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West Cheltenham Transport Improvements Scheme – UK Cyber Business Park
Phase 2 M5 J11 to Arle Court

Full Business Case

Gloucestershire County Council

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1. Introduction

1.1. Background to the Business Case

The A40 Corridor is a key strategic route for both local and national traffic entering Cheltenham from the M5 (Junction 11). It is currently the primary link for commuters travelling between Gloucester and Cheltenham and, with M5-10 not having a southbound slip road, it is the only logical, direct route from the centre of Cheltenham to destinations to the south and west via the M5. The section of A40 between M5 J11 and Cheltenham experiences frequent delays and congestion in both the AM and PM peak periods, with traffic using the eastbound merge from Junction 11 often struggling to find safe gaps within which to merge.

With the level of growth that is planned for Cheltenham and Gloucestershire as a whole, the existing situation is predicted to deteriorate in terms of queueing and delay and will ultimately represent a constraint to housing and business growth in the county. In particular, the Joint Core Strategy (JCS) for Cheltenham, Gloucester and Tewkesbury (which was adopted in 2017) identified a number of strategic land allocations close to the A40. These include West Cheltenham, an urban extension comprising 1,100 houses and 45 hectares of employment land[1] that will lie on land between GCHQ and the B4634 (Old Gloucester Road). This development includes the nationally-important Cyber Park and Innovation Centre, which will require access to the Strategic Road Network.

The County Council is highly supportive of the Cyber Business Park proposals. The proposals will be focussed on cyber industries generating new highly skilled jobs. The site is important to the economic prosperity of the county and the aspiration for Gloucestershire to become a magnet county attracting young professionals. The proposed Cyber Business Park will be served by the currently highly congested A40 corridor from the M5 J11 to Cheltenham Spa Rail Station.

The West of Cheltenham Transport Improvement Scheme (WCTIS) is a series of highway improvements along the A40 corridor in Cheltenham from the M5 Junction 11 to Griffiths Avenue. The package of schemes has been identified to improve key areas, aiming to increase capacity, optimise the efficiency of the infrastructure and reduce journey time delays for all traffic using the A40, whilst also maintaining and improving access for businesses, and facilities for pedestrians and cyclists. The scheme is anticipated to be split into four phases, of which the widening of the A40 to include an additional eastbound lane between M5-J11 and Arle Court Roundabout comprises the second phase.

GFirst Local Enterprise Partnership (LEP) has allocated a total of £22m funding from Growth Deal 3 to WCTIS, subject to business case approvals. The scheme and wider programme have been designed to be deliverable by the end of 2021, the point at which the LEP funding must be committed.

This document is the Full Business Case (FBC) for Phase 2; A40 East Bound Widening: M5-Junction 11 to Arle Court. The FBC is a requirement of GFirst LEP and includes fully developed Strategic and Economic Cases based on transport modelling, along with detailed cost estimates (Financial Case), a clear procurement strategy (Commercial Case) and delivery arrangements (Management Case).

1.2. The A40 East Bound Widening: M5-Junction 11 to Arle Court Roundabout scheme

This section of the A40 between the M5 Junction 11 and Arle Court roundabout currently experiences significant congestion in both the AM and PM peak periods. The congestion would be exacerbated by additional development such as Cyber Business Park (Figure 1-1 shows the geographical context of the scheme, including the location of the proposed Cyber Business Park). It is therefore considered essential that a scheme to reduce congestion at M5 Junction 11 is progressed as a priority. Without addressing this demand, the full benefit of other WCTIS schemes would not be realised.

The Phase 2 scheme facilitates carriageway capacity improvements eastbound along the A40 from M5 Junction 11 to Arle Court Roundabout (Phase 1).

[1] Policy A7 in the adopted Joint Core Strategy

Figure 1-1 - Existing network and location of M5-J11 and Arle Court Roundabout, including the location of the proposed Cyber Business Park

The scheme is the second phase of a wider programme of investments along the A40 corridor in Cheltenham called the West of Cheltenham Transport Improvements Scheme (WCTIS). WCTIS will progress in phases, with each phase needing to stand on its own merits, in terms of aligning to and delivering the objectives as set out in Section 1.3 and proving sound value for money and use of public funds. It is currently proposed that the scheme progress as four phases as summarised in Table 1-1 below and illustrated in Figure 1-2.

Table 1-1 - West of Cheltenham Transport Improvement Scheme - Phasing

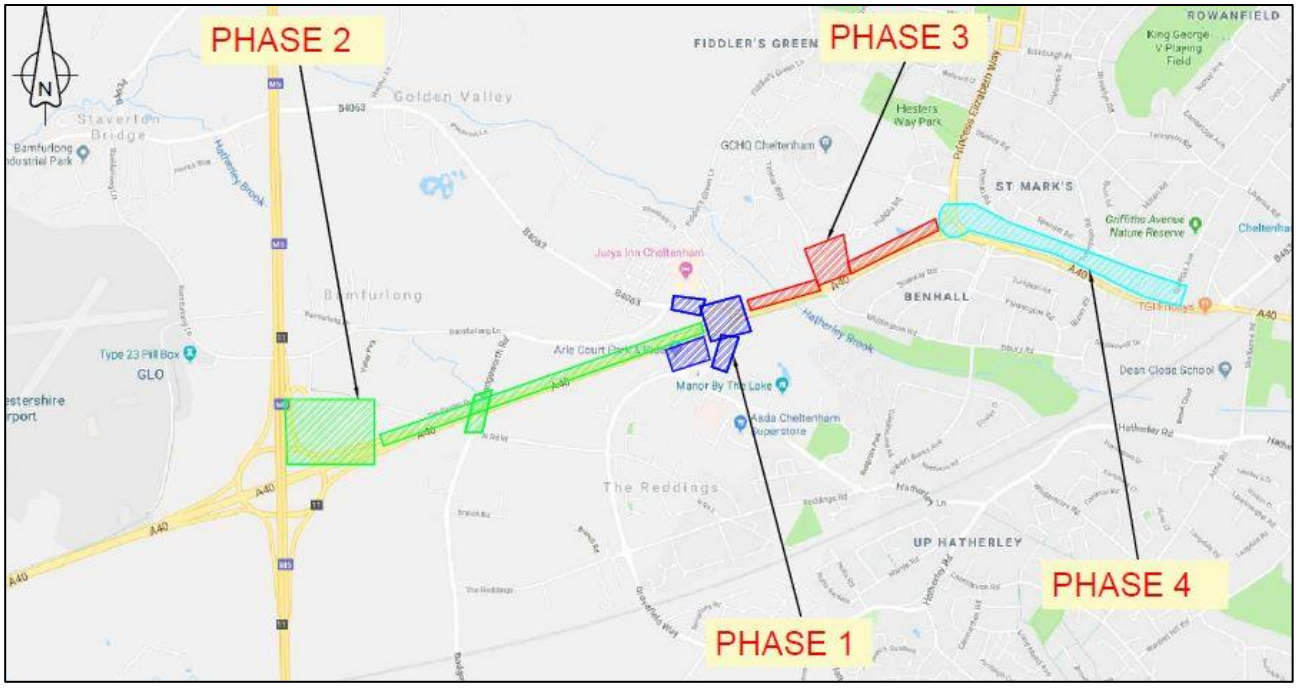
Phase	Scope
1	Capacity improvements to the Arle Court Roundabout
2	Widening of the existing A40 carriageway eastbound from M5 J11 to Arle Court Roundabout
3	Capacity and improvements from Arle Court Roundabout to Benhall Roundabout and Benhall remodelling
4	A40 eastbound widening from Benhall Roundabout towards Griffiths Avenue

Phase 2 will consist of the following elements:

- A40 eastbound merge from M5 Junction 11 upgraded to a lane gain with ghost island merge; and
- A40 eastbound carriageway upgraded to three lanes from this lane gain all the way to Arle Court Roundabout.

Highways England is progressing maintenance works at M5 Junction 11 and Staverton Bridge, and the scheme programme is designed to tie in with this by running concurrently with the works. The present A40 eastbound merge from M5 J11 is not built to the latest standards in DMRB TD22/06, and the proposed layout of the merge addresses this. The new design will allow the merge to accommodate much higher levels of traffic, which in tandem with further mitigating schemes would contribute to enabling large scale development of strategic allocations from the Joint Core Strategy (JCS).

Figure 1-2 - Phase plan map



1.3. Objectives of the scheme

The key objectives which have been agreed by GCC and GFirst LEP have been detailed below. These objectives also led to the provisional allocations of the funds and are as follows:

- Contribute to accelerating the release of the employment land associated with the 'West Cheltenham' Strategic Allocation along with the other strategic allocations in the JCS adjacent to GCHQ, which includes the proposed Cyber Park and Cyber Innovation Centre;
- Deliver transport benefits to people living and working in Gloucestershire by improving traffic flows on the A40, one of the most important and busiest sections of Gloucestershire's road network;
- Aim to have an overall neutral impact on the Cheltenham Air Quality Management Area (AQMA);
- Maintain and improve the options for sustainable travel modes through the junction and on the approaches; walking, cycling, and where feasible providing for enhanced public transport facilities.

1.4. Structure of the document

This document is structured around the DfT's recommended five-case model for a transport business case:

- Strategic Case (Section 2), setting out a rationale for the scheme, the need for investment in this location, options considered and anticipated benefits of the scheme;
- Economic Case (Section 3), identifying the key economic, environmental and social impacts of the scheme and its overall value for money;
- Financial Case (Section 4), presenting evidence of the scheme's affordability both initially (for the construction phase) and in terms of ongoing operations, maintenance and renewal;
- Commercial Case (Section 5), summarising the approach to scheme procurement and justifying the commercial and legal viability of the approach; and

- Management Case (Section 6), setting out how GCC will ensure that the scheme is delivered successfully – on time and to budget, with suitable governance and risk management processes in place.

2. Strategic Case

2.1. Introduction

This Full Business Case is specifically for WCTIS Phase 2 A40 East Bound Widening M5-J10 to Arle Court Roundabout. In order to provide the additional capacity, the scope of Phase 2 comprises the following components. This has been subject to traffic modelling and assessment during the design phase to confirm the preferred layouts:

- A40 eastbound merge from M5 Junction 11 upgraded to a lane gain with ghost island merge; and
- A40 eastbound carriageway upgraded to three lanes from the new lane gain eastbound to Arle Court Roundabout.

The Strategic Case sets out the 'case for change' for WCTIS Phase 2. It explains the rationale for making an investment and presenting evidence on the strategic policy fit of the proposed scheme. Scheme options and the assessment exercises undertaken are set out at the end of this section.

The Strategic Case includes:

- Policy and economic context for the business case;
- Identification of the current and future problems the scheme will be addressing and the impacts of not progressing the scheme;
- A list of specific, measurable, achievable, realistic, time-bound (SMART) objectives for the scheme to address the problems identified, and how they fit with existing national and local plans and priorities;
- Identification of any high-level constraints affecting the scheme's ability to solve the problems identified;
- Identification of any related assumptions or factors (inter-dependencies) upon which the scheme depends to be successful;
- Details of the main stakeholder groups and their contribution to the project; and
- A description of the key components of the scheme, the process by which these have been assessed against other options, and their expected contribution to the objectives.

2.2. Local policy context

2.2.1. Joint Core Strategy (JCS) – Adopted Dec 2017

The JCS Transport Strategy Evidence Base was revised in May 2017 and took account of the transport impact of the Strategic Allocation sites for the JCS areas, of which West of Cheltenham is included (A7). The evidence base concludes that M5 J10 is a priority for the County, which is currently subject to an application for funding by GCC to the Housing Infrastructure Fund (HIF). In addition, the Transport Mitigation Considerations include improved access to the M5 at Junction 10.

2.2.2. M5 J10 HIF Bid

The JCS Transport Evidence Base and other GCC policy focuses on the need for an-all movements junction at M5 J10. A comprehensive bid has been submitted by the GCC and their partners to the Housing Infrastructure Fund (HIF), that links the need for an all-movements M5 J10 to the delivery of housing both at a higher level and earlier than would otherwise be possible without M5 J10. While no funding was sought in the HIF bid for the improvements along the A40 as proposed for the LEP, these improvements were an integral part of the bid for M5 J10. GCC should be informed of the decision on whether to allocate the funds through the HIF Fund by the end of the year, as the scheme is currently at technical checking and verification and being judged competitively against other schemes across the Country.

2.2.3. GFirst LEP Strategic Economic Plan (SEP)

GFirst LEP has the aim to help Gloucestershire realise its economic potential and promote developments and business growth across the County. The SEP for Gloucestershire, submitted to the government in March 2014 in order to obtain Growth Deal funding, outlines how the LEP aims to achieve average economic growth of 4.8% GVA per annum by 2022. It enables the LEP to support local businesses, develop the skills of workers in high-growth sectors, and maximise the connections and opportunities of the M5 growth corridor. From this Growth Deal funding, £22m has been provisionally allocated to Gloucestershire County Council for the WCTIS.

The SEP was recently refreshed in 2018, and restated 'Connectivity' as a strategic priority to improve and integrate transport in the county to stimulate business growth. The SEP defines four 'Enablers for growth' under the Connectivity strategic priority: housing, regeneration, transport infrastructure and digital. The SEP further identifies that unlocking employment land in a growth zone with good access to the M5 is especially important. The scheme will contribute to the aims of the SEP by reducing congestion; improving connectivity between the M5 and west Gloucestershire, including key regeneration areas such as the Forest of Dean.

2.2.4. Gloucestershire Local Transport Plan (LTP) – Adopted June 2016.

The LTP sets out the long-term transport strategy for Gloucestershire up to 2031[2]. The aim for GCC is to influence how and when people choose to travel so that individual travel decisions do not cumulatively impact on the attractiveness of Gloucestershire as a place to live, work and invest. The LTP outlines a number of relevant transport objectives, including:

- Support sustainable economic growth, and
- Enable community connectivity.

The scheme will support these objectives through increasing capacity and improving journey times and reliability on the A40 between Cheltenham from the M5 and the wider Strategic Road Network. The attraction of the West of Cheltenham area as a place to live, work and invest is therefore enhanced, with the capacity for greater economic activity in the county.

2.3. Existing travel demand and level of service

2.3.1. Current road network

The section of the A40 from the M5 J11 to Arle Court Roundabout lies to the east of the motorway on the route into Cheltenham (Figure 2-1). J10 of the M5 only has north-facing slip roads, meaning that the A40 to J11 represents the only direct route from Cheltenham to destinations to the south via the M5, as well as the main route to Gloucester. The A40 is therefore critical to the economy of Cheltenham, connecting the Borough to the wider region and Strategic Road Network. The A40 eastbound merge from M5 J11 is not built to the latest standards, with two lanes heading into a single taper merge[3]. The eastbound mainline carriageway presently has two lanes all the way through J11 to Arle Court Roundabout.

[2] https://www.gloucestershire.gov.uk/transport/gloucestershires-local-transport-plan-2015-2031/
[3] DMRB TD22/06 Chapter 4: Geometric Standards

Figure 2-1 - A40 - Geographical context, including the location of the proposed Cyber Business Park

2.3.2. Traffic flows and network performance

The A40 from J11 of the M5 into Cheltenham carries a significant volume of daily traffic, with large flows in both directions and both the AM and PM peak periods. Table 2-1 summarises the Annual Average Daily Traffic (AADT) observed at a DfT count site between M5 J11 and Arle Court Roundabout from 2014 to 2017. The amount of traffic increased across the period, with the two-way AADT increasing from 42,511 in 2014 to 46,686 in 2017, adding to existing pressures on the road.

In particular, the high traffic flows and lack of spare capacity on the road – especially eastbound on the A40 in the AM peak – lead to issues at the A40 eastbound on-slip at M5 J11. Extremely heavy queuing and congestion is typical.

Table 2-1 - 24hr AADT flows on the A40 between M5 J11 and Arle Court Roundabout

Direction	2014	2015	2016	2017
Eastbound	20,713	23,786	23,348	22,377
Westbound	21,798	24,983	25,475	24,309
Combined	**42,511**	**48,769**	**48,823**	**46,686**

Source: DfT manual counts (Site ID 16412)

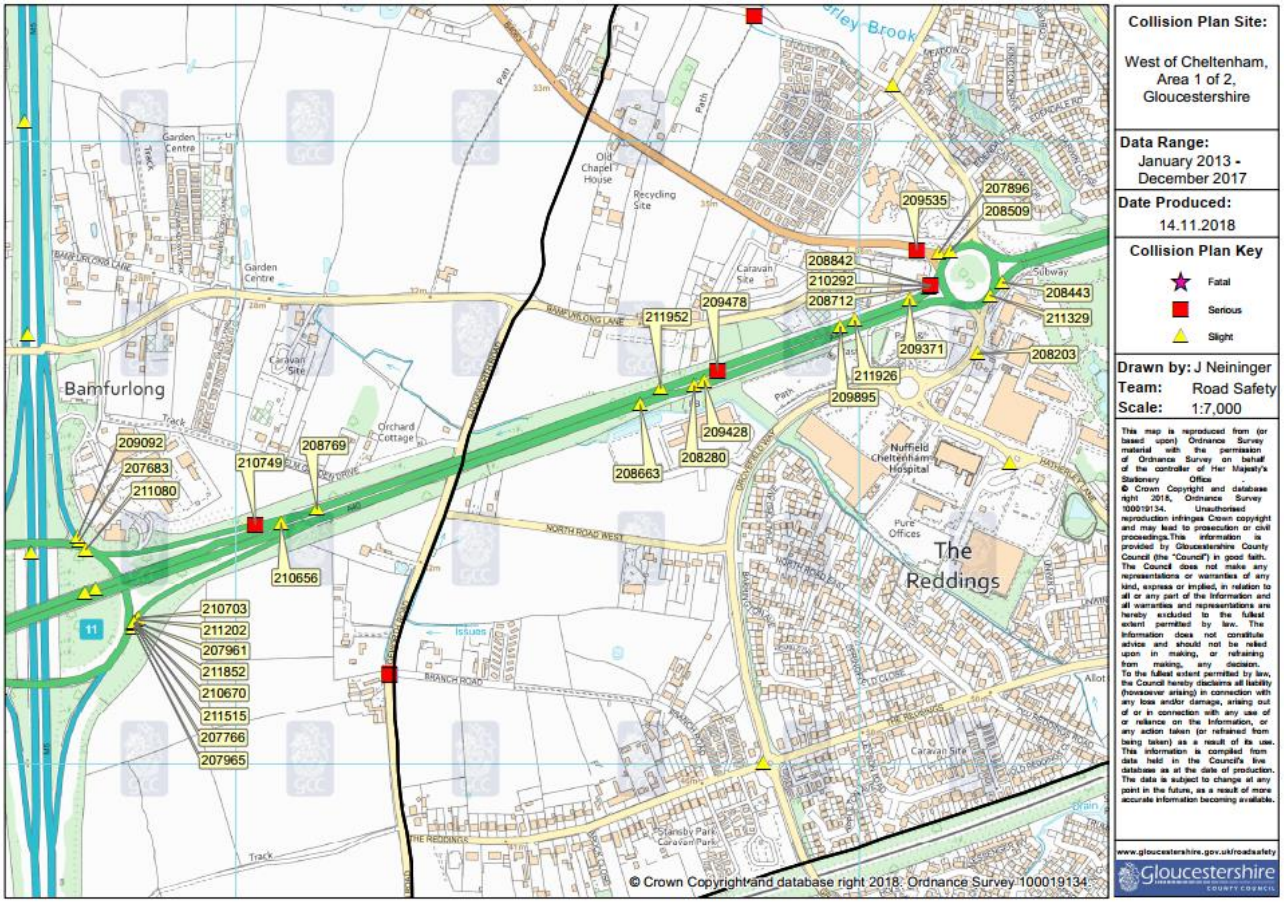
2.3.3. Accident Data

Accident data has been assessed from J11 to Arle Court Roundabout, along with the immediately surrounding road network. The data is for the 5-year period from January 2013 to December 2017, and the summary map is shown in Figure 2-2 below. There are no fatal accidents for the period covered, with a significant cluster of collisions on the approach to the M5 J11 grade-separated roundabout and a smaller cluster on the eastbound approach to Arle Court Roundabout.

The location and severity of the accidents is not considered disproportionate for the traffic volumes on the link and especially given the location of the roundabout. It is also to be noted that the plot only shows reported accidents, and minor rear shunts and other collisions not recorded will be occurring at the roundabout. The scheme is not intended to resolve a significant accident issue, and as reported in the economic case,

statistically accidents may be slightly more likely to occur with increased speeds through the roundabout. However, best practice and consideration of all users (pedestrians and cyclists) has been integral to the final design. The scheme has been subject to a Road Safety Audit Stage 1(RSA1), and the issues highlighted have been fully reviewed by the design team, and a designer's response submitted to Gloucestershire County Council. Upon completion of detailed design, the final layouts will be subjected to RSA2.

Figure 2-2 - 5-year plot for Personal Injury Accidents, January 2013 – December 2017



2.3.4. Public Transport Provision

Stagecoach West provides the main local bus services within Cheltenham and connecting Cheltenham to the wider Gloucestershire area. The routes which the company operates in Cheltenham are shown in Figure 2-3. Of these, the 93 and 94 services provide frequent and strategically important connections between Cheltenham and Gloucester, using the section of the A40 covered by the scheme. These routes are the most-used in the county, with around 2.5 million passenger journeys per year. The 93 and 94 also stop at Arle Court Park and Ride (P&R), providing an alternative for private car users to reach the centre of Cheltenham. In addition to Stagecoach, a number of other local bus service and school bus operators also use the link.

Service 99 (run by Pulhams Coaches) is a Hospitals circular between Gloucester and Cheltenham linking Cheltenham A&E, Gloucestershire Royal Hospital (Gloucester) and Arle Court Park & Ride. There are also intercity services run by National Express and Megabus that stop on the A40 just to the east of Arle Court Roundabout opposite GCHQ. The most frequent services among these connect Cheltenham to Gloucester and Hereford to the north and London to the east.

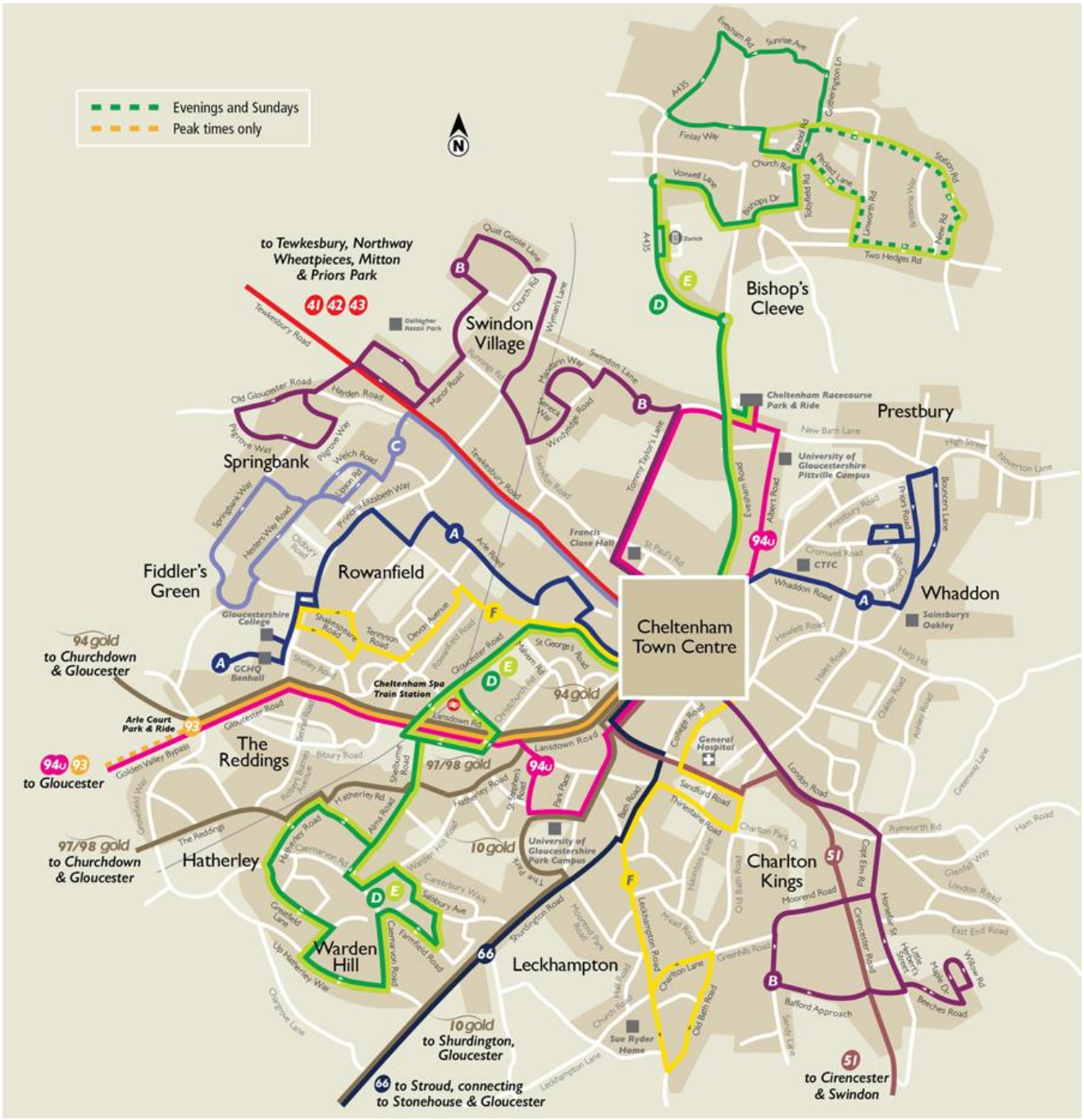
Bus service operators and passengers suffer frequent delays from congestion at peak times on the A40, reducing the reliability and attractiveness of the service. The Managing Director of Stagecoach West confirmed these issues, stating:

The major roads around Arle Court, including the A40 and B4063 are heavily congested in peak periods and traffic congestion causes significant delays for buses travelling in the area, as reflected within the existing timetabling of the 94 service and other services utilising this route. Journey time variability is also an issue

limiting the take up of public transport on this corridor. Without intervention these issues are likely to get worse in the future due to significant expansion in housing and employment planned for the A40 corridor as part of the Gloucester, Cheltenham and Tewkesbury Joint Core Strategy (JCS). The more recently announced Cyber Park will also impact adversely on traffic congestion and the ability for bus operators to provide a punctual and reliable service.

The A40 widening will ensure that the road has enough capacity to enhance bus connectivity between Cheltenham and Gloucester and a good level of service to the P&R. The scheme will therefore improve access to jobs, reduce congestion and make the most of existing investments and assets such as the P&R and Gloucester Transport Hub.

Figure 2-3 - Stagecoach West route map, Cheltenham



2.4. Future challenges

2.4.1. Population and employment growth

As of mid-2017, the population of Cheltenham was estimated to be 117,128[4]. The population is expected to grow and is projected to reach 121,600 by 2026 and 128,000 by 2041, representing population growth of 9.3% over 25 years[5]. While the population in Gloucestershire is forecast to increase in all age groups, the largest increases are expected among those aged at least 65, reflecting an ageing population. Indeed, those aged 65+ accounted for 20.8% of the population in 2016 yet they are expected to reach 28.9% by 2040. An ageing population will present financial and resource implications for Gloucestershire in the future. By investing in infrastructure that can contribute to enabling a growth zone along the M5 corridor, Gloucestershire can mitigate these challenges by attracting the businesses, jobs and working age population that it needs to prosper.

In 2018, 82.7% of working-age residents in Cheltenham were in employment, compared to 78.5% in Great Britain as a whole[6]. In the 2011 census, 29,462 residents of Cheltenham commuted to work within Cheltenham itself and 14,037 commuted to the wider Gloucestershire area, predominantly Tewkesbury and Gloucester[7].

To meet the needs of this growing population, the Joint Core Strategy identifies the need for 35,175 houses across Cheltenham, Gloucester and Tewkesbury between 2011 and 2031. GFirst's Strategic Economic Plan also states that over the period 2014-2022, they aim to create 33,909 jobs in Gloucestershire. With an already congested road network, it is therefore clear that in order to deliver the aims of the Joint Core Strategy and Strategic Economic Plan, investment to increase the capacity for growth is required.

2.4.2. Local (non-strategic) development close to the scheme

Table 2-2 shows smaller scale developments with submitted or approved planning applications within a 300m buffer of the scheme, outside of the Strategic Allocations. The list also excludes sites that do not currently have planning applications submitted. The list demonstrates the high number of developments that will be built within the next few years.

Table 2-2 - Approved and submitted planning applications near the scheme (300m)

Application	Location	Description	Dwellings	Employment	Jobs
13/01501/FUL	Cotswold Court	Extra care facility	3,141sqm (53 apartments)		
13/02139/FUL	32 Church Rd	Erection of 11 apartments/Dwellings	11		
14/00656/FUL	Cotswold BMW	New flagship car show room, repair and maintenance		7595sqm Sui Generis	150**
15/00691/FUL	Gloucestershire Airport	Raising of roof to provide additional office space		137sqm B1(a), B1(c)	9*
15/01133/FUL	Arle Court	Provision of a learning driver school			
15/01701/FUL	GCHQ	Temporary Office Block		4500sqm B1(a)	318*
15/01786/COU	Maguires Transport (Skanska)	Change of use from B2 to B8 Storage		800sqm B8	9*

[4] https://inform.gloucestershire.gov.uk/media/2082290/current-population-of-gloucestershire-overview-2017.pdf
[5] https://inform.gloucestershire.gov.uk/media/2082298/overview_-_population_projections_for_gloucestershire_2016-41-2.pdf
[6] https://www.nomisweb.co.uk/reports/lmp/la/1946157372/report.aspx
[7] https://inform.gloucestershire.gov.uk/media/1520759/economy_of_gloucestershire_2017-35.pdf

16/00439/FUL	Gloucestershire Airport	Temporary car park for car dealer storage (85 spaces)			
16/02302/FUL	Land at Arle Court	Extra care facility	10,036sqm C2		
16/02308/FUL	GCHQ	Visitor centre entrance building		75sqm B1(a)	5*
17/00337/FUL	Talbot House (Former Police station)	Development of former police station site to residential	68		
17/00517/FUL	396 Gloucester Rd	New dwelling + Change of use from D1 to C3 Resi	2		
18/00101/FUL	Briarfields, B4063	12 Glamping pods	12 Glamping pods		
18/00741/FUL	Gloucestershire Airport	Flight Training Academy	2,336sqm (C2) / 79 beds		
18/01044/FUL	Corinthian Way	Mixed use, office space, day care, food shop		5914sqm B1(a), 502sqm D2, 1742sqm A1 (Full permission)+ 8034sqm B1(a) (Outline)	1183*
18/01180/FUL	Rear Nuffield Hospital	3 storey office block		3680sqm B1(a)	260*
19/00431/FUL	Monkscroft Villas	Replacement of existing flats with new dwellings	27		
19/01132/FUL	Cotswold BMW	Temporary Car Park 161-243 spaces			
19/01190/OUT	Former Monkscroft School	Development of former school site to residential	60		

2.4.3. Strategic Development Sites

The JCS Housing Strategy (2011 – 2031) has a number of Strategic Allocations that are located close to the A40 corridor. The locations of these sites are shown in Figure 2-4 below.

Figure 2-4 - JCS Strategic Land Allocations near to M5 J11 to Arle Court Roundabout

Within the Strategic Allocation Sites are two key sites:

- North West Cheltenham (also known as Elms Park) – allocated for 4,285 houses and 23.4 hectares of Employment Land; and
- West Cheltenham – allocated for 1,100 houses and 45 hectares of Employment Land.

It is important to note that the scheme **is not** solely for the enabling of the North West Cheltenham and West Cheltenham developments and is not specifically for their benefit. This is due to a number of factors:

- Existing Traffic Congestion – there is existing congestion in the area. Therefore, the improvements are at present for the local community, both residents and local businesses to reduce the level of delay and enable developments to be brought forward quicker;
- Planning Status – although within the JCS Strategic Allocations, neither site has full planning permission, and both developers need to submit a full Transport Assessment to determine the impacts on the network and levels of traffic that are generated. Therefore, the results of this work and negotiations with the County Council cannot be anticipated or predicted.
- Timescales – the LEP funding is time limited and needs to be committed before the end of 2021. Therefore, the Strategic Allocations will only be at an early stage by 2021 and will only be approaching full build-out towards the end of the JCS period (2031). As a result, the scheme needs to address the existing issues and growth over the next few years as a priority, and at the same time enabling and encouraging early development of the first phases of the Strategic Allocations.

For the West of Cheltenham Development, Gloucestershire County Council's Highways Development Management (HDM) team have contributed the following view:

The developers of the Cyber Park (West of Cheltenham Strategic Site) are currently undertaking traffic modelling, which will include the planned build out programmes. The outputs are not available at the time of submission of this Full Business Case and should be available later this year. However, due to the quantum of

development proposed it is highly likely that planning conditions will be necessary for the advance construction of some or all of the West Cheltenham Transport Improvements Scheme – UK Cyber Business Park Schemes in order to appropriately mitigate impact and create capacity on the A40 corridor to enable the development of the JCS strategic site.

Therefore, an approach to the assessing the levels of traffic in the local area have been agreed with the Independent Assessors acting for the LEP and explained in the modelling assessment within this report.

2.4.4. Future travel demand

TEMPro forecasts for the AM Peak in the Cheltenham area indicate greater growth in car trips originating in Cheltenham than trips ending there, as shown in Table 2-3. This suggests that there will be a greater growth in housing and residents in Cheltenham than there is of jobs, reflecting the ageing population but also leading to out-commuting, and making strategic connections such as the A40 and M5 via Arle Court Roundabout critical for connecting people to jobs.

Table 2-3 - TEMPro trip end forecasts and growth factors for Cheltenham 2017-31 (AM peak)

		2017	2021	2031
Growth Factor	Origins	-	1.0278	1.0823
	Destinations	-	1.0183	1.0635
Trip Ends	Origins	69,403	71,333	75,118
	Destinations	76,562	77,961	81,426

Source: TEMPro (7.2) – all modes and purposes

2.4.5. Planned changes in the transport network

Apart from the West of Cheltenham Transport Improvement Scheme, a number of changes and highway improvements in the area are at various stages of planning. These include:

- Converting M5 J10 to an all-movements junction;
- Innsworth Gateway, a new roundabout to the west on the A40 (Gloucester Northern Bypass) providing access to the Innsworth development, another strategic allocation in the JCS; and
- Capacity improvements at Longford (A40/A38) roundabout.

The Phase 2 widening scheme has the potential to complement these other schemes along the A40, contributing to improved journey times and reliability, and therefore the capacity for growth, in the corridor between the Forest of Dean, Gloucester and the M5 and Cheltenham.

2.4.6. Future traffic flows and network performance

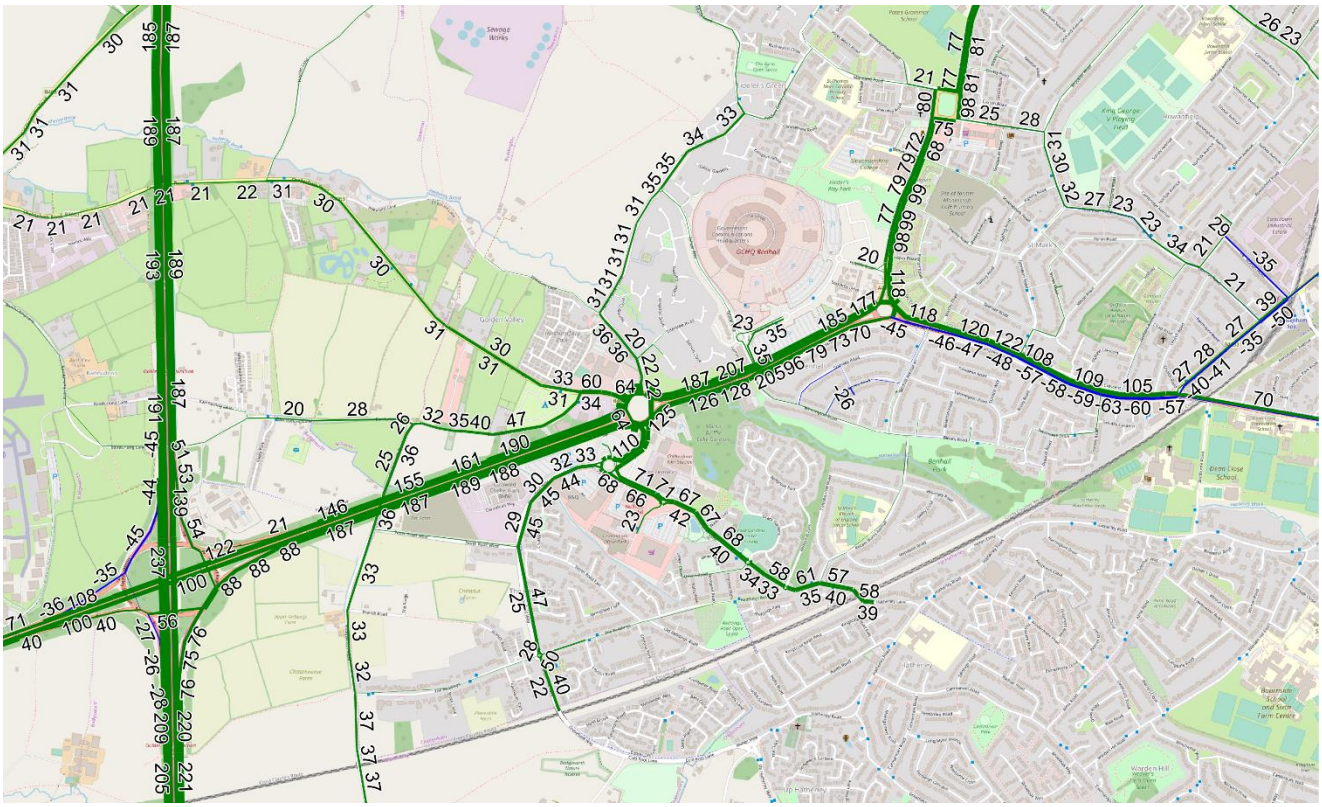
The following section presents outputs from the A40 Paramics microsimulation traffic model developed to appraise the scheme for the Do-Minimum scenario, and therefore provides a calculated estimate and prediction of likely changes in traffic flows and behaviour. In 2021, the Phase 1 (Arle Court Roundabout) scheme is included but the A40 eastbound carriageway remains with its present arrangement and two lanes up to the roundabout. Traffic demand growth is constrained to TEMPro (7.2) forecasts.

Figure 2-5 and Figure 2-6 show the forecast changes in vehicle flows on the modelled road network for the AM and PM Peak hours from the 2017 base model to the 2021 Do-Minimum forecast. In both time periods, the increase in demand in the region leads to increases in flow on the A40 between the motorway and the centre of Cheltenham. In the eastbound direction, this exceeds 100 vehicles in both of the peak hours, adding to the pressure on the already-congested road network.

At the A40 eastbound merge, there is notably no significant change in flow despite the general flow increases on the M5 and A40. This indicates that the slip is already operating at capacity, and that the additional traffic on the A40 mainline only serves to make it even more challenging for traffic to merge at peak times. In this way, the slip road is forecast to be a constraint to future growth, limiting connectivity between Cheltenham and destinations via the M5.

Figure 2-5 - Growth from Base 2017 to 2021 (including Phase 1) - AM

Figure 2-6 - Growth from Base 2017 to 2021 (including Phase 1) - PM



Modelled journey times were also calculated. As shown in Figure 2-7, these cover the M5 between J10 and J11 and the A40 from Benhall Roundabout to M5 J11, with the journey times, in seconds, summarised in Table 2-4 and Table 2-5. The base signal timings are not well optimised for the traffic conditions. For this reason, the impact of changing the signal timings to the 2021 values is presented before showing the impact of increasing the demand.

Without intervention, the additional demand on the A40 has an adverse impact on journey times in both of the peak hours, especially in the eastbound direction. In the AM peak hour, the eastbound journey time on the A40 increases by 24 seconds, while the during the PM peak hour it increases by some 107 seconds.

Figure 2-7 - Journey time route

Table 2-4 - Change in journey time along the A40 – AM peak hour 2017 to 2021 (Seconds)

Section		2017 Base	2021 Do-Minimum (Base demand)	2021 Do-Minimum	Difference (2021 Do-Minimum vs Base demand)
1	SB	181	180	177	-3
	NB	219	209	210	1
2	EB	362	88	91	3
	WB	56	61	61	0
3	EB	124	114	135	21
	WB	162	98	104	6
A40 (2&3)	EB	486	226	226	24
	WB	218	165	165	6
Full route	**SB**	**668**	**382**	**403**	**21**
	NB	**437**	**368**	**374**	**6**

Table 2-5 - Change in journey time along the A40 – PM peak hour 2017 to 2021 (Seconds)

Section		2017 Base	2021 Do-Minimum (Base demand)	2021 Do-Minimum	Difference (2021 Do-Minimum vs Base demand)
1	SB	177	172	181	9
	NB	214	214	215	1
2	EB	129	98	124	26
	WB	56	61	61	0
3	EB	230	111	192	81
	WB	206	92	95	3
A40 (2&3)	EB	359	209	316	107
	WB	262	153	156	3
Full route	**SB**	**535**	**380**	**497**	**117**
	NB	**476**	**367**	**371**	**4**

2.5. Summary of identified problems and impact of no intervention

Table 2-6 - Summary of identified problems and impact of no intervention

Challenge	Impact identified
Limited capacity on the A40	Despite general increases in traffic on the M5 and A40, there is no significant change in flow on the A40 eastbound merge. This indicates that the slip is already operating at capacity, acting as a constraint to future growth by limiting connectivity between Cheltenham and destinations via the M5.
Increased journey times on the A40	Notwithstanding the benefits of signal optimisation, journey times on the A40 are adversely impacted by the increase in demand. In the AM peak hour, the eastbound journey time on the A40 increases by 24 seconds, while during the PM peak hour it increases by some 107 seconds.
Population and employment growth	The population of Cheltenham is expected to grow by 9.3% from 2017 to 2041. It is also ageing, with 28.9% of the population expected to be in the 65+ age group by 2040. An ageing population will present financial and

	resource implications for Gloucestershire in the future. By investing in infrastructure that can contribute to enabling a growth zone in the M5 corridor, Gloucestershire can mitigate these challenges by attracting the businesses, jobs and working age population that it needs to prosper. More housing and jobs will be needed to support this increased population, and the JCS identifies land for an additional 35,175 houses across Cheltenham, Gloucester and Tewkesbury. GFirst's SEP identifies a need for nearly 34,000 jobs in Gloucestershire in the period 2014-2022. This development will add to the strain on what is an already-congested road network.
Strategic land allocations in the JCS are near the A40	Most notably the 'West Cheltenham' strategic allocation lies just off the A40 next to GCHQ and a proportion of the traffic from this site would use the A40 eastbound from the motorway. While West Cheltenham is not considered to be dependent on the scheme, without intervention this development would only add to the pressure at the junction.

2.6. Objectives of the scheme

In response to these future challenges, GCC has developed a set of key objectives for the scheme which were reviewed and agreed by GFirst LEP. These objectives also led to the provisional allocations of the funds and are as follows:

- Contribute to accelerating the release of the employment land associated with the 'West Cheltenham' Strategic Allocation along with the other strategic allocations in the JCS adjacent to GCHQ, which includes the proposed Cyber Park and Cyber Innovation Centre;
- Deliver transport benefits to people living and working in Gloucestershire by improving traffic flows on the A40, one of the most important and busiest sections of Gloucestershire's road network;
- Aim to have an overall neutral impact on the Cheltenham Air Quality Management Area (AQMA);
- Maintain and improve the options for sustainable travel modes through the junction and on the approaches; walking, cycling, and where feasible providing for enhanced public transport facilities.

2.7. Scheme constraints and dependencies

2.7.1. Design constraints

There are a number of critical scheme design constraints and dependencies for the project, of which the constraints are predominately physical, and the dependencies related to the planning programme and phasing of schemes being implemented.

2.7.2. Planning dependencies

Improvements to the operation of the A40 inbound and outbound from Cheltenham are essential to realise the full benefits of the planned Strategic Allocations Sites (West of Cheltenham and NW Cheltenham). At the time of submission, no Strategic Sites have planning permission, and therefore schemes are not directly linked to WCTIS. It is however likely that without the scheme, the scale of development that can be approved would be constrained and the efficacy of any other mitigation measures reduced. There are also Local Planning Applications for smaller development sites in the area. In addition, Highways England has a programme of highways and bridge improvements for the M5, and the scheme at A40 eastbound on-slip will have to be sensitive to these changes and the impacts of construction.

The proposed WCTIS works would fall within the definitions of permitted development as works carried out by the highway authority, required for the improvement of the road either on land within the boundaries of a road or on land outside but adjoining the boundary of an existing highway, under Section 55(2)(b) of the Town and Country Planning Act 1990 and Part 9, Class A of the Town and Country Planning (General Permitted Development) (England) Order 2015.

Screening and scoping assessments are being carried out to determine whether the Scheme is likely to have significant adverse effects requiring an Environmental Impact Assessment (EIA). It is currently envisaged that the overall scheme will not have significant adverse impacts. However, If the relevant local planning authorities determine that the Scheme is EIA development, then permitted development rights would be removed and a planning application would be required.

In terms of Strategic approach and dependencies, there is clear justification to undertake Phase 2 now, there are a number of key drivers, including the following:

- It is intended that Phase 2 construction be closely co-ordinated with and follow very closely on from Phase 1 (Arle Court Roundabout Improvements), therefore achieving significant economies of scale and ability to plan both phases together:
- Scheme costs can be reduced because of the use of a shared site compound;
- Delays and disruption will be minimised by co-ordination of Phase 2 works with Phase 1 and Highways England works in the area.

2.8. Scheme selection and option identification

2.8.1. Outline Business Case – scheme selection

All phases of the scheme (for WCTIS) have been evaluated and prioritised through a comprehensive evaluation process, described in the Outline Business Case. This started with an initial assessment of 23 combined options on the corridor to identify those schemes that would be taken forward to the next stage of evaluation. This is summarised in the Schemes Prioritisation Master Schedule, included with the Outline Business Case. Consideration was given to whether each scheme had the potential to meet the objectives and was deliverable. The criteria used in the assessment is listed below, with those schemes meeting the criteria taken forward to the next stage of evaluation.

Transport Objectives

- Deliver transport benefits to people living and working in Gloucestershire by improving traffic flows on one of the most important and busiest sections of Gloucestershire's road network;
- Neutral impact on the Cheltenham Air Quality Management Area (AQMA); and
- Maintain or improve the options for sustainable travel modes through the junction and on the approaches. Walking, cycling and where feasible providing for enhanced public transport facilities.

Deliverability Objectives

- Most suitable for the funding source (LEP);
- Deliverability; and
- Ensuring additional land was not required to avoid extended purchase negotiations.

A priority status was attached to each scheme on the basis of the above criteria for the assessment. This led to the allocation of schemes to be discounted, low, medium or high priority. Only schemes that were identified as high and medium priority – a total of 11 scheme combinations – were taken forward to further detailed assessment.

A detailed assessment was then carried out for these 11 options, assessing them against the core business case criteria listed below:

- Economy;
- Social;
- Environmental impact;
- Verify Deliverability (within LEP time scale of 2021); and
- Indicative Cost.

The scoring is summarised below. Note that the A40 eastbound widening scheme scores highly, with a Cumulative Assessment Score of 61.0, justifying the carrying forward of WCTIS Phase 2.

The Phase 2 scheme was part of Option 6 in the priority assessment, which is now split in to Phases 1 and 2. The scheme has not fundamentally changed since the OBC, but has been through a rigorous detailed design and modelling exercise, as reported in this document.

Table 2-7 - Scheme priority assessment

	Project	Assessment Cumulative Score
1	Arle Court Roundabout Capacity Improvements	70.0
2	Benhall Roundabout Capacity Improvements	65.5
3	*Staverton Crossroads Capacity Improvements	65.5
4	**M5 Jct 11 South Bound Off Slip Capacity Improvements (May be part funded by HE)	64.5
5	Telstar Way Junction to A40 Improvements	63.5
6	A40 Eastbound - Widening M5 J11 to Arle Court, upgrade Westbound access to Park & Ride	61.0
7	Telstar Way Capacity Improvements	60.5
8	A40 Eastbound Telstar Way Junction to Benhall Roundabout Capacity Improvements	59.0
9	A40 Eastbound Benhall Roundabout to Esso Garage Capacity Improvements	57.5
10	*** Tewkesbury Road (A4019) Capacity Improvements (May be funded by Developers)	56.5
11	A40 Eastbound Arle Court Junction to Telstar Way Junction Capacity Improvements	52.5

* Staverton Crossroads Capacity Improvements could be developer funded or subject on another LEP funding stream. Discussions are ongoing with Highways England, who also have Cycle Superhighway scheme that runs through this junction.

** Highway England are developing a scheme through their VM process but decisions on preferred options will not be available in time for the proposed package.

*** The Tewkesbury Road scheme could be developer funded, however it has been included within the schedule as a contingency, in case the programme for the Highways England schemes conflicts with some of the proposals and the A40 schemes cannot be progressed.

2.9. Scheme impacts and outcomes

To forecast the impacts of the scheme, the Paramics model was adapted to create a “Do-Something” scenario which includes the A40 widening scheme. The outputs from this model were then compared to a “Do-Minimum” scenario (without the scheme) to determine the impacts. A cumulative approach has been taken for the modelling of the phases of WCTIS, and that therefore both the Do-Minimum and Do-Something scenarios include Phase 1 (Arle Court Roundabout). The results of these comparisons for journey times and traffic flows are summarised in the following sections.

2.9.1. Journey times

Modelled journey times along the A40 were calculated for both the Do-Minimum and Do-Something forecast models. As shown in Figure 2-7, these cover the M5 between J10 and J11 and the A40 from Benhall Roundabout to M5 J11, with the journey times, in seconds, summarised in Table 2-8 and Table 2-9 below. With the scheme, there are journey time reductions in the eastbound direction. This is logical since it is the direction which benefits from the scheme, with the largest improvement in the PM peak hour, at 58 seconds. The journey time on the route in the AM peak hour the journey time also decreases by 17 seconds.

Table 2-8 - Scheme impact on journey time along the M5 and A40 – AM peak hour 2021 (Seconds)

Section		2021 Do-Minimum	2021 Do-Something	Difference
1	SB	177	174	-3
	NB	210	210	-
2	EB	91	85	-6
	WB	61	61	-
3	EB	135	126	-9
	WB	104	104	-
A40 (2&3)	EB	226	211	-15
	WB	165	165	-
Full route	**SB**	**403**	**386**	**-17**
	NB	**374**	**374**	**-**

Table 2-9 - Scheme impact on journey time along the M5 and A40 – PM peak hour 2021 (Seconds)

Section		2021 Do-Minimum	2021 Do-Something	Difference
1	SB	181	173	-8
	NB	215	216	1
2	EB	124	115	-9
	WB	61	61	-
3	EB	192	151	-41
	WB	95	95	-
A40 (2&3)	EB	316	266	-50
	WB	156	156	-
Full route	**SB**	**497**	**439**	**-58**
	NB	**371**	**372**	**1**

2.9.2. Traffic flows

In addition to improving journey times, the scheme aims to allow more traffic from the A40 eastbound to merge onto the A40. The modelled flows on the slip were therefore extracted for both the Do-Minimum and Do-Something 2021 models. These are summarised in Table 2-10 below. The scheme permits an additional 6.1% vehicle movements in the AM peak hour and 6.7% in the PM peak hour.

Table 2-10 - Traffic flows on the slip road with and without the scheme, 2021

Time Period	Do-Minimum	Do-Something	Scheme impact
AM (08:00-09:00)	995	1,056	+6.1%
PM (17:00-18:00)	944	1,007	+6.7%

2.9.3. Summary of scheme impacts and outcomes

A summary of scheme impacts is presented in Table 2-11, which demonstrates that the scheme will achieve all the scheme objectives.

Table 2-11 - Summary of scheme impacts on transport objectives

Transport objectives	Summary of forecast scheme impacts
Contribute to accelerating the release of the employment land associated with the 'West Cheltenham' Strategic Allocation along with the other strategic allocations in the JCS adjacent to GCHQ, which includes the proposed Cyber Park and Cyber Innovation Centre	Improving connectivity between west Cheltenham and the SRN makes the area a more attractive place to invest and will increase demands to accelerate the release of employment land. The scheme will improve connectivity through reduced delay on the A40 eastbound on-slip, and increased traffic flow enabled by an increase to capacity. Journey times improve in the eastbound direction on the A40. The largest improvement is in the PM peak hour, at 58 seconds, and in the AM peak hour, the journey time saving is 17 seconds. Traffic flows increase on the slip road, reflecting the fact that more traffic is able to pass through with the increased capacity.
Deliver transport benefits to people living and working in Gloucestershire by improving traffic flows on one of the most important and busiest sections of Gloucestershire's road network	Monetised Transport Economic Efficiency of £10.7m in 2010 prices and values (Table 3-16 in the Economics chapter).
Aim to have an overall neutral impact on the Cheltenham Air Quality Management Area (AQMA)	The air quality assessment indicates that the scheme would not result in any new exceedances of AQS objectives or worsening of existing exceedances. No additional air quality mitigation for the operational phase of the scheme is therefore required (see section 3.3.6.
Maintain and improve the options for sustainable travel modes through the junction and on the approaches; walking, cycling, and where feasible providing for enhanced public transport facilities.	The Phase 2 scheme does not provide specifically for any new or enhanced sustainable transport facilities. However, by improving the operation of the road network in the area, it will also benefit local and national bus operators and passengers.

The scheme will also contribute towards a selection of the "Enablers for Growth" from the SEP, as detailed in Table 2-12.

Table 2-12 - Summary of scheme contribution to SEP Enablers for Growth

Enabler for Growth	Summary of forecast scheme impacts
Transport Projects – reducing congestion pinch points including the A40 from west of Gloucester through to Cheltenham town centre	The scheme is forecast to reduce journey times on the A40 into Cheltenham, by improving the operation of the A40 eastbound on-slip from M5 J11.
A40 Regeneration Areas – Improving Connectivity and Resilience	By reducing queuing on the M5 southbound off-slip at J11, the scheme will improve connectivity between the M5 and west Gloucestershire, including key regeneration areas such as the Forest of Dean.

3. Economic Case

3.1. Overview

The proposed phase 2 scheme aims to facilitates carriageway capacity improvements eastbound along the A40 from M5 Junction 11 to Arle Court Roundabout (Phase 1). This section of the A40 between the M5 Junction 11 and Arle Court currently experiences significant congestion in both the AM and PM peak periods. The congestion would be exacerbated by additional development such as Cyber Business Park

The scheme is expected to produce Present Value Benefit (PVB) of £10.71m over the 60-year appraisal period (2021 - 2080), of which £10.51m from the travel time savings, £0.21m from vehicle operating costs and change in Government Indirect Tax of -£0.01m.

The total scheme construction costs expressed as a Present Value of Costs (PVC) is £4.01m.

Overall assessment of costs and benefits generated by the project shows that the scheme achieves a **Benefit Cost Ratio figure of 2.67** with a Net Present Value (NPV) of £6.70 million. The scheme can be therefore categorised as achieving **high value for money** in the classification provided by DfT.

The sensitivity analysis carried out informs that on the optimistic scenario, where demand is expected to grow until 2031 levels in line with forecasting report prepared by Jacobs (7.2.Appendix B), the NPV reaches £7.88m, resulting in a BCR of 2.97.

There is a neutral impact overall to air quality and noise, as there is no significant impact to income quintiles 1-3. However, there is a slight adverse air quality impact for income quintile 4 and 5 and a slight adverse impact to noise for income quintile 5.

3.2. Methodology

3.2.1. Modelling

The modelling for the economics was based on the Paramics Discovery 19 model developed for the Phase 1 improvements scheme, covering a Do Minimum and Do Something scenario for the 2021 and 2031 forecast years.

The Do Minimum modelling scenario assumes that the Phase 1 scheme has already been implemented and is therefore consistent with the Do Something 3 model from the first phase.

The Do Something network comprises of the Do Minimum with proposed Phase 2 scheme in place. Phase 2 consists of capacity improvements to the M5 Junction 11 slip road onto the A40 eastbound, and A40 eastbound mainline widening between Junction 11 and the Arle Court Roundabout. More details can be found in the Phase 2 Modelling Report included as 7.2.Appendix A.

3.2.1.1. Compatibility with Economic Appraisal

To quantify the economic impacts, the Paramics models were converted into ones suitable for producing outputs for economics analysis. Table 3-1 lists the parameters defined by Systra which are essential to undertaking fixed trip matrix economic assessments.

Table 3-1 - Paramics and TUBA Parameters

Parameter	Setting / Comment
Seed Value	It is essential to undertake both the Do Minimum and Do Something model runs using the same random seed values in each case. This ensures consistency of the number of trips released and in their modelled characteristics.
Preserve Choice	The “preserve choice” option must be toggled on in all models. This ensures consistency of release link within a zone where multiple options exist.

Parameter	Setting / Comment
Simulation Time	The simulation must be run for long enough to ensure that all trips that are released between 07:00 and 19:00 complete their journey and are recorded in the outputs.

The Do Minimum and Do Something Paramics models were therefore set up following these settings, whilst keeping the original models separate for other forms of analysis. Additionally, with regards to the simulation time parameter, a total of 30 runs for the 2021 models and 40 runs for the 2031 models were carried out, with an extra cool-down hour without demand. This was to ensure that there are enough model runs where the additional simulated traffic during the AM and PM peaks was able to completely leave the network over the modelled period.

The runs were further filtered by removing those where the mean difference in distance and travel time from the average exceeded 15% for the 2031 models and 10% for the Base and 2021 models. This was to remove runs which experienced extreme changes from the average and were therefore potentially skewing the results. A list of the runs removed during this process is shown in Table 3-2.

Table 3-2 - Count and Seed Values of the Paramics Model Runs Removed During the Filtering Process

Model	Year	Count	Seed Value(s)	Count	Seed Value(s)
Base	2017	3	7, 12, 30	8	1, 15, 16, 18, 20, 22, 26, 29
Do Minimum	2021	2	5, 6	0	-
	2031	2	4, 13	8	1, 4, 6, 8, 16, 25, 26, 32
Do Something	2021	1	5	1	6
	2031	4	12, 29, 32, 38	13	1, 2, 3, 7, 9, 12, 29, 30, 31, 32, 34, 37, 40

Despite the same demand matrices being used across the DM and DS models, and due to how Paramics assigns trips, there are occurrences where a trip may occur for a particular Origin-Destination (OD) movement in one model and not the other. For TUBA modelling, these OD pairs need to be consistent across all modelled years for the AM and PM peaks separately, else TUBA flags a serious warning. Therefore, the model outputs were filtered across the years for the AM and PM peaks individually to contain only OD pairs which occurred across the Base, DM and DS models. The difference between the unfiltered demand and the final demand appraised is considered to be insignificant in the context of this study, see Table 3-3 below.

Table 3-3 - Proportion of Demand Filtered from the 2017, 2021 and 2031 Matrices

Time	Demand Year	Unfiltered Total	Filtered Total	Difference	% Difference
AM (08:00 – 09:00)	Base (2017)	27168	27114	-54	-0.20%
	2021	28622	28566	-56	-0.20%
	2031	31503	31443	-60	-0.19%
PM (17:00 – 18:00)	Base (2017)	27565	27442	-123	-0.45%
	2021	28861	28731	-130	-0.45%
	2031	31678	31536	-143	-0.45%

3.2.2. Estimation of Costs

The scheme capital costs have been estimated as £4.48m (2019 prices) see table below. A risk adjustment has been included which amounts to £0.90m (2019 prices). Table 3-4 displays the breakdown of the capital costs of the scheme in 2019 prices.

Table 3-4 – Capital cost of the A40 East Bound Widening scheme

Project Cost Components Phase 2 Cyberpark	Capital Cost Items	* Cost Estimate Status	Costs by year (£)				Totals
			Year of Estimate:				
			2018/19	2019/20	2020/21	2021/22	
		(O/P/D/T)					
Design & Management	Design fees, Surveys and trial holes, Land Purchase	P	£277,300	£600,000	£63,000		£940,300
Construction including Traffic-Related Maintenance	Non-Routine Re-construction	P	-	50,000	£2,591,900	-	£2,641,900
	Site clearance, Diversions of Statutory services. Widening and re-Surfacing of carriageway.						
Contingency	Risk Adjustment	P	-		£897,800	-	£897,800
Indirect Tax	Non-Recoverable VAT (if applicable)	-	-	-	-	-	-
Total Cost	(NB - Not Base Cost with Real Cost Adjustment)	P	£277,300	£650,000	£3,552,700	£0	£4,480,000

*O = Outline estimate, P= Preliminary estimate, D = Detailed estimate, T = Tender price

3.2.3. Maintenance Costs

The BCR has been calculated using capital costs only. To cover two surface treatments and a surface course resurfacing, the cost of the ongoing maintenance is estimated as £23.20 per m^2. Over a 30-year design life this would equate to £0.77 per m^2 per year. The scheme will construct additional carriageway area of 3350 m^2. The additional maintenance liability would therefore equate to £2,580 per year and GCC will include for this in maintenance budgets, and therefore does not impact on the budget and LEP funding for the Scheme. Therefore, operation and maintenance costs will be negligible for calculating the BCR.

3.2.4. Economic Appraisal Approach

Economic assessment compares the monetised costs and benefits of the proposed scheme against the alternative without scheme scenario. It also considers non-monetised impacts to provide a broad view of the scheme performance beyond that captured in the BCR.

The Economic Assessment for this scheme was carried out using standard procedures and economic parameters as defined by TAG Unit A1 – Cost Benefit Analysis.

The results from the different elements of the economic assessment are presented in TEE, PA and AMCB tables. The following key economic statistics are used to demonstrate the case for the scheme:

- The PVB (Present Value of Benefits) represents the total monetised benefits from the scheme, including the impact of the scheme on central government indirect tax revenues, discounted to 2010 prices and values;
- The PVC (Present Value of Costs) represents the total scheme investment and maintenance costs;
- The NPV (Net Present Value) represents the absolute difference between the PVB and PVC; and
- The BCR is the ratio of PVB to PVC and represents the scheme's overall value for money.
- The Appraisal Summary Table (AST) helps to summarises all the monetised, qualitative and quantitative impacts of the scheme.

3.2.5. Software used for the Appraisal

TUBA (Transport Users Benefit Appraisal) software (version 1.9.13) was used in this appraisal. This version incorporates the latest values set out in the DfT WebTAG data book (version v1.12) published in May-2019. This software has been produced by the DfT to carry out transport scheme economic appraisals using a 'willingness to pay' approach with fixed or variable demand. As noted, the economic impacts of a scheme are derived by comparing the future year situation with the scheme (Do Something scenario) to the situation without the scheme (Do Minimum).

3.2.6. TUBA Assessment and the use of Paramics Outputs in the Economic Appraisal

An economic assessment to facilitate the quantification and monetisation of scheme costs and benefits is undertaken over a 60-year economic appraisal period in accordance with the requirement of TAG Unit A1.1. Economic assessment results are presented in the form of Transport Economic Efficiency (TEE), Public Accounts (PA), and Analysis of Monetised Costs and Benefits (AMCB) tables. The results are also input to an Appraisal Summary Table (AST) and combined with qualitative assessments which demonstrate overall VfM.

The following sections provide details of how the various elements of the Paramics transport model outputs have been used within the TUBA economic assessment to conduct the economic appraisal.

3.2.6.1. Time Periods

The Paramics model was developed for a base year of 2017. This model has been used to develop forecast models for 2021, which corresponds to the scheme opening year, and 2031 forecast years for a Do Minimum scenario and a Do Something scenario.

Models have been developed for AM and PM peak periods, which cover:

- AM Peak: 0700 to 1000
- PM Peak: 1600 to 1900

For input into TUBA, outputs were taken from the model in the peak hours:

- AM Peak: 0800 to 0900 hours
- PM Peak: 1700 to 1800 hours

Although 3-hour demand matrices were assigned using 3-hour average demand profile, the first and the last hours acted as the warm up period and cooling off period respectively.

3.2.6.2. Demand

Three matrix levels, one for car, one for LGV's and one with a combination of OGV1 and OGV2 are included within the model:

- Matrix Level 1 = Car (100%)
- Matrix Level 2 = LGV (100%)
- Matrix Level 3 = HGV with split of OGV1 (50%) and OGV2 (50%)

Accordingly, the Paramics model has produced demand, time and distance skims/matrices required for TUBA assessments for three user classes only, namely for Car, LGV and HGV.

3.2.6.3. Derivation of Annualisation Factors

Annualisation factors are used to scale-up the modelled hours to represent traffic in peak periods throughout the year. In line with the calibration and validation methodology and in order to guarantee accuracy in the economic analysis, only demand of the AM peak hour of 0800-0900 and the PM peak hour of 1700-1800 were used in the economic analysis. To obtain annualisation factors, a comparison analysis of single hour demand to the overall 3-hour demand for the AM and PM peaks was carried out. Based on this analysis the peak hour to peak period expansion factors were derived as:

- AM Peak: 2.64
- PM Peak: 2.76

Using this expansion factor, the derived annualisation factors are as follows:

- Weekday AM Peak – 668
- Weekday PM Peak – 698

Note: Number of weekdays was considered 253 days (365 total days in a year, reduced by 104 weekend days and 8 Bank Holidays)

3.2.6.4. User Classes and Journey Purposes

As explained in previous section, the demand matrices have been taken from the M5 Junction 11 and 12 Paramics Discovery Model developed by Amey that disaggregates the demand by purpose in three user classes. These three user classes have been further segregated into following seven user classes as per WebTAG guidelines as required for the TUBA economic appraisal:

- Car Commuting;
- Car Business;
- Car Other;
- OGV1;
- OGV2;
- LGV Personal; and
- LGV Freight.

The Car user class was disaggregated using TUBA default purpose splits defined in the economics file[8]. The LGV user class was disaggregated into LGV Personal and LGV Freight using the WebTAG Data Book Table A1.3.4, giving a default proportional split of 12% for LGV Personal and 88% for LGV Freight. The HGV user class was disaggregated into 50% of OGV1 and 50% of OGV2 using the original split of matrix level 3 used in the M5 Junction 11 and 12 Paramics Discovery Model developed by Amey.

[8] TUBA default purpose splits are based on WebTAG Data Book Table A 1.3.4.
Default purpose split: for AM Peak 16.5% Car Business, 44.1% Car Commute and 39.4% Car Other, while for PM Peak 11.8% Car Business, 41.3% Car Commute and 46.9% Car Other.

3.2.6.5. Travel Time Savings

Travel time savings are calculated using the 'rule of a half' applied to generalised time skims from the Traffic Model. Since there are no modelled tolls, and parking costs are not included in the M5 Junction 11 and 12 Paramics Discovery Model developed by Amey, generalised time equates solely to in-vehicle time.

Travel times in the traffic model are represented in seconds. These have been converted to vehicle hours and annualised for each time period, so that annual travel time savings can be calculated.

Annual time savings are calculated for each modelled year by comparing the DS and DM time skims extracted from the Paramics model. Benefits for non-modelled years are calculated via linear interpolation between modelled years, and flat-line extrapolation beyond the final modelled year. However, the impact of discounting on estimated benefits means that the benefits 'curve' declines towards the end of the appraisal period.

Default economic assumptions have been applied, as contained in the TUBA software (v1.9.12) and based on the guidance contained in the DfT WebTAG data book (version v1.11.1) published in November-2018.

3.2.6.6. Vehicle Operating Cost Savings

Vehicle operating costs (VOCs) are calculated for both fuel and non-fuel elements of the journey, based on formulae set out in the DfT's WebTAG guidance. The 'rule of a half' formula is broadly applied as for travel times, but with vehicle operating costs being based on distance travelled (vehicle-kilometres) and average vehicle speeds. The change in distance travelled as the result of the scheme is measured by comparing the Paramics model skim matrices values in DM and DS. Additionally, the average network speed for each scenario is derived from the time and distance Paramics skim matrices and the change is then measured by comparing the DM and DS values.

All assumptions relating to fuel costs, duty and vehicle efficiency are those contained in the default TUBA economics file. The same annualisation factors as defined above are applied to derive VOC benefits.

3.2.7. Present Value of Costs

The scheme construction costs have been estimated by the engineering team. These include the results of a quantified risk assessment (rather than Optimism Bias) and the effects of construction price inflation, as presented in section 3.2.2.

To convert the costs to Present Value Costs (PVC), the following adjustments have been applied:

- Values converted into 2010 prices;
- Real inflation added (i.e. Tender Price Index or Retail Price Index depending on the cost type less background inflation);
- Optimism bias was considered at 15%. As scheme costs are based on an estimation stage prior to the detailed design, an optimism bias of 15% to the total costs was applied, in line with guidance set out in DfT TAG unit A1-2.
- Conversion to market prices (using a factor for the average rate of indirect taxation in the economy of 1.19); and
- Discounting to 2010 at 3.5% per annum.

3.3. Environment

A high-level proportionate assessment has been conducted to gauge the environmental sensitivity of the scheme, providing information on environmental features and impacts within a 2km search area. Suggested mitigation measures and further studies required to limit these impacts that can be implemented as the scheme progresses are also provided where impacts are assessed to be significant.

3.3.1. Biodiversity

A desktop assessment and extended Phase 1 Habitat Survey were conducted in 2018. The scheme has evolved since then and includes works that may not have previously been considered. Atkins have undertaken a Preliminary Ecological Appraisal (PEA) of the Scheme in September 2019. It is therefore important to note

that this summary is based on incomplete survey information and, as a consequence, may not identify all of the biodiversity issues associated with the scheme.

The desktop survey found two statutory sites within 2km of the works required to deliver the Scheme: Badgeworth Site of Special Scientific Interest (approximately 900 m to the South) and Griffith Avenue Local Nature Reserve (approximately 1.5km to the east). Three other designations were also identified: Cold Pool Lane Conservation Road Verge, and two 'Unconfirmed Key Wildlife Sites'. There should be no impact from the Phase 1 Scheme on any statutory or non-statutory sites.

Surveys identified the following habitats of potential ecological value within the Scheme area: linear strips of deciduous woodland, scrub, a shallow slow-flowing watercourse, semi-improved neutral grassland (road verges). The Scheme will impact upon these areas. Deciduous woodland is identified as a Priority Habitat on the Priority Habitat Inventory. Some loss to deciduous woodland is unavoidable but the Scheme should seek to keep this to the absolute minimum necessary. Impacts on the watercourse should also be kept to a minimum.

Some vegetation clearance occurred within the scheme area after the ecological survey was undertaken, but the extent of removal is not recorded. Further ecological surveys have been scheduled for September 2019 to inform which ecological constraints remain present.

Two badger setts are present on the site (as recorded in December 2018): An abandoned badger sett that has partially collapsed and a single abandoned collapsed badger sett entrance (locations are given in the report of the 2018 Phase 1 Habitat Survey). Other evidence of badger activity was recorded but no other setts. Usage of the badger setts will be re-assessed during surveys scheduled for September 2019. If the setts continue to show no signs of use, they offer no significant constraints to the proposals.

Several of the trees and structures within the Scheme area were identified as having potential for roosting bats:

- A bridge structure situated at SO 89823 21296 where the A40 extends over the M5 J11 roundabout on the east side was identified as having low bat roosting potential owing to the presence of gaps between the metal supports;
- Two beech trees with dense ivy situated at SO 90770 21646 identified as having medium bat roosting potential;
- A group of two mature and 3 semi-mature trees situated at SO 90749 21639 identified as having medium bat roost potential owing to the presence of dense ivy; and
- An ash tree situated at SO 90655 21602 identified as having low bat roosting potential owing to the presence of dense ivy over most of the main trunk and branches.

Two additional features were identified just outside the Scheme:

- An outbuilding situated at SO 90188 21393 on the south side of the A40 identified as having low bat roosting potential owing to the gaps and ivy located on the eaves; and
- An outbuilding situated at SO 90223 21400 on the south side of the A40 identified as having medium bat roosting potential owing to the moderate amount of gaps and cracks and presence of dense ivy within and on the structure.

There is a potential for the works to impact the above trees or structures either directly through vegetation removal or indirectly through noise, vibration and light pollution. The current status of these trees and structures will be reassessed during surveys scheduled for September 2019. Further bat surveys and mitigation measures will be necessary prior to scheme commencement to comply with legal requirements regarding the protection of bats and their roosts.

Previous surveys identified that there are several ponds within the vicinity of scheme. Great crested newts (GCN) can use habitats within 500m of breeding ponds but tend to make greater use of habitat within 250m. The Figure below shows a 250m buffer around an indicative Phase 2 works extent and shows ponds identified from desk assessment (circled in blue).

The Atkins PEA will determine the number and location of ponds within 500m of the Scheme, will include an assessment of ponds within 500m of the scheme (where access allows) and will assess the risk of impacts to GCN.

Until the ponds are assessed, it must be assumed that they have suitability for GCN, and that there is a possibility of impacting GCN or their habitat during the works. Where the chances of impacts on GCN are

limited, (either minor works or works in locations distant from a pond) a Precautionary Method of Working (PMW) may be applicable and is likely to include mitigation (for example careful vegetation clearance and ecological clerk of works). More significant works or works close to ponds used by GCN will require a European Protected Species (EPS) Licence issued by Natural England, as well the measures outline above. This is likely to require an appropriate method to clear the site of any GCN and translocate them to a safe location prior to works. Depending on the results of the PEA, further surveys during March to June 2020 may be required to confirm the great crested newt status of the ponds (this would be necessary to inform any EPS Licence application). This could potentially impact on the construction programme.

Surveys have identified potential for common species of reptile and amphibian within the scheme area. Appropriate mitigation (for example careful vegetation clearance and ecological clerk of works) will be required during site clearance works and any species of common reptile will need to be re-located to an appropriate place of safety (either within the scheme or at possibly on a separate 'receptor site' which might need to be created or enhanced). There is habitat suitable for nesting birds and appropriate mitigation will be required during site clearance, ideally through the avoidance of the bird nesting season.

The Atkins PEA and further bat surveys will identify the need for any further ecological field surveys prior to commencement of works to ensure findings are complete and up to date and mitigation is appropriate.

Appropriate measures will be required in relation to protection of water courses from silt and other contaminants.

3.3.2. Water environment

Environment Agency national scale flood mapping indicates that the proposed development site is located within Flood Zone 1, and thus has a low risk of flooding, see figure below.

Figure 3-1 – Flood Zone Area

The Hatherley Brook, a Main River, runs beneath the A40 Gloucester Road, to the east of Arle Court Roundabout for which there is an associated flood risk. The proposed scheme does not fall within the floodplain of the Hatherley Brook, with Flood Zone 2 over 200m away from the Arle Court roundabout, and it is not anticipated that it will directly impact upon the watercourse. There is an existing Ordinary Watercourse east of Badgeworth Road culverted underneath the A40 which is likely to require an extension as a result of the earthworks widening. Any culvert extension is likely to require a Water Framework Directive (WFD) assessment, and potentially WFD mitigation measures such as a river realignment.

The Environment Agency Risk of Flooding from Surface Water (RoFSW) maps show that sections of the A40 have a medium to high risk of flooding from surface water. The flood extents shown on the RoFSW on the southern side of the A40 are the floodplain of the Ordinary Watercourse crossing the A40. Widening of earthworks within the floodplain will require compensatory flood storage to be provided, this will be assessed within the Flood Risk Assessment produced for the scheme. Any changes to floodplain storage as a result of the proposed works may impact adjacent receptors (both upstream and downstream) such as businesses, residential properties and the local road network.

The proposed works will increase the hardstanding by widening the road and therefore there is potential to alter the existing surface water flow paths. As a result, the movement of surface water into the Hatherley Brook and the Ordinary Watercourse may be altered. The need for improved drainage will be investigated during the design stage and appropriate measures shall be put in place to ensure the risk of flooding from potential increased surface water is avoided.

A Flood Risk Assessment and Drainage Strategy will be produced for the scheme. The Flood Risk Assessment will require detailed hydrological and hydraulic modelling of the Ordinary Watercourse and may require channel topographic survey of the watercourse to be undertaken; this modelling will need to be approved by the appropriate regulator. Detailed design will be progressed in consultation with the Lead Local Flood Authority and Environment Agency to discuss any flood management actions/issues under the Flood and Water Management Act 2010. Appropriate pollution prevention measures will be implemented during construction and operation to prevent contamination of the water environment. Allowance for compensatory flood storage, surface water drainage features and WFD mitigation measures (such as river realignments) should be allowed for within the red-line boundary from an early stage of scheme development to ensure adequate allowance for mitigation is included.

It is anticipated therefore that with appropriate mitigation measures in place the overall effect of Phase 2 of the WCTIS with appropriate mitigation measures in place will be **neutral**.

3.3.3. Geology

The British Geological Survey (BGS) online open geosciences mapping indicates that the scheme is underlain by the Charmouth Mudstone Formation, part of the Lias Group. No artificial ground is recorded, however Made Ground associated with the previous phases of construction along the scheme is expected to be encountered.

Reference to two borehole logs undertaken in 2019 on the northern side of the A40 (approximately half way along the scheme) indicate the site to be underlain by Made Ground to 0.6m and 0.8m bgl overlying weathered Charmouth Mudstone Formation to 6.50m bgl and c.8.34m bgl. This formation is described as a stiff becoming very stiff grey silty clay with mudstone lithorelicts and extremely to closely spaced planar smooth fissures with fossils and shells. No groundwater was recorded during drilling. The weathered Charmouth Mudstone was underlain by the solid strata comprising weak indistinctly structured Mudstone with shells to 8.40m bgl.

Chemical analysis was undertaken on 2 No. shallow soil samples from each borehole (4 No. total). The analysis identified Polycyclic Aromatic Hydrocarbons (PAHs), heavy metals, TPH-CWG Aliphatic C12-C35 and Aromatic C16-C35 marginally elevated above the laboratory limit of detection (LOD) within BH3 and heavy metals above the lab LOD within BH4.

The topography of the surrounding area appears to be relatively level, with the exception of the slip road off the M5 and the slip road onto the A40. However, given the potential for residual shear planes to be present in the Lias Clay Group strata it is recommended that a watching brief is kept of all excavations by a suitably qualified Engineer in order that any shear planes may be identified.

There is a historic landfill site (Land off Hatherley Lane) located to the south of the scheme. The landfill was operated from 21/04/1994 to 06/10/1994 although no information on the waste accepted is available. It is not anticipated that the Phase 2 road realignment works will affect this feature.

There is no additional information on current or historical potential contamination issues along the scheme and consequently a full assessment of contamination risk cannot be completed. However, based on a review of readily available online data no contamination sources are anticipated on site. Contamination testing will be undertaken in conjunction with the geotechnical ground investigation that will be used to inform the MMP and/or SWMP.

The stiff to very stiff weathered Charmouth Mudstone is likely to be suitable founding strata for any proposed structures, pending confirmed loads.

The Charmouth Mudstone is a potentially pyritic strata and as such suitable sulphate resistant buried concrete used in construction.

There is no information on whether the scheme is located in the vicinity of a Mineral Safeguarding Areas (MSA). Further clarification on this matter is required.

Appropriate Construction Environmental Management Plans (CEMP), Site Waste Management Plans (SWMP) and/or Materials Management Plans (MMP) should be in place prior to commencement of works.

Consultation with the EA and LA will be required should visual evidence of contaminated land be identified during the works.

The overall effect of Phase 2 of the WCTIS is not considered to be significant.

3.3.4. Heritage

A high-level review of designated heritage assets and known non-designated heritage assets was undertaken, including collating details of any World Heritage Sites, Scheduled Monuments, Listed Buildings, Historic Parks and Gardens, Registered Battlefields and conservation areas within the proposed scheme location, and a 250m buffer identified as a study area for the scheme. Sources reviewed for this included:

- The National List for Heritage in England (NHLE) for designated heritage assets;
- Cheltenham Borough Council for Conservation Areas; and
- Heritage Gateway for non-designated heritage assets[9].

The review found that there were no World Heritage Sites, Scheduled Monuments, Historic Parks and Gardens, Registered Battlefields or conservation areas within the study area. In addition, there are no Grade I or Grade II* listed buildings within the study area.

The nearest designated heritage assets to the proposed scheme are Grade II listed buildings located on the eastern-most edge of the study area, grouped in three specific locations:

- Nesley Croft (1333240), a Grade II listed house, located on Fiddlers Green Lane at Edendale Approach;
- Redgrove Cottages (1104331, 1104332, an 1104333), a series of three Grade II listed cottages on Hatherley Lane; and
- Gate piers, railings, and gates to Arle Court (1245783) and the Lodge to Arle Court (1245785), both Grade II listed buildings on Gloucester Road, east of the Arle Court roundabout.

These listed buildings are surrounded by modern development and infrastructure, with very little contribution of setting to the expression of their significance. Nesley Croft, as a relatively intact 17th century house, retains some contribution of its close setting through association with nearby outbuildings, but is otherwise surrounded by modern business and housing estates. The 19th century buildings, including Redgrove Cottages and the piers, gates, and railings to Arle Court, are likewise surrounded by modern infrastructure and development, with little contribution from their setting, other than the immediate surrounding of the Redgrove Cottages, where they can easily be distinguished as part of a group.

In addition, Heritage Gateway includes two Gloucestershire HER records within the study area:

- Stone Cottage (HER 50255), the site of a post-medieval farm, demolished in the 1960s; and
- A cropmark thought to be a ring ditch (HER 48233) identified through aerial photography during the Severn Vale National Mapping Programme (NMP), located off Elm Garden Drive near the M5.

It is unlikely that anything significant remains from the post-medieval Stone Cottage as the location is now covered by a retail park. The cropmark off Elm Garden Drive suggests there is potential for buried archaeology in the study area that may extend into the proposed scheme. A desk-based assessment, to include a search of the Gloucestershire HER and consultation with the local planning authority archaeologist, is recommended to support any planning applications.

In summary, there are no known heritage assets of high value that would be substantially impacted by the proposed scheme, and the impact of the scheme on the historic environment is assessed as **neutral**.

3.3.5. Landscape and visual

The surrounding landscape is varied with linear strips of deciduous woodland, arable farmland, semi-improved grassland and considerable screening vegetation along the A40. Cutting back and some removal of trees and vegetation in 3 sections are required to accommodate the works which may open up views for approximately four properties, who already have glimpses of the A40. Avoidance of trees removal will be explored in detailed design, but replacement and enhancement planting would be proposed to mitigate any impact. The impact of the proposed works overall is expected to be **slight adverse** on the landscape and visual amenity of the area.

[9] www.heritagegateway.com includes publicly available information from the Gloucestershire Historic Environment Record (HER). It is intended to be used as an information baseline, but is not considered appropriate for planning purposes.

3.3.6. Air quality

Local air quality impacts for WCTIS Phase 2 were assessed following the guidance presented in TAG Unit A Chapter 3[10], updated May 2019.

Traffic data was for the with and without scheme scenarios for an opening year (2021) and forecast year (2031). The study area was defined by the extents of the traffic model area.

Road sources included in the traffic model were modelled using DEFRA's Emission Factor Toolkit (EFT) v9.0[11] published in May 2019. For this assessment, traffic data were input as annual average daily LDV and HDV[12] flows respectively and the annual average daily speed from the traffic model.

Total emissions of NOx and $PM_{2.5}$ for each link in the with and without scheme scenarios were calculated in the opening (2021) and forecast (2031) years. It was assumed that emissions of NOx and $PM_{2.5}$ would change incrementally between these two years and would remain unchanged post 2031 for the remainder of the 60 year appraisal period. The change in emissions is presented in the Appraisal Summary Table and air quality valuation workbook. The change in NOx and $PM_{2.5}$ emissions were used to determine a Net Present Value (£) for air quality for the proposed scheme.

Greenhouse Gases

Changes in greenhouse gas emissions were assessed following the guidance presented in TAG Unit A Chapter 4. The traffic data and emissions data prepared for the air quality study area were also used to calculate total emissions of CO_2 with and without the proposed scheme.

The change in CO_2 emissions as a result of the Proposed Scheme was calculated in the opening (2021) and forecast (2031) years. It was assumed that emissions of CO_2 would change incrementally between these two years and would remain unchanged post 2031 for the remainder of the 60-year appraisal period.

Assumptions

Vehicle emission factors are only available within the EFT up to 2030 and therefore the 2030 factors were used in the calculations for the forecast year (2031). This limitation is considered conservative, given that vehicle emissions are expected to improve further in the future, and is consistent with industry practice.

Results

Table 3-5 - Air Quality

Methodology	Value of changes in air quality
Appraisal (WebTAG)	**Emissions 60-year period (tonnes):** PM2.5: 3 NOx: 36 **Monetary £(NPV)** PM2.5 NPV: -£258,139 NOx NPV: -£172,019 **Total value of change in air quality: -£430,157**

The Cheltenham city-wide Air Quality Management Area (AQMA) borders the extent of the proposed scheme, and is unlikely to be significantly affected by changes in road traffic emissions as a result of the proposed scheme, as evidenced in the air quality assessment.

[10] Department for Transport - TAG Unit A3 -Environmental Impact Appraisal, published May 2019, Available from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/825064/tag-unit-a3-environmental-impact-appraisal.pdf
[11] Department for Environment and Rural Affairs – Emissions Factor Toolkit v9.0, published May 2019, Available from https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html
[12] LDV – Light Diesel Vehicles - weight<3.5 tonnes and HDV – Heavy Diesel Vehicles - weight > 3.5 tonnes

Overall there would be a small increase in $PM_{2.5}$ and NOx emissions across the traffic model area as a result of increases in road traffic movements across the wider traffic modelled area.

Table 3-6 - Greenhouse Gas Emissions (GHGs)

Methodology	Value of changes in GHG emissions
Appraisal (WebTAG)	**Change in non-traded carbon over 60y (CO2e tonnes)** +27,285 **Monetary £(NPV)** **-£1,226,561**

The change in non-traded carbon dioxide emissions in the opening year 2019 would be +209 tCO2e due to an increase in traffic movements across the model area. The results of the TAG assessment show that over the 60-year appraisal period there would be an increase in CO2 emissions, (+0.2% in opening year and +0.5% in forecast year) with a commensurate damage cost of £1.2m.

Conclusions

The results of this assessment suggest the proposed scheme is likely to result in limited increases in emissions of NOx, $PM_{2.5}$ and CO_2, as a result of increased road traffic movements across the traffic model area. Despite this, the impact on the AQMA itself is **neutral** since no new or worsening exceedances of AQS objectives are forecasted.

3.3.7. Noise and vibration

The Phase 2 project involves a number of improvements to the A40 between Junction 11 of the M5 and the Arle Court roundabout, including carriageway widening. The project also involves resurfacing of some of the carriageway, and the noise modelling has considered the effects of this due to the high speeds on the link (> 75 kph).

The proposed Phase 2 improvements are part of a larger package of works (Phases 1-4), the cumulative effects of which will be the subject of a separate Environmental Impact Assessment (EIA). However, for the purposes of this business case, only the potential effects of proposed carriageway widening/resurfacing are considered. It should be noted that the Do Minimum scenario for Phase 2 includes the effects of Phase 1, as it is assumed that this will already have been developed.

The Scheme is designed to alleviate congestion on this part of the A40, and therefore accommodate larger traffic flows at higher average speeds than is possible in the current scenario. The effects of these predicted changes have been modelled, in addition to the physical changes on and around the carriageway.

Noise Modelling

Study Area

The study area for the assessment of noise and vibration effects is defined in the DMRB 11:3:7 as 600 m from the carriageway edge of any proposed new routes or existing routes to be bypassed or improved, and 600 m from any other affected routes within 1 km of the proposed new routes or altered existing routes. An affected route is defined as where it is calculated that there is a possibility of a change of 1dB $L_{A10,18h}$ in the short term or 3dB $L_{A10,18h}$ in the long term (assessed between the opening year and the future year).

The DMRB provides the following methodology for identifying the size and extents of the study area:

1. Identify the start and end points of the physical works associated with the road project;
2. Identify the existing routes that are being bypassed or improved and any proposed new routes between the start and end points (for each option);
3. Define a boundary 1 km from the carriageway edge of each of the options identified in (2) above;
4. Define a boundary 600 m from the carriageway edge around each of the options identified in (2) above and also 600 m from any other affected routes within the boundary defined in (3) above. The total area within these 600 m boundaries is termed the 'calculation area';

5. Identify any affected routes beyond the boundary defined in (3) above; and
6. Define a boundary 50 m from the carriageway edge of routes identified in (5) above.

The study area includes several Noise Important Areas (NIAs), as follows:

- NIA 3901, a small Highways England NIA, located adjacent to the M5 J11 southbound exit slip-road
- NIA 3902, a small Highways England NIA, located adjacent to the M5 southbound carriageway, before the southbound exit slip-road diverges.
- NIA 3898, a small local-authority NIA, approximately 350 m west of the junction.
- NIA 3899, a local authority NIA covering an area of the A40 approximately 300 m east and west of the junction.

Methodology

Noise modelling has been undertaken to predict noise levels with and without the Scheme in its projected opening year (2021) and future assessment year (2031). This information was used to complete a detailed assessment in accordance with the guidance contained within the DMRB 11:3:7, consisting of the following elements:

- Prediction of daytime ($L_{A10, 18h}$) noise levels in the short-term (Scheme opening) and the long-term (future assessment year) at noise-sensitive receptors in the study area using the Calculation of Road Traffic Noise (CRTN) procedures and the advice in DMRB 11.3.7, Annex 4 / Interim Advice Note 185;
- Prediction of night-time (L_{night}) noise levels in the long-term at noise-sensitive receptors within the study area; and
- Assessment of noise levels at traffic links located in the wider area.

To complete the assessment, as outlined above, the following traffic scenarios have been modelled and assessed:

- Do Minimum (without the Scheme) in the opening year (DM 2022);
- Do Something (with the Scheme) in the opening year (DS 2022);
- Do Minimum in the future assessment year (DM 2037) and
- Do Something in the future assessment year (DS 2037).

The noise modelling was undertaken using NoiseMap v5.2.4 software and traffic projections provided by Atkins' transport team. The traffic data comprised 18-hour average annual weekly traffic flows for each traffic link in the study area and the wider area, and the corresponding traffic speed and fleet composition for each traffic link. The noise modelling software predicted the road traffic noise levels at sensitive receptors by implementing the calculation procedure detailed in CRTN, which involves calculating the Basic Noise Level at 10 m from the kerb using the traffic parameters described above and considering topography, ground absorption and screening from intervening structures.

No existing noise mitigation measures are present in the study area. The topographical model was built from scheme drawings and LiDAR DTM 2m data at locations further away from the Scheme.

Ordnance Survey base mapping (MasterMap) were used to establish the relevant noise sensitive receptors within the appropriate calculation area. This included residential noise sensitive receptors and non-residential noise sensitive receptors, such as schools, medical facilities and places of worship.

All buildings in the noise model were set to 6m in height. Noise maps were generated in each case at 4m height with a grid resolution of 10m.

Results

The noise modelling results are presented in the following figures in Appendix H:

- Figure 1: Absolute Noise Levels Daytime (LA10, 18h), Do Minimum Opening Year (2021)
- Figure 2: Absolute Noise Levels Daytime (LA10, 18h), Do Something Opening Year (2021
- Figure 3: Absolute Noise Levels Daytime (LA10, 18h), Do Something Design Year (2031)

- Figure 4: Noise Level Change Daytime (with scheme), Short Term (LA10, 18h) – Do Minimum Opening Year (2021) vs Do Something Opening Year (2021)
- Figure 5: Noise Level Change Daytime (with scheme), Long Term (LA10, 18h) – Do Minimum Opening Year (2021) vs Do Something Design Year (2031)
- Figure 6: Absolute Noise Levels Night-time (LA10, 18h), Do Minimum Opening Year (2021)
- Figure 7: Absolute Noise Levels Night-time (LA10, 18h), Do Something Design Year (2031)
- Figure 8: Noise Level Change Night-time (with scheme), Long Term (LA10, 18h) – Do Minimum Opening Year (2021) vs Do Something Design Year (2031)

Assessment

Potential Significance of Environmental Effects

As a starting point, assessment of the Scheme is undertaken using the magnitude of change descriptors provided in the DMRB 11:3:7. These are summarised in Table 3-7.

Table 3-7 - Classification of magnitude of noise impacts

Short-term noise change ($L_{A10,18h}$, dB)	Long term noise change ($L_{A10,18h}$, dB)	Magnitude of impact (adverse or beneficial)
0	0	No change
0.1 - 0.9	0.1 - 2.9	Negligible
1 - 2.9	3 - 4.9	Minor
3 - 4.9	5 - 9.9	Moderate
5+	10+	Major

Table Source: IEMA (2014) and DMRB Volume 11, Section 3, Part 7, HD 213/11

Detailed predictions have been carried out for a total of 701 residential receptors identified within the study area.

The sections below detail the short-term and long-term impacts of the Scheme. For short-term impacts, a comparison is made between the Do Something and Do Minimum scenarios in 2021, the opening year of the Scheme. For long term impacts as a result of the Scheme, a comparison is made between the Do Minimum scenario in 2021 and the Do Something scenario in 2031. Long-term impacts without the Scheme have also been considered.

Daytime road traffic noise levels

Table 3-8 onwards show the predicted changes in daytime noise levels (06:00 to 00:00) for residential and non-residential receptors in the study area. The predicted daytime noise levels throughout the study area are shown in noise change contours provided in Figure 4 and Figure 5 to illustrate how road traffic noise levels change in the short-term and the long-term.

The predicted changes in daytime road traffic noise levels in the short term with the Scheme are shown in Table 3-8.

Table 3-8 - Short-term traffic noise magnitude changes with the Scheme

Change in noise level		DMRB impact magnitude	Number of dwellings	Number of other sensitive receptors
Increase in noise level, $L_{A10,18h}$ dB	0.1 - 0.9	Negligible	554	0
	1 - 2.9	Minor	1	0
	3 - 4.9	Moderate	0	0
	≥ 5	Major	0	0

No change	0	No change	121	0
Decrease in noise level, $L_{A10,18h}$ dB	0.1 - 0.9	Negligible	25	0
	1 - 2.9	Minor	0	0
	3 - 4.9	Moderate	0	0
	≥ 5	Major	0	0

Table 3-8 and Figure 5 show that when the Scheme becomes operational, 554 properties will be subject to negligible increase in noise levels, no change is expected at 121 properties and a further 25 properties will be subject to a negligible decrease in noise level.

A minor increase in noise level is expected at 1 property when the scheme becomes operational. Changes at this property are due to predicted increases in road traffic flow and/or average speeds on nearby roads, and the location of the property is summarised as follows:

- 1 No. property Elm Gardens, Badgeworth Road;

For road traffic noise levels of minor magnitude, it is normally concluded that this change would not result in changes to behaviour or response to noise, and hence would not give rise to a potentially significant effect.

The predicted changes in daytime road traffic noise levels in the long-term with and without the Scheme are shown in the tables below.

Table 3-9 - Long-term traffic noise magnitude changes without the Scheme

Change in noise level		DMRB impact magnitude	Number of dwellings	Number of other sensitive receptors
Increase in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	327	0
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0
	≥ 10	Major	0	0
No change	0	No change	134	0
Decrease in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	240	0
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0
	≥ 10	Major	0	0

Table 3-10 - Long-term traffic noise magnitude changes with the Scheme

Change in noise level		DMRB impact magnitude	Number of dwellings	Number of other sensitive receptors
Increase in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	458	0
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0
	≥ 10	Major	0	0
No change	0	No change	55	0
	0.1 - 2.9	Negligible	188	0
	3 - 4.9	Minor	0	0

Decrease in noise level, $L_{A10,18h}$ dB	5 - 9.9	Moderate	0	0
	≥ 10	Major	0	0

Table 3-10 shows that in the long term, all receptors will be subject to a negligible change in noise levels.

With the Scheme, it is predicted that 458 properties will be subject to a negligible increase in noise level, with no change predicted at 55 properties and negligible decrease at 188 properties. Overall, the potential impacts of the scheme on daytime noise levels in the long term are negligible, and hence would not cause changes to behaviour or response to noise and vibration. As such, these will not give rise to a significant environmental effect in the long term.

Although there are minor impacts at one receptor expected in the short term, other factors must also be taken under consideration, such as the absolute level of noise. For this purpose, the absolute noise levels predicted at noise sensitive receptors in the opening year of the Scheme have been compared with the SOAEL of 68 dB $L_{A10, 18h}$.

Analysis of the predicted noise levels (Do Something 2021 / Do Something 2031) for the daytime indicates that there is potential for the SOAEL to be exceeded at a number of properties. However, the noise changes due to the scheme in the short-term would be negligible (<1dB). It is therefore concluded that no significant environmental effect is expected at these receptors in the short term.

Night-time road traffic noise levels

The change in road traffic noise levels at night throughout the study area has also been considered in the assessment of the Scheme.

Table 3-11 and Table 3-12 show the change in night-time noise levels in the long-term for properties with predicted noise levels above 55 dB L_{night}, as required by the DMRB 11:3:7.

Table 3-11 - Long-term traffic noise magnitude changes without the Scheme, Night

Change in noise level		DMRB impact magnitude	Number of dwellings	Number of other sensitive receptors
Increase in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	9	0
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0
	≥ 10	Major	0	0
No change	0	No change	5	0
Decrease in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	2	0
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0
	≥ 10	Major	0	0

Table 3-12 - Long-term traffic noise magnitude changes with the Scheme, Night

Change in noise level		DMRB impact magnitude	Number of dwellings	Number of other sensitive receptors
Increase in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	6	0
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0
	≥ 10	Major	0	0
No change	0	No change	6	0

Decrease in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	4	0
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0
	≥ 10	Major	0	0

The results show that in the long term, all receptors with predicted noise levels >55 dB L_{night} will be subject to a negligible change in noise levels.

Overall, the potential impacts of the scheme on night-time noise levels in the long term are negligible, and hence would not cause changes to behaviour or response to noise and vibration. As such, these will not give rise to a significant environmental effect in the long term.

Changes to road traffic noise levels in the wider area

To determine the potential effects within the wider area, the Basic Noise Levels (BNLs) were calculated using the methodology in the CRTN for road links outside of the detailed calculation area.

In the short-term and the long-term, the BNL calculations indicated that there are no affected road links outside of the DMRB detailed calculation area.

Noise Important Areas (NIAs)

In accordance with the Environmental Noise (England) Regulations 2006, and as defined within DEFRAs Noise Action Plan: Roads (2 July 2019), Important Areas with respect to noise from major roads outside agglomerations are where the 1% of the population that are affected by the highest noise levels from major roads are located (according to the results of the Round 3 strategic noise mapping).

In general, any increases in noise levels within NIAs are to be avoided, whilst improvements in noise level (i.e. a reduction) should be delivered, where possible.

Analysis of the short-term and long-term change maps for NIAs indicate that there may be negligible increases in road traffic noise for receptors in the following NIAs:

- NIA 3901, a small Highways England NIA, located adjacent to the M5 J11 southbound exit slip-road;
- NIA 3902, a small Highways England NIA, located adjacent to the M5 southbound carriageway, before the southbound exit slip-road diverges; and
- NIA 3898, a small local-authority NIA, approximately 350 m west of the junction.

Although the scheme impacts on receptors in NIAs are negligible, there may be opportunities for improving noise levels in NIA 3898 during the detailed design of Phase 2, for example, by provision of noise barriers and/or low noise road surfacing.

Noise Insulation Regulations (NIRs)

Regulation 3 of the UK Noise Insulation Regulations 1975 (as amended 1988), imposes a duty on authorities to undertake or make a grant in respect of the cost of undertaking noise insulation work in or to eligible (residential) buildings, subject to meeting certain criteria, as follows:

- The relevant noise level[13] is greater by at least 1dB(A) than the prevailing noise level[14] and is not less than the specified level[15], and

[13] "relevant noise level" means the level of noise, expressed as a level of L 10 (18-hour), one metre in front of the most exposed of any windows and doors in a facade of a building caused or expected to be caused by traffic using or expected to use any highway;

[14] "prevailing noise level" means the level of noise, expressed as a level of L 10 (18-hour), one metre in front of the most exposed of any windows and doors in a facade of a building caused by traffic using any highway immediately before works for the construction of a highway or additional carriageway, or for the alteration of a highway, as the case may be, were begun;

[15] "specified level" means a noise level of L 10 (18-hour) of 68dB(A).

- Noise caused or expected to be caused by traffic using or expected to use the highway makes an effective contribution to the relevant noise level of at least 1 dB(A).

It is important to note that the above refers to the effects of noise cause by a new or improved highway, and not to any effects on the wider road network as a result of the Scheme.

Analysis of the absolute noise level maps[16] and change maps indicates that there are no dwellings in the vicinity of the junction improvements where noise levels have the potential to meet both of the above criteria. There is therefore no risk that the Phase 2 scheme would, in and of itself, trigger works or grants in respect of the NIRs.

webTAG Appraisal

An appraisal of predicted changes in noise level across the study area (as determined in accordance with DMRB 11:3:7) was completed, in accordance with the online Transport Analysis Guidance (webTAG) for Noise. For each one decibel change in average noise level, a monetary value is assigned for the change in the following health impacts: amenity (annoyance), acute myocardial infarction, dementia, stroke and sleep disturbance.

Completion of the TAG workbook for noise yields a result of -£69,426 for the Net Present Value of the Scheme. The negative value indicates a net increase in noise as a result of scheme development, and hence a net adverse effect on health and wellbeing.

Summary

In summary, the assessments undertaken in relation to proposed Phase 2 scheme as outlined above have shown that:

- The Scheme would have no significant, adverse environmental effects in the short term on any properties considered;
- The Scheme would have no significant, adverse environmental effects on any receptor in the long term;
- The Scheme impacts on NIAs would be negligible. However, in accordance with DEFRAs Noise Action Plan: Roads (2 July 2019), improvements in noise levels (i.e. a reduction) should be delivered, where possible;
- There are no properties qualifying for works or grants in respect of the Noise Insulation Regulations 1975 (as amended 1988); and
- An appraisal of the scheme in accordance with WebTAG indicates a Net Present Value of -£69,426, i.e. a net increase in noise and a net adverse effect on health and wellbeing.

16 Note that a correction of +3 dB must be added to the free-field values shown on these maps.

3.4. Social and Distributional Impacts

This section provides details of the methodology followed to deliver the Social and Distributional Impacts (SDI) appraisal. Social impacts (SI) cover the human experience of the transport system and its impact on social factors, on different indicators and Distributional impacts (DI) consider the variance of impacts across different social groups. The analysis of SDIs is mandatory in the appraisal process and undertaken in accordance with WebTAG guidance Unit A4.1 (Social Impact Appraisal) and A4.2 (Distributional Impact Appraisal) and is a constituent of the Appraisal Summary Table (AST).

The indicators considered for social or distributional impacts are shown in Table 3-13.

Table 3-13 Indicators considered for social and distributional impacts

Indicator	Social Impact	Distributional Impact
User Benefits		✓
Air Quality		✓
Noise		✓
Personal Security	✓	✓
Severance	✓	✓
Accessibility	✓	✓
Personal Affordability	✓	✓
Accidents	✓	✓
Physical Activity	✓	
Journey Quality	✓	
Option Values and Non-Use Values	✓	

A full analysis of the social and distributional impacts can be found in 7.2.Appendix D.

3.4.1. Social Impacts Assessment

The social impacts assessment is summarised in the following eight sub-sections, covering each of the eight indicators assessed.

3.4.1.1. Physical activity

The addition of a lane on the A40 eastbound between the M5 Junction 11 and Arle Court Roundabout may cause a modal shift away from active travel. This is due to increased capacity leading to reduced congestion and travel times. This may make private car travel a more attractive mode, leading to a mode shift from active modes to private car travel.

However, there are no pedestrian facilities and limited cycle facilities along the section of the A40, hence it is unlikely that a significant number of people would travel along this route by active modes. Therefore, it is assumed that there won't be a significant mode shift away from active modes as a result of the Phase 2 upgrades. Therefore, the immediate impact of the scheme to physical activity is **neutral**.

3.4.1.2. Journey quality

The scheme maintains all existing pedestrian and cycle facilities and there is unlikely to be any significant impact to traveller care for these user groups. The lane gain between the M5 Junction 11 and Arle Court will increase capacity on the A40, which is likely to reduce travel time for motorists. In addition, the ghost island merge to the A40 eastbound from the M5 Junction 11 is expected to improve the smooth flow of traffic.

The reduced congestion for buses travelling eastbound along the A40 may improve the reliability of buses in the area, hence having a reducing traveller stress for public transport users in the area.

Overall, there is a slight beneficial impact to journey quality for motorists and public transport users. Cyclists and pedestrians are unlikely to be significantly impacted by the scheme, hence there is a neutral impact to journey quality for these users. Therefore, the overall impact of the Arle Court Improvement Scheme Phase 2 to journey quality is **slight beneficial**.

3.4.1.3. Accidents

According to the change in AADT, there is a significant increase in speed on sections of the A40 eastbound that occur within the scheme extent. This is likely due to the increased capacity along the A40 eastbound reducing congestion, meaning vehicles can travel faster along the road. Vehicles travelling at higher speeds are as a result more likely to result in an accident.

However, this is countered by the replacement of the sub-standard two-lane taper merge, where there have been three identified accidents with the inherently safer lane gain. Therefore, on balance, it is estimated there will be a **neutral** impact to accidents as a result of the scheme.

3.4.1.4. Security

The scheme includes the conversion of the eastbound merge to the A40 from the M5 Junction 11 to a ghost island merge with a lane gain. This may improve traffic flow leading to a reduction in queueing on the merge. However, all perimeters to the carriageway are expected to be maintained, hence not impacting on perceptions of security.

It is expected that all lighting and security cameras along the route will be maintained, therefore not impacting on security. Informal surveillance is unlikely to have an impact as the changes are in an area where the majority of trips will be private car trips. There are no public transport stops along the section of the A40. It is not known if any changes will be made to landscaping in the area, but it has been assumed that any landscaping in the area will be maintained.

Therefore, it is unlikely that there will be any significant impact to security as a result of Phase 2. Hence, there is a neutral security impact.

3.4.1.5. Accessibility

At this stage in the assessment it is not known if the frequency or routings of buses will be altered as a result of the Phase 2. However, it is assumed that there will be journey time savings as a result of reduced congestion along the section of the A40. Services from Gloucester towards Cheltenham, which currently run along the section of the A40, may have slight journey time savings as a result of the scheme. However, it is unlikely there will be any significant accessibility impact as a result of this. Therefore, there is a neutral impact to accessibility due to the scheme.

3.4.1.6. Personal Affordability

The calculation of impact in the appraisal tables are based on vehicle operating costs (fuel and non-fuel) for home-based 'commuting and other' trips (i.e. excluding business users). Only highways benefits have been modelled, and only internal to internal trips within an assessment area. The outputs of the 60- year appraisal from TUBA show approximately £55,000 disbenefit, as a result of the scheme. This slight disbenefit is likely caused by increased vehicle speeds along the A40 eastbound leading to increased fuel consumption.

There are some affordability benefits likely caused by increased capacity along the A40 eastbound causing congestion to reduce in the area. This will reduce fuel costs as there's reduced vehicles idling, braking and accelerating while queueing.

Although the affordability disbenefits slightly outweigh the affordability benefits for the Phase 2 Scheme, the impact per person is negligible and imperceptible. The overall impact of the scheme is therefore **neutral.**

3.4.1.7. Severance

Speed changes resulting from the Phase 2 scheme have been examined to determine the effect on severance. These occur on the A40 scheme location, which isn't accessible to pedestrians, so won't impact on severance in the area. However, there are some increases in speed on minor routes within the area that can be accessed by pedestrians, such as Cheltenham Road East northbound. It is likely that increased speeds will increase severance on this road. There is a decrease in speed on approach to the Cheltenham Road East/A40 Roundabout along Cheltenham Road East. These changes in traffic speed are likely due to vehicles rerouting towards the upgraded A40. Within the eastern suburbs of Cheltenham there are approximately the same number of links with increased traffic speed as decreased traffic speed. Hence, not significantly impacting severance within this area.

Overall, it is likely that the effect of the Arle Court Phase 2 Scheme on severance will be **neutral** since there are approximately the same number of links with increased traffic speed as decreased traffic speed.

3.4.1.8. Option Values and Non-Use Values

TAG Unit 4.1 requires that option values and non-use values are assessed if the scheme being appraised includes measures that will substantially change the availability of transport services within the study area (e.g. the opening or closure of a rail service, or the introduction or withdrawal of buses serving a particular rural area). The Phase 2 scheme includes no changes to any public transport routes or services provided in the area. Therefore, there are no significant changes to transport services, so this indicator will not be assessed.

3.4.2. Distributional Impacts Assessment

An assessment of eight indicators has been undertaken for this DI assessment. The impact area has been determined for each indicator as an area likely to be affected by the Phase 2 Scheme. The full analysis of the distributional impacts can be found in 7.2.Appendix D.

The distributional impact appraisal matrix for income and vulnerable groups, as described in WebTAG Unit 4.2, are shown in Table 3-14 and Table 3-15.

There is a neutral impact overall to air quality and noise, as there is no significant impact to income quintiles 1-3. However, there is a slight adverse air quality impact for income quintile 4 and 5 and a slight adverse impact to noise for income quintile 5, as shown in Table 3-14.

There are beneficial impacts for all income quintiles and overall for user benefits. However, there is a large adverse impact to affordability for income quintile 5 and beneficial impacts for all other income groups. The overall impact is moderate beneficial for both these indicators since there are moderate beneficial impacts for income quintiles 1-3.

Table 3-14 – Distribution of impacts across income groups

	Distributional impact of income deprivation					Are the impacts evenly distributed?	Key impacts – Qualitative statements
	0-20%	20-40%	40-60%	60-80%	80-100%		
Air Quality	**0**	**0**	**0**	×	×	**No**	There are neutral air quality impacts for income quintiles 1, 2 and 3 and slight adverse impacts for income quintiles 4 and 5.
Noise	**0**	**0**	**0**	**0**	×	**No**	There is a slight adverse noise impact for income quintile 5 and neutral impacts for all other income groups.
User Benefits	✓✓	✓✓	✓✓	✓✓	✓✓	**Yes**	There are moderate beneficial user benefits for all income quintiles.
Affordability	✓✓	✓✓	✓✓	✓✓✓	×××	**No**	There is a large adverse impact for income quintile 5 and beneficial affordability impacts for all income quintiles.

Key: ✓✓✓ Large Beneficial ✓✓ Moderate Beneficial ✓ Slight beneficial 0 Neutral
× Slight adverse ×× Moderate adverse ××× Large adverse

Table 3-15 – Distribution of impacts across vulnerable groups

Impact	Social groups					Qualitative statement
	Children & young people	Older people	Women	Disabled	BME	
Noise	**0**	-	-	-	-	There is a neutral impact to noise for children due to there being no significant change in traffic flow in areas with high proportions of children or near a school.
Air Quality	**0**	-	-	-	-	Links with a significant change in traffic speed for air quality are in more rural areas, with low proportions of children.
Accidents	**0**	**0**	-	-	-	There are approximately the same number of historical accidents involving children and elderly on links with an increase in traffic speed as on links with a decrease in traffic speed.
Security	-	-	-	-	-	This indicator was screened out due to there being no changes to public transport waiting/interchange services or pedestrianised areas.
Severance	**0**	**0**	-	✓	-	There are several links with decreased traffic speed in areas with high proportions of DLA claimants. Reduced speeds may lead to pedestrians perceiving that it is easier to cross the road.
Accessibility	-	-	-	-	-	This indicator was screened out due to there being no changes to public transport frequency or services.

Key: ✓✓✓ Large Beneficial ✓✓ Moderate Beneficial ✓ Slight beneficial 0 Neutral
× Slight adverse ×× Moderate adverse ××× Large adverse

3.5. Reliability Impacts

Reliability impacts have not been explicitly assessed or monetised following WebTAG guidelines. However, it is expected that the additional capacity will improve reliability due to the reduction in congestion and result in consistent benefits throughout the day but most significantly during peak hours.

3.6. Economic Appraisal Results: Core Scenario

This chapter sets out the results of the economic appraisal for the core scenario in line with the assessment methodologies set out in chapter 3.

3.6.1. Core Scenario definition

The following section describes the Core Scenario benefits analysis during normal operation in terms of savings relating to travel times, vehicle operating costs and user charges user benefit.

The forecasting report (7.2.Appendix D) produced by Jacobs informs that it was decided to use the NTEM District level growth factors for forecasting the future car demands from 2017 base demand, and National traffic model (NTM) forecast growth for LGV and HGV. These high-level growth factors have not been adjusted locally and the impact of uncertainty around demand forecast was not taken into account. The Forecasting method did not feature an uncertainty log covering the central forecasting assumptions made in the model that will affect travel demand and supply.

There is however information on the economic development in the area of the model until 2021, namely there are targets set for Gloucestershire over the growth period out to 2021. The First LEP Strategic Economic Plan (SEP) identifies unlocking employment land in a growth zone with good access to the M5 as especially important. Specifically, in the model area the SEP informs that funding has been secured for Cheltenham Cyber Business Park with occupation expected in 2021. The Gloucestershire, Cheltenham and Tewkesbury Joint Core Strategy 2011-2031 identifies housing needs following the National Planning Policy Framework and Guidance, that take as its starting point the official population forecasts and household projections. The Joint Core Strategy does not project other housing developments in addition to the national households forecast.

In the long term there is no significant development identified in the vicinity of the model area, therefore we understand that the high-level growth applied in 2031 lacks in detail for the local area of the model. Due to the nature of the microsimulation model, with a focus on a limited local area, the demand forecast would be more appropriately represented if adjusted to reflect the local conditions and uncertainties. Given that the high level (District and National) forecast growth has been applied unadjusted to the study area, we have capped the growth to the forecast year 2021 in the core scenario, since 2021 is the most illustrative forecast scenario in the context of this project. This scenario represents the realistic demand scenario. Additional demand scenarios (a conservative and optimistic scenario) were tested in the sensitivity analysis (section 0).

3.6.2. Transport Economic Efficiency (TEE)

All benefits and costs were calculated in monetary terms and expressed as present values (PV) in 2010 prices, discounted to 2010.This enables direct economic comparison with other schemes which may have very different timescales.

Table 3-16 – Transport Economic Efficiency Benefits (all values in £000s) below presents the TEE table for the core scenario TUBA assessment results.

Table 3-16 – Transport Economic Efficiency Benefits (all values in £000s)

Non-business: Commuting	
User benefits	**TOTAL**
Travel time	3,972
Vehicle operating costs	-21
User charges	0
During Construction & Maintenance	0
NET NON-BUSINESS BENEFITS: COMMUTING	3,950
Non-business: Other	**ALL MODES**
User benefits	**TOTAL**
Travel time	2,922
Vehicle operating costs	-29
User charges	0
During Construction & Maintenance	0
NET NON-BUSINESS BENEFITS: OTHER	2,893
Business	
User benefits	
Travel time	3,615
Vehicle operating costs	256
User charges	0
During Construction & Maintenance	0
Subtotal	3,871
Private sector provider impacts	
Revenue	0
Operating costs	0
Investment costs	0
Grant/subsidy	0
Subtotal	0
Other business impacts	
Developer contributions	0
NET BUSINESS IMPACT	3,871
TOTAL	
Present Value of Transport Economic Efficiency Benefits (TEE)	10,714

Notes: Benefits appear as positive numbers, while costs appear as negative numbers. All entries are discounted present values, in 2010 prices and value

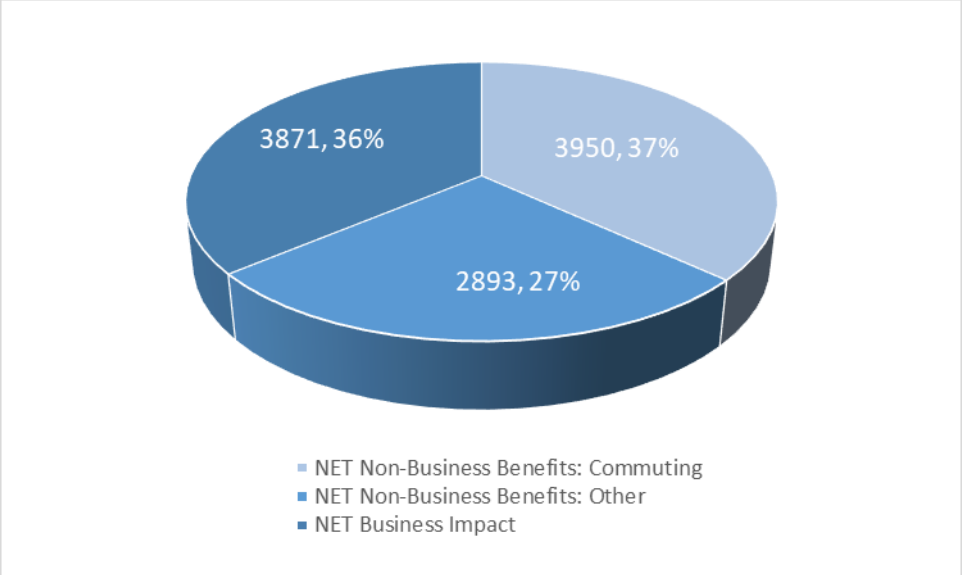
The economic appraisal conducted in compliance with WebTAG (Data Book), evaluates the travel time savings and the vehicle operating costs (VOC) that the scheme is forecast to produce.

The scheme is forecast to produce net benefits for all users of £10.51 million from the travel time savings and £0.21 million from vehicle operating cost savings. In conclusion, the transport economic benefits assessment predicts the scheme will deliver overall net benefits for all users of £10.71 million. It should be noted that no

private sector provider impacts benefits nor developer contributions were considered. In addition, the impact of delays during construction and maintenance was not assessed.

Closer analysis of the results, presented in Figure 3-2, shows that transport economic benefits accrued from non-commuting purposes of non-business users is 27%. Net business benefits account for 36%, and non-business commuters' account for 37% of the total value of transport economic benefits

Figure 3-2 – Core Scenario Transport economic efficiency structure by travel purpose



3.6.3. Present Value of Benefits (PVB)

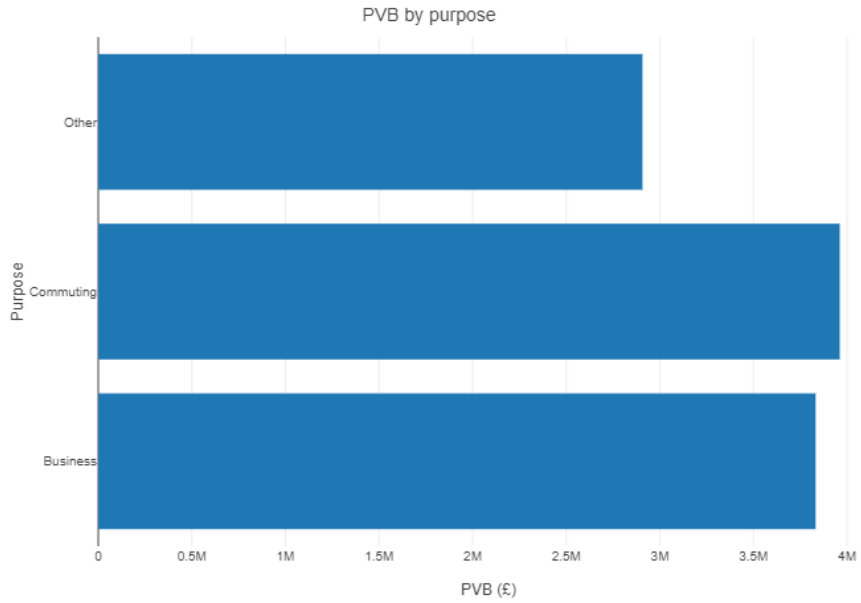
The scheme is expected to bring a Present Value Benefit (PVB) of £10.71m over the 60-year appraisal period (2021 - 2080). These benefits are generated by travel time savings of £10.51m and vehicle operating costs benefits of £0.21m and change in Government Indirect Tax of -£0.01m.

The scheme is estimated to provide user benefits of £273k during the first forecast modelled year (2021), and £225k during the second modelled year (2031). The AM peak provides higher benefits than the PM peak throughout the 60-year appraisal period, as shown in Figure 3-3.

Figure 3-3 - Core Scenario profile of Present Value of Benefit per year

Over the 60-year appraisal period, the distribution of benefits by purpose follows Figure 3-4.

Figure 3-4 – Core Scenario Benefit profile breakdown by Purpose



3.6.4. Present Value of Costs (PVC)

The scheme construction costs have been estimated by the engineering team, as detailed in section 3.2.2. To convert the costs to present value the calculations presented on section 3.2.7 have been performed. The total scheme construction costs expressed as a PVC is £4.01m.

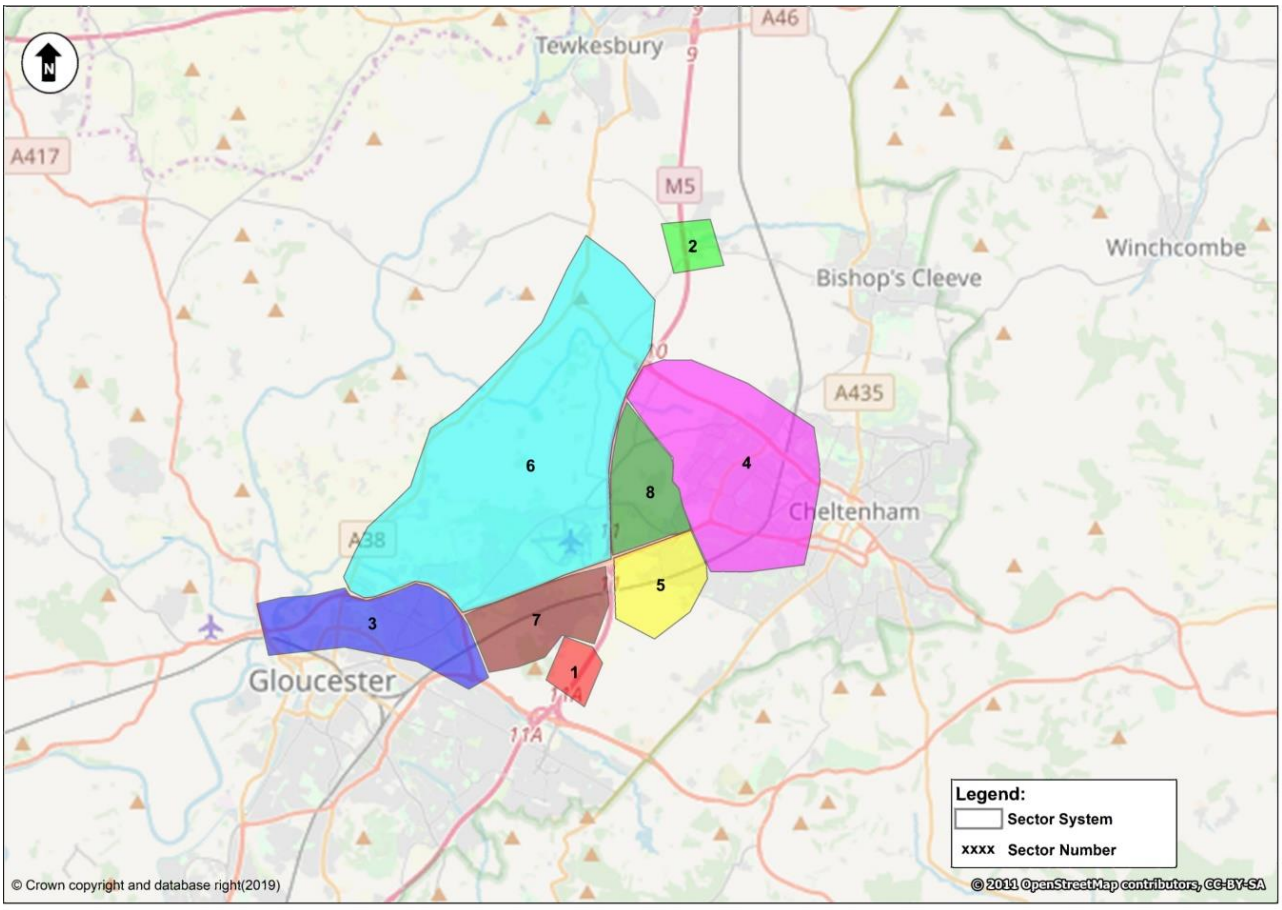
3.6.5. Spatial Distribution of Benefits

To understand the spatial distribution of benefits from the scheme, sector analysis was carried out. The following section describes the sector system used for the study.

3.6.5.1. Sector System

A system of eight sectors was developed to provide grouping of zones that are expected to be affected in similar manner by the scheme. The proposed sector system is composed of two sectors in the vicinity of the scheme (two sectors immediately north and south of Arle Court junction), two sectors for the strategic M5 long distance trips running north and south of J11 and the remaining four sectors providing geographical groupings of more distant local areas that are quite likely to feed trips through A40 / Arle Court corridor. The sector system is shown in Figure 3-5 below.

Figure 3-5 - Sector System



A detailed description of the sectors adopted in the sector system is listed below:

- Sectors 1 and 2 capture strategic traffic running on the M5;
- Sector 3 is the built-up area of Gloucester within the A40 northern and A417 eastern bypasses;
- Sector 4 is rest of Cheltenham east of the scheme;
- Sector 5 is the build-up area of Cheltenham south of Arle Court including The Reddings and Badgeworth which lie very close to the scheme;
- Sector 6 is the villages west of M5 and north of A40 such as Staverton Bridge, Innsworth and Churchdown (N) and Gloucester Airport;
- Sector 7 is remaining part of Churchdown south of A40; and
- Sector 8 is the area immediately north of the scheme extending to include Fiddlers Green and Golden Valley.

3.6.5.2. Sectoral Distribution of Benefits

Sectoral benefits are shown in Figure 3-6 and Table 3-17 below.

Figure 3-6 – Core Scenario Sectoral Distribution

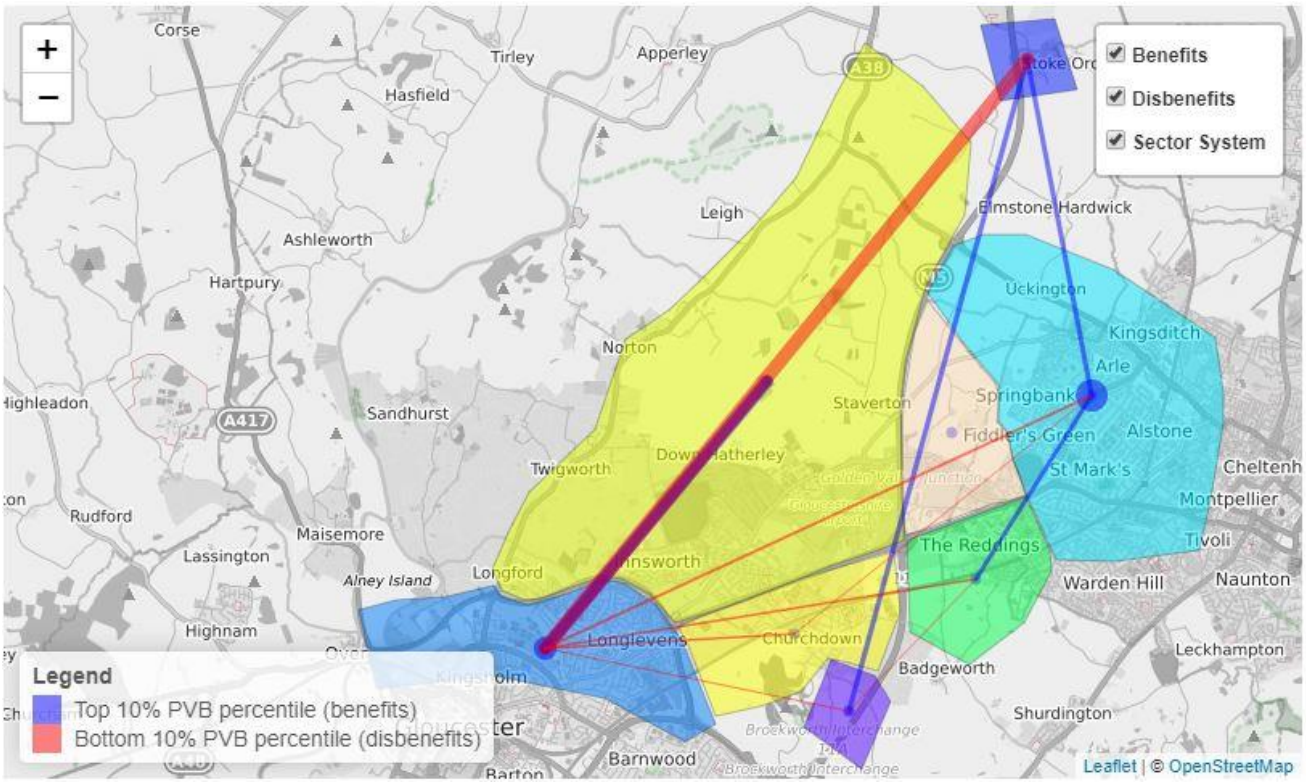


Table 3-17 – Sectoral distribution of benefits

Sector	1	2	3	4	5	6	7	8	Total
1	0.00	676.34	-1.75	144.86	-107.85	6.05	-0.92	8.28	**725.01**
2	102.09	0.00	97.88	270.63	-59.15	-36.83	-24.35	37.78	**388.04**
3	-157.24	-1479.52	2503.72	-353.04	-246.52	995.25	131.79	42.26	**1436.70**
4	290.26	546.99	143.15	3582.24	143.46	138.30	-112.31	180.93	**4913.03**
5	-59.47	-6.48	-40.93	494.17	-17.91	20.88	-14.41	18.94	**394.80**
6	119.26	10.57	1436.23	476.28	20.71	61.85	211.15	17.54	**2353.57**
7	-3.05	-102.76	-303.98	22.55	1.92	-36.04	-37.11	-9.42	**-467.89**
8	146.14	67.85	64.79	407.99	32.60	45.63	0.28	0.34	**765.62**
Total	**437.99**	**-286.99**	**3899.10**	**5045.68**	**-232.75**	**1195.09**	**154.11**	**296.64**	**10508.88**

Note - Cells in red are the bottom 5 movements and cells in green are the top 5 movements. All values are in £000 in 2010 market prices discounted to 2010.

It can be observed from Table 3-17 that approximately 47% of all scheme journey time benefits are experienced by trips originating from sector 4 and 48% of all journey time benefits are experienced by trips destined to sector 4.

Focussing on the 60-year appraisal period, the movements with the highest benefits are:

- £3.58m - Sector 4 to Sector 4

- £2.50m - Sector 3 to Sector 3
- £1.44m - Sector 6 to Sector 3
- £1.00m - Sector 3 to Sector 6
- £0.68m - Sector 1 to Sector 2

The highest benefits can be observed in movements originating from sector 4 to sector 4.

Some sector-to-sector movements are forecast to experience a dis-benefit, and the movements with the highest dis-benefits are:

- – £1.48m - Sector 3 to Sector 2
- – £0.35m - Sector 3 to Sector 4
- – £0.30m - Sector 7 to Sector 3
- – £0.25m - Sector 3 to Sector 5
- – £0.16m - Sector 3 to Sector 1

Compared with sector time benefits, sector time disbenefits are relatively low.

3.6.6. Public Accounts

The Public Accounts table shown in Table 3-18 brings together the costs of the scheme and the revenue and tax changes which would result. The revenue and tax changes which follow from changes in traffic routes and speeds are derived from the TUBA output, while the capital and operating costs, less any offsetting developer contributions, are as described.

Table 3-18 – PA Table (all values in £000s)

Local Government Funding	
Revenue	0
Operating Costs	0
Investment Costs	4,009
Developer and Other Contributions	0
Grant/Subsidy Payments	0
NET IMPACT	4,009
Central Government Funding: Transport	
Revenue	0
Operating costs	0
Investment Costs	0
Developer and Other Contributions	0
Grant/Subsidy Payments	0
NET IMPACT	0
Central Government Funding: Non-Transport	-
Indirect Tax Revenues	14
TOTALS	
Broad Transport Budget	4,009
Wider Public Finances	14

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers. All entries are discounted present values in 2010 prices and values

3.6.7. Analysis of Monetised Costs and Benefits

Table 3-19 presents the Analysis of Monetised Costs and Benefits (AMCB) table.

Table 3-19 – Analysis of Monetised Costs and Benefits (all values in £000s)

Noise	Not assessed
Local Air Quality	Not assessed
Greenhouse Gases	9[17]
Journey Quality	Not assessed
Physical Activity	Not assessed
Accidents	Not assessed
Economic Efficiency: Consumer Users (Commuting)	3,950
Economic Efficiency: Consumer Users (Other)	2,893
Economic Efficiency: Business Users and Providers	3,871
Wider Public Finances (Indirect Taxation Revenues)	-14
Present Value of Benefits (PVB)	10,709
Broad Transport Budget	4,009
Present Value of Costs (PVC)	4,009
OVERALL IMPACTS	
Net Present Value (NPV)	6,700
Benefit to Cost Ratio (BCR)	2.671

3.7. Appraisal Summary Table (AST)

Following the production of the AMCB table, the relevant values in the TEE/PA/AMCB tables are transcribed to the AST and are complemented by the environmental and social and distributional impacts assessment results. The AST table is reproduced in 7.2.Appendix E.

3.8. Value for Money Statement

The Value for Money (VfM) assessment is carried out as a staged process to ensure that a complete and robust analysis is undertaken. A VfM statement has been produced for the core scenario using information within the AST to provide a summary of the conclusions from the VfM assessment. The DfT VfM categories and their relationship with BCRs to be generated through the cost-benefit analysis is presented on Table 3-21.

[17] Greenhouse gases taken from TUBA assessment. These values are converted into a monetary value, calculating a net present value (NPV) of the greenhouse house benefits over the appraisal period.

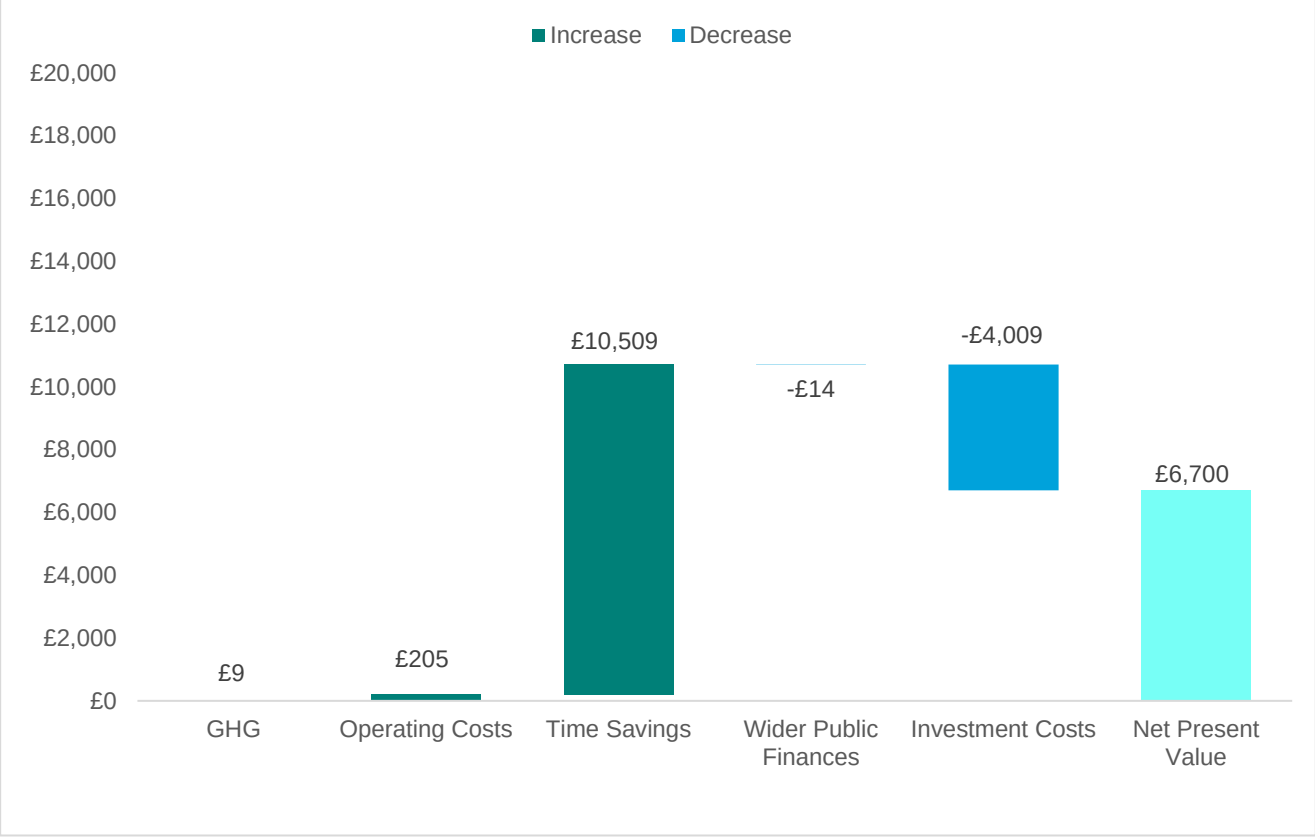
Table 3-20 - DfT VfM Categories

BCR	Category
Less than 1.0	Poor
1.0 to 1.5	Low
1.5 to 2.0	Medium
2.0 to 4.0	High
Greater than 4.0	Very High

Overall assessment of costs and benefits generated by the project shows that the scheme achieves a Benefit Cost Ratio figure of 2.67 with a Net Present Value (NPV) of approximately £6.70 million. The scheme can be therefore categorised as achieving high value for money in the classification provided by DfT This BCR value confirms the importance of the scheme and urgency of its implementation. The majority of benefits derives from time savings, because current poor traffic conditions cause long delays to all types of trips and thus hinder the productivity of local communities and local economic growth. This scheme will help to overcome these issues which otherwise would have a cumulative negative impact in the next few years.

The structure of the benefits is presented in Figure 3-7. These are presented as the cumulative benefits from lower benefits to higher benefits and lower disbenefits to higher disbenefits, adding up to the Net Present Value.

Figure 3-7- Value for Money of the scheme, costs and benefits structure, £000s



A number of other benefits have been assessed qualitatively as part of this Business Case. These include Environmental impacts (biodiversity, heritage, landscape, air quality, noise and vibration and water environment/ flooding) and Social impacts (social and distributional impacts, physical activity, journey quality, accidents, security, access to services, affordability, severance). Reliability impacts on commuting and other users was not assessed as part of this study.

The Value for Money statement presented below summaries the benefits in each category and clarifies which monetised assessments were completed.

Table 3-21 - Value for Money Statement

Scheme Name	WCTIS Phase 2 : M5-J11 to Arle Court
Description of Scheme	Phase 2 will consist of the following elements: • A40 eastbound merge from M5 Junction 11 upgraded to a lane gain with ghost island merge; and • A40 eastbound carriageway upgraded to three lanes from this lane gain all the way to Arle Court Roundabout.
PV Costs (in £000s)	
PVC, 2010 prices/values	**4,009**
PV Benefits (in £000s)	
Physical Activity	Not Assessed
Urban Realm	Not Assessed
Travel Time savings	10,509
Vehicle operating costs (Fuel)	23
Vehicle operating costs (Non-fuel)	182
Indirect Taxation Revenues	-14
Greenhouse gases	9
Deduction to account for private sector contributions	0
PVB, 2010 prices/values	10,709
Accidents	Not Assessed
Air Quality	Not Assessed
Noise	Not Assessed
Wider Impacts	Not Assessed
Public Transport Impacts	Not Assessed
Benefit to Cost Ratio	2.67
Value for Money category	High

The detailed Appraisal Summary Table is presented in 7.2.Appendix E.

3.9. Sensitivity testing

This section describes the sensitivity tests carried which reflect the uncertainty in local demand growth factors.

The sensitivity testing carried out consisted of comparing the PVB derived from the TUBA appraisals of the following alternative scenario:

- **The optimistic scenario,** where demand will grow until the last forecasting year 2031, in line with what was set out in the forecasting report (7.2.Appendix B).

Table 3-22 summarises the results of the sensitivity test. Results produced from this analysis show that the expected BCR range from 2.67 in core to 2.97 in optimistic scenario.

Table 3-22 Summary of Forecast Growth Sensitivity Tests (values in £000s)

Item	Core	Optimistic
Greenhouse Gases	£9	-£126
Economic Efficiency: Consumer Users (Commuting)	£3,950	£4,806
Economic Efficiency: Consumer Users (Others)	£2,893	£2,898
Economic Efficiency: Business Users and Providers	£3,871	£4,046
Wider Public Finances (Indirect Taxation Revenues)	-£14	£261
Present Value of Benefits (PVB)	£10,709	£11,885
Broad Transport Budget	£4,009	£4,009
Present Value of Costs (PVC)	£4,009	£4,009
Net Present Value (NPV)	£6,700	£7,876
Benefit to Cost Ratio (BCR)	2.671	2.965

4. Commercial Case

4.1. Introduction

The Commercial Case provides evidence that the proposed investment can be procured, implemented and operated in a viable and sustainable way. The aim is to achieve best value during the process, by engaging with the commercial market.

4.2. Expected Outcomes from the Commercial Strategy

The outcomes which the commercial strategy must deliver are to:

- Confirm that procedures are available to procure the scheme successfully;
- Check that available/ allocated capital funds will cover contractor and Construction costs;
- Verify that the risk allowance is sufficient; and
- Ensure that arrangements have been made to handle cost overruns.

4.3. Procurement - Scheme Procurement Strategy

GCC have identified three procurement options for the delivery of LEP funded schemes. The alternative options are:

A. Full Public Contracts Regulations (PCR) 2015 compliant tender (Schemes greater than OJEU limit of £4,551,413)

GCC would opt for an 'open' tender, where anyone may submit a tender, or a 'restricted' tender, where a Pre-Qualification is used to whittle down the open market to a pre-determined number of tenderers. This process takes approximately one month, and the first part is a 35 day minimum period for GCC to publish a contract notice on the OJEU website.

Once the tenders are received, they will be assessed, and a preferred supplier identified. There is a mandatory 10 day 'standstill' period, during which unsuccessful tenderers may challenge the intention to award to the preferred contractor.

B. Open Tender (Schemes greater than £1M but less than OJEU limit)

GCC would opt for an 'open' tender, where anyone may submit a tender. The tender would include a set of eligibility criteria and a quality submission. Depending on the exact tender assessment method chosen the contractors would be required to meet a quality threshold score or selected using a quality / price evaluation.

Schemes will be procured via ProContract and this would include prior notifications of the tender approximately 4 weeks before the formal tender. Depending upon the complexity of the scheme supplier engagement presentations will be arranged.

The minimum tender period is 5 weeks but could be longer for more complex schemes. All suppliers that meet the eligibility criteria will be assessed and a preferred supplier identified.

C. Delivery through Term Maintenance Contract (TMC) (Schemes less than £1M)

This option is strictly not procurement as the TMC is an existing contract. The TMC is based on a Schedule of Rates agreed at the inception of the contract. The price for each individual scheme is determined by identifying the quantities of each required item into a Bill of Quantities. TMC may price 'star' items if no rate already exists for the required item. If the scope of a specific scheme is different from the item coverage within the TMC contract a new rate can be negotiated.

The preferred procurement route for is **Option A, Full PCR 2015 compliant Tender,** as the scheme is above the PCR financial limit.

For budget certainty the scheme will be procured on a lump sum basis as an ECC Option A contract (Lump Sum with Activity schedule). This option is preferred as the scheme will be fully designed with a clear specification of works which allows for a greater transfer of risk to the Contractor through a priced contract. The Activity Schedule used in this form of contract also gives greater confidence in the Contractor's price. This is as a result of the importance given to the Contractor's programme, as tenderers have to plan the scheme whilst preparing their Activity Schedule. This also means the programme is realistic and more likely to be adhered to as payments to the Contractor are linked to their activity schedule.

The ECC Option A contract is Gloucestershire County Councils preferred method of delivery for this size and type of highway scheme. This ensures consistency with internal processes, staff members, supply chain, benchmarking, performance etc. which should all aid successful delivery.

4.4. Commercial Risk Assessment

The table below provides a summary of the identified commercial risks surrounding the scheme.

Table 4-1 - Scheme Commercial Risk Assessment

Qualitative Commercial Risk Assessment										
Scheme Commercial Risk Item	**Likelihood of Risk Arising (✓)**			**Impact Severity (✓)**			**Predicted Effect on Scheme Procurement, Delivery & Operation (✓)**			**Immediate Bearer of Risk and Suggested Mitigation**
	Low	**Medium**	**High**	**Slight**	**Moderate**	**Severe**	**Slight**	**Moderate**	**Severe**	
***Scheme construction is delayed and/or costs increase.** **E.g. from unexpected engineering difficulties.**		✓				✓		✓		GCC, as scheme promoter, bears the risk. Ensure that scheme development, design, procurement and construction procedures are sufficiently robust to minimise likelihood of construction difficulties.
Ongoing maintenance costs of scheme higher than expected	✓			✓			✓			GCC, as scheme promoter, bears the risk. Ensure that scheme design, materials selection and construction procedures are sufficiently robust to minimise likelihood of maintenance issues.

*Risk allocation will be apportioned between GCC and the Contractor undertaking the site works. This will be based upon NEC principles and regular on-site Risk Management meetings will be held to ensure prompt mitigation of risks.

5. Financial Case

5.1. Project Costs

Commitment to funding the scheme will be sought at a full LEP Board meeting. This section considers the capital costs associated with the proposed scheme investment. Note that in the Outline Business Case, the costs for Phase 2 were estimated as £5.33m. The further design work and estimates has reduced this cost to £4.48m. This is predominately due to a reduction in significant utilities diversions; the current full breakdown is as below.

5.2. Breakdown and Time Profile of Project Costs

Table 5-1 - Breakdown of scheme capital costs, 2019 prices

Project cost components	Capital cost items	Estimate status*	Costs by year (£)				Totals
			2018/19	2019/20	2020/21	2021/22	
Design & Management	Design fees, Surveys and trial holes, Land Purchase	P	£277,300	£600,000	£63,000	-	£940,300
Construction including Traffic-Related Maintenance	Non-Routine Re-construction	P	-	£50,000	£2,591,900	-	£2,641,900
	Site clearance, Diversions of Statutory services. Widening and re-Surfacing of carriageway.						
Contingency	Risk Adjustment	P	-	-	£897,800	-	£897,800
	Optimism Bias	-	-	-	-	-	-
Indirect Tax	Non-Recoverable VAT (if applicable)	-	-	-	-	-	-
Total Cost	**(NB – Base cost + 3% inflation)**	**P**	**£277,300**	**£650,000**	**£3,552,700**	**-**	**£4,480,000**

*O = Outline estimate, P = Preliminary estimate, D = Detailed estimate, T = Tender price

5.3. Project Funding

This section considers the capital funding requirements and commitments for the proposed scheme investment.

5.3.1. Sources of Funding

The sources of funding for the scheme are summarised below.

Table 5-2 - Scheme funding sources and profile of contributions

	2018/19		2019/20		2020/21		2021/22		Total
	Capital	Rev	Capital	Rev	Capital	Rev	Capital	Rev	
LEP funding (Growth Deal 3)	£277,300	n/a	£650,000	n/a	£3,552,700	n/a	-	n/a	£4,480,000
GCC	-	n/a	-	n/a	-	n/a	-	n/a	-
Total	**£277,300**	**n/a**	**£650,000**	**n/a**	**£3,552,700**	**n/a**	**-**	**n/a**	**£4,480,000**

All figures are in outturn prices

5.3.2. Security and earliest availability of funds

Table 5-3 - Security and availability of scheme funding contributions

		Security of funding contribution (✓)			Earliest available date for securing fund contribution	
Funding source	Fund details	Low	Medium	High	Part funding date	Full funding date
LEP	LEP			✓ Subject to approval by the LEP Board	n/a	On Board approval November 2019
GCC	GCC – Capital Funds	n/a	n/a	n/a	n/a	n/a

This FBC has been reviewed and accepted for submission by GCC's S151 officer. As scheme promoter, GCC will be liable for any future cost overruns associated with the delivery of the suite of transport schemes. This will be funded from within the scheme funding envelope of the full £22 million Capital grant or alternative funding, such as the highways capital programme, Section 106 developer contributions, Community Infrastructure Levy, etc.

As stated in the County Council's Constitution, 'Directors are responsible for ensuring that variations in capital project estimates that occur during the course of a contract are contained within the resources allocated to that service'. The scheme's costs will be monitored and managed accordingly.

Funding for delivery for each of phase of the WCTIS Cyber Park Scheme is subject to variation in scope, market forces and risks being realised, agreement is in place with the GFirst LEP that funding can be transferred between phases to reflect underspend/overspend and this will be reflected in the extent of scheme developed in phases 3 and 4 of the works.

5.4. Financial Risk Management Strategy

This section examines the risks associated with the costs and financial requirements of the onsite infrastructure and engineering works. It considers the mitigation that may be needed to handle the identified risks, if they arise.

5.4.1. Risks to the Scheme Cost Estimate and Funding Strategy

Table 5-4 shows the financial risks and suggested mitigation measures associated with this scheme. The Risk Register in Appendix F has assessed the costs for the risks, and is therefore a Quantified Risk Register.

Table 5-4 - Qualitative financial risk assessment

Scheme financial risk item	Likelihood of risk arising (✓)			Impact severity (✓)			Predicted impact on scheme delivery and outcome (✓)			Suggested mitigation
	Low	Medium	High	Slight	Moderate	Severe	Slight	Moderate	Severe	
Unforeseen increase in scheme cost reduces the VfM (i.e. BCR nearer to 1.0 'low')	✓			✓			✓			Scheme will be amended to reduce costs whilst ensuring that agreed Outputs are achieved. In the event of cost overruns, GCC would value engineer the schemes to fit the available budget.
Earmarked / secured funds do not cover current scheme capital cost		✓			✓			✓		As above

5.5. Ongoing Maintenance

For information only (and not accounted for in the BCR), to cover two surface treatments and a surface course resurfacing, the cost of the ongoing maintenance is estimated as £23.20 per m2. Over a 30-year design life this would equate to £0.77 per m2 per year. The scheme will construct additional carriageway area of 3350 m2.

The additional maintenance liability would therefore equate to £2,580 per year and GCC will include for this in maintenance budgets, and therefore does not impact on the budget and LEP funding for the scheme.

5.6. Land Purchase

No additional land is required to be purchased from third parties in order to progress the scheme, either for the widened carriageway or its construction. This Phase 2 scheme will be able to benefit from the land purchase in Phase 1 for the works compound. Should, for reasons not anticipated, the land is not available, an alternative arrangement would be sought.

6. Management Case

6.1. Overview

The Management Case outlines how the proposed scheme and its intended outcomes will be delivered successfully. It gives assurances that the scheme content, programme, resources, impacts, problems, affected groups and decision makers, will all be handled appropriately, to ensure that the scheme is ultimately successful.

6.2. Project Governance, Roles and Responsibilities

Project Governance

GCC have set up a clear and robust structure to provide accountability and an effectual decision-making process for the management of the LEP funded schemes. Each scheme will have a designated project manager who will be an appropriately trained and experienced member of GCC staff.

A detailed breakdown of meetings (along with the attendees, scope and output of each) which make up the established governance process is set out below.

Project Board Meetings (PBM)

Project Board Meetings are held monthly to discuss individual progress on each scheme and are chaired by Gloucester County Council term contractor Project Managers (PMs). Attendees include representatives for different aspects of LEP management (i.e. Communication, Traffic, Risk Management, and GCC Consultants design and/or construction team). Progress is also discussed in technical detail raising any issues or concerns for all to action. A progress report, minutes of meeting and an update on programme dates are provided ahead of the meeting for collation and production of the LEP Progress and Highlight Report.

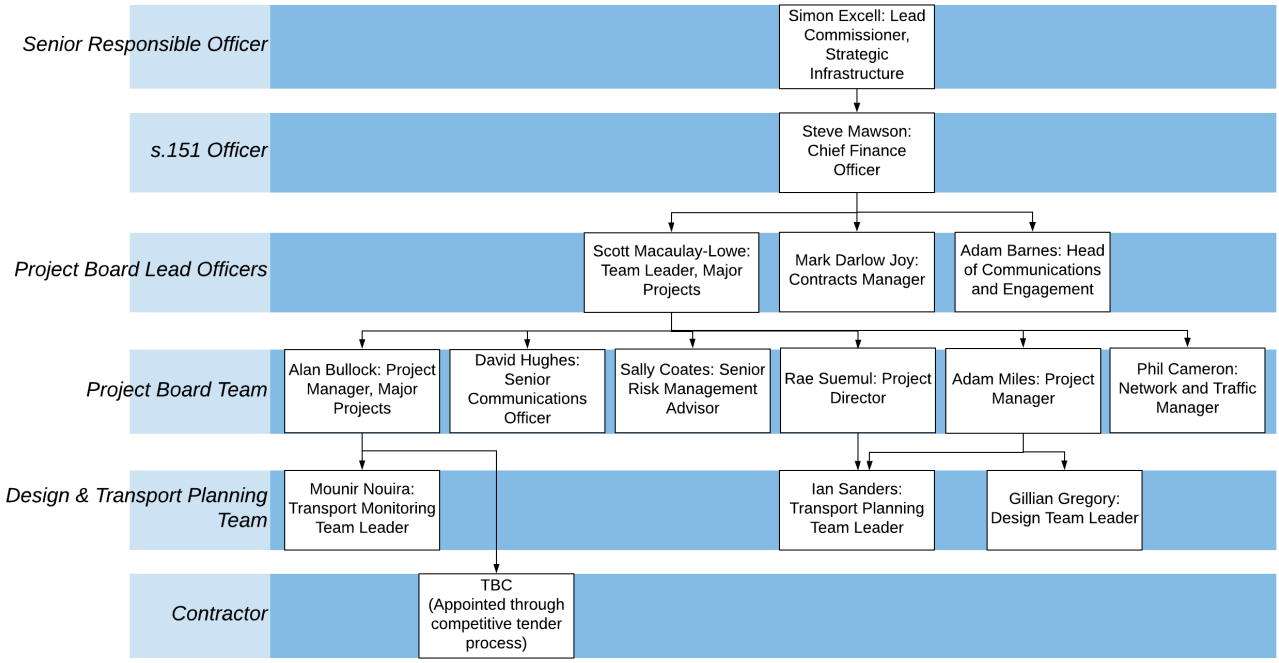
LEP Progress and Highlight Report

The Progress and Highlight Reports sent by the GCC PMs comprise of the following updates; general progress, project finances, issues, risks and meeting dates. The report also identifies any areas of concern or where decisions are required by the PBM. An agreed version of the latest Progress and Highlight Report is issued to the PB meeting attendees during the meeting.

6.3. Project Management Structure

Gloucestershire County Council and their Consultants have agreed a project management structure for the project, as shown in Figure 6-1 below.

Figure 6-1 - Project Management Structure



6.4. Public Share Events

A total of two Public Share Events covering Phases 1 and 2 of the West of Cheltenham Transport Improvement Scheme – UK Cyber Park have been held at two different locations in Cheltenham:

1. 18th June 2019 (14:00 – 19:00): Jury's Inn Hotel, Gloucester Road, Cheltenham GL51 0TS
2. 20th June 2019 (17:30 – 21:00): St Mark's C of E Junior School, Robert Burns Avenue, Cheltenham GL51 6NU

The attendance at the events was unprecedented: the most highly-attended public drop in sessions ever held by Gloucestershire County Council for a highways scheme, with close to 500 people visiting across the two sessions. The events were promoted following a full letter drop of 1,600 letters (area covered shown in Figure 6-3), press releases, social media, personal invites to key stakeholders, promotion on the Gloucestershire County Council Website and promotion on local radio. At both events, presentation boards were provided with large scale artist's impressions, general arrangement plans and graphics together with scheme introduction, background and Frequently Asked Questions. A number of GCC and Atkins staff were on hand to answer questions from key stakeholders and members of the public. Attendees were offered a personal tour of information available and in-depth discussions about issues, concerns and improvements. Most attendees took the opportunity to ask questions and give their own views of the scheme using feedback forms that were available for people to leave comments. In addition, key stakeholders were invited to provide a formal written response either online, or through the GCC Major Projects Email Inbox.

Figure 6-2 – Artist's Impression – Phase 2 A40 Widening

Figure 6-3 - Letter drop area

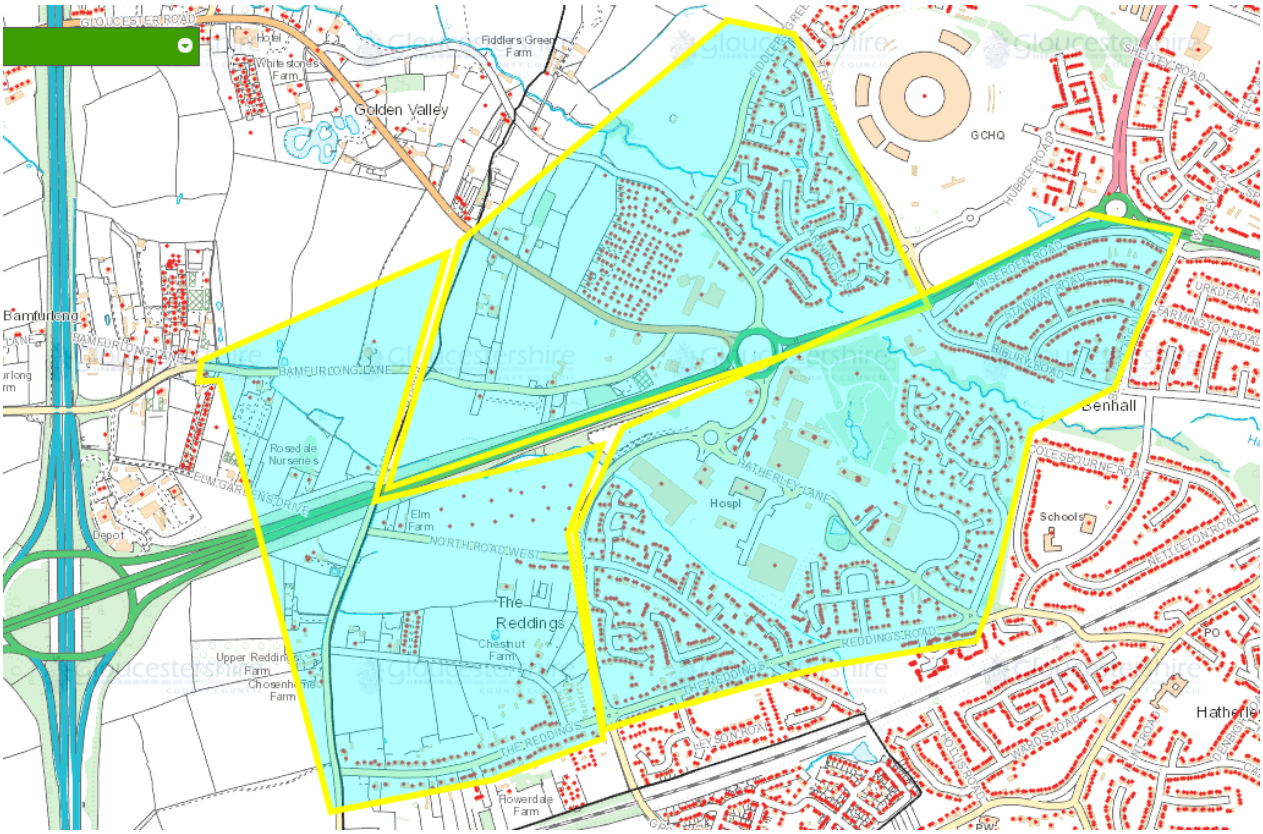


Figure 6-4 - Presentation boards at the 18th June event, Jury's Hotel Cheltenham

6.4.1. Feedback form responses

On the feedback form, attendees were asked if they agreed or disagreed that four different objectives would be achieved by the scheme. The results of the feedback from the sessions are summarised in Table 6-1 below.

Overall the statements received more agreement than disagreement (181 'agree' responses vs 162 'disagree' responses).

- People were most sceptical about the walking and cycling provision, with 45 respondents indicating that they thought that the scheme wouldn't increase walking and cycling provision against 39 who agreed that it would; but
- More people agreed that the scheme would alleviate congestion than disagreed (62 vs 40); and
- More people agreed that the scheme would encourage development in the West of Cheltenham (38 vs 35).

Opinion was split on whether the scheme represents good use of public monies. One key factor contributing to negative responses, especially in the first event, was concerns that the Phase 1 (Arle Court Roundabout) scheme does not address a difficulty getting out of Fiddler's Green Lane at peak times. Over half (65) of the feedback forms submitted referred to this concern. This particular issue does not directly affect the Phase 2 scheme.

Table 6-1 - Summary of the feedback at the Public Share Events

Statements	Agree	Neither agree nor disagree	Disagree
Alleviate existing congestion at Arle Court Roundabout and on the A40 (from M5 J11 to Arle Court)	62	32	40
Encourage future development in the West of Cheltenham area by releasing network capacity	38	59	35
Increase the level of walking and cycling provision for the West of Cheltenham areas	39	51	45
Represent good use of public monies	42	47	44
Total	**181**	**189**	**164**

50 spoiled/missed questions. 20 of the attendees responded online after the events.

The feedback form also had a box where respondents could write any further comments and feedback. It is important to note that most responses focused on Phase 1 (Arle Court Roundabout) but some themes were identified which also have relevance to Phase 2. These are shown in Table 6-2 below, along with our responses to these comments.

Table 6-2 - Themes identified from the comment box responses relevant to Phase 2

Theme	Examples	Mentions	How we responded to and / or addressed the comments
Air quality / climate change	Increased traffic taking advantage of the extra capacity could increase greenhouse gas emissions and air quality concerns at a time when the 'climate emergency' is hitting the headlines.	16	While highway improvements may in certain cases result in more traffic attracted to the network, free-flowing traffic is integral to mitigating the impact of road traffic on air-quality. The overall impact on Air Quality of the scheme has been fully assessed and is expected to be neutral.
Cyber Business Park	Concern that some of the anticipated journey time benefits would be short-lived once traffic from Cyber Park starts using Arle Court.	20	It was clarified that the overall scheme would not mitigate for the full Cyber Park development but will assist in bringing forward potential developments in the West of Cheltenham by addressing some of the existing traffic issues. It was made clear that it would be incumbent on and developer to continue to provide the necessary transport infrastructure improvements as part of any planning application/transport assessment. The team were also able to provide further information on the proposals for M5 J10 and the positive impact this would have on A40 traffic
Modal shift	Responses described induced demand resulting from increasing highway capacity, potentially encouraging single-	12	The scheme will also benefit users and operators of public transport, with routes along the A40 the most well-used in the county. The biggest operator, Stagecoach, is supportive of the scheme, which will reduce journey times and improve

Theme	Examples	Mentions	How we responded to and / or addressed the comments
	occupancy car use instead of public transport.		reliability, improving the attractiveness of public transport as an alternative to the private car.
M5 J10	Upgrading J10 of the M5 would alleviate some of the pressure on the A40 from J11.	12	J10 is subject to a live bid submitted by GCC and their partners, in seeking funding for a full-movements junction from the Housing Infrastructure Fund. It is not a question of transferring the funds from this scheme to J10 as the quantum of scheme and monies required are of a different scale.
Consideration of development in the area	Responses were centred around wider concerns about planning allocations sites to the west of Cheltenham.	29	Although it is known that the Cyber Park and North West Cheltenham (Elms Park) Strategic Allocation Sites are close to full planning applications, there are at present no agreed Transport Assessments or trip generations/distributions that are agreed by the Council (submitted by the developers). Therefore, the scheme **is not** solely for the enabling of the North West Cheltenham and West Cheltenham developments and is not specifically for their benefit, but to relieve current traffic congestion and facilitate early development for all potential developments. However, all planning applications are subject to approval in terms of traffic and typically require a full Transport Assessment with appropriate mitigation proposed to enable the application.

13 of the attendees of the 20th June event responded online after the event.

During the consultation phase, liaison with key local stakeholders and BT took place. Following feedback on the scope and size of diversion works to the northern verge, the scheme alignment was amended to avoid the need for these major works. This both reduced the cost of the scheme and significantly reduced the risk of diverting the apparatus.

At the public consultation, concerns were raised about closures of Badgeworth Road to allow works on the overbridge to take place. These closures would also impact on the National Cycle Route that passes under the bridge. Originally, long road closures were envisaged, but following feedback and further careful amendment of the design the need to widen the bridge was removed. Whilst the need for closures has not been removed entirely, the length and impact of the diversions has been greatly reduced.

6.4.1. Formal responses

In addition to the feedback received at the Public Share Events, a number of formal responses and emails to the Major Projects team at GCC were also received from key stakeholders in the area. These included politicians, members of the Walking, Cycling and Horse-riding Assessment and Review (WCHAR) group, planning officers and local employers. Comments followed a similar theme to the Public Share Event, focusing on the first phase at Arle Court, where the need for good cycling provision was emphasised.

Two stakeholders in particular gave detailed responses:

- GCHQ, whose main Benhall site lies just to the east of the proposed scheme; and
- Stagecoach West, the principal bus operator in Cheltenham.

Both responses from these organisations were generally supportive of the schemes but had further comments and suggestions. On the section of the A40 between Arle Court Roundabout and the M5, the respondent on

behalf of GCHQ suggested extending the third lane westbound out of Arle Court Roundabout further towards the M5 J11. This would be to reduce the need for rapid lane changes soon after leaving the junction, preventing a potential bottle neck and queueing back into the roundabout.

This has been reviewed as part of the detailed design and there is little opportunity to extend the merge length beyond that previously provided without introducing a hazard in the vicinity of the bus interchange. The 120m (approx.) provided is greater the desirable minimum by design standards. Extending the merge further would introduce the following additional aspects;

- Purchase of additional third-party land;
- Construction of retaining walls;
- Extension to local bridge structure;
- Additional earthworks; and
- Increased environmental impact as more trees would be affected.

The above issues are outside of the scope of this scheme due to budgetary and programme constraints.

The Managing Director of Stagecoach West welcomed the proposals, stating that existing issues are leading to unreliable journey times and reduced take-up of public transport. He highlighted that the 93 and 94 services, which use this section of the A40, are the most popular in the county and that the scheme will benefit some 2.5 million passenger journeys per year.

6.5. Communications and Engagement Management

GCC have a tried and tested Communication and Engagement Management Plan which is used on all major projects. Effective use of the plan has resulted in limited adverse feedback from the public and ensured successful delivery of schemes both from a project management and public relations perspective. This section will provide further information on how stakeholders are identified, how they are communicated to and the methods/ techniques used to communicate.

Aims and objectives

The main aim of the Communication and Engagement Plan is to ensure that stakeholders and members of the public are kept informed throughout the development and implementation of a scheme. This can range from keeping key stakeholders updated with critical information, (essential to the successful delivery of the scheme) to providing information to the public.

Table 6-3 - Stakeholder categorisation approach

Stakeholder Category	Stakeholder Characteristics
Beneficiary	Stakeholders who will receive some direct or indirect benefit from the scheme.
Affected	Stakeholders who are directly affected by the scheme in terms of its construction and/ or operation
Interest	Stakeholders who have some interest in the scheme, although not affected directly by its construction or operation
Statutory	Stakeholders who have a statutory interest in the scheme, its construction, operation or wider impacts
Funding	Stakeholders who are involved in the funding of the construction or operation of the scheme

Engagement categories

The information supplied to stakeholders can vary depending on their involvement with the scheme. The following table indicates the level of engagement that the variety of stakeholders can expect in relation to this scheme.

Table 6-4 - Stakeholder engagement levels

Engagement Category	Details of Engagement Method
Intensive consultation	Stakeholders who are directly affected by the scheme and whose agreement is required in order for the scheme to progress. Consultation throughout the design and implementation.
Consultation	Stakeholders who are affected by the scheme and can contribute to the success of its design, construction or operation. Consultation at key stages.
Information	Stakeholders with some interest in the scheme or its use. Information to be provided at appropriate stages.

6.6. Communications and Engagement Strategy

The Table below summarises the strategy for managing engagement with stakeholders for the scheme. It itemises the relevant stakeholders and interests and indicates the stakeholder category with which each is associated.

Liaison has taken place with the following stakeholders:

Table 6-5 - Stakeholder management strategy and method

Name of Stakeholder / Interested Group	Stakeholder Category	Engagement and Consultation Level	Engagement Method
Property owners and businesses operating in building affected by the works	Affected	Intensive consultation	Pre-exhibition briefing Direct contact with owners and where appropriate their agents.
Local MPs	Interest	Consultation	Pre-exhibition briefing
Elected Members	Interest	Intensive consultation	Pre-exhibition briefing
Scheme users	Beneficiary	Consultation Information	Public Share Events
Local press/radio	Interest	Information	Pre-exhibition briefing
Local Enterprise Partnership	Beneficiary Funding	Information	Through LGF Business Cases & progress reports

The following list details the statutory consultees who were contacted by email and provided with an overview of the scheme and copies of the current plans:

- Gloucestershire Constabulary;
- Gloucestershire Fire and Rescue Service;
- South Western Ambulance Service;
- Road Haulage Association;
- Freight Transport Association;
- GCC Highway Records;
- GCC Local Highway Manager; and
- Parish/Town/District Council.

6.7. Evidence of Previously Successful Management Strategy

GCC continue to deliver a wide and varied range of highway schemes from design conception through to delivery. The following examples are selected from a range of schemes that demonstrate GCC delivery capability and support the success of the management and governance strategy used.

Since 2014, the A40 Gloucester Northern Bypass has seen significant junction improvements funded through both the GFirst LEP and the DfT. Primarily these improvements have focussed on delivering additional network capacity at key pinch points, to alleviate congestion and improve journey times. The Walls Roundabout, C&G roundabout, Elmbridge Court roundabout and Over roundabout have all been subject to significant highway improvements in the last 5 years – Over roundabout being completed most recently in 2018. All of these schemes were managed by GCC from feasibility, through detailed design, procurement and construction. These projects are good examples of schemes previously completed by GCC which had a very similar management structure to the proposed A40 eastbound merge scheme.

The Walls and C&G scheme, completed in October 2014, was designed to support economic development, job creation and social regeneration, improving access with high quality connections between the urban centres, transport hubs and development sites. The overall objectives of the scheme were to unlock the development potential of the area, attract inward investment and maximise job opportunities for local people.

The scheme was successfully delivered within budget and on programme through the adoption of a robust management approach. The total value of the scheme was £3.1M of which £0.5M was funded by Central Government. The scheme was procured through an open tender process using the NEC 3 Option A contract which will also be the preferred method for this scheme

GCC also worked in partnership with Griffiths contractors Ltd on the Elmbridge Court Roundabout major scheme. This was a £6.4m contract to improve capacity and reduce journey times on the A40 at the busiest roundabout in the County. This scheme follows the management strategy set out in this business case and was completed both on time (September 2017) and on budget.

Finally, Over roundabout was completed in autumn 2018, again using the tried and tested procurement and management/governance methods detailed in this FBC.

Other recently completed schemes within the portfolio included the junction, signals and footway/cycleway improvements scheme at Metz Way/Abbeymead Avenue. This was a smaller contract (£1.4m), but one set across a number of sites (eight in total) that required a different approach to how the scheme was procured, the on-site management and stakeholder communications.

GCC acknowledges the importance of continual assessment for the appropriateness of the management and governance structure within our major schemes. And whilst recent projects can demonstrate a high level of success, we continue to work with our Members, commercial support, consultants and delivery partners to ensure that we deliver future schemes to the same, high standard.

The scheme is intended to be delivered using a collaborative approach between GCC staff and their appointed support organisations. GCC have identified appropriately trained and experienced staff that will be responsible for the management of the scheme. The identified staff fulfilling the GCC Project Manager and Atkins Project Manager roles, have been ring-fenced to support the scheme throughout its duration, from design through scheme procurement and onto construction supervision. They will have more junior staff available to support them as required.

GCC will utilise dedicated Professional Services Consultant resource through an existing contract to undertake design and also arrange early contractor involvement (ECI), where appropriate, to the design process to ensure best value.

6.8. Design and Construction Methodology

6.8.1. Design Methodology

The scheme design is standard detail and in accordance with current issues of:

- Gloucestershire County Council's Manual for Gloucestershire Streets;
- Design Manual for Roads and Bridges;

- Local Transport Notes;
- Inclusive Mobility;
- Traffic Signs Manual and Traffic Signs Regulations and General Directions 2016;
- Sustrans Handbook for Cycle Friendly Design.

6.8.2. Construction Methodology

The proposed works all involve standard construction methodology in accordance with Specification for Highway Works. The proposed works do not require special construction techniques and could be wholly carried out by conventional methods.

The Contractor selected for the works will have a proven track record in carrying out similar works.

6.8.3. Works compound

It is intended that the works compound for construction will be in the same location as the one for WCTIS Phase 1. This will be situated within land to the south-west of Arle Court Roundabout, as shown in the figure below.

Figure 6-5 - Works compound proposals

The works compound will consist of hardstanding areas for material storage and welfare facilities. The proposed compound boundary treatment along Hatherley Lane and the A40 would be close boarded fencing.

Access to the works compound is likely to be from Hatherley Lane. A minimum of 10m from the edge of Hatherley Lane shall be surfaced with bituminous material. An exit from the compound, onto the bus lane slip road on the A40, shall be provided with the same treatment.

6.8.4. Demolition

No demolition is required to complete the scheme.

6.8.5. Traffic management

The traffic management arrangements for the scheme will be based on the requirement to meet constraints in respect of HE strengthening works at M5 JCT 11 and Staverton Bridge, which are programmed to run concurrently with the works. There will be programme constraints ensuring traffic management restriction are not in place during Public Holidays, Cheltenham Festival of Racing in March and other significant festivals in the annual Cheltenham calendar. The HE works and the Festivals have the potential to substantially increase traffic flows in the area.

The methodology of delivery of the construction will be shaped to maintain existing flow capacity during peak traffic hours. This will be achieved by off-carriageway working behind Varioguard barrier and some night and off-peak working when we can safely reduce flow capacity without detriment to vehicle movements. Traffic orders will be in place to reduce road speeds during the works and the successful contractor will be charged with booking roadspace and liaising with HE, GCC and Stakeholders via direct contact and (where appropriate) social media.

6.9. Legal Powers Required for Construction

6.9.1. Land/Access

Works are all within the highways boundary and there is no requirement for land purchase for temporary and permanent works.

6.9.2. Traffic Regulation Orders (TRO)

The requirement of a TRO has been reviewed and the proposed alterations to the mainline carriageway will be covered by an existing Clearway order. No further TROs are required for the purposes of this scheme.

6.9.3. Environmental Restraints

As part of the preliminary design, environmental site walkovers have been carried out as well as desktop environmental scoping reports. Liaison is ongoing with Environmental Health Officer to confirm whether a Section 61 permissions will be required for night-working. Any other permissions that may arise, although not anticipated, will be addressed via the legally required procedures.

Where further detailed design work or environmental surveys are required, any mitigation or identified risk will be included in the Risk Register and costed for.

6.10. Project Programme

The following milestone dates are from the Scheme's delivery programme which is shown as a Gantt chart is included as an 7.2.Appendix B:

Table 6-6 - Programme key dates

Activity	Target Date
Detailed Design Start	22/07/2019
Detailed Design End	11/10/2019
Submit Full Business Case for Approval	01/11/2019
Issue Supplier Engagement Notice	25/11/2019
Approve Full Business Case	10/12/2019
Issue Tender Documents	10/12/2019

Tenders Return	10/02/2020
Complete Tender assessment and award	03/04/2020
Construction Start	18/05/2020
Construction End	25/12/2020

6.11. Benefits realisation strategy

The benefits realisation strategy is designed to allow benefits that are expected to be derived from the scheme to be planned for, tracked and realised. It also sets out the evaluation of the scheme delivery, including construction and budget management.

The outputs and outcomes are those expected to be derived from the scheme:

- **Outputs** - tangible effects that are funded and produced directly as a result of the scheme; and/or
- **Outcomes** - final impacts brought about by the scheme in the short, medium and long term.

The scheme objectives and desired outputs / outcomes are summarised in Table 6-7.

The monitoring of the benefits realised against each objective is controlled within the Monitoring and Evaluation Plan which will set out the necessary data and information requirements to track the performance of the objectives.

Table 6-7 - Logic map between scheme objectives and desired outputs and outcomes

Objective	Output / outcome
Contribute to accelerating the release of the employment land associated with the 'West Cheltenham' Strategic Allocation along with the other strategic allocations in the JCS adjacent to GCHQ, which includes the proposed Cyber Park and Cyber Innovation Centre	Improvement to roads New lanes Increased traffic capacity for the corridor • *This outcome will contribute to the objective by providing the capacity needed for new employment developments*
Deliver transport benefits to people living and working in Gloucestershire by improving traffic flows on one of the most important and busiest sections of Gloucestershire's road network	Improvement in journey time along the A40
Aim to have an overall neutral impact on the Cheltenham Air Quality Management Area (AQMA)	Neutral impact on the Cheltenham AQMA
Maintain and improve the options for sustainable travel modes through the junction and on the approaches; walking, cycling, and where feasible providing for enhanced public transport facilities	Improved journey times and reliability for buses on the A40 corridor

Tracking the scheme benefits will be a key element in understanding the success of the scheme. Table 6-8 links the benefit realisation for specific measures with responsibility. It is also important to refer to the Risk Register for specific risks and associated controls throughout the project.

Table 6-8 - Benefits realisation responsibilities

Measure	Benefits Realisation	Responsibility
Delivery on time	Through contract management	Contractor
Delivery on budget	Through contract management	Contractor
Accelerating the release of employment land	New employment delivered at the West of Cheltenham strategic allocation	GCC / Cheltenham Borough Council / Developers

Wider transport benefits	Realisation involves completion of the scheme to enhance capacity at the junction	LEP / GCC

6.12. Monitoring and Evaluation Plan

The purpose of the Monitoring and Evaluation Plan is to identify how the scheme benefits (direct and wider) and actual scheme delivery, (including construction and budget management), are to be evaluated.

The Monitoring and Evaluation Plan is to be owned by the Senior Responsible Officer (SRO), although ownership will be reviewed and delegated as necessary.

To determine whether the scheme benefits are being realised, the desired outputs and associated outcomes have been converted into measurable indicators of scheme benefits, as set out in Table 6-9 below.

In order to evaluate the impacts of the scheme, baseline data will be collected which will allow the pre-scheme opening situation to be quantified. This is required for benefit assessment indicators #02, #03, #04, and #05. This will include the following:

- Automatic Traffic counts (ATCs);
- Journey Times on the A40,
- NO2 concentrations; and
- Accident records – data to be obtained from GCC over a 5-year period.

There is already a permanent ATC site on the A40 between the M5 and Arle Court Roundabout and this will enable monitoring of traffic volumes travelling along the A40. In addition, temporary counters will be placed on the upgraded merge to provide a full picture of the level of traffic demand using the scheme. Baseline traffic surveys will be carried out prior to the construction of the scheme, while avoiding any planned roadworks in the local area. NO2 monitoring data will also be obtained from Cheltenham Borough Council.

The scheme implementation monitoring will focus on scheme delivery including the extent to which the construction programme was delivered within the estimated timescales and budget.

A Monitoring Report will be produced prior to scheme opening detailing the baseline survey data. After opening, studies will be carried out approximately one year and five years later. These will include assessment against the scheme details and desired outcomes, with benefit indicator #03 (minimal accidents along the A40 corridor) covered in the five-year post opening study only to allow sufficient evidence to compare the situation before and after scheme opening.

Table 6-9 - Outputs and outcomes - indicators and targets

Ref #	Benefit (Desired output / outcome)	Benefit indicator	Target	Type	Specific data requirements
Desired outputs					
1	New lane created	Completion of project	0.9km - From M5 J11 to the intersection with the Phase 1 scheme, (approach to Arle Court Roundabout)	Highway Improvement	n/a
Desired outcomes					
2	Improvement in journey time along the A40.	Reduced journey times along the A40	Reduction in vehicle journey times immediately after the scheme is implemented	Quantitative	Basemap

3	Minimal accidents along the A40 corridor	Number of accidents Baseline	No increase in accidents 5 years after construction	Quantitative	Accident data
4	Increased traffic capacity for the corridor	Increasing traffic flows through the junction	Increased actual flow along the A40, especially eastbound	Quantitative	Traffic counts (ATC)
5	Neutral impact on the Cheltenham AQMA	Stable NO_2 concentration	No statistically significant increase in annual mean NO_2 concentration in the Affected Road Network after opening	Quantitative	NO_2 diffusion tubes

6.13. Risk Register

A project risk register is to be maintained throughout the scheme duration. The Project Risk Register is included as 7.2.Appendix F and a Construction phase risk register will be developed with the Contractor and proactively managed during the construction phase.

7. Conclusion

7.1. Summary

Phase 2 of WCTIS, A40 M5 J11 to Arle Court Roundabout is a critical section of infrastructure for Cheltenham and connects both local and strategic routes across the County. The scheme will link in with the WCTIS Phase 1 scheme, which addresses the bottleneck at Arle Court Roundabout with a capacity improvement scheme.

The most significant benefit from this scheme is derived from reductions in travel times, however the level of benefits far exceeds the cost of the scheme resulting in a high Present Value Benefit (PVB) value and a Benefit Cost Ratio (BCR). The scheme generates a PVB of £10.71m over 60 years.

The total scheme construction costs expressed as a Present Value of Cost (PVC) is £4.01m.

Overall assessment of costs and benefits generated by the project shows that the scheme achieves a Benefit Cost Ratio figure of **2.67** with a Net Present Value (NPV) of £6.70 million. The scheme can be therefore categorised as achieving '**High Value for Money'**.

Further justification for the selection of the scheme is detailed throughout the report and in the results of traffic modelling and analysis via the Business Case.

It is also advised that the planned improvements would provide further betterment and future-proofing of the corridor for increased traffic flows that are anticipated, due to significant ongoing and future development in the local area. It is also strategically prudent and logical to undertake Phase 2 as close to the Phase 1 schedule as is possible to minimise disruption for businesses and residents, and to reduce set-up costs for construction

7.2. Recommended Next Steps

Development and delivery of the scheme should be approved.

Due to the outcomes reported in this study, and the anticipated return on the public funded aspects of the proposal, it is advised that the scheme represents good value for money, meets the criteria of schemes for the LEP, and therefore should be approved for funding.

Appendix A.

Modelling Technical Note

Appendix B.

Modelling Forecasting Report

Appendix C.

Modelling Validation Report

Appendix D.

Social and Distributional Impact Assessment

Appendix E.

Appraisal Summary Table (AST)

Appendix F.

Risk Register

Appendix G.

Noise modelling plots

Appendix H.

Air Quality Report

Appendix I.

General Arrangement Drawings