11%
PM	377,039	2,041,382	3,473,571	602,032	191,841	6,685,865	10%
OP	64,378	319,300	815,338	108,040	65,314	1,372,370	NA
2041							
AM	452,233	2,285,305	2,660,643	895,185	319,208	6,612,574	22%
IP	430,874	991,263	3,475,031	855,017	306,455	6,058,640	24%
PM	412,950	2,208,268	3,909,995	723,095	200,050	7,454,358	23%
OP	70,528	345,197	918,574	129,775	68,089	1,532,163	NA

Source: Highways England

5.2.13 From Table 5-2 it can be seen that the number of vehicle trips increases by 10% between 2015 and 2026 and by 23% between 2015 and 2041.

High and low growth scenarios

5.2.14 As per TAG unit M4, uncertainty around the core scenario was tested using low and high growth sensitivity tests. These scenarios are intended to test the impact on the scheme of high and low background traffic growth.

5.2.15 High and low growth reference case matrices (i.e. pre-VDM matrices) were derived in accordance with the TAG guidance[20].

5.2.16 Results of the economic appraisals using high and low growth demand are presented and discussed in Section 15 of the ComMA Report (Document Reference 7.6).

Do-Minimum infrastructure improvements

5.2.17 Highway networks have been produced for the DM and the DS scenarios for each of the four forecasting years (2026, 2031, 2041 and 2051). The DS scenario is based on the design at August 2020.

5.2.18 The inclusion of the scheme is the only difference between the DM and DS networks.

5.2.19 A transport supply uncertainty log has been compiled that contains the RIS[21] schemes as well as relevant local schemes identified by the local highway's authority (Gloucestershire County Council).

5.2.20 As per TAG, the transport schemes included in the DM scenarios have a likelihood of at least 'Near certain' or 'More than likely', as defined by classifications set out in TAG and reproduced in Table 5-3.

Table 5-3 Transport supply certainty classification

Probability of the input	Local authority/Development scheme	Highways England	Network Rail
Near certain: The outcome would happen or there is a high probability that it would happen	Intent announced by proponent of regulatory agencies. Approved development proposals. Projects under construction.	PCF stage 4 completed, scheme entering or in PCF stage 5 (i.e. scheme consented)	Governance for Railway Investment Projects (GRIP) stage 5 completed, scheme entering or in GRIP stage 6 (i.e. scheme consented)
More than likely: The outcome is likely to happen but there is some uncertainty	Submission of planning or consent application imminent. Development application within the consent process.	PCF stage 2 completed, scheme entering or in PCF stage 3 (i.e. preferred route announced)	GRIP stage 3 completed, scheme entering or in GRIP stage 4 (i.e. single option development)
Reasonably foreseeable: The outcome may happen, but there	Identified within a development plan. Not directly associated with the transport strategy/scheme, but	Scheme in PCF stage 1 or 2 (i.e. option selection)	GRIP stage 2 completed, scheme entering or in GRIP

[20] Department for Transport (2019) TAG unit M4 – Forecasting and Uncertainty [Online]. Available at: (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938878/tag-m4-forecasting-and-uncertainty.pdf)
[21] https://www.gov.uk/government/collections/road-investment-strategy

Probability of the input	Local authority/Development scheme	Highways England	Network Rail
is significant uncertainty	may occur if the strategy/scheme is implemented. Development conditional upon the transport strategy/scheme proceeding. Or, a committed policy goal, subject to tests (e.g. of deliverability) whose outcomes are subject to significant uncertainty.		stage 3 (i.e. option selection)
Hypothetical: There is considerable uncertainty whether the outcome would ever happen	Conjecture based upon currently available information. Discussed on a conceptual basis. One of a number of possible inputs in an initial consultation process. Or, a policy aspiration.	Scheme in PCF stage 0 (i.e. major road project initiated)	Scheme in GRIP stage 1 (i.e. output definition)

Source: TAG unit M4

5.2.21 Information on the local schemes, including scheme layouts and their level of certainty, has been provided by Gloucestershire County Council (GCC). In agreement with GCC, some major schemes that form part of the Gloucestershire Joint Core Strategy (JCS) have been classified as 'more than likely', and therefore included in the DM networks, despite being at a relatively early stage in scheme development. This includes the M5 J10 'all movements' scheme, the Cyber Park link road in Cheltenham and the A38 to A40 link road north of Gloucester.

5.2.22 Full details of the schemes included in the forecast year scenarios, and the approach taken to code them, are included in Section 10.3 of the ComMA Report (Document Reference 7.6).

Variable Demand Modelling

5.2.23 Variable Demand Modelling (VDM) has been carried out for all forecast scheme traffic model runs and this approach is consistent with that applied in the development of the SWRTM. VDM represents traveller responses to changing transport costs resulting in re-routing, mode choice and time period choice.

5.2.24 Full details on the application of VDM are included in Section 11.3 of the ComMA Report (Document Reference 7.6). In summary the approach for the VDM is the same as for the DM and DS scenario with the same matrices used as the starting point when using the scheme traffic model and these are referred to as reference case matrices. This means that the same level of growth is used for both the DM and DS scenarios.

5.3 Summary of Do-Minimum Scenario

Assignment convergence

5.3.1 Convergence is required in order to provide stable, consistent and robust model results and to differentiate between real changes and those associated with

differing degrees of convergence. The convergence criteria are set out in Table 4 of TAG unit M3.1[22].

5.3.2 All forecast scheme traffic model assignments satisfy the convergence criteria set out in TAG unit M3.1 (see Table 7-4 of the ComMA Report (Document Reference 7.6)).

Variable Demand Modelling

5.3.3 In summary the VDM process results in only minor matrix total changes with a maximum change of ±1% of the Reference Case matrix total for the relevant peak.

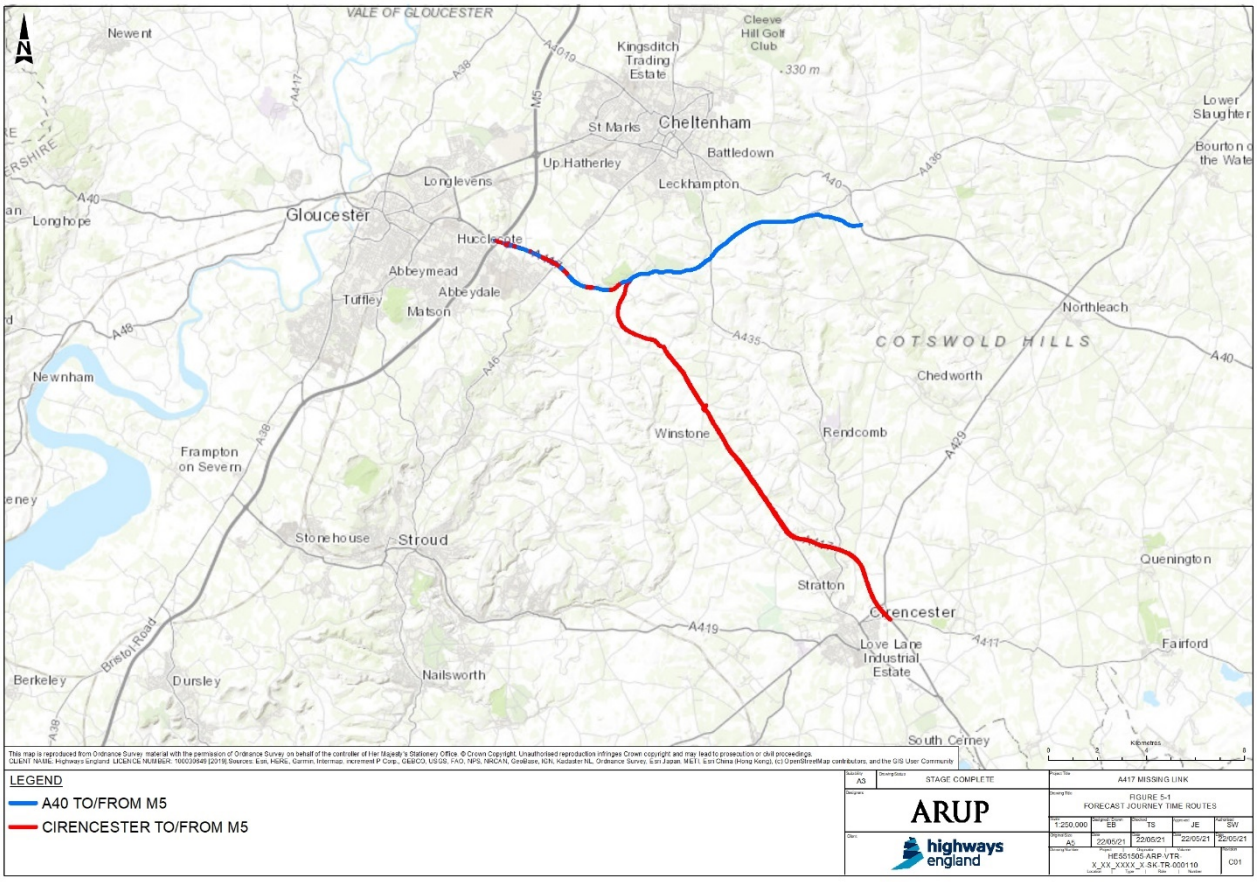
5.3.4 For more details on the impact of VDM on the DM matrices see Section 11.3 of the ComMA Report (Document Reference 7.6).

Journey times

5.3.5 To illustrate the impact of the scheme on forecast journey times, modelled journey times have been extracted for the following routes, which are shown in Figure 5-1:

- A417 between the A429 junction at Cirencester and the M5/A417/B4641 roundabout
- A40/A436 junction at Shipton to the M5/A417/B4641 roundabout

[22] Department for Transport (2014) TAG unit M3.1 – Highway Assignment Modelling [Online]. Available at: (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938864/tag-m3-1-highway-assignment-modelling.pdf)



Source: Highways England

Figure 5-1 Forecast journey time routes

5.3.6 Table 5-4 and Table 5-5 present the modelled journey times for the A417 route between Cirencester and the M5 for the westbound and eastbound directions respectively. The DM percentage differences are relative to the 2015 Base scenario.

Table 5-4 A417 modelled journey times – Cirencester to M5 (westbound)

Year	Scenario	AM peak		IP		PM peak	
		Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.
2015	Base	17:33	N/A	17:12	N/A	18:25	N/A
2026	Do-Minimum	18:19	+4%	17:55	+4%	18:55	+3%
2041	Do-Minimum	19:33	+11%	19:08	+11%	20:17	+10%

Source: Highways England

Table 5-5 A417 modelled journey times – M5 to Cirencester (eastbound)

Year	Scenario	AM peak		IP		PM peak	
		Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.
2015	Base	15:38	N/A	14:42	N/A	15:03	N/A
2026	Do-Minimum	17:01	+9%	15:09	+3%	15:38	+4%
2041	Do-Minimum	18:45	+20%	16:09	+10%	17:13	+14%

Source: Highways England

5.3.7 As can be seen from Table 5-4 and Table 5-5 journey times in both directions increase in all three time periods for both 2026 and 2041.

5.3.8 The results show that eastbound 2041 sees a much greater increase in journey times compared to those westbound. This is due to increased congestion at the Air Balloon roundabout.

5.3.9 Table 5-6 and Table 5-7 present the modelled journey times for the A436/A417 route between the A436/A40 junction and the M5 for the westbound and eastbound directions respectively.

Table 5-6 A436/A417 modelled journey times – A436/A40 to M5 (westbound)

Year	Scenario	AM peak		IP		PM peak	
		Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.
2015	Base	13:37	N/A	13:21	N/A	15:18	N/A
2026	Do-Minimum	14:15	+5%	13:37	+2%	16:51	+10%
2041	Do-Minimum	15:25	+13%	14:45	+10%	19:01	+24%

Source: Highways England

Table 5-7 A436/A417 modelled journey times – M5 to A436/A40 (eastbound)

Year	Scenario	AM peak		IP		PM peak	
		Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.
2015	Base	13:24	N/A	12:45	N/A	12:54	N/A
2026	Do-Minimum	14:21	+7%	13:02	+2%	13:22	+4%
2041	Do-Minimum	16:22	+22%	13:37	+7%	14:43	+14%

Source: Highways England

5.3.10 As can be seen from Table 5-6 and Table 5-7 journey times in both directions increase in all three time periods for both 2026 and 2041.

5.3.11 The results show that eastbound 2041 AM sees a much greater increase in journey times compared to those westbound and that in 2041 PM peak westbound sees a much greater increase than westbound. This is due to increased congestion at the Air Balloon roundabout.

Traffic flows

5.3.12 Forecast Annual Average Daily Traffic (AADT) flows at key locations, near the scheme, are presented in Figure 7-1 and Figure 7-2. AADTs are shown for the DM and DS scenarios for both the 2026 opening year and the 2041 design year. The 2015 base year flows are also presented on the plans. Details on the wider network traffic flows and rerouting, including figures, are in Section 11.4 and Appendix I of the ComMA Report (Document Reference 7.6). Each of the locations on the AADT figures contained in Figure 7-1 and Figure 7-2 has been allocated a reference number (e.g. ID 6 is A417 Crickley Hill). The following sections refer to these ID numbers to aid the reader.

5.3.13 The forecasts show that the AADT on the A417 at Crickley Hill (ID 6) is forecast to increase from 36,900 in the base scenario to 42,100 in the opening year (2026) and 48,000 in the design year (2041) in the DM scenarios. These forecasts

represent increases from the base year of approximately 14% and 30% for 2026 and 2041 respectively. HGV proportions are forecast to change from 13% in the base scenario to 11% in 2026 and to 10% in 2041.

5.3.14 The AADT on the A417 immediately to the south of the Air Balloon roundabout (ID 5) is forecast to increase from 29,500 in the base scenario to 33,000 in the opening year (2026) and 37,000 in the design year (2041) in the DM scenarios. These equate to increases of 12% in 2026 and 25% in 2041 when compared to the base scenario. HGV proportions are forecast to change from 12% in the base scenario to 10% in 2026 and to 9% in 2041.

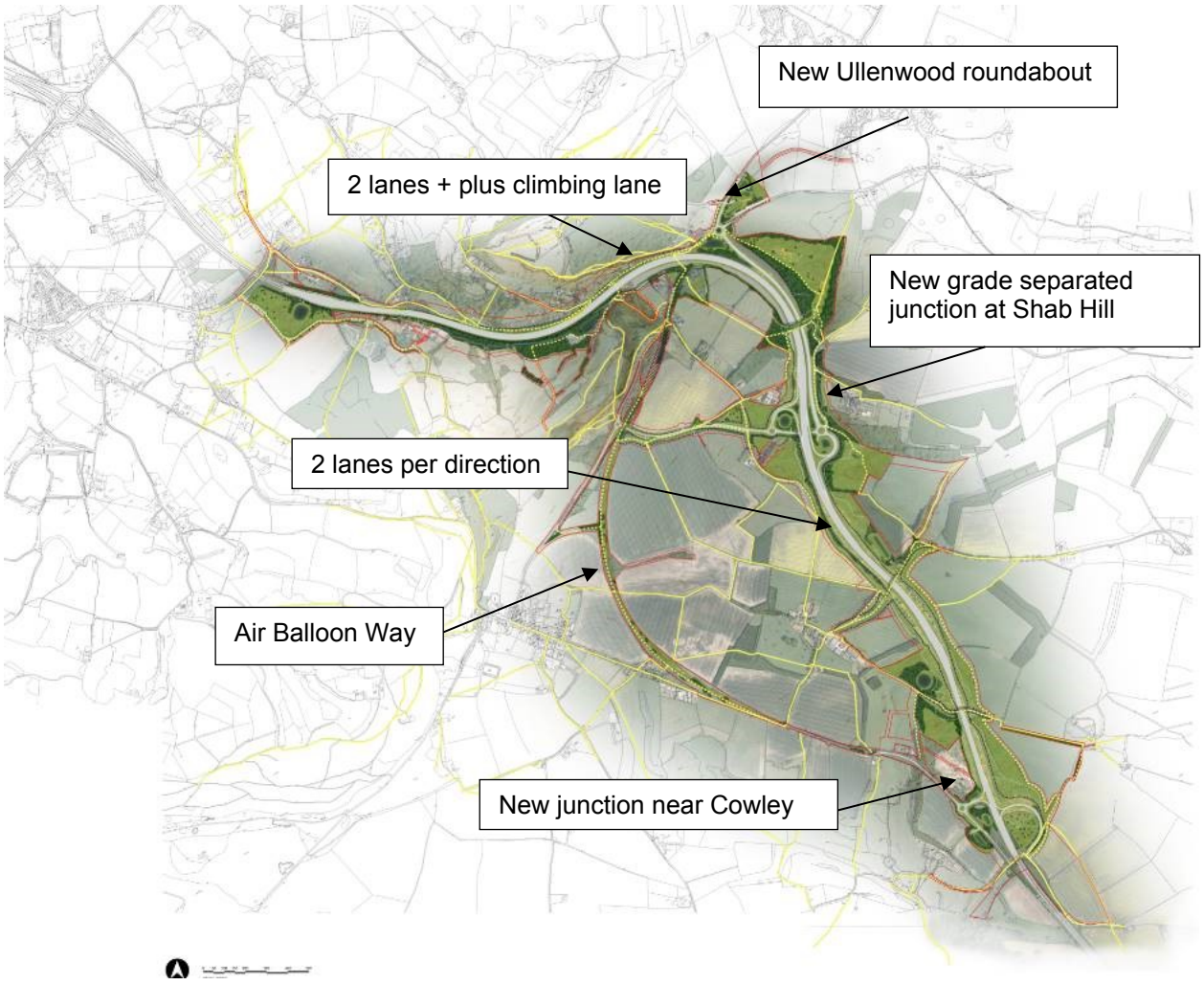
5.3.15 A lack of capacity at the Air Balloon roundabout would restrict the amount of traffic growth able to be accommodated on this section of the A417. This is reflected in the larger flow increases forecast to occur in the future DM scenarios on the A417 section south of Cowley roundabout (ID 12). At this location, flows are forecast to increase from 29,800 in the base year to 34,600 (+16%) in 2026 and to 41,200 (+38%) in 2041. HGV proportions are forecast to change from 12% in the base scenario to 10% in 2026 and to 8% in 2041.

5.3.16 These flow increases are a result of forecast increased traffic demand arising from a combination of local developments and wider NTEM growth forecasts.

6 The scheme

6.1 Overview

6.1.1 Figure 6-1 shows the scheme alignment for the A417, repurposed A417 (including the Air Balloon Way between Stockwell junction and Cotswold Way crossing), the new Cotswold Way and Gloucestershire Way crossings and existing and proposed walking, cycling and horse-riding routes.



Source: Highways England

Figure 6-1 Scheme alignment

6.2 Construction of new dual carriageway

6.2.1 The scheme compromises the following main features associated with the construction of the new dual carriageway:

- New length of dual carriageway generally following the existing A417 between Brockworth bypass and Air Balloon roundabout.
- New length of offline dual carriageway between Air Balloon roundabout and the existing A417 at Cowley roundabout.
- Climbing lane serving Crickley Hill between the end of the Brockworth bypass and Shab Hill junction.

- New all movements grade-separated junction at Shab Hill with new single carriageway connection to the existing A436.
- New local grade separated junction (major/minor) comprised of left-in and left-out minor junctions on either side of the A417 connected by the existing Cowley underbridge enabling all movements for the junction near the existing Cowley roundabout.
- New B4070 single carriageway road between Shab Hill junction and the proposed roundabout junction near the access to the car park at Barrow Wake.
- New Barrow Wake roundabout adjacent to Barrow Wake car park connecting the new B4070 link from Shab Hill junction with the link from Birdlip to Barrow Wake.
- The link from Barrow Wake roundabout would make use of the existing road to Birdlip which would connect to the existing section of the B4070 on the approach to Birdlip.
- Birdlip Radio Station Lane would also be provided on the proposed B4070 near Shab Hill junction providing access to Birdlip Radio Station via a simple priority junction.
- New access to Grove Farm from Cold Slad Lane via a new underpass.
- New access road to Rushwood Kennels and Cuckoopen Barn Farm (to be known as Ullenwood Lane).

6.3 Changes to existing local roads

6.3.1 Limited changes to the local road network are planned for the scheme:

- Rerouting of the B4070 to Birdlip via Barrow Wake with a new roundabout providing access to the Barrow Wake car park.
- The existing A417 would be retained between Cowley roundabout Stockwell junction and the width reduced to six metres.
- Cold Slad Lane currently connects to the A417, this would be diverted via the proposed Ullenwood junction.
- Leckhampton Hill would connect to the A436 via the proposed Ullenwood junction.
- Cowley Wood Lane would be closed to motorised vehicles.

6.4 Construction of new walking, cycling and horse-riding routes

6.4.1 The scheme offers the opportunity to improve the provision for pedestrians, cyclists and horse-riders by removing the current at grade crossings and providing grade separated crossings. More details on these can are in the Public Rights of Way Management Plan (ES Appendix 2.1 Environmental Management Plan Annex F (Document Reference 6.4)), Section 12.10 of ES Chapter 12 Population and Human Health (Document Reference 6.4) and ES Appendix 12.2 Walking, Cycling and Horse-riding including Disabled Users Review at Preliminary Design (Document Reference 6.4).

6.4.2 A summary of the new walking, cycling and horse-riding structures/routes are as follows:

- Cotswold Way crossing – 5 metre restricted byway crossing in the vicinity of Emma's Gove and connecting to Cold Slad.

- Gloucestershire Way crossing – a 37-metre-wide multi-purpose crossing that would accommodate the Gloucestershire Way long distance footpath.
- Cowley overbridge – this crossing over the new A417 would provide access between Stockwell and Cowley.
- Stockwell overbridge – this crossing over the new A417 would primarily provide a farm track access from Stockwell Farm in an east-west direction but would include provision for WCH.
- Grove Farm underpass – this underpass would provide access to local properties and agricultural land with provision for WCH via new sections of bridleways and footpath diversions to connect Cold Slad Lane.
- Repurposed A417 – part of the existing A417 would be repurposed to provide a restricted byway connection between the new car park near Stockwell junction and the Cotswold Way crossing (and beyond), proposed to be called the 'Air Balloon Way'.

6.4.3 The scheme includes numerous proposals that seek to improve accessibility and connectivity across the PRoW network within the study area. In summary this includes:

- Seven sections of proposed new footpath (including new stepped accesses)
- Ten sections of proposed new bridleway
- Seven sections of proposed new restricted byway, including the repurposed A417/Air Balloon Way
- Two sections of new byways open to all traffic
- Three instances where proposals include reclassification of PRoW in order to provide greater access rights and improve connectivity for users between the existing and proposed network (two footpaths to bridleway, and one footpath to restricted byways)
- Two instances where access rights are proposed to provide greater connectivity between the existing and proposed PRoW

6.5 Changes to existing walking, cycling and horse-riding routes

6.5.1 In relation to changes to existing walking, cycling and horse-riding routes, As identified in the PRoW Management Plan (ES Appendix 2.1 Environmental Management Plan Annex F (Document Reference 6.4)) this would mean:

- One PRoW would be stopped up without a substitute, although alternative routes exist/would be provided (Badgeworth bridleway 125)
- 18 PRoW would be stopped up with substitutes/diversions provided
- 19 PRoW would be created to help increased or improve connectivity
- Three PRoW would be reclassified (two footpaths to bridleway, and one footpath to restricted byway)
- Five unclassified roads/'other route with public access' (ORPAs) would be promoted for use of access rights to help increased or improve connectivity across the PRoW network (three existing and two new routes)

6.5.2 In relation to the Cotswold Way National Trail, the scheme proposes to divert the route across a new WCH bridge, providing a safe and attractive route for the National Trail compared to a route which at present follows the A417 at grade for a section prior to users having to cross the A417 at grade.

6.5.3 In relation to the Gloucestershire Way long distance footpath, proposals include a new WCH crossing north of the Shab Hill junction, new section of footpath to

connect into the Air Balloon area and connecting sections of bridleway and highway. Although this could add journey distance and time to this route for some users, it is considered that the proposals provide sufficient mitigation for the users of the Gloucestershire Way long distance footpath who would also benefit from no longer having to cross the A417 at grade.

6.5.4 Additional crossings at the Cowley and Stockwell overbridges and Shab Hill junction would also mitigate severance of existing footpaths, restricted byways and highways.

6.6 Construction phasing

6.6.1 The approach to construction described below is indicative and subject to change during detailed design but it is representative of the likely approach to be adopted and has been defined taking advice from the appointed buildability advisors for the scheme.

6.6.2 The construction activities for the scheme would be typical of a major highway scheme and consist of the following:

- preparatory works comprising archaeological investigation and ecological mitigation works, ground investigation works including trial pits, site set up works (including the erection of temporary fencing and provision of access points), top-soil stripping and stockpiling for access points and compounds
- establishment of site compounds, laydown areas and facilities
- vegetation clearance
- statutory utility diversions
- bulk earthworks
- drainage works
- construction of bridge structures including piling
- road pavements work
- landscape and planting works

6.6.3 Further details regarding the construction phasing details can be found in the outline Construction Traffic Management Plan provided as ES Appendix 2.1 Environmental Management Plan (EMP) Annex B (Document Reference 6.4).

7 Forecast year Do-Something scenario scheme traffic model summary

7.1 Approach

7.1.1 For the DS forecast years, the demand matrices used are the reference case matrices and therefore are the same as those used for the DM modelling. Sections 5.1 and 5.2 of this report and Section 10.5 of the ComMA Report (Document Reference 7.6), outline the process undertaken for developing the forecast reference case matrices.

7.2 Development assumptions included in forecasts

7.2.1 The only difference between the DM and DS scheme traffic model scenarios is the inclusion of the scheme in the DS scenario. Therefore, the matrices used for the DS scenario are the same as those for the DM.

Do-Something infrastructure improvements

7.2.2 The DS network is based on the DM network, but also includes the scheme. For details of the infrastructure schemes included in the DM networks please see Section 5.2 of this report or for more details see Section 10.3 of the ComMA Report (Document Reference 7.6).

7.2.3 The route alignment and other elements of the scheme are shown in Figure 6-1. Only those aspects relating to the highway alignment are coded into the scheme traffic model. This includes the following:

- Two lanes per direction with climbing lane for westbound traffic up Crickley Hill.
- New grade separated junction at Shab Hill.
- New roundabout at Ullenwood.
- New roundabout near Cowley.
- Closure of Cowley Wood Lane to motorised vehicles.

7.2.4 The scheme was coded into the DM networks to create the DS networks.

7.3 Summary of Do-Something Scenario

Assignment convergence

7.3.1 All forecast scheme traffic model assignments satisfy the convergence criteria set out in TAG unit M3.1 (see Table 7-4 of the ComMA Report (Document Reference 7.6)). For more details on the scheme traffic model convergence see Section 11.2 of the ComMA Report (Document Reference 7.6).

Variable Demand Modelling

7.3.2 In summary the VDM process results in only minor matrix total changes with a maximum change of ±1% of the Reference Case matrix total for the relevant peak.

7.3.3 For more details on the impact of VDM on the DM matrices see Section 11.3 of the ComMA Report (Document Reference 7.6).

Journey times

7.3.4 To illustrate the impact of the scheme on forecast journey times, modelled journey times have been extracted for the following routes, which are shown in Figure 5-1:

- A417 between the A429 junction at Cirencester and the M5/A417/B4641 roundabout
- A40/A436 junction at Shipton to the M5/A417/B4641 roundabout

7.3.5 Table 7-1 and Table 7-2 present the modelled journey times for the A417 route between Cirencester and the M5 for the westbound and eastbound directions respectively. The DS percentage differences shown are relative to the corresponding DM scenario. The DM percentage differences are relative to the 2015 Base scenario.

Table 7-1 A417 modelled journey times – Cirencester to M5 (westbound)

Year	Scenario	AM peak		IP		PM peak	
		Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.
2015	Base	17:33	N/A	17:12	N/A	18:25	N/A
2026	Do-Minimum	18:19	+4%	17:55	+4%	18:55	+3%
	Do-Something	13:33	-26%	13:21	-25%	13:49	-27%
2041	Do-Minimum	19:33	+11%	19:08	+11%	20:17	+10%
	Do-Something	14:07	-28%	13:49	-28%	14:21	-29%

Source: Highways England

Table 7-2 A417 modelled journey times – M5 to Cirencester (eastbound)

Year	Scenario	AM peak		IP		PM peak	
		Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.
2015	Base	15:38	N/A	14:42	N/A	15:03	N/A
2026	Do-Minimum	17:01	+9%	15:09	+3%	15:38	+4%
	Do-Something	13:15	-22%	12:36	-17%	12:54	-17%
2041	Do-Minimum	18:45	+20%	16:09	+10%	17:13	+14%
	Do-Something	14:12	-24%	12:58	-20%	13:38	-21%

Source: Highways England

7.3.6 The scheme is forecast to reduce journey times along the A417 in both directions compared to the DM scenarios.

7.3.7 Given the large amounts of existing delay experienced by westbound traffic, the largest journey time savings are forecast to be achieved in that direction. In the 2041 forecasts, the westbound journey times reduce by over five minutes in the AM peak and by nearly six minutes in the PM peak.

7.3.8 The journey time savings on the A417 are not as great in the eastbound direction, but still equate to more than four minutes in the AM peak and more than three minutes in the PM peak in 2041.

7.3.9 Table 7-3 and Table 7-4 present the modelled journey times for the A436/A417 route between the A436/A40 junction and the M5 for the westbound and eastbound directions respectively.

Table 7-3 A436/A417 modelled journey times – A436/A40 to M5 (westbound)

Year	Scenario	AM peak		IP		PM peak	
		Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.
2015	Base	13:37	N/A	13:21	N/A	15:18	N/A
2026	Do-Minimum	14:15	+5%	13:37	+2%	16:51	+10%
	Do-Something	14:44	+3%	14:35	+7%	15:13	-10%
2041	Do-Minimum	15:25	+13%	14:45	+10%	19:01	+24%
	Do-Something	15:10	-2%	15:03	+2%	15:56	-16%

Source: Highways England

Table 7-4 A436/A417 modelled journey times – M5 to A436/A40 (eastbound)

Year	Scenario	AM peak		IP		PM peak	
		Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.	Time (mm:ss)	% Diff.
2015	Base	13:24	N/A	12:45	N/A	12:54	N/A
2026	Do-Minimum	14:21	+7%	13:02	+2%	13:22	+4%
	Do-Something	15:03	+5%	14:25	+11%	14:44	+10%
2041	Do-Minimum	16:22	+22%	13:37	+7%	14:43	+14%
	Do-Something	16:06	-2%	14:50	+9%	15:31	+5%

Source: Highways England

7.3.10 Westbound traffic currently experiences greater delay at the Ullenwood roundabout than the eastbound equivalent during the PM peak. Delay in other periods is comparable.

7.3.11 The scheme slightly increases journey times for the westbound A436/A40 to M5 route in the 2026 AM and IP periods as a result of the increased journey distance compared to the DM. The scheme decreases journey times for the westbound A436/A40 to M5 route in the 2026 PM peak period, despite the increase in journey distance, as a result of the decrease in delay compared to the DM.

7.3.12 In 2041, journey times in the AM and IP periods are comparable between the DM and DS as the impact of the delay reduction with the scheme begins to be equable with the disbenefit of the increased journey distance. The scheme decreases journey times in the 2041 PM peak period by nearly three minutes.

7.3.13 Journey times for the eastbound M5 to A436/A40 route are generally forecast to increase with the scheme. This is as a result of the increased journey distance compared to the DM without the equivalent delay reductions achieved in the westbound direction. Increases in all periods are forecast to be greater in 2026 than in 2041; with journey times in the AM peak period in 2041 comparable to the DM.

Traffic flows

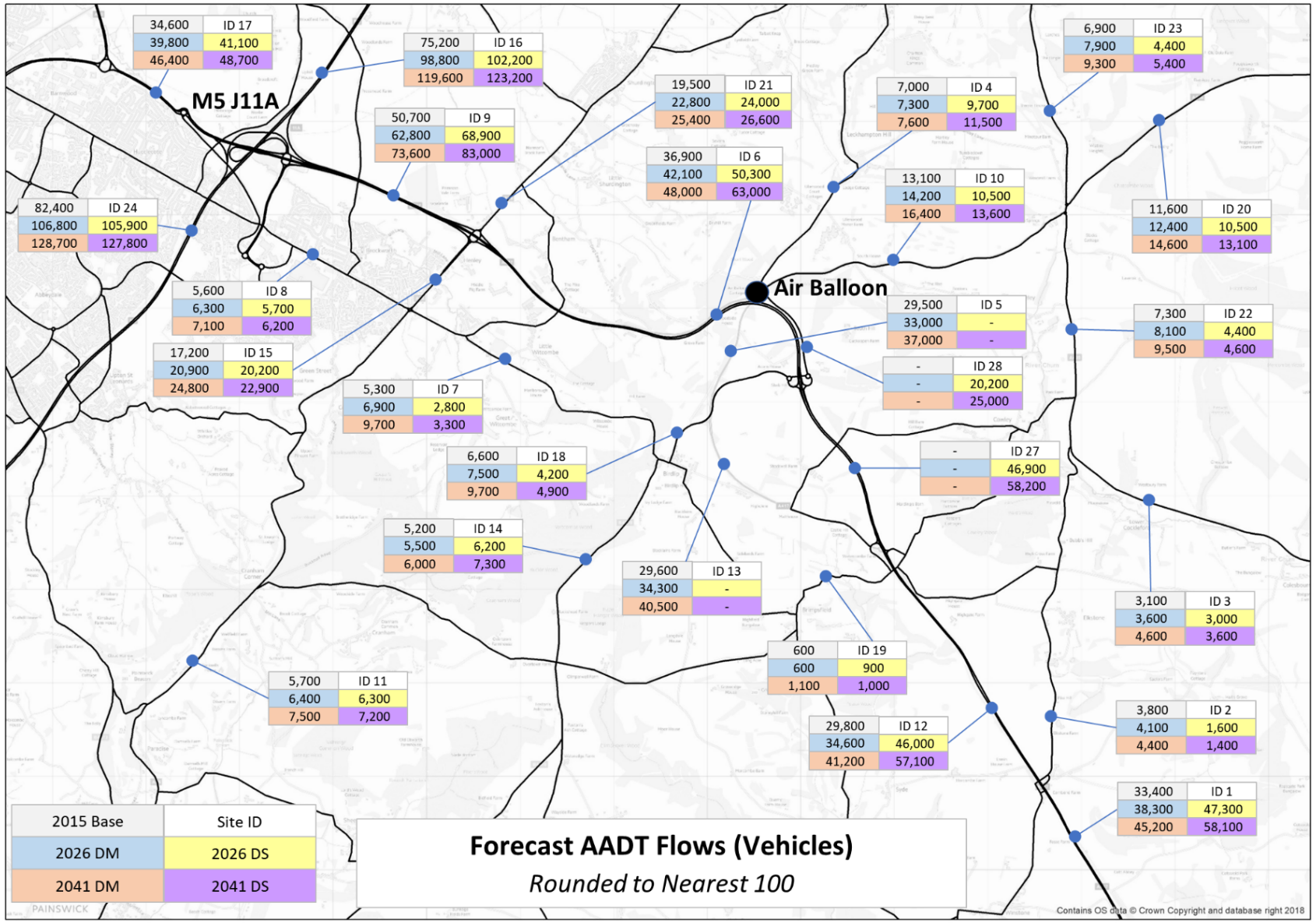
7.3.14 Figure 7-1 and Figure 7-2 show the forecast AADTs and forecast percentage HGVs for the local area. Details on the wider network traffic flows and rerouting, including figures, are in Section 11.4 and Appendix I of the ComMA Report (Document Reference 7.6).

7.3.15 Forecast AADTs on the new dual carriageway section to the south of the new junction at Shab Hill (ID 27) are forecast to be 46,900 in 2026 and 58,200 in 2041. These are increases of 37% and 44% respectively when compared to the corresponding single carriageway section (ID 13) of the DM. HGV proportions are forecast to change from 10% to 8% in 2026 and from 8% to 7% in 2041.

7.3.16 On the Crickley Hill section (ID 6) of the new dual-carriageway AADTs are forecast to be 50,300 in 2026 and 63,000 in 2041 with the scheme. These are increases of 19% and 31% respectively when compared to the DM. HGV proportions are forecast to change from 11% to 9% in 2026 and from 10% to 8% in 2041.

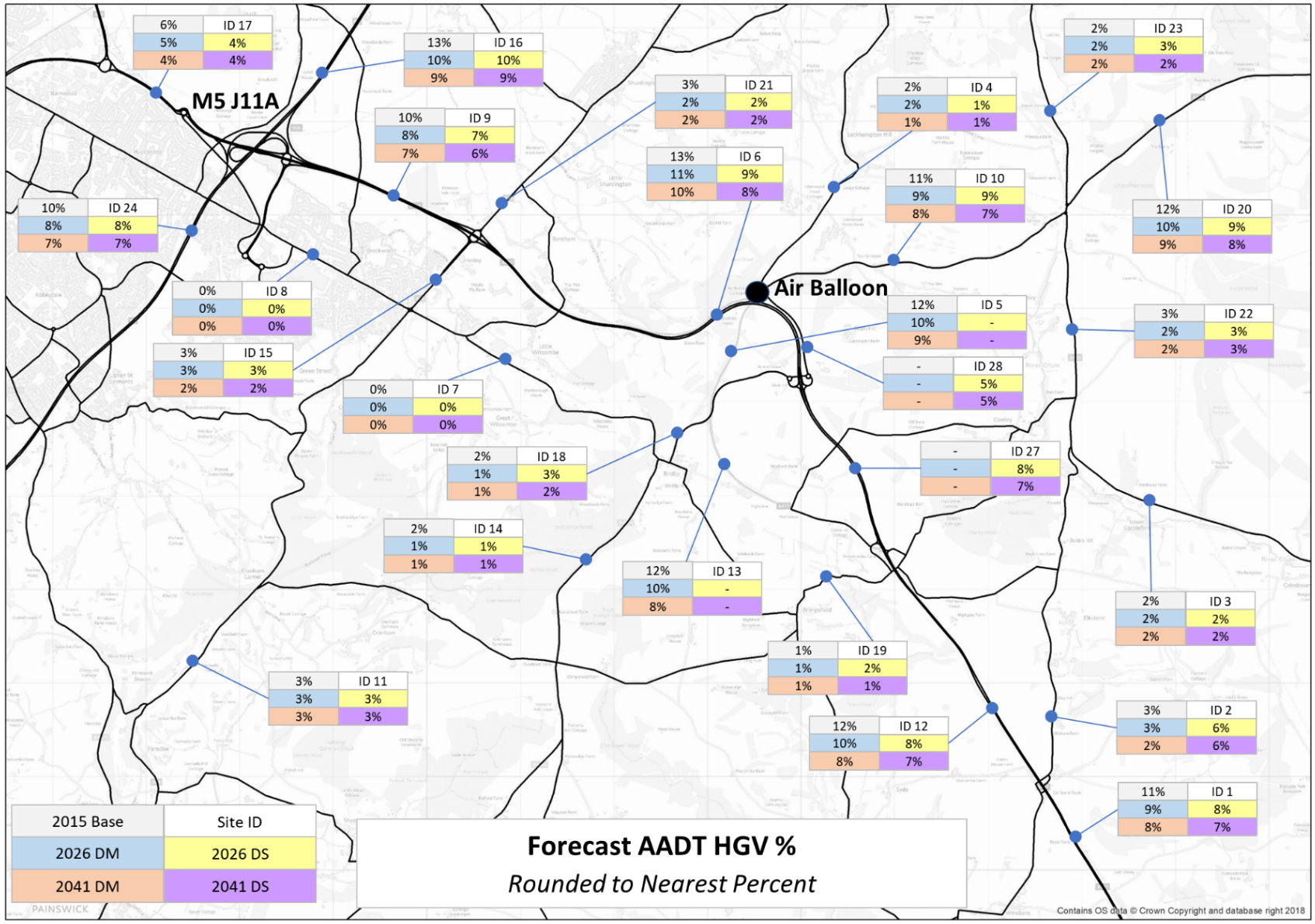
7.3.17 Flows on the existing adjacent dual carriageway sections of the A417 are also forecast to increase as a result of the scheme. To the south of the A417 Elkstone junction (ID 1) AADTs are forecast to increase from 38,300 to 47,300 (+23%) between the DM and DS in 2026 and from 45,200 to 58,100 (+29%) in 2041. HGV proportions are forecast to change from 9% to 8% in 2026 and from 8% to 7% in 2041.To the west of Brockworth bypass (ID 9) AADTs are forecast to increase from 62,800 to 68,900 (+10%) between the DM and DS in 2026 and from 73,600 to 83,000 (+13%) in 2041. HGV proportions are forecast to change from 8% to 7% in 2026 and from 7% to 6% in 2041.

7.3.18 The forecast increases in traffic on the A417 in the vicinity of the scheme are a result of traffic rerouting from various alternative routes, both local and strategic, to take advantage of the improvements to the route.



Source: Highways England

Figure 7-1 Forecast AADT flows in the local area



Source: Highways England

Figure 7-2 Forecast AADT HGV proportions for the local area

Network rerouting effects

7.3.19 At the local level, traffic is forecast to re-route away from existing known rat runs including via Elkstone towards Cheltenham and also via Birdlip Hill towards Gloucester.

7.3.20 On the former route, the AADT through Elkstone (ID 2) with the scheme is forecast to decrease compared to the DM from 4,100 to 1,600 (-61%) in 2026 and from 4,400 to 1,400 (-68%) in 2041. HGV proportions are forecast to change from 3% to 6% in 2026 and from 2% to 6% in 2041.

7.3.21 Comparable relative reductions as a result of the scheme are forecast to occur on the Birdlip Hill route (ID 7). AADT is forecast to decrease from 6,900 in the DM to 2,800 in the DS scenario (-59%) in 2026 and from 9,700 to 3,300 (-66%) in 2041. HGV proportions are forecast not to change on this route in 2026 or in 2041.

Operational assessments of scheme junctions

7.3.22 Operational assessments, including junction capacity and merge/diverge assessments, have been undertaken for the scheme design year of 2041.

7.3.23 The assessments show that the scheme junctions are forecast to operate within capacity in the weekday peak hours. However, there are some instances in which scheme junctions are forecast to experience some delay and queuing.

7.3.24 The proposed Ullenwood roundabout is forecast to operate within capacity in the scheme design year, with some limited queuing on the A436/A417 link in the morning peak hour and on the A436 approach in the evening peak hour. The Shab Hill eastern roundabout is forecast to operate within capacity in the 2041 scheme design year, with some small queues and delay on all arms in both morning and evening peak hours. The Shab Hill western roundabout would work largely within capacity in the 2041 scheme design year, with some queuing on the underpass arm in the evening peak hour.

7.3.25 More details on the operational assessments are contained in Appendix J of the ComMA Report (Document Reference 7.6).

Summary

7.3.26 The impact of the scheme is significant on the A417 with journey times decreasing by 20-30% in 2041 when travelling between Cirencester and the M5 Junction 11a on the A417 when compared to the DM scenario. The impact of the scheme on journey times between the A40 and M5 Junction 11a is mixed and depends on the direction of travel and the time period.

7.3.27 The impact of the scheme on local roads is to generally reduce the amount of traffic using these roads. The additional capacity provided on the A417 as a result of the scheme leads to less vehicles using local roads as an alternative route to avoid congestion on the existing A417 and at the Air Balloon roundabout. The exception to this is Leckhampton Hill where traffic increases as a result of the scheme.

7.3.28 Overall, the A417 scheme has an improvement on the road network in relation to journey time savings due to the reduced congestion and increased capacity.

7.4 Walking, cycling and horse-riding

7.4.1 The existing A417 acts as a severance for the Cotswold Way National Trail, Gloucestershire Way long distance footpath and other routes that cross the A417. All existing crossings are at grade. With the A417 being used by more than 34,000 vehicles it is considered that this acts as a barrier to usage and that this supresses usage of these routes.

7.4.2 To mitigate against this, the scheme would divert the Cotswold Way on to a new WCH bridge that would provide a safe and attractive route for the National Trail and remove the A417 as a barrier to usage. This diversion would potentially add journey length and time to some users and reduce journey length and time for others. Given the improved environment of the route, on balance, it is considered that the proposal would bring moderate beneficial effects to this PRoW and its users, which would be significant.

7.4.3 The scheme would provide a new WCH crossing north of the Shab Hill junction for the Gloucestershire Way long distance footpath. This would include a new section of footpath to connect into the Air Balloon area and connecting sections of bridleway and highway. Although this could add journey distance and time to this route for some users, it is considered that the proposals would provide sufficient mitigation for the users of the Gloucestershire Way long distance footpath who would also benefit from no longer having to cross the A417 at grade.

7.4.4 Proposals provide two alternative options for people using this route and the new footpath to the Air Balloon area would provide a landscaped environment through which walkers would travel near Ullenwood. On balance it is considered that the proposals would bring a slight adverse effect to the existing footpaths given increase in journey distance, but in providing this route and its users with an alternative grade separated and high quality crossing of the A417, it is considered that the scheme would bring a slight beneficial effect to the Gloucestershire Way long distance footpath.

7.4.5 Additional crossings at the Cowley and Stockwell overbridges and Shab Hill junction would also mitigate severance of existing footpaths, restricted byways and highways.

7.4.6 This would provide favourable WCH routes between key features and facilities within the study area (e.g. Crickley Hill Country Park, Barrow Wake and The Golden Heart Inn), offering opportunities for recreational rides and circular routes.

7.4.7 All new structures proposed, as described in detail in ES Chapter 2 The project (Document Reference 6.2), would carry public access rights and/or PRoW, providing a key element of mitigation in order to reduce severance for WCH across the study area.

7.4.8 The opportunity in relation to reclassification of the existing A417 for the part referred to as the Air Balloon Way would also facilitate and allow improved conditions for walkers, cyclists and horse riders. The proposals within the PRoW Management Plan (ES Appendix 2.1 Environmental Management Plan Annex F (Document Reference 6.4)) and summarised in Table 12-27 and Table 12-28 of ES Chapter 12 Population and Human Health (Document Reference 6.2) aim to utilise the repurposing of the A417 to greatest benefit, connecting this route into the existing network and to new proposals such as the Grove Farm underpass, B4070 link and connections to Cold Slad and Leckhampton Hill.

7.4.9 In summary, when considering the proposed re-provision, increased access rights and extent of new provision detailed within Table 12-28 of ES Chapter 12 Population and Human Health (Document Reference 6.2) and the PRoW Management Plan, it is considered that the proposals bring moderate beneficial effects to the PRoW and WCH network in the study area, which would be significant to users and the local communities.

8 Economic appraisal

8.1 Introduction

8.1.1 This section provides a description of the processes used during the economic appraisal of the scheme and the results of the appraisal. The estimated scheme costs are presented within this section. Mode detailed information is available in the ComMA Report (Document Reference 7.6).

8.1.2 The economic appraisal undertaken for the scheme includes monetisation of travel time benefits, vehicle operating costs, accident savings, construction and maintenance impacts, journey time reliability, environmental impacts, and wider economic impacts.

8.1.3 All costs and benefits have been discounted in-line with guidance from TAG unit A1.1 to provide the total Present Value of Costs (PVC) and total Present Value of Benefits (PVB), from which the scheme's Benefit Cost Ratio (BCR) can be calculated. The BCR is given by the ratio of PVB/PVC and so indicates how much benefit is obtained for each unit of cost, with a BCR greater than 1 indicating that the benefits outweigh the costs[23].

8.1.4 Table 8-1 identifies the approach adopted to appraise the economic impacts of the scheme.

Table 8-1 Overview of economic assessments

Element	Assessment method
Transport economic appraisal	TUBA (Transport Users Benefit Appraisal) software (version 1.9.14)
Accidents	COBALT (COst and Benefit to Accidents – Light Touch) software (version 2013.02)
Journey time reliability	Comparison of observed journey time reliability (using journey time standard deviations derived from TrafficMaster data)
Construction impacts	QUADRO (QUeues And Delays at ROadworks) software (QUADRO 2019 version 4.17.0.1)
Air quality	DfT's 'Local Air Quality Workbook' and 'Air Quality Valuation Workbook'
Noise impacts	Approach set out in TAG unit A3 chapter 2
Greenhouse gas emissions	Approach set out in TAG unit A3 chapter 4
Wider economic impacts	WITA (Wider Impacts in Transport Appraisal) software (version 2.0 beta)

Source: Highways England

8.2 Costs

8.2.1 All costs for the scheme have been rebased to 2010 prices, consistent with DfT requirements.

[23] Department for Transport (2018) TAG unit A1.1 – Cost-Benefit Analysis [Online]. Available at: (https://www.gov.uk/government/publications/webtag-tag-unit-a1-1-cost-benefit-analysis-may-2018)

Construction

8.2.2 Table 8-2 summarises the costs for the scheme. The costs are in 2010 prices, are undiscounted and are based on the design at August 2020.

Table 8-2 Scheme cost summary (2010 prices, undiscounted)

Cost type	The scheme
Preparation	£22,751,364
Supervision	£8,793,835
Works	£217,483,913
Land	£25,678,208
Operation & maintenance	£8,329,901
TOTAL	**£283,037,220**

Source: Highways England

8.2.3 The Highways England scheme costs already make allowance for risk and contingencies. Optimism bias has therefore not been added to the costs shown. Additional information on scheme costs are in Section 12.3 of the ComMA Report and the detailed cost profiles for the scheme are included in Appendix K of the ComMA Report (Document Reference 7.6).

Maintenance

8.2.4 Operation and maintenance costs are presented as net values (i.e. the costs associated with maintaining the new road(s) less the cost of maintaining the existing alignment in the DM scenario). These costs have been calculated using values included within Part 2, chapter 9 of the COBA manual (July 2017).

8.2.5 The maintenance costs over the 60-year appraisal period are in Table 8-2.

8.3 Travel time and vehicle operating costs (transport user benefits – TUBA)

Approach

8.3.1 The DfT's economic appraisal software TUBA version 1.9.14 has been used to calculate the transport user benefits for the scheme in accordance with published DfT guidance.

8.3.2 The appraisal is based on matrices of trips and costs extracted from the scheme traffic model. From these, TUBA calculates the user benefits in travel time, vehicle operating costs for fuel and non-fuel, and charges.

8.3.3 TUBA uses the input trip and cost matrices for the four forecast years and, through a process of interpolation and extrapolation, appraises the economic benefits of the scheme for a 60-year period from scheme opening (i.e. 2026 to the end of 2085). Both the benefits, and the scheme costs, are discounted by TUBA to the present value year (2010) in accordance with TAG unit A1.1.

8.3.4 Further details on the approach for the transport user benefits are in Section 12.4 of the ComMA Report (Document Reference 7.6).

8.3.5 The scheme traffic models have been built to represent a weekday in March and include an average AM peak hour (07:00-10:00), an average IP hour (10:00-16:00), an average PM peak hour (16:00-19:00), and an average OP hour (19:00-

07:00). Annualisation factors have been used to uplift the results produced for the modelled periods to represent all hours during the year as far as possible.

8.3.6 Details on the calculation of these annualisation factors are in Section 12.4 of the ComMA Report (Document Reference 7.6).

Results

8.3.7 The results of the assessment of TUBA user benefits are shown in the Traffic Economic Efficiency (TEE) table of the TUBA output file, which is presented in Table 8-3.

Table 8-3 Transport Economic Efficiency - benefits (£000s)

Item	The scheme
Consumer – commuting user benefits	**ALL MODES**
Travel time	57,635
Vehicle operating costs	-12,279
User charges	1
During Construction & Maintenance	0
NET CONSUMER - COMMUTING BENEFITS	**45,357**
Consumer - other user benefits	**ALL MODES**
Travel time	87,368
Vehicle operating costs	-50,884
User charges	-0
During construction & maintenance	0
NET CONSUMER - OTHER BENEFITS	**36,484**
Business impacts	**ALL MODES**
Travel time	169,310
Vehicle operating costs	4,673
User charges	13
During construction & maintenance	0
Sub Total	**173,995**
Private sector provider impacts	
Revenue	0
Operating costs	0
Investment costs	0
Grant/subsidy	0
Sub Total	**0**
Other business impacts	
Developer contributions	0
NET BUSINESS IMPACT	**173,995**
TOTAL	
Present value of Transport economic Efficiency benefits (TEE)	**255,836**

Source: Highways England

Notes: All monetary values are expressed in 2010 prices, discounted to 2010. Numbers may not sum due to rounding.

8.3.8 Additional information on the Transport User Benefits of the Core scheme are in Appendix M of the ComMA Report (Document Reference 7.6).

8.4 Accident analysis

Approach

8.4.1 Economic benefits due to accident savings following the implementation of the scheme have been assessed using the DfT's COBALT programme (Cost and Benefit to Accidents – Light Touch) – version 2013.2.

8.4.2 COBALT uses accident rates for different road types to estimate the number of accidents and the resulting casualties based on modelled traffic flows. The accidents are monetised to determine the economic benefits from the scheme.

8.4.3 For the scheme, the COBALT assessment evaluates, over a 60-year appraisal period, the number of Personal Injury Accidents (PIAs), the number of casualties and also a monetised present value cost of accidents. The results from the DS are then compared against the DM results to provide the relative saving in PIAs, casualties, and a monetised present value of accident benefits (over the 60-year appraisal period).

8.4.4 The entire SATURN simulation area has been used for the COBALT assessment to ensure the impact of the scheme is covered in relation to accidents. This network, along with AADT flows and accident rates for major roads within the study area were needed as inputs for this process.

8.4.5 More details on the COBALT methodology are in Section 12.4 of the ComMA Report (Document Reference 7.6).

Results

8.4.6 The results of the COBALT assessment for the scheme are presented in Table 8-4.

Table 8-4 Summary of accident benefit results

Accident benefits (£000s)	Number of PIAs saved	Number of casualties saved			
		Fatal	Serious	Slight	Total
64,890	-51.8	66.1	201.2	-29.4	237.9

Source: Highways England
Notes: All monetary values are expressed in 2010 prices, discounted to 2010.

8.4.7 The scheme is forecast to lead to a large reduction in the number of killed or seriously injured (KSI) casualties, with 66 fewer fatalities forecast over the 60 year appraisal period. There is forecast to be an increase in the total number of accidents and slight casualties, which is a result of the forecast increase in total traffic (vehicle kilometres) within the COBALT study area arising from the scheme.

8.4.8 The large forecast reduction in KSIs equates to substantial economic benefits of £65 million.

8.4.9 The majority of benefits are achieved from the removal of the existing single carriageway section of the A417, which, as discussed previously, has a high

incidence of serious and fatal accidents. Other benefits occur on routes on which traffic is forecast to reassign from, including the Birdlip Hill and Elkstone rat runs.

8.4.10 Disbenefits occur where forecast increases in traffic flows are shown to increase accidents on the A417/A419 route.

8.5 Construction and maintenance

Approach

8.5.1 The construction of a scheme on the A417 would inevitably lead to disruption on the existing local road network. Roadworks during the construction phase would be expected to cause delays to traffic (due to physical presence of the works with associated speed limits and any delays caused by breakdowns or accidents occurring within the works). This would lead to impacts on travel times, vehicle operating costs, carbon emissions and accident costs.

8.5.2 To quantify the impacts of scheme construction on transport users an economic assessment has been performed with QUADRO (QUADRO 2020 v4.18.0.1).

8.5.3 The assumptions used in the appraisal are based on an assessment of the traffic management arrangements that are considered to be necessary in order to construct the scheme.

8.5.4 The affected sections of existing carriageway include:

- A417 Crickley Hill (between the end of the Brockworth bypass and Air Balloon roundabout) – 1.33 miles (2.15km).
- A417 Cowley junction – 0.5 miles (0.8km).
- Unnamed side road at Cowley junction – 0.31 miles (0.5km).
- Leckhampton Hill – 0.62 miles (1.0km).
- A417/A436 Air Balloon roundabout.
- Shab Hill junction.

8.5.5 For more details on the assessment of construction impacts please see Section 12.4 of the ComMA Report (Document Reference 7.6).

8.5.6 A quantitative assessment of the impact of on-going routine maintenance has not been undertaken.

8.5.7 The scheme replaces the existing single carriageway section of the A417 with dual carriageway. There is therefore expected to be a reduction in the impact of routine maintenance on traffic as the additional capacity provided by the dual carriageway gives more scope to mitigate disruption to traffic during roadworks. Furthermore, it is anticipated that routine maintenance would largely be undertaken in the OP period, where possible, and so the foregone benefits of excluding this element from the appraisal would be expected to be very small in scale.

Results

8.5.8 The QUADRO assessment evaluated the disbenefits due to roadworks during the construction stage of the scheme improvements. The disbenefits are a result of roadworks causing delays to traffic, leading to impacts on travel times, vehicle operating costs, carbon emissions and accident costs.

8.5.9 The costs of disruption due to construction estimated by QUADRO are £17.15 million. The impacts estimated by QUADRO are primarily a consequence of speed reductions implemented during construction, along with a smaller component of cost arising from a number of weekend and night-time closures on the A417.

8.5.10 The full results of the QUADRO appraisal are in Table 13-6 of the ComMA Report (Documents Reference 7.6).

8.6 Environmental impacts

Approach

8.6.1 Environmental impacts have been assessed in-line with Design Manual for Roads and Bridges (DMRB) guidance, for the following three categories:

- noise
- air quality
- greenhouse gases

8.6.2 More details on the methodology for these assessments is in Section 12.4 of the ComMA Report (Document Reference 7.6).

8.6.3 Each assessment utilises traffic flows from the forecast years for both the DM and DS scenarios, to assess any environmental costs or benefits arising from the scheme. The monetisation of the environmental impacts of the scheme has been completed in line with TAG unit A3 – Environmental Impact Appraisal

Results

8.6.4 The monetised environmental impacts are presented in Table 8-5.

Table 8-5 Monetised environmental Impacts

Item	Monetised impact
Noise	466
Air quality	-3,630
Greenhouse gases	-39,284

Source: Highways England

8.6.5 The results from the noise assessment for the scheme show an overall benefit for the scheme with a reduction in traffic using the bypassed existing section of A417, coupled with a reduction in traffic on some minor roads contributing to the noise reduction benefits. The NPV for the noise assessment is £0.466 million. More details on the TAG noise assessment results are in Section 13.8 of the ComMA Report (Document Reference 7.6).

8.6.6 The TAG air quality assessment concludes a negative impact for the scheme with a Net Present Value (NPV) of -£3.63million. This disbenefit is due to an increase in capacity in the road network and increased traffic volumes as a result of the scheme. More details on the TAG air quality assessment results are in Section 13.7 of the ComMA Report (Document Reference 7.6).

8.6.7 The results from the greenhouse gases assessment show an overall negative impact for the scheme. This is due to increases in traffic volumes using the A417/A419 corridor between the M5 and M4. The NPV for the greenhouse gas

assessment is -£39.3 million. More details on the TAG greenhouse gas assessment results are in Section 13.9 of the ComMA Report (Document Reference 7.6).

8.7 Journey time reliability

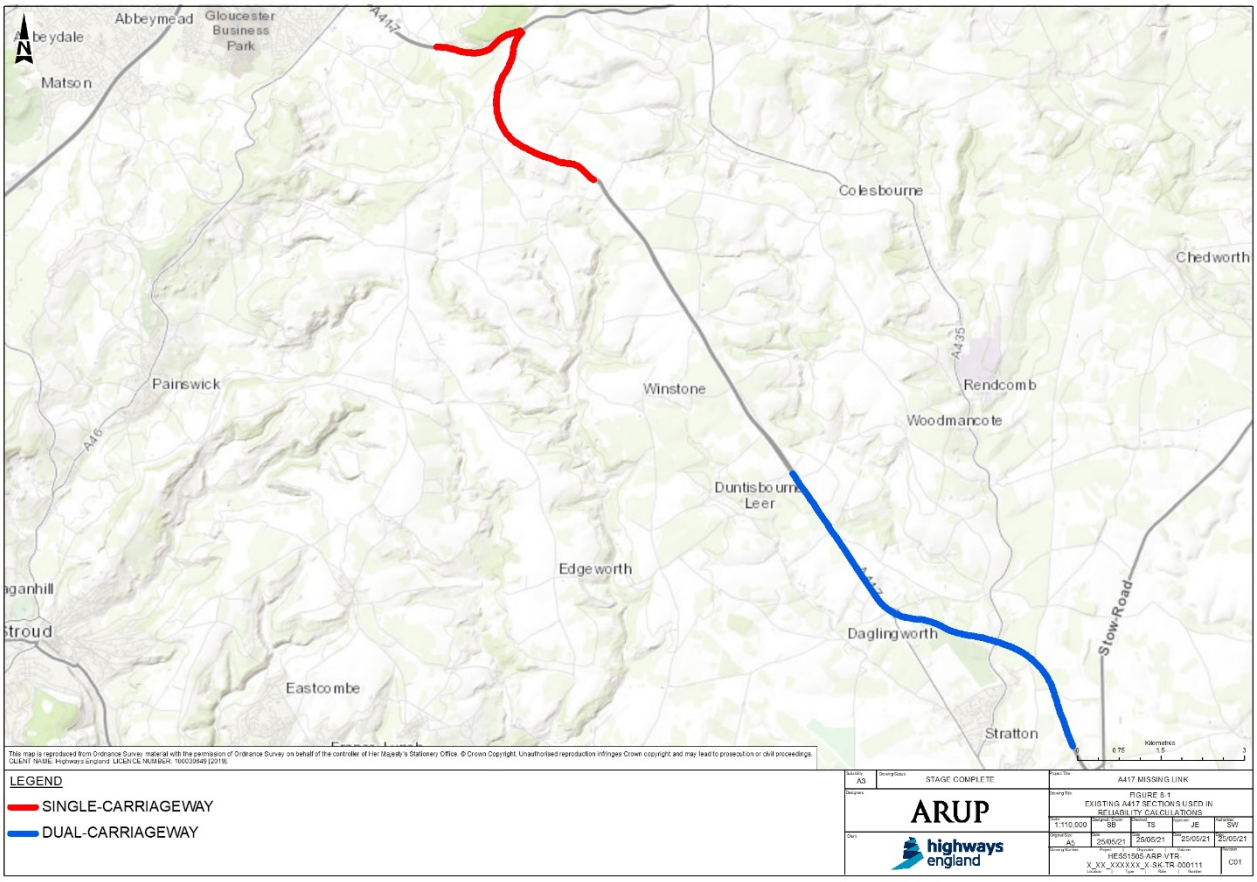
Approach

8.7.1 As defined in TAG unit A1.3, 'reliability' in this section refers to unpredictable variations in journey times, which could include day to day variation in congestion.

8.7.2 The existing single carriageway section of the A417, which includes at grade junctions at Air Balloon, Birdlip and Cowley, is known to experience large variations in journey times. The removal of the existing at grade junctions and provision of the new dual carriageway section would lead to improved journey time reliability along the A417 route.

8.7.3 As recommended in TAG, for the purpose of assessing the impact on journey time reliability, the standard deviation of travel time has been adopted as a measure of travel time variability. The standard deviation of travel times on existing single and dual carriageway sections of the A417 has been measured using TrafficMaster data covering the period September 2014 to August 2015.

8.7.4 Figure 8-1 identifies the sections of the A417 used when calculating travel time variability for the single and dual carriageway sections. Travel time variability has been calculated in both directions separately for the existing single carriageway section. An existing section north of Cirencester was chosen as a representative dual carriageway section, as it includes a grade separated junction and is also far enough south of Cowley roundabout so as to avoid including any delays associated with the start of the single carriageway section at Nettleton Bottom.



Source: Highways England

Figure 8-1 Existing A417 sections used in reliability calculations

8.7.5 Travel time variability was identified for each weekday time period separately (AM 07:00 10:00, IP 10:00 16:00, PM 16:00 19:00 and OP 19:00 07:00), by calculating the standard deviation of journey times in seconds per kilometre for the above sections.

8.7.6 More details on the journey time reliability methodology are in Section 12.4 of the ComMA Report (Document Reference 7.6).

Results

8.7.7 Table 8-6 presents the results of the journey time reliability assessment.

Table 8-6 Summary of reliability results (£000s)

Opening year reliability benefits	The scheme
AM peak	514.0
IP (includes weekday and weekend IP)	685.6
PM peak	342.9
OP (includes weekday and weekend OP)	164.4
60-year reliability benefits	**70,502**

Source: Highways England

Notes: All monetary values are expressed in 2010 prices, discounted to 2010

8.7.8 The results indicate that the scheme would provide significant reliability benefits of £71 million. This reflects the high levels of travel time variability currently experienced on the existing single carriageway section of the A417.

8.8 Wider economic impacts

Approach

8.8.1 As defined in TAG unit A2.1, wider economic impacts refer to economic impacts that are additional to the standard transport user benefits assessed by TUBA software.

8.8.2 The following wider economic impacts have been included in the appraisal undertaken:

- agglomeration impacts
- labour supply impacts
- output change in imperfectly competitive markets

8.8.3 The wider economic impacts have been assessed using the DfT's Wider Impacts in Transport Appraisal (WITA version 2.0 beta) software. WITA assesses the wider economic impacts of a scheme in accordance with the calculations and methodologies set out in TAG unit A2.1.

8.8.4 In assessing wider economic impacts, and the agglomeration impacts in particular, it is important to have confidence in the generalised travel costs extracted from the scheme traffic model. The simulation area of the scheme traffic model includes a detailed highway network and is considered to provide a good representation of travel costs. Outside of the simulation area, confidence in the representation of travel costs is reduced due to the more simplified nature of the network in these areas. Therefore, although the WITA assessments cover the whole extent of the scheme traffic model (including the external areas) only results for the scheme traffic model simulation area are extracted and used in the economic appraisal of the scheme.

8.8.5 For more details on the methodology for calculating the wider economic impacts please see Section 12.4 of the ComMA Report (Document Reference 7.6).

Results

8.8.6 Table 8-7 presents the wider economic impacts. Agglomeration and labour supply impacts are restricted to the scheme traffic model simulation area, while the benefits associated with increased output in imperfectly competitive markets, which is estimated using a 10% uplift to business user benefits, cover the entire scheme traffic model.

Table 8-7 Estimated wider economic benefits (£000s)

Wider economic impact category	Monetised impact
Agglomeration – manufacturing	10,196
Agglomeration – construction	8,626
Agglomeration – consumer services	23,975
Agglomeration – producer services	77,366
Agglomeration – Total	120,163
Labour supply impact	2,764
Increased output in imperfect competitive market	17,400
Total Wider Economic Impacts	140,327

Source: Highways England

Notes: All monetary values are expressed in 2010 prices, discounted to 2010. Numbers may not sum due to rounding.

8.8.7 The scheme is forecast to provide significant wider economic benefits, totalling £140 million.

8.8.8 For more details on the results from the wider economic assessment please see Section 13.10 of the ComMA Report (Document Reference 7.6).

8.9 Analysis of Monetised Costs and Benefits table

8.9.1 Table 8-8 shows the Analysis of Monetised Costs and Benefits (AMCB) which includes economic assessment results from the TUBA, COBALT, QUADRO, environmental, wider economic benefits and reliability analysis. As per TAG all costs and benefits reported in this section are in 2010 prices, discounted to 2010.

Table 8-8 Analysis of monetised costs and benefits (£000s)

Item	The scheme
Accidents (not assessed by TUBA)[1]	64,890
Roadworks (not assessed by TUBA)[2]	-17,148
Greenhouse gases (not assessed by TUBA)[3]	-39,284
Noise (not assessed by TUBA)[4]	466
Air quality (not assessed by TUBA)[5]	-3,630
Economic efficiency: consumer users (commuting)	45,357
Economic efficiency: consumer users (other)	36,484
Economic efficiency: business users and providers	173,995
Wider public finances (indirect taxation revenues)	44,691
Present value of benefits (PVB)	305,821
Broad transport budget present value of costs (PVC)	205,457
OVERALL IMPACTS	
Net present value (NPV)	100,364
Initial benefit cost ratio (BCR)	**1.49**
Reliability benefits	70,502
Wider economic benefits	140,327
Adjusted BCR	**2.51**

Source: Highways England

Notes: All monetary values are expressed in 2010 prices, discounted to 2010. 1 from COBALT, 2 from QUADRO, 3 TAG unit A3 chapter 4, 4 TAG unit A3 chapter 2, 5 TAG unit A3 chapter 3. Numbers may not sum due to rounding.

8.9.2 The present value of benefits (PVB) over the 60-year appraisal period are £306 million for the scheme.

8.9.3 The scheme achieves an initial BCR of 1.49 and an adjusted BCR of 2.51 when reliability and wider economic benefits are included.

8.9.4 The adjusted BCR represents Medium Value for Money based on the DfT's Value for Money Framework.

9 Summary

9.1.1 The purpose of this report is to provide a summary of the transport planning works that have been completed to support the DCO application for the scheme. Details of the scheme background, the policy context within which the scheme sits and the existing conditions demonstrating the need for the scheme are provided.

9.1.2 The methodology to develop both the base year and forecast year scheme traffic model is presented. Analysis of the calibration and validation of the scheme traffic model demonstrates it is a model which is fit for purpose in line with TAG criteria for testing the scheme.

9.1.3 Economic assessment of the scheme undertaken using outputs from the scheme traffic model in line with TAG criteria shows it is a medium value for money scheme which will provide significant benefits to road users and residents of Gloucestershire.

9.1.4 Further information is provided to present the impact of the scheme to walkers, cyclists and horse riders.

Abbreviations List

AADT	Annual Average Daily Traffic
AMCB	Analysis of Monetised Costs and Benefits
AONB	Areas of Outstanding Natural Beauty
BCR	Benefit-Cost Ratio
BYFM	Base Year Freight Matrices
COBA	Cost Benefit Analysis
COBALT	Cost and Benefit to Accidents – Light Touch
ComMA	Combined Modelling and Appraisal Report
DCO	Development Consent Order
DfT	Department for Transport
DM	Do Minimum
DMRB	Design Manual for Roads and Bridges
DS	Do Something
GCC	Gloucestershire County Council
GEH	Geoffrey E Havers
GIS	Geographical Information System
GRIP	Governance for Railway Investment Projects
HGV	Heavy Goods Vehicle
JCS	Joint Core Strategy
KSIs	Killed or Seriously Injured
LGV	Light Goods Vehicle
ME	Matrix Estimation
MPD	Mobile Phone Data
NPV	Net Present Value
NTEM	National Trip End Model
NTM	National Transport Model
NTS	National Travel Survey
ORPA	Other Route with Public Access
PCF	Project Control Framework
PIA	Personal Injury Accident
PRoW	Public Rights of Way
PVB	Present Value of Benefits

PVC	Present Value of Costs
QUADRO	QUeues and delays at ROadworks
RIS	Road Investment Strategy
RoF	Region of Focus
RTF18	Road Traffic Forecasts 2018
RTM	Regional Traffic Model
SATURN	Simulation and Assignment of Traffic to Urban Road Networks
SRN	Strategic Road Network
SWRTM	South West Regional Traffic Model
TAG	Transport Appraisal Guidance
TEE	Transport Economic Efficiency
TIS	Trip Information System
TUBA	Transport User Benefits Appraisal
VDM	Variable Demand Modelling
WITA	Wider Impacts of Transport Appraisal

Glossary

Agglomeration benefits	Wider economic benefits of the scheme that arise from improved connectivity and reduced journey times
All costs and benefits are in 2010 prices	All costs and benefits are in a 2010 price base and discounted to 2010 to provide a consistent base for comparison of costs and benefits during the scheme development and to allow ease of comparison across schemes in the United Kingdom
Annual Average Daily Traffic (AADT)	Average traffic flow for a 24-hour period across the year, this includes weekends and bank holidays
Annualisation factor	A factor applied to modelled traffic flows to convert a peak hour flow or an average hour modelled flow to a number which represents all hours during a year
Benefit cost ratio	A benefit cost ratio (BCR) is a ratio used in a cost-benefit analysis to summarize the overall relationship between the relative costs and benefits of a proposed scheme
Buffer network	The buffer networks represent the highway network in the traffic model where impacts of the scheme are forecast to be minimal. The buffer area is coded in less detail and may only include key roads in and out of the model simulation area.

Convergence criteria	Criteria to assess the stability of the traffic model. These criteria demonstrate the traffic model provides stable, consistent and robust results
Cost and Benefit to Accidents – Light Touch	Department for Transport software for assessing the impact a scheme will have on road traffic accidents. The assessment is calculated on a monetary basis for a 60-year appraisal period.
Discounted to 2010	The process of converting the monetised benefits/disbenefits over the 60-year appraisal period to a common base for comparison during the scheme development stage. Allows ease of comparison across schemes in the United Kingdom
Do-Minimum	A traffic modelling term. The 'Do Minimum' is referred to as the future year traffic model scenario that includes committed development and schemes but does not include the scheme being appraised.
Do-Something	A traffic modelling term. The 'Do Something' is referred to as the future year traffic model scenario that includes committed development and schemes, but also includes the scheme being appraised.
GEH Statistic	A mathematical formula similar to the CHI-Squared test that compares two sets of data, in this case modelled and observed traffic flows
Heavy Goods Vehicle (HGV)/Heavy Duty Vehicle (HDV)	Any vehicle over 3.5 tonnes
Link Flow Validation	The process of comparing modelled traffic data on a section of road to observed traffic data. The difference between the modelled and observed traffic flows should be within the defined criteria as set out in TAG M3.1 to satisfy the link flow validation.
Matrix Estimation Process	A traffic modelling term. A modelling process that uses observed traffic count data to refine the trip matrices to improve the fit between modelled and observed traffic data
Modelled Flows	Traffic flows extracted from the scheme traffic model (base year or forecast year)
National Transport Model	A Department for Transport model that provides the Regional Traffic Forecasts. These growth forecasts are applying to traffic models to create forecast year models
National Travel Survey	A regular household survey to monitor long-term trends in personal travel. This survey collects information on how, why, when and where people travel as well as factors affecting travel (e.g car availability and holders of driving licences)
Node	A traffic modelling term. A 'node' is a junction coded into the traffic model. It can either form all of the junction, part of a large

	complex junction or can be used as a point at which the characteristic of road changes
Observed Flows	Traffic flow data collected from traffic surveys
Optimism bias	Optimism bias is a form of contingency added to the overall scheme costs to allow for items such as unknown risks. The level of contingency is applied relative to the current stage of the project, i.e. optimism bias costs are removed as issues are further defined through the detailed design stage. As more issues become 'known' risks they can be estimated more accurately.
Present Value of Benefits (PVB)	The total benefits/disbenefits of a scheme over the 60-year appraisal period that are expressed in 2010 prices and discounted to 2010
Present Value of Costs (PVC)	Construction/maintenance costs of the scheme over the 60-year appraisal. Costs are in 2010 prices and discounted to 2010
Priority- controlled junction	A priority junction is where one or more side arms give way to the main road.
QUeues and delays at ROadworks	Department for Transport software to assessing the impact of the construction/maintenance of a scheme will have on the road network. The assessment is calculated on a monetary basis for a 60-year appraisal period.
Regional Traffic Model	Highways England have five Regional Traffic Models to cover the following regions; South West Regional Traffic Model (SWRTM) South East Regional Traffic Model (SERTM) Midlands Regional Traffic Model (MRTM) Trans-Pennine Regional Transport Model (TPSRTM) North Regional Transport Model (NRTM) These models were built by Highways England for the assessment of Road Investment Strategy and Road Investment Programme. The RTM base models are representative of an average weekday in March 2015
Road Traffic Forecasts 2015	Forecasts for traffic demand, congestion and emission for England and Wales from the DfTs National Transport Model for 2015
Road Traffic Forecasts 2018	Forecasts for traffic demand, congestion and emission for England and Wales from the DfTs National Transport Model for 2018
SATURN (Simulation and Assignment of Traffic to Urban Road Networks)	Traffic modelling software that assigns traffic from a trip matrix onto a road network. The Highways England Regional Transport Models and the A417 Model use SATURN software.

Screenlines	A traffic modelling term. 'Screenlines' are defined through the model calibration/validation stage to check modelled flows against observed flows along a defined 'screenline'. For example, at locations where roads may cross a river or a railway line.
Skeletal network	A traffic modelling term. These routes are included in the traffic model but with limited information.
Strategic road network	The road network that Highways England has responsibility for. This includes all motorways and key A roads for which Highways England have jurisdiction.
TEMPRO (Trip End Model Presentation Programme)	Software used for viewing the forecast rates from the National Trip End Model
TrafficMaster Data	TrafficMaster data is GPS sourced and centrally purchased by the Department for Transport. It contains data from vehicles travelling over the highway network.
Transport modelling	Traffic Modelling is undertaken to help transport decision makers – and related decision makers, e.g. land-use planners, industrial investors, public health officers – to better understand the current, the future and sometimes the past transport systems, and to make informed decisions about how to update the network.
Trunk road	See Strategic Road Network
Wider Impacts of Transport Appraisal	Department for Transport software for assessing the impact a scheme will have on the wider economy. The assessment is calculated on a monetary basis for a 60-year appraisal period