West of England Combined Authority

A4 Bath to Bristol Strategic Corridor

Outline Business Case

70093741-WSP-TP-0012
February 2024

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1 Introduction

1.1 Overview

1.1.1. The A4 Bath to Bristol Strategic Corridor (BBSC) Programme is being developed jointly by the West of England Combined Authority (the Combined Authority), Bristol City Council (BCC) and Bath & North East Somerset Council (B&NES) as part of the Department for Transport's (DfT's) City Region Sustainable Transport Settlement (CRSTS).

1.1.2. This document represents the Outline Business Case (OBC) for the B&NES Section of the proposed BBSC Programme, which runs from Emery Road (to the east of Bristol City Centre) to Bath (Windsor Bridge Road). This OBC submission follows on from the Strategic Outline Case (SOC) for the Programme which was submitted to the Combined Authority in 2021.

1.2 BBSC Programme Description

1.2.1. In July 2022, the West of England Combined Authority was awarded £540m under the DfT's CRSTS to improve sustainable transport provision in the region. The BBSC Programme was the key flagship project to be developed and delivered within this award.

1.2.2. The vision for the Programme is:

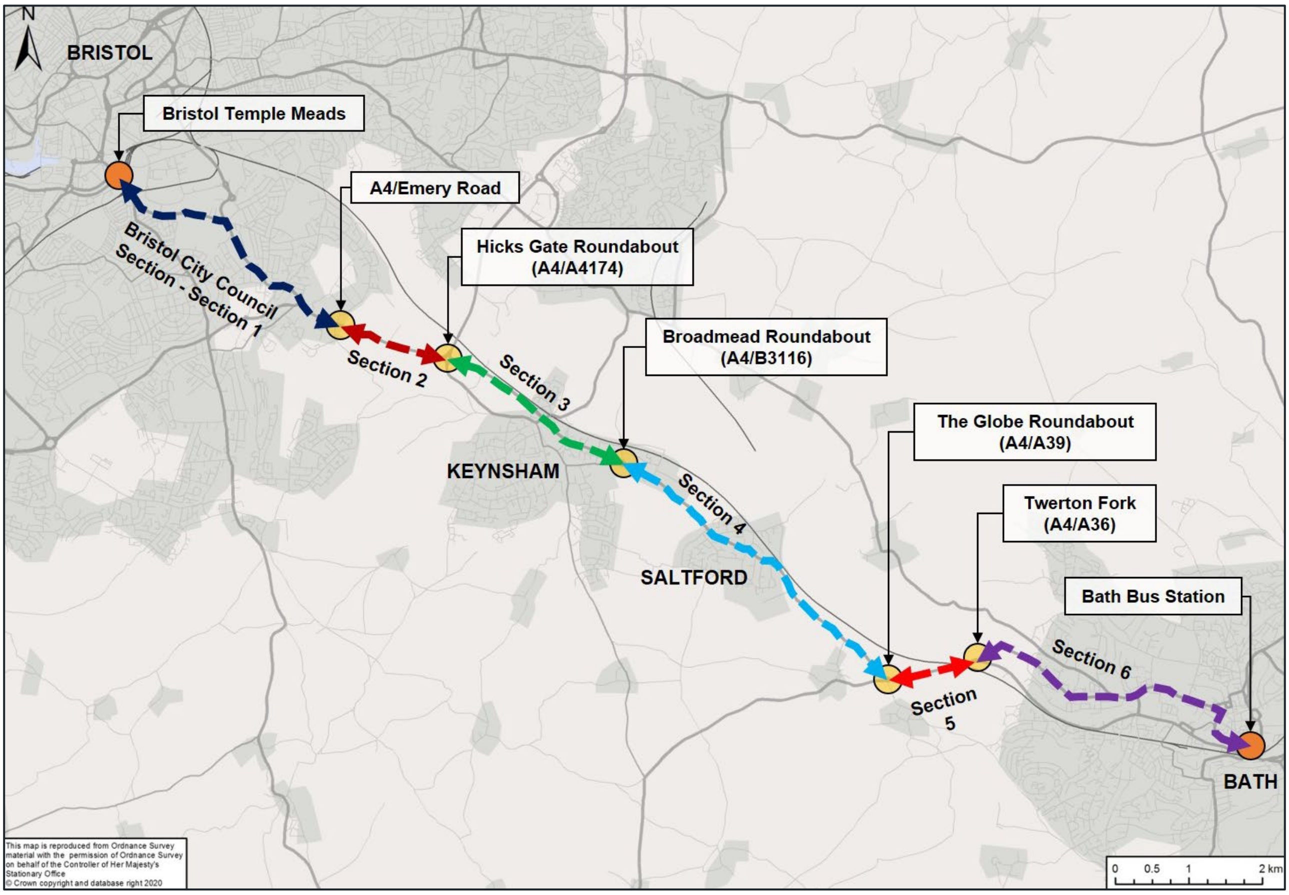
"To connect new and existing communities along the A4 via sustainable modes of transport to places of employment, study and key services to enhance the lives of existing and future residents and those travelling to and along the corridor. This will be achieved by increasing the access to, attractiveness and availability of sustainable and active transport modes for those living, working and travelling through the area."

1.2.3. The Programme focuses on improving access, reducing journey times and improving reliability for bus users, cyclists and pedestrians through the provision of:

- A high-quality, high frequency bus service between Bath and Bristol
- A continuous segregated cycling corridor between Bath and Bristol
- Cycling and walking connections between local communities along the A4 between Bath and Bristol and the new bus service, and strategic cycling corridor

1.2.4. The Programme has been sub-divided into six sections as shown in **Figure 1-1**.

Figure 1-1 - BBSC Programme: Location and Sections Overview



1.3 Scheme Progression

1.3.1. In the CRSTS submission to the DfT, the Programme was split into three projects:

- Project 1 – Bristol to Emery Road (BCC section)
- Project 2 – Keynsham to Bath (B&NES section)
- Project 3 – Emery Road to Keynsham and Keynsham Transport Hub (B&NES section).

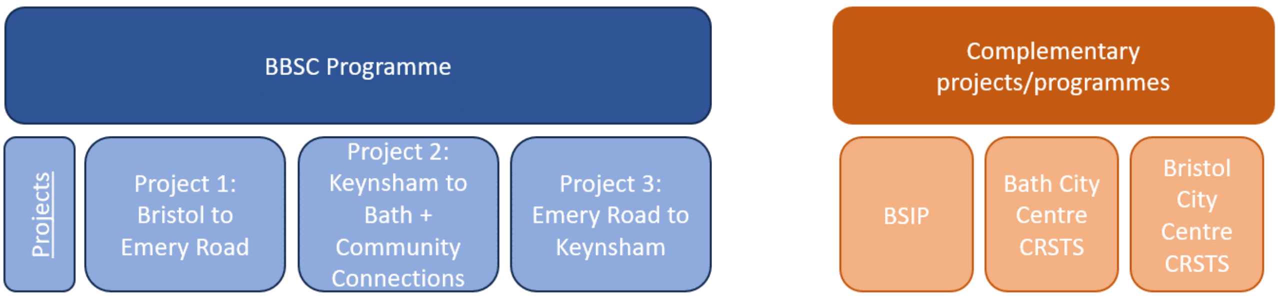
1.3.2. The SOC for the Programme, which was submitted to the Combined Authority in 2021, covered the full length of the corridor. However, the SOC was supported by two Option Assessment Reports (OARs), one covering the BCC Section (Project 1) and one covering the B&NES Sections (Projects 2 and 3). All three projects are managed by the same team at the Combined Authority.

1.3.3. This OBC covers Projects 2 and 3, which encompass Sections 2 to 6, as presented in **Figure 1-1**. For the purposes of this OBC these Projects are referred to as 'the scheme'. It should be noted that Section 6 ends just east of Midland Road in Bath, with the section of the corridor between Nile Street and the bus station covered by the Bath City Centre Project, which also forms part of the wider CRSTS Programme. The approach to considering Projects 2 and 3 within one OBC has been previously agreed with the Combined Authority Grant Assurance team.

1.3.4. Whilst Project 1 is being developed under a separate business case at the OBC stage, the project teams work in an integrated way to ensure consistency between the projects where required. The Management Dimension details how the projects report to each other.

1.3.5. The SOC submitted in 2021 included an increase in service frequency of the bus services as part of the Programme. Service improvements are now being considered and developed as part of the wider Bus Service Improvement Plan (BSIP) for the region. This is to ensure coordination with improvements across the region. Therefore, whilst the BBSC Programme is closely aligned and integrated with the BSIP, the scope of the scheme does not include changes to the service frequency on the corridor. Similarly, there are separate CRSTS projects for Bath (Bath City Centre Sustainable Transport Corridor) and Bristol (Bristol City Centre) City Centres. These projects are being developed by the Combined Authority and B&NES and BCC respectively. Whilst being developed and delivered separately to the scheme and the wider BBSC Programme, these projects form part of a holistic ambition to improve sustainable travel on the corridor, acting together to maximise benefits from the CRSTS programme and its available funding. Projects 2 and 3 of the BBSC Programme provide the foundations to delivering an improved public transport and active mode service offer on the corridor. Therefore, the impacts of this scheme alone do not reflect the full potential of the corridor, in particular because this scheme does not directly serve Bristol or Bath City Centres. **Figure 1.2** shows the structure of the BBSC Programme including these complementary schemes.

Figure 1-2 - BBSC Programme Structure



1.3.6. The OBC has been prepared in accordance with the DfT's Transport Business Cases Guidance, the Combined Authority Local Assurance Framework, and the West of England Combined Authority Transport Appraisal Guidance Advice Note, which set out the requirements for each stage of the business case process. Each business case stage builds upon the last and evidence is reviewed at each stage to ensure that it remains up to date, accurate and relevant.

1.4 Report Structure

1.4.1. The remainder of this OBC is structured as follows:

- **Chapter 2**: Strategic Dimension – provides the context for the scheme in relation to strategic priorities as well as outlining the case for change
- **Chapter 3**: Economic Dimension – demonstrates the value for money of the scheme, considering the benefits and costs
- **Chapter 4**: Financial Dimension – provides an overview of the costs of the scheme, funding sources and demonstrates affordability
- **Chapter 5**: Commercial Dimension – outlines the proposed procurement approach for delivery of the proposed scheme
- **Chapter 6**: Management Dimension – sets out the proposed programme governance arrangements, risk management, and monitoring and evaluation approach

2 Strategic Dimension

2.1 Introduction

2.1.1. The Strategic Dimension covers:

- The policy context in which the scheme has been developed
- The existing problems which the scheme needs to address
- The effect on the study area if the scheme is not delivered - the impact of not changing
- The objectives of the scheme
- How success will be measured

2.1.2. It also addresses the practical delivery of the scheme, outlining:

- What the scheme will, and will not include
- Any constraints (physical, financial, political, environmental. etc.) that could affect delivery of the scheme
- Interdependencies - other factors, schemes or projects that interact with the scheme
- How stakeholders have been involved in the development of the scheme thus far, and how they can support the delivery of the scheme

2.2 Organisational Overview

2.2.1. The West of England Combined Authority is a combined authority within the West of England area, consisting of the local authorities of Bristol, South Gloucestershire, and Bath & North East Somerset. It is led by the Mayor of the West of England and was established in early 2017 through the region's devolution deal. This deal transferred significant powers and funding to the region.

2.2.2. Bath & North East Somerset is a unitary authority district in Somerset, South West England. B&NES Council was created on 1 April 1996 following the abolition of the county of Avon. It is a unitary authority with the powers and functions of a non-metropolitan county and district council combined.

2.3 The Current Situation

2.3.1. A clear understanding of the current context is required to understand the needs and challenges to be overcome. This section sets out the following:

- The **socio-economic context** (the current demographics and socio-economic situation along the corridor, including areas of deprivation)
- The **transport context**:
  - The road network (the current road network, traffic flows and the high levels of congestion on the A4)
  - The public transport network (the current network and services, the slow bus journeys times and the poor journey time reliability)

- The active travel network (the current lack of provision for cycling along the A4 and the challenges faced by people moving on foot)
- The trip patterns and mode share (where people are travelling from and to, and highlighting the very high car mode share for journeys from/to the corridor)

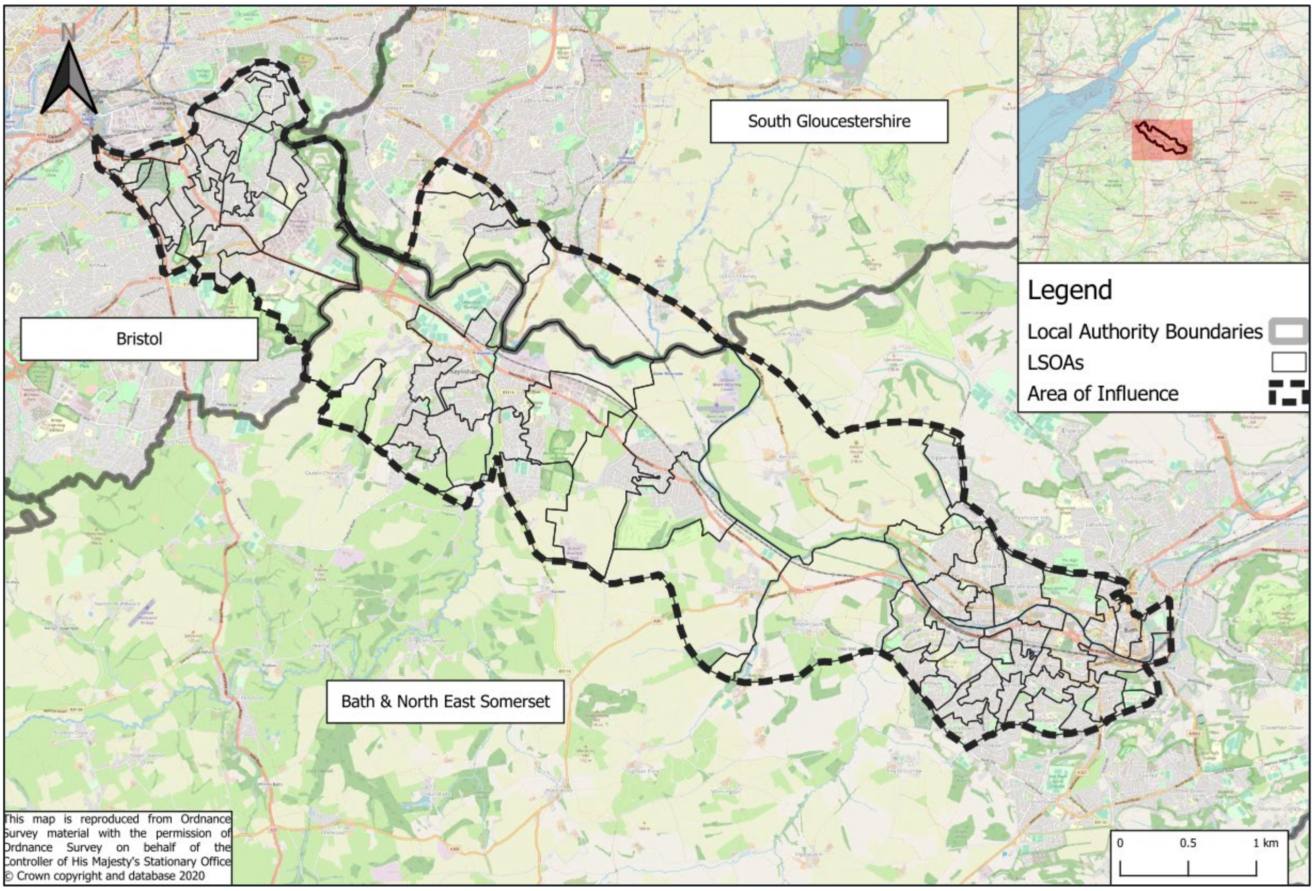
- The **environmental context** (the key environmental constraints and the impact on carbon of transport along the corridor)

Area of Influence

2.3.2. The Area of Influence (AoI) for the scheme was derived to understand the impacts on local communities and neighbourhoods that will be served by the corridor. The AoI was defined using traffic flows and encompasses neighbourhoods and communities considered to be able to access the A4 through walking, wheeling, and cycling.

2.3.3. **Figure 2.1** presents the AoI and the local authority boundaries it crosses. The Lower Super Output Areas (LSOAs) which fall within the buffer from the BCC, B&NES and South Gloucestershire are also presented.

Figure 2-1 – Area of Influence



Socio-Economic Context

Population

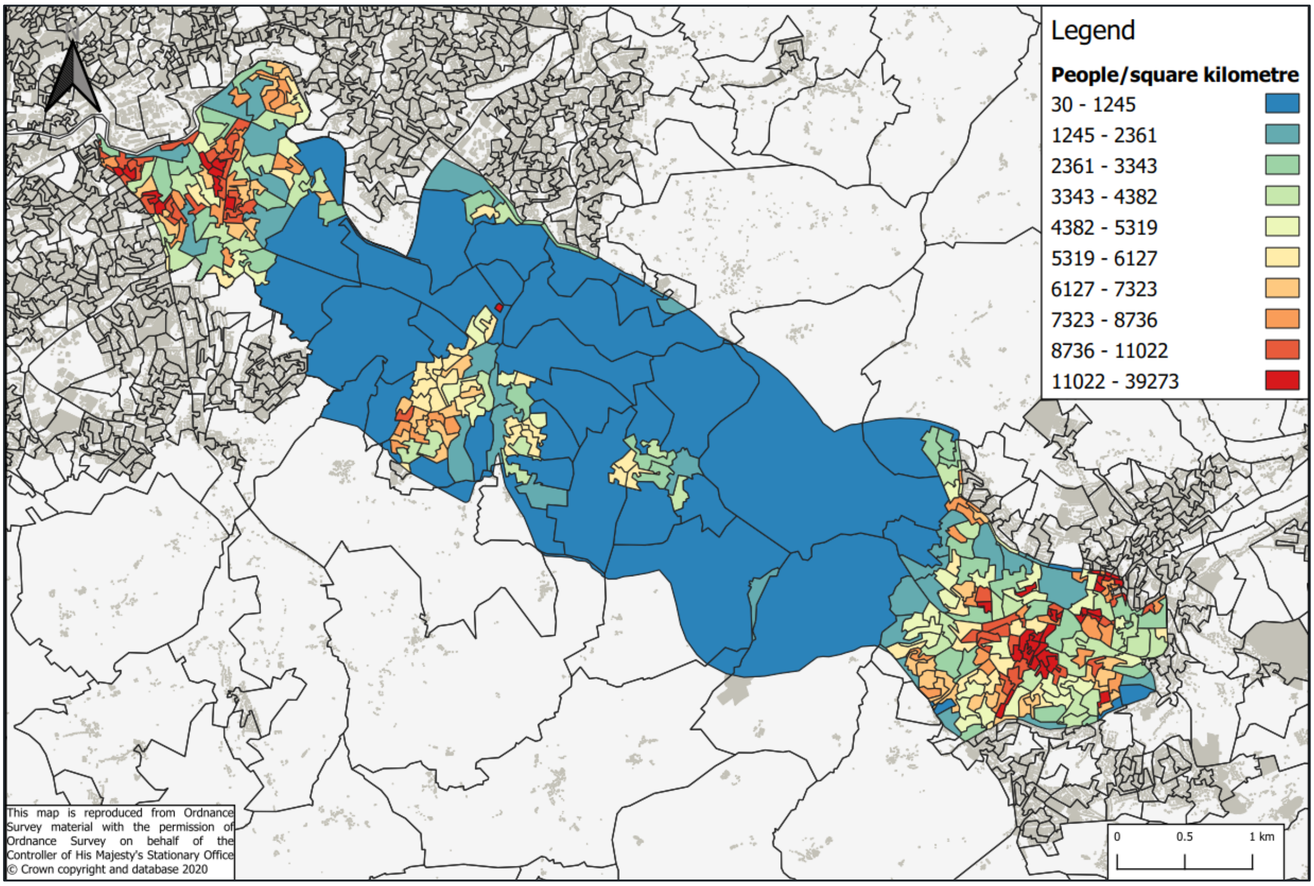
2.3.4. The population in the AoI, according to Census 2021 data, was 125,651. This has been measured for all Census Output Areas (OAs) which are partially or entirely within the AoI. This population is concentrated in the Bath and Bristol ends of the corridor, with a much lower population density along the length of the corridor. As can be seen in **Figure 2-2**, there are two smaller, but significant settlements along the length of the corridor; Keynsham and Saltford.

Density

2.3.5. **Figure 2.2** shows the population density within the AoI. Much of the area has a very low population density (30-1,245 people per square kilometre), as indicated by the large polygons on the figure. The population density increases significantly at either end of the area, in Bristol and in Bath. Additionally, there are some smaller settlements with higher population densities along the route such as in Keynsham and Saltford.

2.3.6. Areas with higher population densities are more likely to utilise the scheme compared to areas with lower population densities. This is due to the dual advantages of a larger potential user base and enhanced accessibility facilitated by better public transport connections. This means the scheme is expected to be used heavily by the residents of Bath and Bristol, whilst also providing benefits for the communities of Keynsham and Saltford.

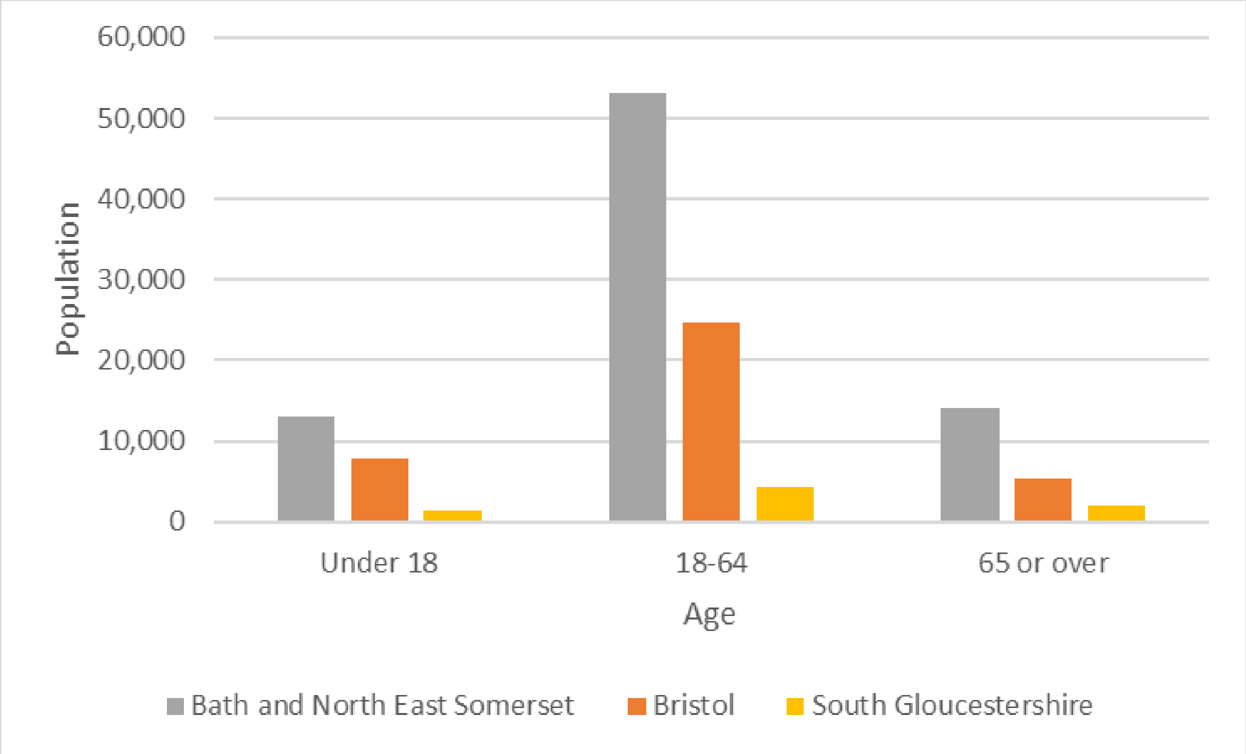
Figure 2-2 - Population density within the AoI



Age

2.3.7. **Figure 2-3** shows the proportion of the population within different age brackets in the AoI. The figure shows the overall population of OAs which fall within each of the Unitary Authority (UA) areas within the AoI. Approximately 18% of residents are aged under 18, and approximately 17% of residents are aged 65 or over. Making up approximately 35% of the local population, these age groups may have limited access to cars and therefore are more likely to depend on public transport. Approximately 65% of the population are between the ages of 18-64 years old and are more likely to be economically active and may use the corridor to commute to work.

Figure 2-3 - The age structure within the AoI



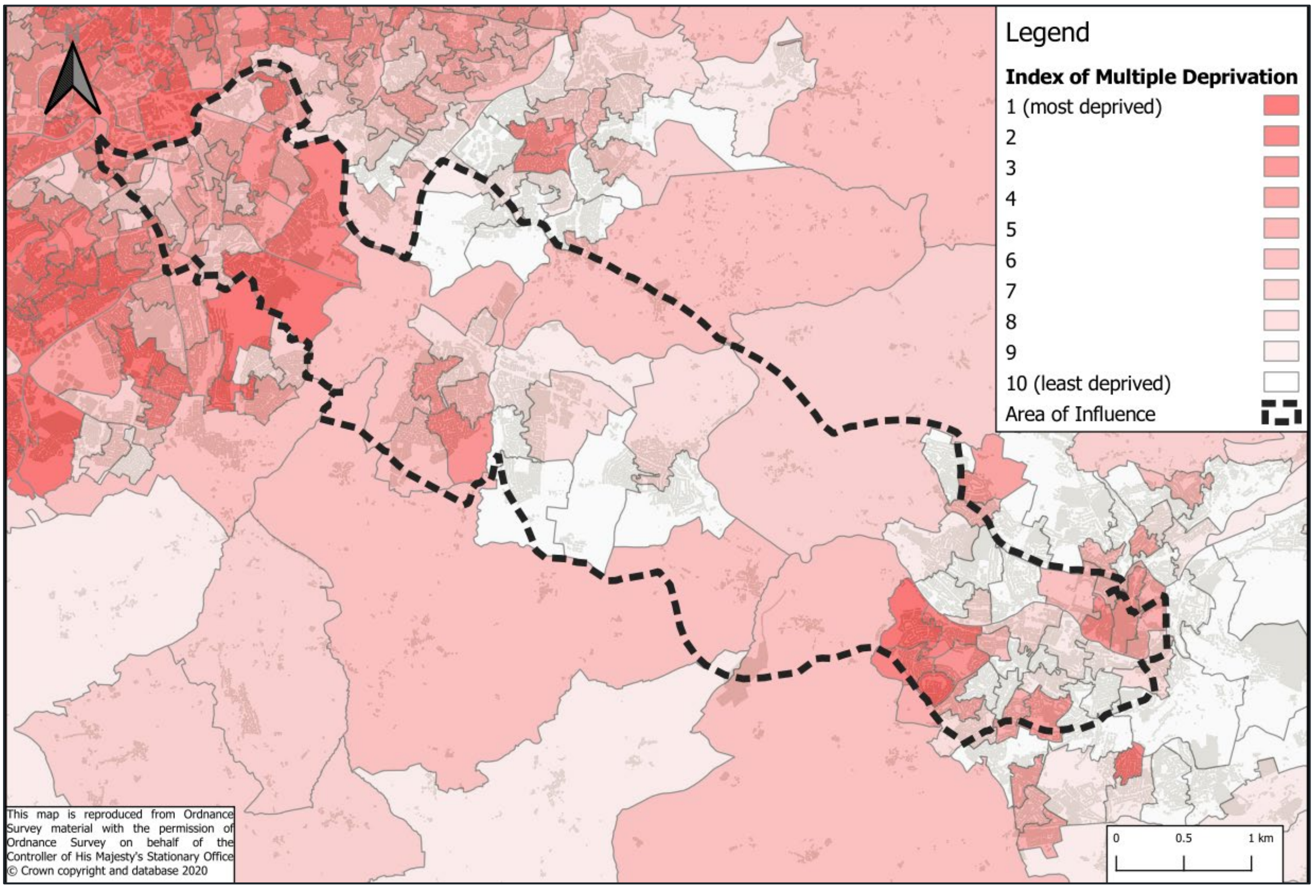
Deprivation

2.3.8. The Indices of Multiple Deprivation (IMD) demonstrate the overall level of deprivation in an area. It comprises of seven distinct domains of deprivation which, when combined and appropriately weighted, form the IMD. These include income, employment, health, deprivation and disability, education, skills and training, crime, barriers to housing and services and living environment.

2.3.9. **Figure 2-4** shows the 2019 IMD rankings for Lower Super Output Areas (LSOAs) within the AoI. High ranking LSOA or neighbourhoods can be referred to as the 'most deprived' or as being 'highly deprived'. This presents the proportions of households facing deprivation in two or more domains.

2.3.10. There are areas within the AoI which are within the 10% most deprived areas in the country. The areas of highest deprivation include Stockwood (Bristol), Twerton (Bath) and Whiteway (Bath). As well as these areas there are further pockets of deprivation at St Anne's (Bristol), South Keynsham, Kingsmead (Bath), Walcot (Bath), and Beechen Cliff (Bath). The rest of the corridor falls within the deciles 4 and 7, where decile 1 is the most deprived 10% and decile 10 is the least deprived 10% of the population.

Figure 2-4 - Indices of Multiple Deprivation (IMD), 2019



Health Deprivation

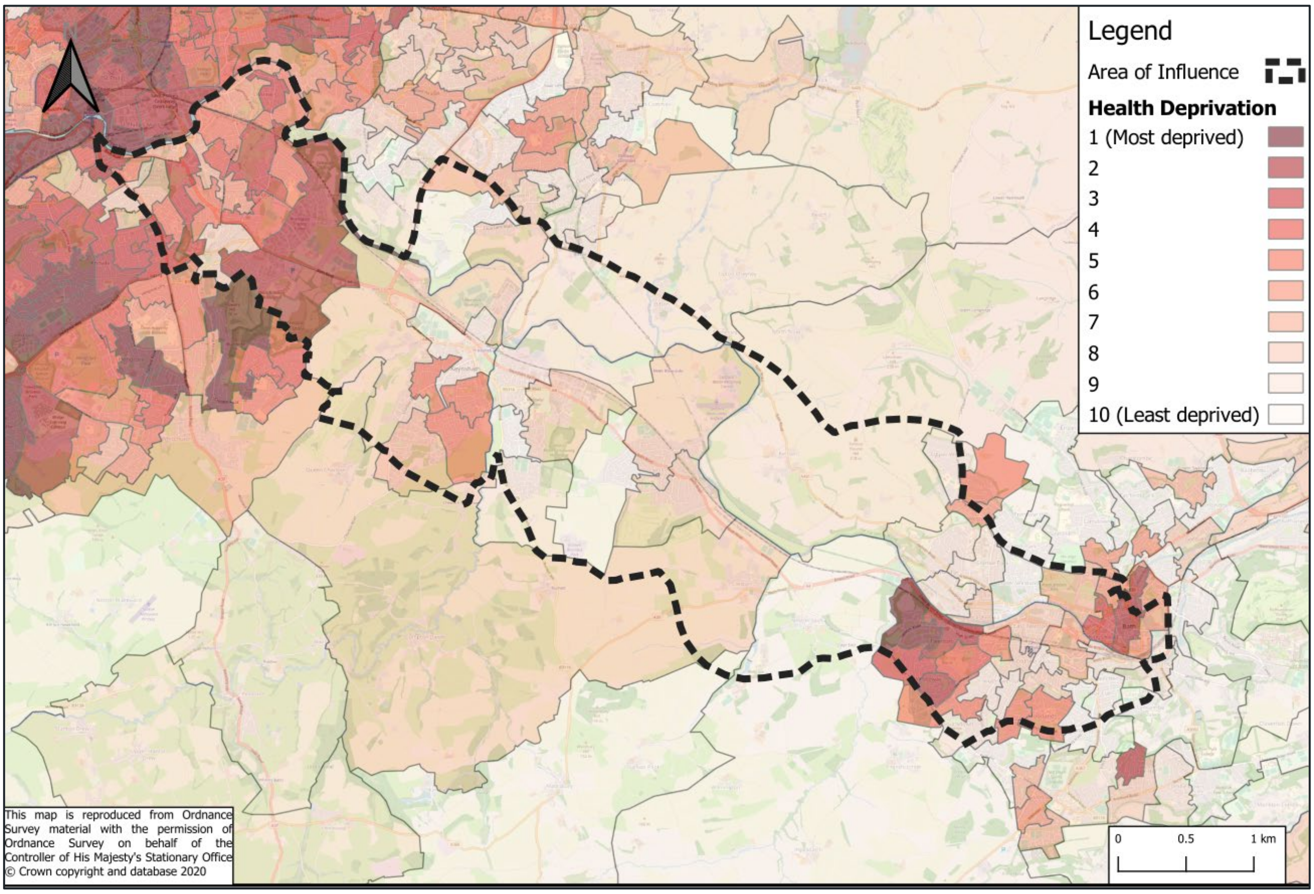
2.3.11. Health deprivation measures the risk of premature death and the impairment of quality of life through poor physical or mental health.

2.3.12. **Figure 2-5** presents the indices of health deprivation for 2019 for the LSOAs within the AoI. The data shows that the most deprived areas (decile 1) are located at either end of the AoI. For example, Bristol, Brislington and Eastwood are shown to have the highest levels of health deprivation. In Bath, the areas of Twerton, Kingsmead and Whiteway are also shown to have high levels of health deprivation (decile 1 to 3).

2.3.13. Areas with the lowest levels of health deprivation (decile 10) are mainly located towards the southern section of the AoI such as in Saltford and Newton Saint Loe, as well as small pockets in Bath such as Bear Flat and Lower Weston. On average however, the majority of the AoI has low levels of health deprivation (decile 7-9) in terms of geographical area. However, in terms of population (with the highest concentration of people), there are quite high levels of health deprivation (deciles 2-5).

2.3.14. Providing a well-connected sustainable transport network along the corridor will support the health and well-being of residents along the corridor by providing walking and cycling opportunities (to increase physical activity) which will support the reduction of congestion and poor air quality. Improved transport services will also improve accessibility to services including hospitals, GPs and wider facilities.

Figure 2-5 - Indices of Health Deprivation (IMD), 2019

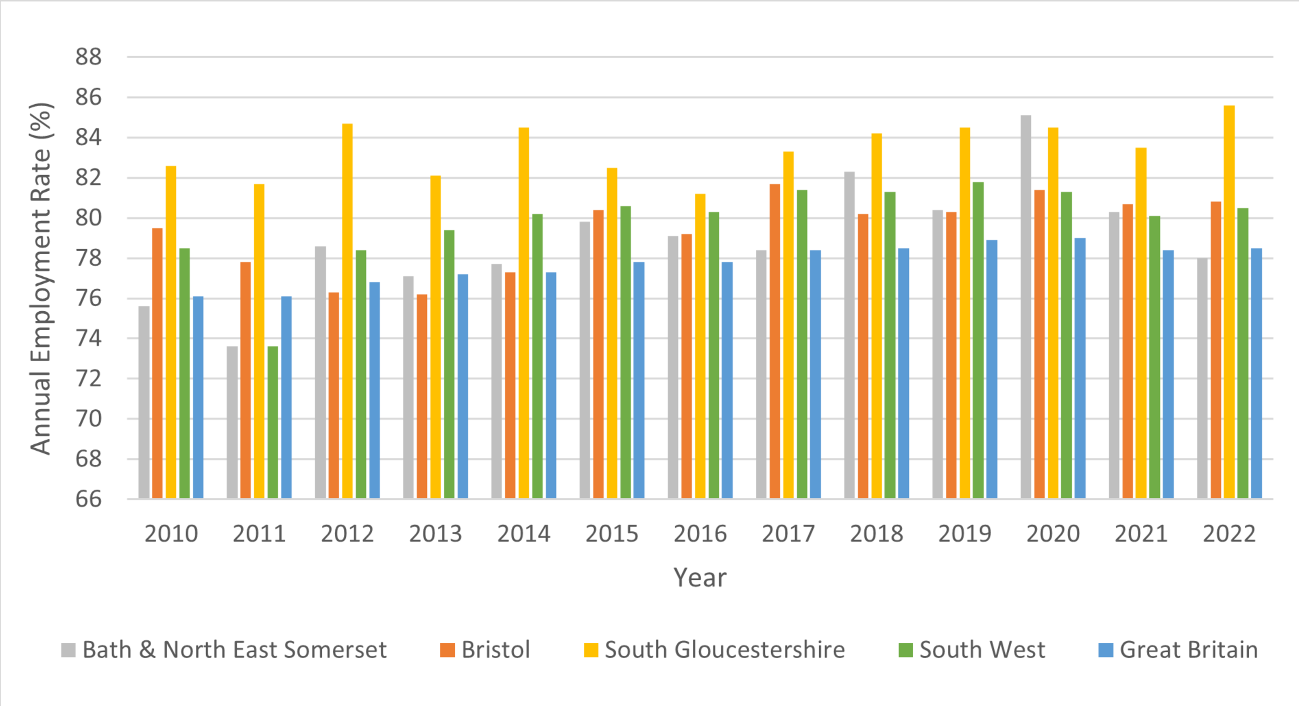


Employment

2.3.15. **Figure 2-6** shows the overall employment rates for the UAs within the Bath to Bristol corridor between 2010 and 2023 compared to the national and the South West averages. Between 2010 and 2023, employment rates for B&NES and Bristol were generally higher than the national average (with the exception of 2011 for B&NES and 2012-2013 for Bristol).

2.3.16. The data also indicates that South Gloucestershire has consistently maintained the highest employment levels compared to the other UAs, as well as to both the South West and the national average. Bristol has typically experienced the lowest employment rate among UAs, although it remains higher than the national average.

Figure 2-6 - Annual Employment Rate: Aged 16 to 64 (2010-2023)



Source: ONS Data

2.3.17. In 2022, the industries with most employees in Bristol were:

- 'Human Health and Social Work Activities' (16.1%)
- 'Professional, Scientific and Technical Activities' (13.8%)
- 'Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles' (10.4%)[1]

2.3.18. In B&NES, the most popular sectors were:

- 'Human Health and Social Work Activities' (17.2%)
- 'Education' (14%)
- 'Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles' (11.8%)

[1] Labour Market Profile - Nomis - Official Census and Labour Market Statistics (nomisweb.co.uk)

Key Employment Sites

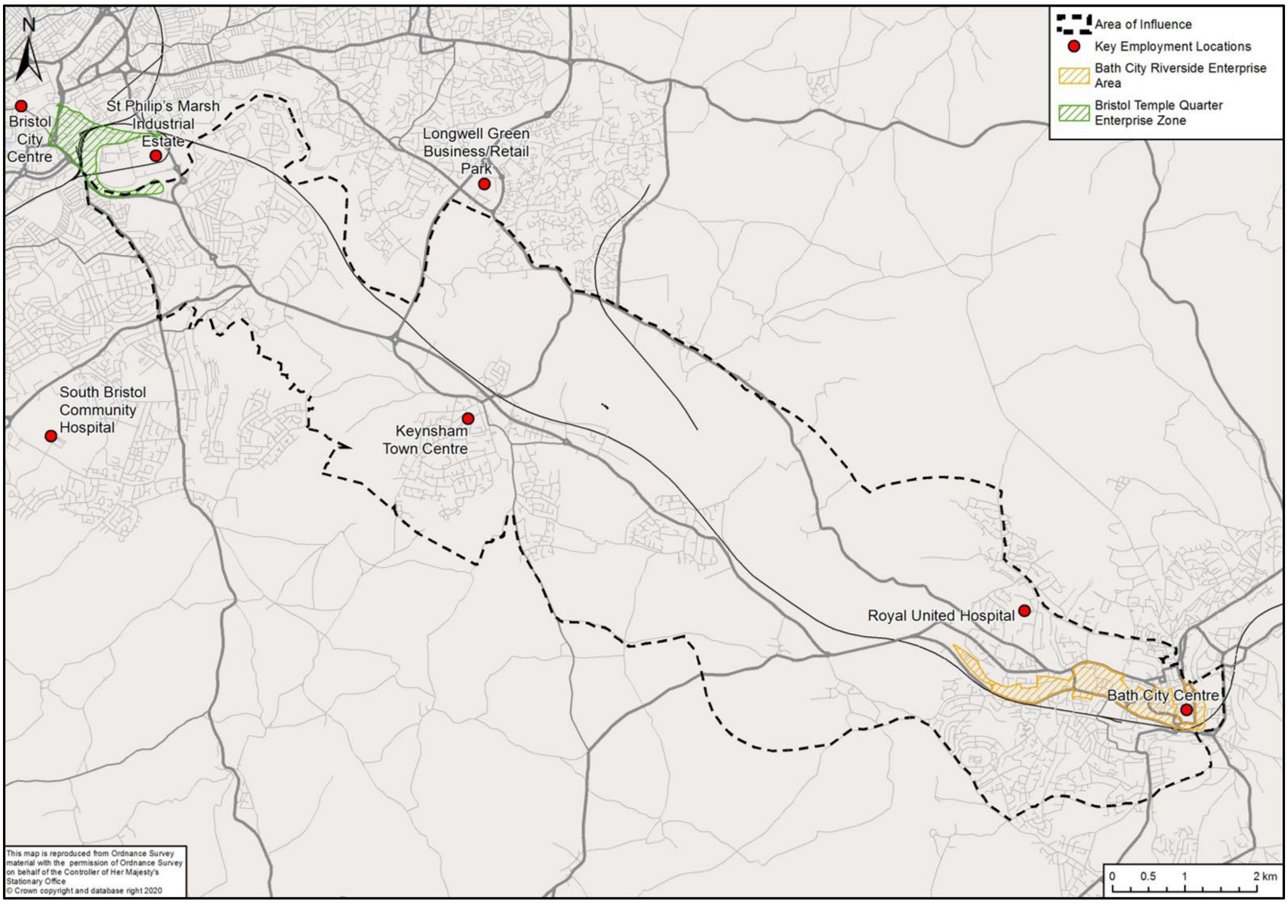
2.3.19. The Bath to Bristol corridor links employment centres at either end of the corridor in the cities to communities along the corridor, as well as connecting to current and future employment sites along the corridor. The key employment sites include:

- At the Bristol end of the corridor there is the South Bristol Community Hospital, the Bristol Temple Quarter Enterprise Zone (BTQEZ) and St Philip's Marsh Industrial Estate. The BTQEZ is based around Bristol Temple Meads railway station and includes the University of Bristol's Temple Quarter Campus.
- At the Bath end of the corridor the key employment locations are the Royal United Hospital (RUH), businesses in Bath City Centre and the Bath Riverside Enterprise Area, and Bath Spa University.
- Along the corridor, Keynsham Town Centre is home to the main civic office for B&NES, with approximately 2,500 staff located there.
- To the north of the corridor there is the Longwell Green Business Park, in South Gloucestershire.

2.3.20. The key employment sites along the corridor are shown on **Figure 2-7** as well as the location of enterprise areas which will help to support economic growth and skill development within the West of England.

2.3.21. There are employment sites located along and at either end of the Bath to Bristol corridor. There is an opportunity for better connectivity to these sites from existing areas of deprivation and to support employment for all residents, particularly for 16- to 24-year-olds, through the provision of improved sustainable transport along the corridor linking deprived communities with employment opportunities.

Figure 2-7 - Key Employment Destinations and Enterprise Zones



Education and Leisure

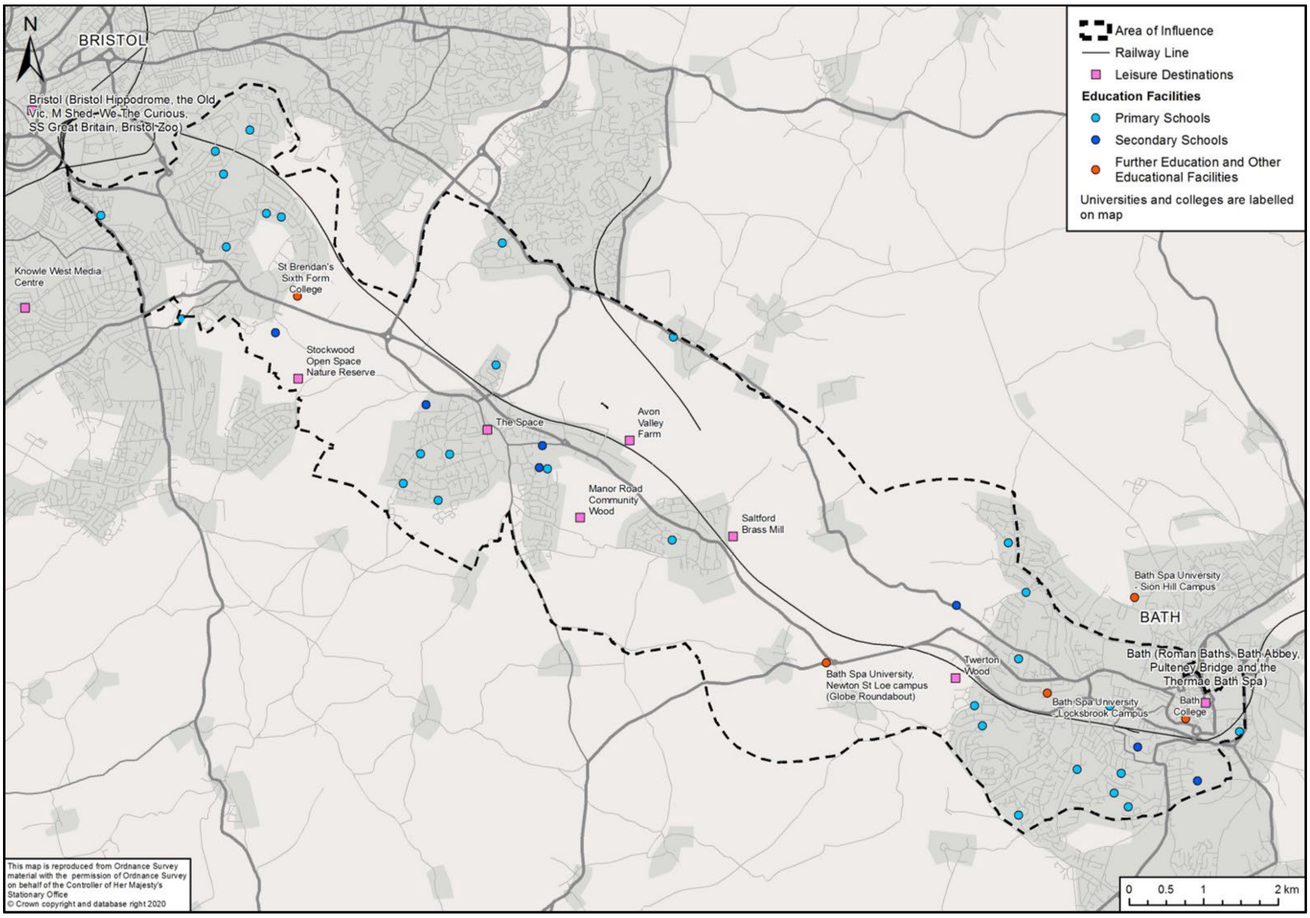
2.3.22. **Figure 2-8** provides a high-level overview of education centres, cultural and leisure destinations within the AoI.

2.3.23. There are a number of primary and secondary schools and further education colleges located along the corridor, including Bath Spa University and the University of Bristol Temple Quarter Campus. Along the corridor, there are cultural attractions such as the Avon Valley Wildlife Park, Arnos Vale Cemetery, Saltford Brass Mill and The Space in Keynsham.

2.3.24. Both Bath and Bristol are consistently voted top places to live and are popular with tourists. Bath has a dual World Heritage Site status and contains attractions such as theatres, concert halls, the Roman Baths, Bath Abbey, Pulteney Bridge and the Thermae Bath Spa. Bristol contains attractions such as the Bristol Hippodrome, Old Vic, M Shed, We the Curious, SS Great Britain, art galleries and museums. There are also attractions along the corridor, including Avon Valley Adventure & Wildlife Park, and two golf clubs (Stockwood Vale Golf Club and Saltford Golf Club).

2.3.25. These trip attractors need to be accessible to local residents and visitors. As such, there is an opportunity to provide improved connectivity within the AoI in a sustainable manner through improved walking and cycling facilities (to facilitate shorter journeys and access to public transport) and through an improved public transport service along the corridor. Improved connectivity would help to reduce the potential for residents to become isolated.

Figure 2-8 – Education Centres and Leisure Destinations in the AoI



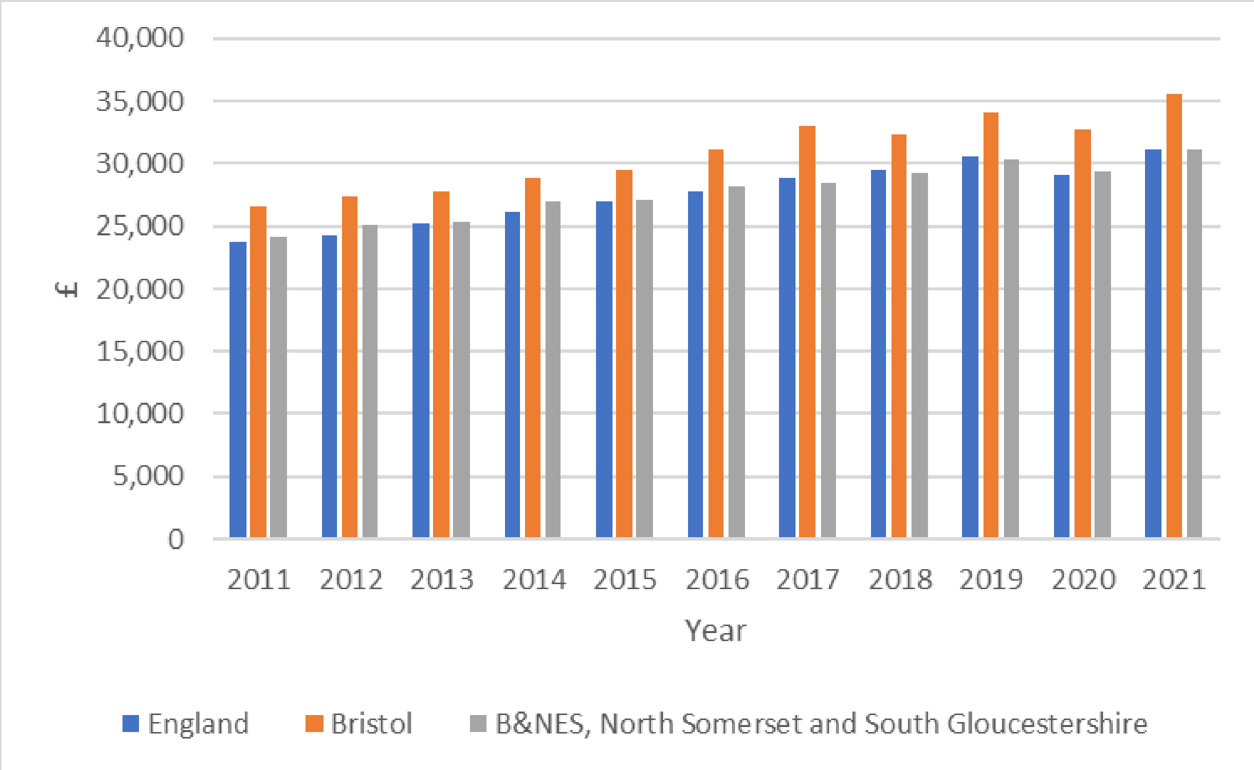
Gross Value Added

2.3.26. The West of England Economic Connectivity Report[2] published by the Combined Authority has highlighted four main areas of economic development within the region, including business linkages, infrastructure connectivity, movement of people and flow of ideas. Under the section on business linkages, the report suggested that for every £1 of Gross Value Added (GVA) generated by West of England based businesses the rest of the UK gains by about 60p. This shows the economic strength of the region.

2.3.27. **Figure 2-9** demonstrates the GVA per head in Bristol, B&NES together with North Somerset (NS) and South Gloucestershire (SG), and England. The GVA per head has been higher in the West of England than England throughout the 10-year period from 2011 to 2021.

2 https://www.westofengland-ca.gov.uk/wp-content/uploads/2019/02/6A.-WofE-LIS-Economic-Connectivity-exec-summary.pdf

Figure 2-9 – GVA per head count at current basic prices (£)



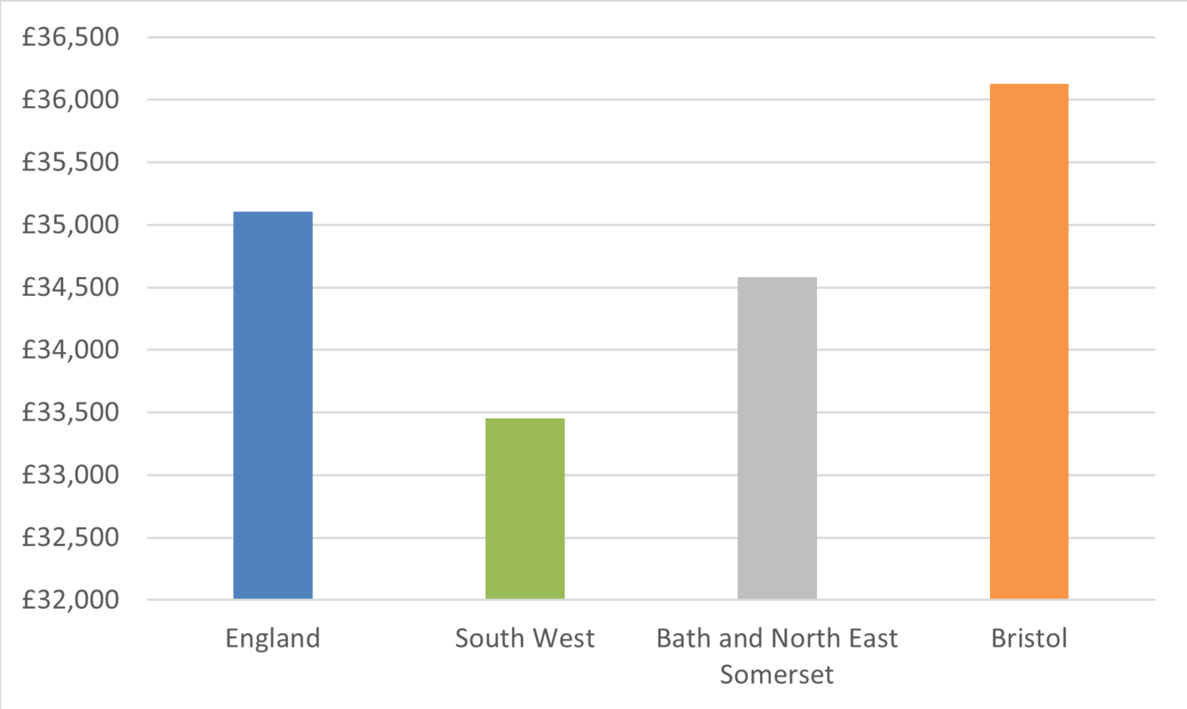
Gross Annual Pay

2.3.28. Continued economic development is dependent on attracting new businesses and increasing the productivity of existing firms. Providing the necessary supporting infrastructure and upgrading and enhancing the walking, wheeling, cycling and public transport infrastructure will be essential if the area is to remain competitive, enhance regional labour mobility, support further housing and infrastructure developments and ultimately, help achieve economic growth.

2.3.29. **Figure 2-10** shows average earnings in Bristol, B&NES, the South West and England.

2.3.30. The figure illustrates that the gross annual pay in Bristol (£36,106) is slightly higher than in England (£34,963). B&NES has a lower gross annual pay than that of England with a salary of £34,584 per annum. This suggests that Bristol has a comparatively skilled workforce with its population being paid more than the average across England. The South West has a relatively lower gross annual pay compared to B&NES, Bristol and England. B&NES and Bristol are performing comparatively better in terms of salary within the South West. This is an indication that both places have a higher concentration of skilled workforce in the region. It is important to further promote the economic growth of both places to induce wider economic growth.

Figure 2-10 – Gross Annual Pay



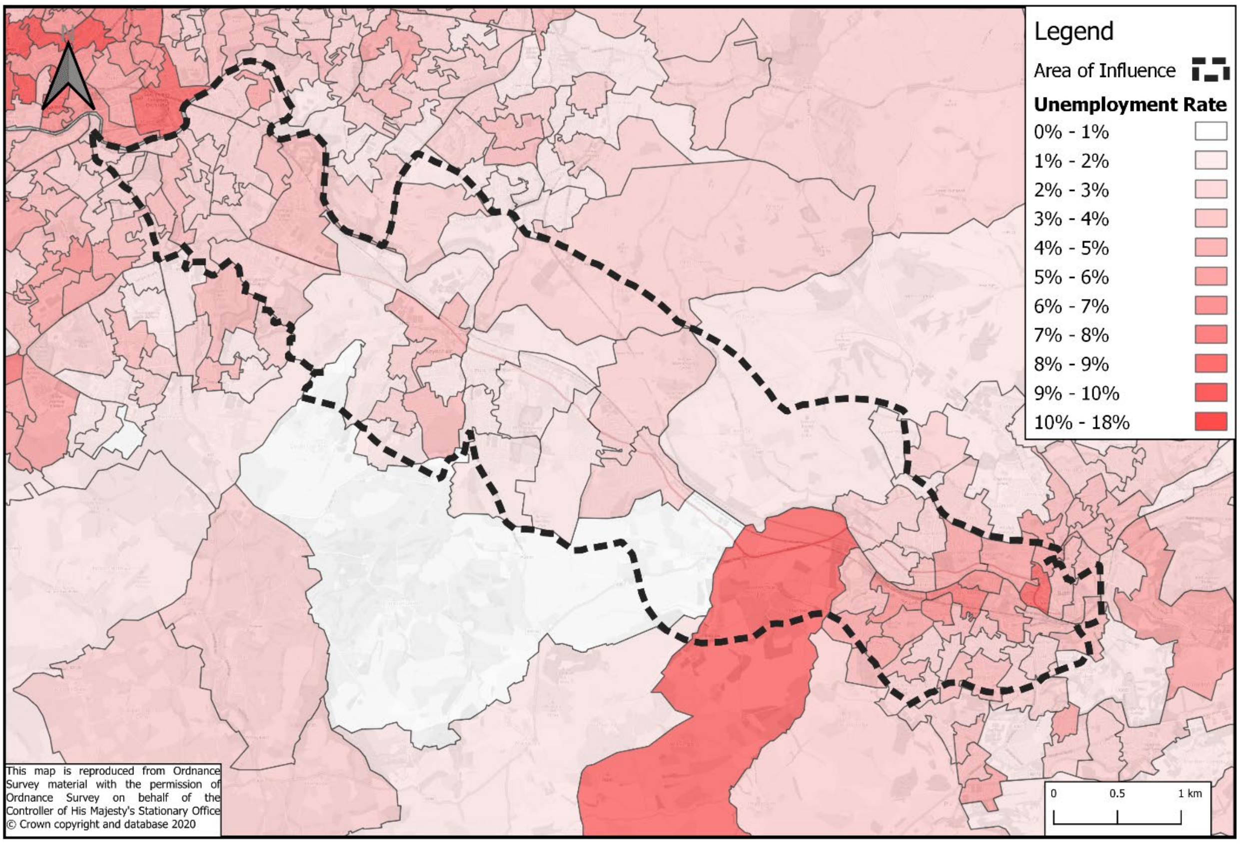
Source: Annual Survey of Hours and Earnings 2022

Unemployment

2.3.31. **Figure 2-11** presents the unemployment rate for 2021 in each local authority (B&NES, Bristol, and South Gloucestershire), as well as along the AoI. The data shows that the average rate of unemployment along the corridor is relatively low, between 1-3% for much of the corridor. The average across England and Wales is 3.4%.

2.3.32. The highest unemployment rate is located in and around Newton Saint Loe near Bath, and Kingsmead (7-8%). The former is the LSOA in which Bath Spa University is located. There are also small pockets of higher unemployment (3-7%) in Bath and Bristol centres and South Keynsham. In particular, these pockets are located in Twerton and St. Anne's.

Figure 2-11 – Unemployment Rate (2021)



Source: 2021 Census

Key Summary Points: Socio-Economic Context

- There is a high proportion of residents who are economically active in the areas served by the proposed scheme. As such, there is an opportunity to improve connectivity via sustainable means to better serve current and future users along the corridor.
- There are some areas of deprivation and unemployment along the corridor. The proposed scheme would support these residents by providing improved sustainable transport connections along the corridor, providing better access to education and employment opportunities.
- There is an opportunity for the existing employment sites along the corridor to support employment for residents in areas of deprivation and for 16- to 24-year-olds through the provision of improved walking and cycling and public transport connectivity.

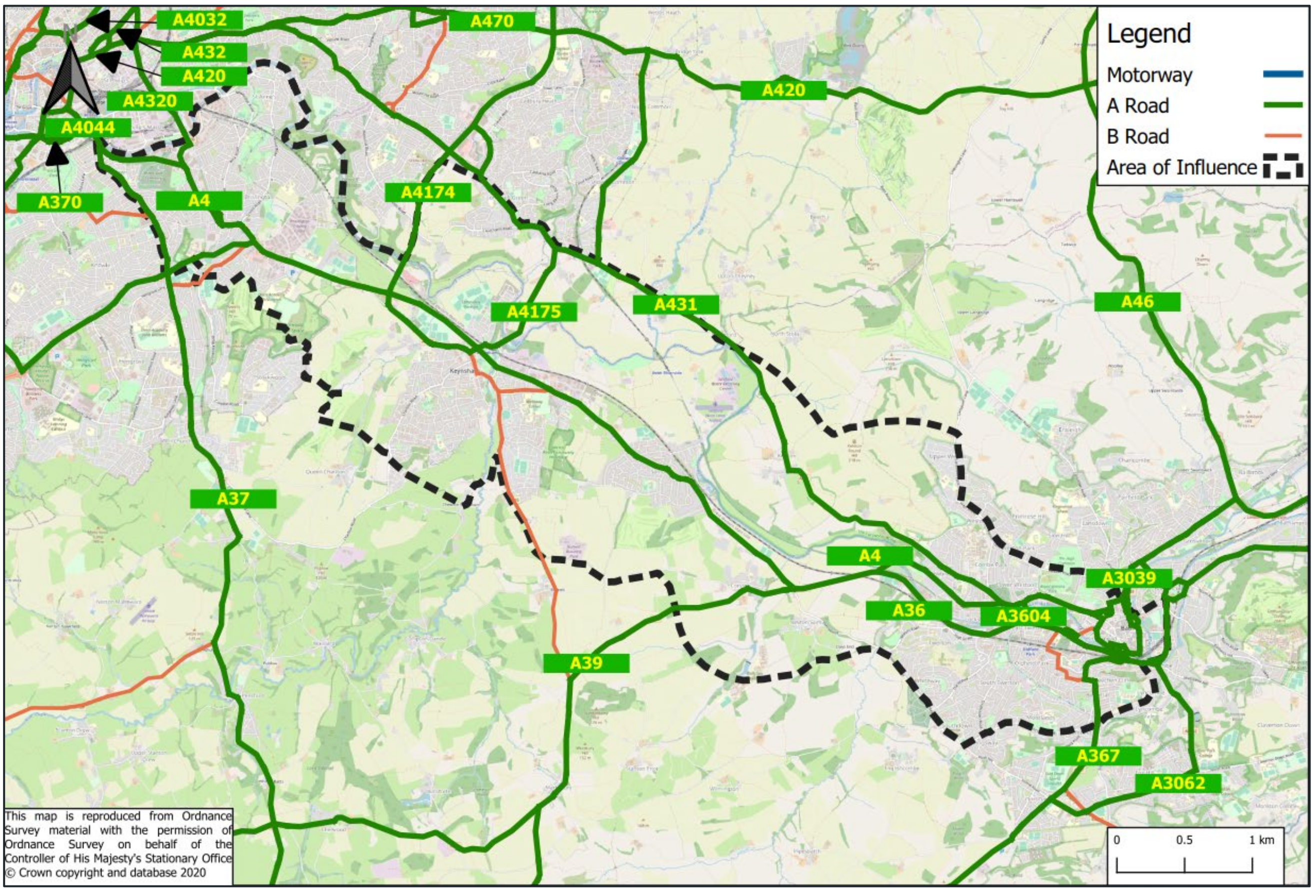
Transport Context

Road Network

2.3.33. **Figure 2-12** shows the highway network along the corridor. The A4 connects Bath and Bristol. The majority of the A4 is single carriageway but there are sections of dual carriageway along the Keynsham Bypass (between Hicks Gate Roundabout and the A4/B3116 Broadmead Roundabout) and between the A43/A39 Globe Roundabout and the A4/A36 Twerton Fork junction. It is a regionally important route, being part of the Key Route

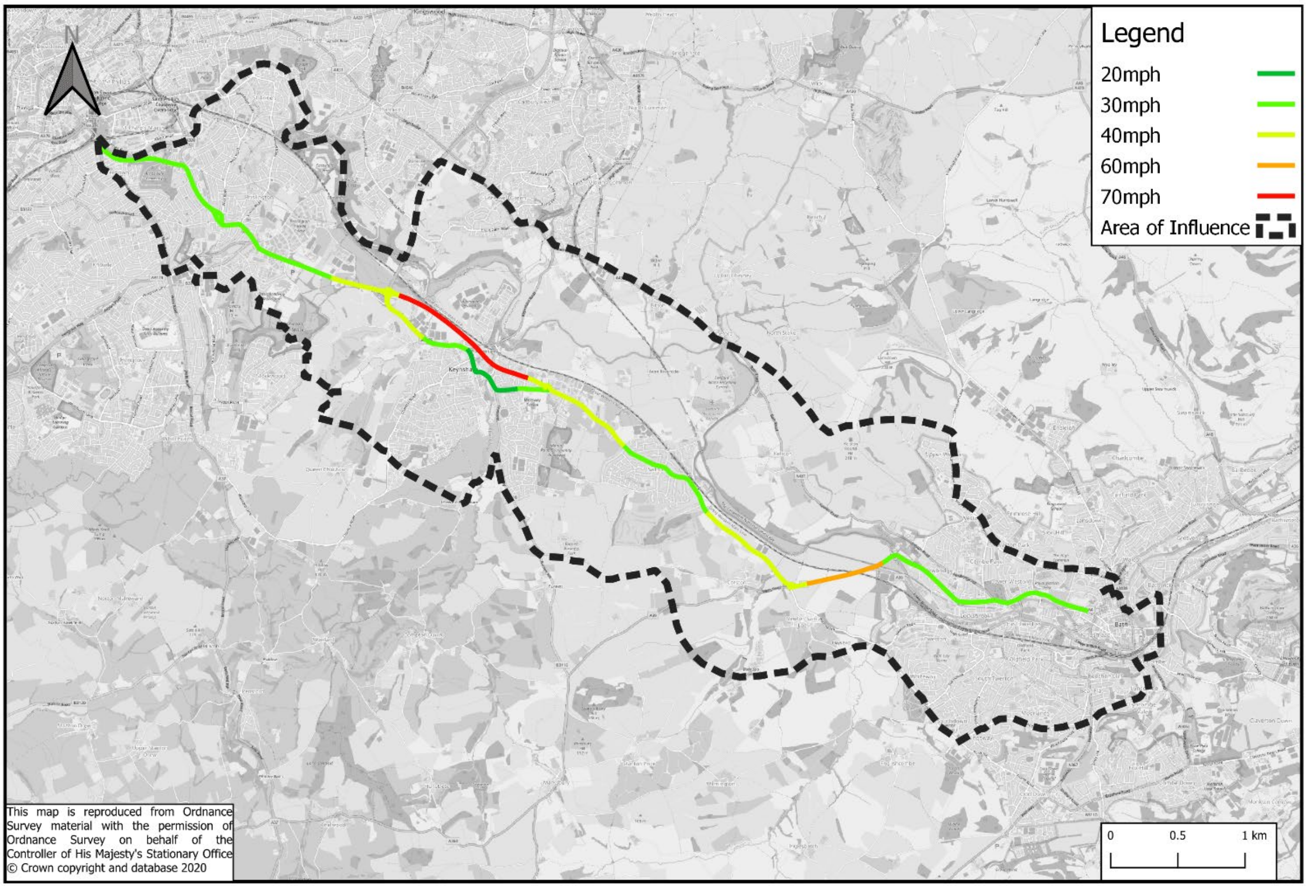
Network for the West of England. The A4 between Bristol and Bath is also part of the Major Road Network (MRN) specified by DfT in 2018.

Figure 2-12 – Highway Network



2.3.34. **Figure 2-13** shows the speed limit of the roads in the AoI. Only the Keynsham Bypass section of the corridor is at the national speed limit, with the remainder of the road subject to speed limits between 30mph and 60mph, with the 30mph limits set within the urban areas. At the north-western corner of the AoI, the A4 connects to Bristol City Centre via the signal-controlled Bath Bridge Roundabout. Thereafter, there are a series of signal-controlled junctions at St Philips Causeway, Sandy Park Road, the A4174, and Stockwood Road. The majority of the signals incorporate technology to maximise junction efficiency. There are also two roundabouts along the Keynsham Bypass route connecting the A4 with A4147 (Hicks Gate Roundabout) and the B3116 Bath Road (Broadmead Roundabout).

Figure 2-13 – Highway Network: Speed Limits



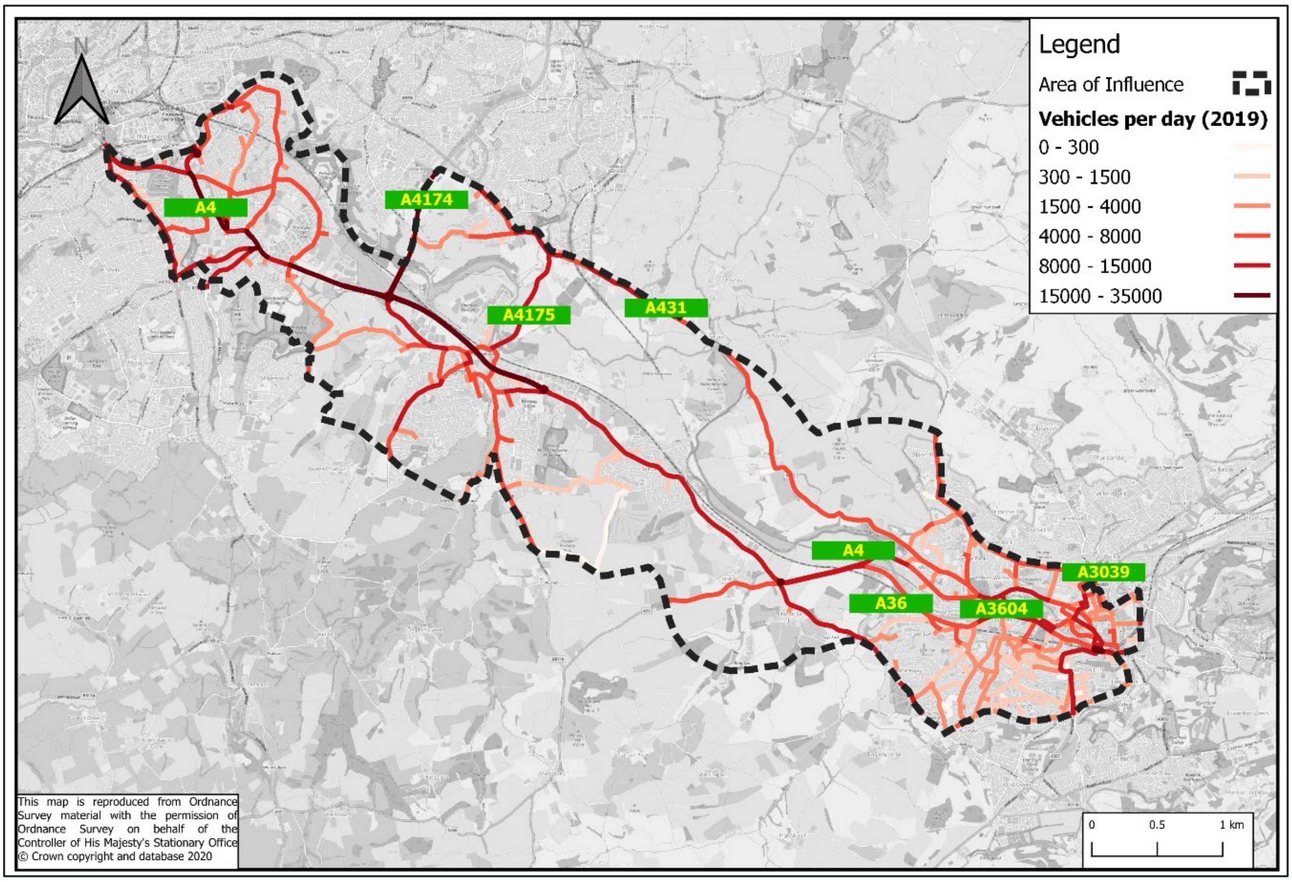
Traffic Flows

2.3.35. **Figure 2-14** presents the daily traffic flows along the A4 between Bath and Bristol as per the West of England Regional Transport Model (WERTM). The highest flows are between the edge of Bristol (near Brislington Trading Estate) and the B3116/A4 roundabout on the east of Keynsham, which includes a short stretch of single carriageway, with traffic flows of approximately 16,000 – 17,000 in each direction. A single carriageway link can typically accommodate up to 22,000 daily trips (both directions) and a dual carriageway up to 68,000 daily trips (both directions)[3].

2.3.36. Currently, the strategic modelling undertaken to assess the scheme shows that flows along this section do not exceed the theoretical capacity for that link. Hourly flows are 1,200 in the AM peak, 1,071 in the interpeak and 1,333 in the PM peak period.

[3] DMRB (TA 46/97 – Annex D) - Table D/2 in TA 46/97 defines the AADT values at which a rural single carriageway trunk road (S2[3]) would become congested as 22,000 and a dual carriageway (D2AP) as 68,000

Figure 2-14 – Average Daily Traffic Flows



Collisions

2.3.37. The Personal Injury Collisions (PIC) on the corridor from 2018 to 2022 are shown in **Figure 2-15**, using DfT collision data. Between 2018 and 2022, there were 196 total collisions along the corridor, of which 180 (92%) were slight, 15 (8%) were serious and 1 (1%) was fatal. The fatal collision occurred on the Keynsham Bypass (the only section of the corridor with the national speed limit).

2.3.38. Generally, there are clusters of collisions at junctions along the corridor, including at the extents of the Keynsham Bypass and within the urban areas.

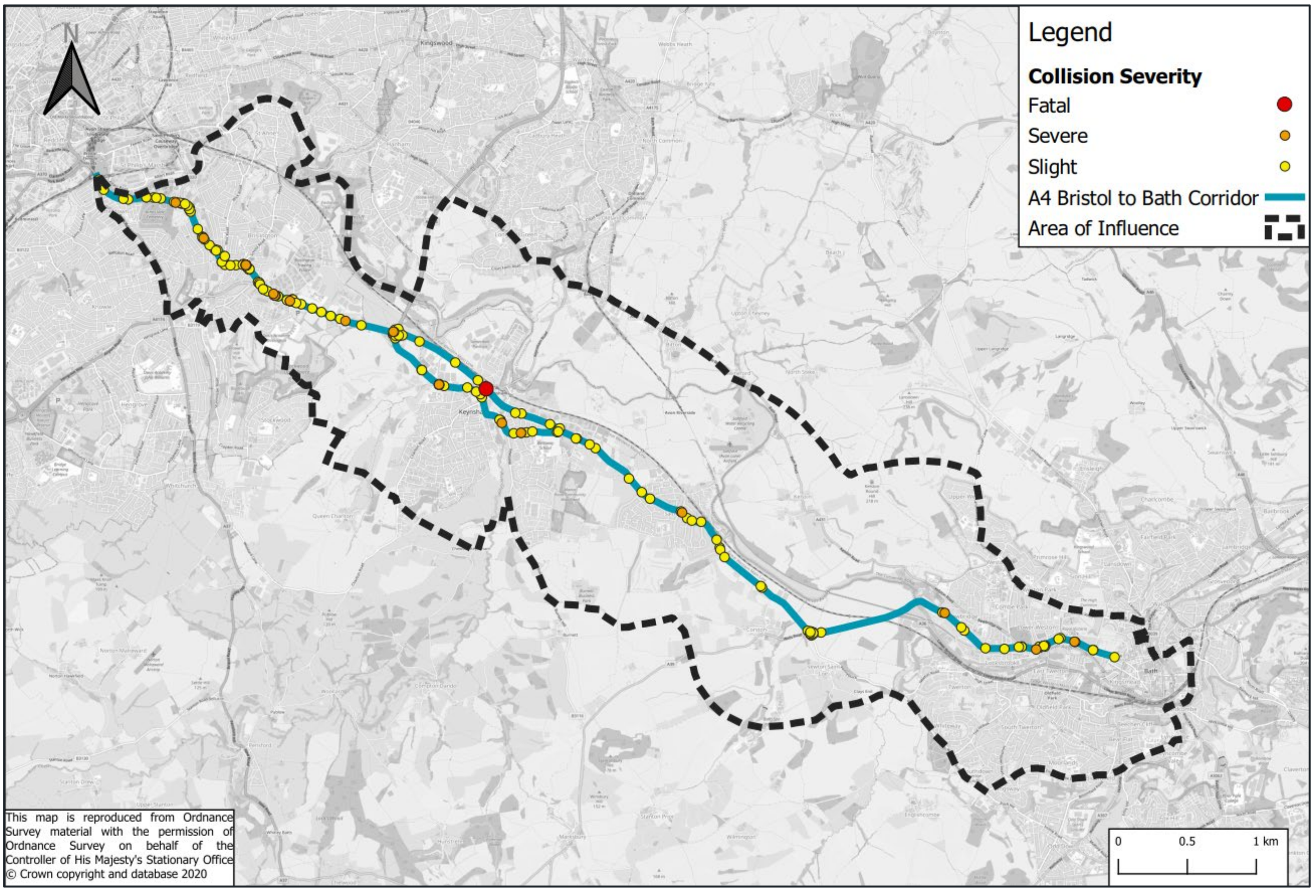
2.3.39. Specific collision hotspots along the route include:

- A4 Bath Road/Saint Phillips Causeway junction
- A4 Brislington Hill/Hollywood Road/Church Hill junction
- A4 Bath Road/Emery Road junction
- Hicks Gate Roundabout
- A4 Bristol Road/A39 Wells Road junction
- A4 Upper Bristol Road/Bridge Road junction

2.3.40. Almost half of the casualties on the route were car occupants (92), which was by far the most common mode of transport. The rest were split between cyclists (50), motorcyclists (29) and pedestrians (21).

2.3.41. Of the pedestrian casualties, 17 were slight, 4 were serious, and 1 was fatal. Of the cyclist casualties, 46 were slight, 4 were serious, and none were fatal. Cyclists were more likely to be involved in a collision and be considered casualties. However, if involved in a collision, pedestrians were more likely to be killed or seriously injured.

Figure 2-15- Collisions (2018-2022)



Congestion

2.3.42. **Appendix A** includes average flow-weighted speeds and delays along A-roads in the BCC and B&NES areas from 2017 to 2019. This data shows that the average flow-weighted delay along the A4 in 2018 was more than 47.8 spvpm[4] in B&NES (making the A4 the third most congested A-road in B&NES) and 56.4 spvpm in BCC.

[4] spvpm = seconds per vehicle per mile

2.3.43. The data also shows that the average daily flow-weighted speed along the A4 in 2019 was 26.5mph (B&NES) and 22.9mph (BCC). However, the speed limit along the majority of the route is between 40mph and the national speed limit. This indicates that congestion is a likely factor in reduced vehicle speeds and is impacting on journey times.

2.3.44. **Table 2-1** shows the average minimum and maximum journey times along the A4 from Emery Road to Bath (Ashley Avenue) during the AM (08:00 – 09:00), Inter-Peak (IP) (10:00-16:00) and PM (17:00 – 18:00) peak periods for general traffic. The table highlights the variability in journey times throughout the day, with minimum travel times ranging from 16-18 minutes and maximum times ranging from 35-40 minutes. The table also shows the average journey time. This further demonstrates that there is congestion along the route resulting in highly variable journey times.

Table 2-1 – Average Journey Time (minutes)

Time Period	Minimum Journey Time	Maximum Journey Time	Average Journey Time
AM (08:00 – 09:00)	16	40	28
IP (10:00-16:00)	14	35	20
PM (17:00 – 18:00)	18	40	29

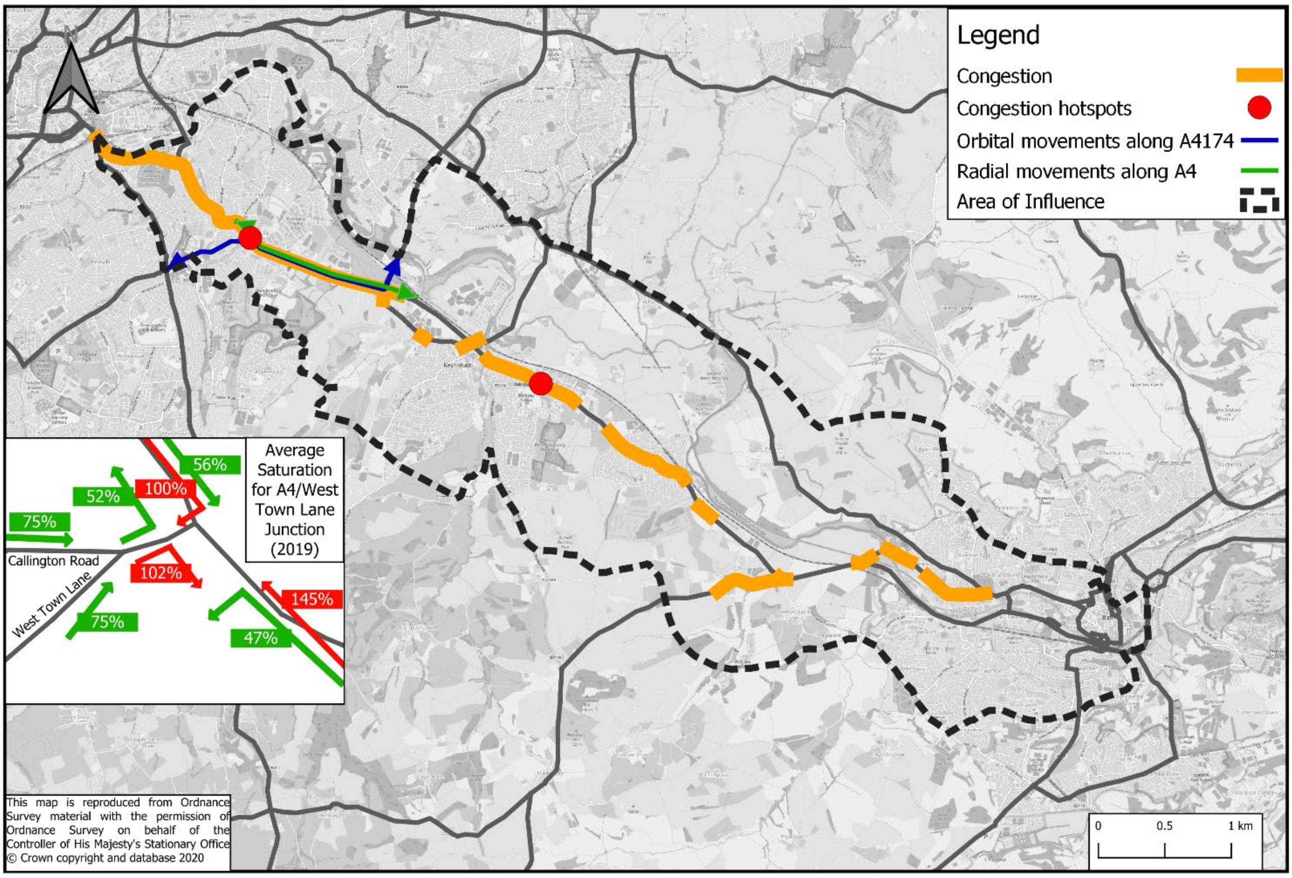
Source: Google Maps 2023

2.3.45. The key congestion hotspot junctions and congested links within the AoI are shown in **Figure 2-16**.

2.3.46. The most congested junctions include the A4 Bath Road /A4174 West Town Lane junction in Bristol and Hicks Gate Roundabout (A4/A4174). These coincide with locations where there are conflicting movements (orbital vs radial) between movements along the A4 (the radial route) and the A4174 (the orbital route). The A4 through Salford is particularly congested between Beech Road and the A39 (Globe Roundabout), which is a contributing factor to variable journey times as shown in **Table 2-1**.

2.3.47. The congestion in Saltford is attributable to several factors including the number of side road junctions and the pedestrian crossing facilities with the town. The strategic model shows that the road at this location is operating at its theoretical link capacity, therefore no further increases in traffic flow will be achievable.

Figure 2-16 – A4 Corridor Congestion



2.3.48. The combination of relatively high traffic flows along sections of the A4 and the intersection with movements on the A4174 results in high levels of delay on the corridor. This delay impacts on general traffic and buses.

2.3.49. Congestion in Saltford is likely to result in vehicles using other routes between Keynsham Town Centre and Bath which can include diverting via Corston (A39) and the B3116 to access Keynsham Town Centre or Bath. As a result of the delays during peak times (which can add up to 24 minutes to an end-to-end journey as shown in **Table 2-1**) it can be quicker to use alternative routes such as the A39/B3116.

2.3.50. Traffic congestion leads to increased and unreliable journey times for both general traffic and public transport. This impacts accessibility to jobs, businesses, education, leisure, and healthcare facilities. It also impacts network resilience in the event of incidents, rat-running of traffic through residential areas and idling traffic, causing poor air quality. Congestion results in commercial vehicles being delayed and impacts on deliveries, which has a negative impact on the economy.

2.3.51. In summary, there is significant congestion along the A4 with hotspots at the Hicks Gate Roundabout (A4/A4174) and the A4/West Town Lane (A4174 Brislington) junctions and Saltford. This congestion results in delays to journeys by car and by bus along the corridor (with associated costs to the economy) and results in additional vehicle-kilometres on the network, which works against the targets set by BCC and B&NES to reduce vehicle-kilometres as part of their responses to the Climate Emergency.

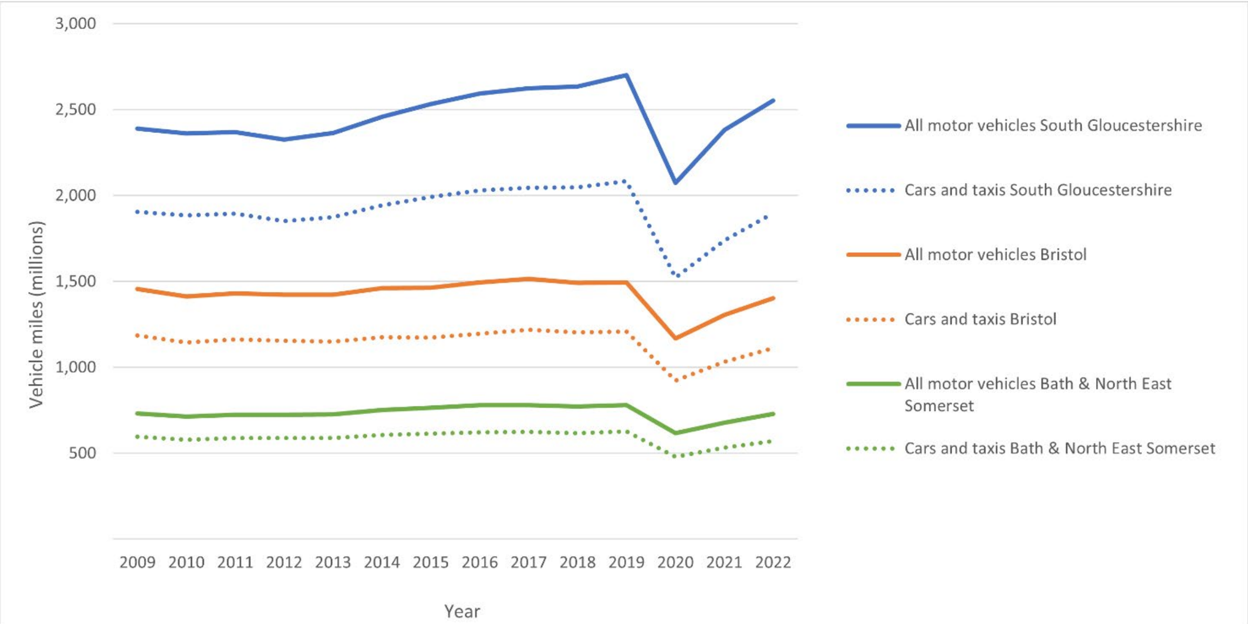
Traffic Growth

2.3.52. **Figure 2-17** shows that the number of vehicle miles travelled increased between 2009 and 2022 across all UA areas in the West of England. Between 2009 and 2019 the average annual growth in vehicle miles was 0.6% in the BCC area and 0.9% in B&NES, though since around 2017 (Pre-pandemic) in B&NES and Bristol, vehicle miles travelled seems to have plateaued with limited growth year on year.

2.3.53. There has been a steady increase in vehicle miles since the pandemic, with vehicle miles having an average annual growth between 2020 and 2022 of 9.6% in Bristol. Traffic flows in all three local authorities are close to pre-pandemic levels and can be expected to meet or exceed them in the coming years if traffic flow growth continues at its current rate.

2.3.54. Travel growth is likely to continue (due to population growth and planned housing growth in the region) and, if sustainable capacity is not provided in the network, then increased demand will result in worsening congestion. According to the West of England Combined Authority's Joint Local Transport Plan, a lack of action could result in, by 2036, congestion costing £800m a year, CO_2 emissions increasing by 22%, delays increasing by 40%, vehicle trips increasing 26%, time spent queuing in traffic increasing by 74%, and journey time increasing by 9%.

Figure 2-17 - Vehicle Miles Travelled



Source: DfT Road Traffic Statistics 2009-2022

Workplace Parking Provision

2.3.55. Parking provision and its associated cost at journey destinations (particularly within City Centre locations) has a significant influence on mode choice.

2.3.56. The number and location of workplace parking spaces available along the Bath to Bristol corridor is shown in **Figure 2-18**. It highlights the concentration of parking in city and town centre locations, these are areas which are currently served by public transport alternatives (e.g., Keynsham rail station and bus services through the town centre).

Figure 2-18 – Current Workplace Parking Provision

2.3.57. The management of city and town centre workplace parking along the Bath to Bristol corridor will require a balance between promoting economic vitality, reducing the reliance of commuter journeys on car and managing residents' parking. However, there is an opportunity to support mode shift by decreasing the amount of workplace parking available in locations served by public transport, and to improve the public transport services themselves, in order to encourage mode shift.

Key Summary Points: Road Network

- The A4 carries high traffic volumes on sections of the corridor.
- There is significant congestion along the A4 with hotspots at the Hicks Gate Roundabout (A4/A4174) and the A4/West Town Lane (A4174 Brislington) junctions and Saltford. This congestion results in delays to journeys by car and buses along the corridor (with associated costs to the economy) and in additional vehicle-kilometres on the network, which works against the targets set by BCC and B&NES to reduce vehicle-kilometres as part of their responses to the Climate Emergency. The delays due to congestion further impact on commercial vehicles and deliveries.
- Traffic growth is likely to continue (due to planned housing growth in the region) and if sustainable capacity is not provided in the network, then increased demand will result in worsening congestion.
- There is a concentration of workplace parking along the corridor in Keynsham, Bath and Bristol. There is an opportunity to support mode shift by decreasing the amount of workplace parking available in locations served by public transport, and to improve the public transport services themselves, in order to encourage sustainable mode shift.

Public Transport Modes

Bus Network

2.3.58. The existing bus network serving the Bath to Bristol corridor is shown in **Figure 2-19**, with frequency shown in **Figure 2-20**. The only frequent end-to-end service is the X39 (which is supplemented by the 39 stopping service through Keynsham Town Centre for parts of the day). The X39 service runs at a 15-minute frequency at peak times and a 20-minute frequency throughout the rest of the day.

2.3.59. The 39/X39 is the primary bus service connecting Keynsham and Saltford to Bath and Bristol. The A4 Air Decker and WESTlink DRT do serve these areas, but neither offer the same frequency as the X39, with the A4 Air Decker being once per hour and WESTlink being bookable-only. WESTlink is a new type of bus service which operates in the vast majority of the West of England, outside of Bristol and Bath City Centres. It runs without a fixed timetable or route and is booked ‘on demand’ by users through the WESTlink app or by phone.

2.3.60. The 39 services (which run through Keynsham) only operate at the shoulders of the day, before 05.45 and after 18.45 Monday to Friday, and before 07.45 and after 18.30 on Saturdays. The X39 service runs between 05.45 and 18.45 Monday to Friday. The X39 service does not run through Keynsham Town Centre but instead runs along the bypass with the closest bus stops located at Hicks Gate to the west and Ellsbridge House to the east, over two miles and one mile from Keynsham High Street respectively. The A4 Air Decker runs once per hour, travelling from Bath to Bristol via Saltford and Keynsham (or vice versa), taking between 49 and 84 minutes from end to end. The WESTlink DRT provides bookable bus travel across the rural areas of the West of England Combined Authority, serving Keynsham, Saltford, and parts of Bristol.

2.3.61. There are three services that connect Keynsham (but not Saltford) to Bath and Bristol. These are services 349, 522 and 17. Service 349 to Bristol provides a 30-minute frequency and service 522 to Bath an hourly frequency. Service 349 follows a route round Keynsham before returning to Bristol and takes approximately 35 minutes, while the 522 service connects to Bath and Bristol via Paulton and Midsomer Norton, with the journey taking 40 minutes to Bristol and over 90 minutes to Bath. Service 17 travels from Keynsham to Southmead Hospital (Bristol) via the perimeter of Bristol and takes 65 minutes with a 30-minute frequency.

Figure 2-19 – Existing Bus Network Bath to Bristol

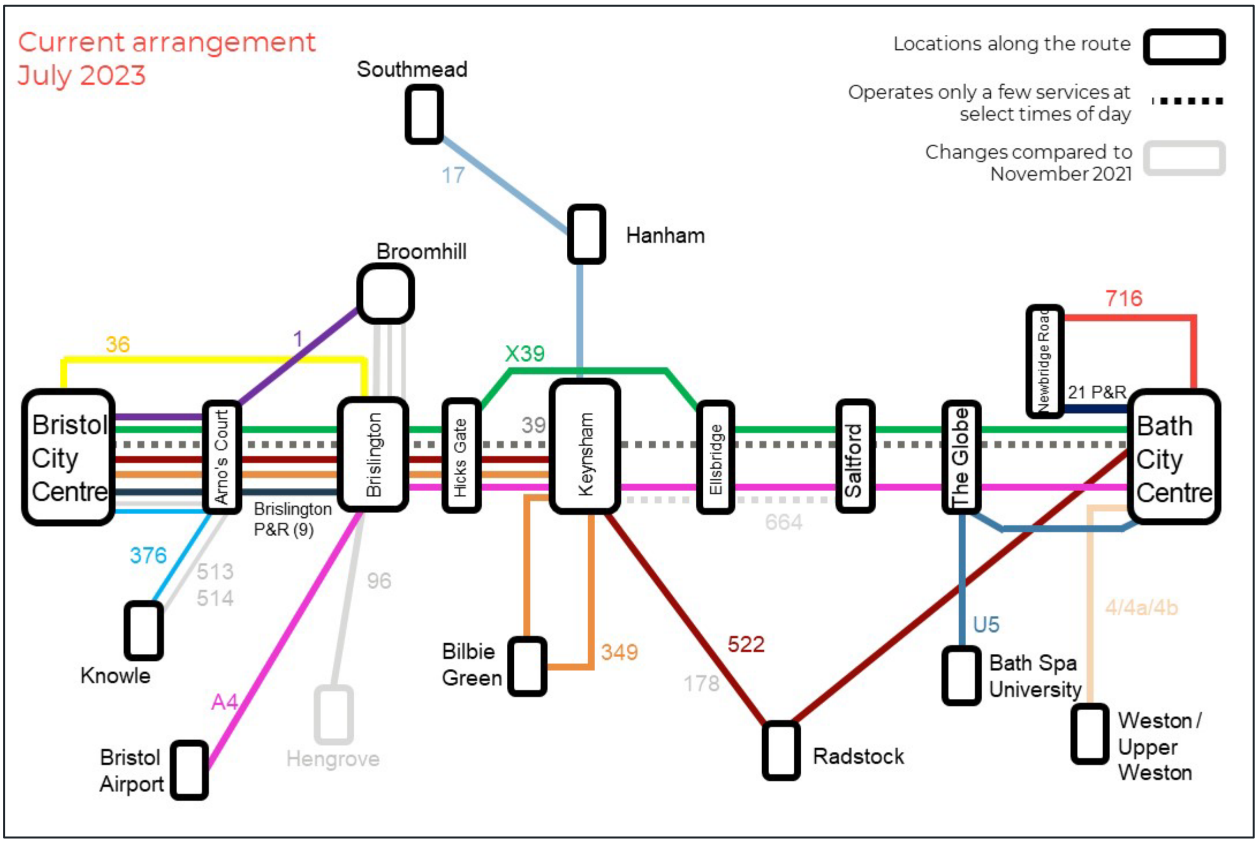
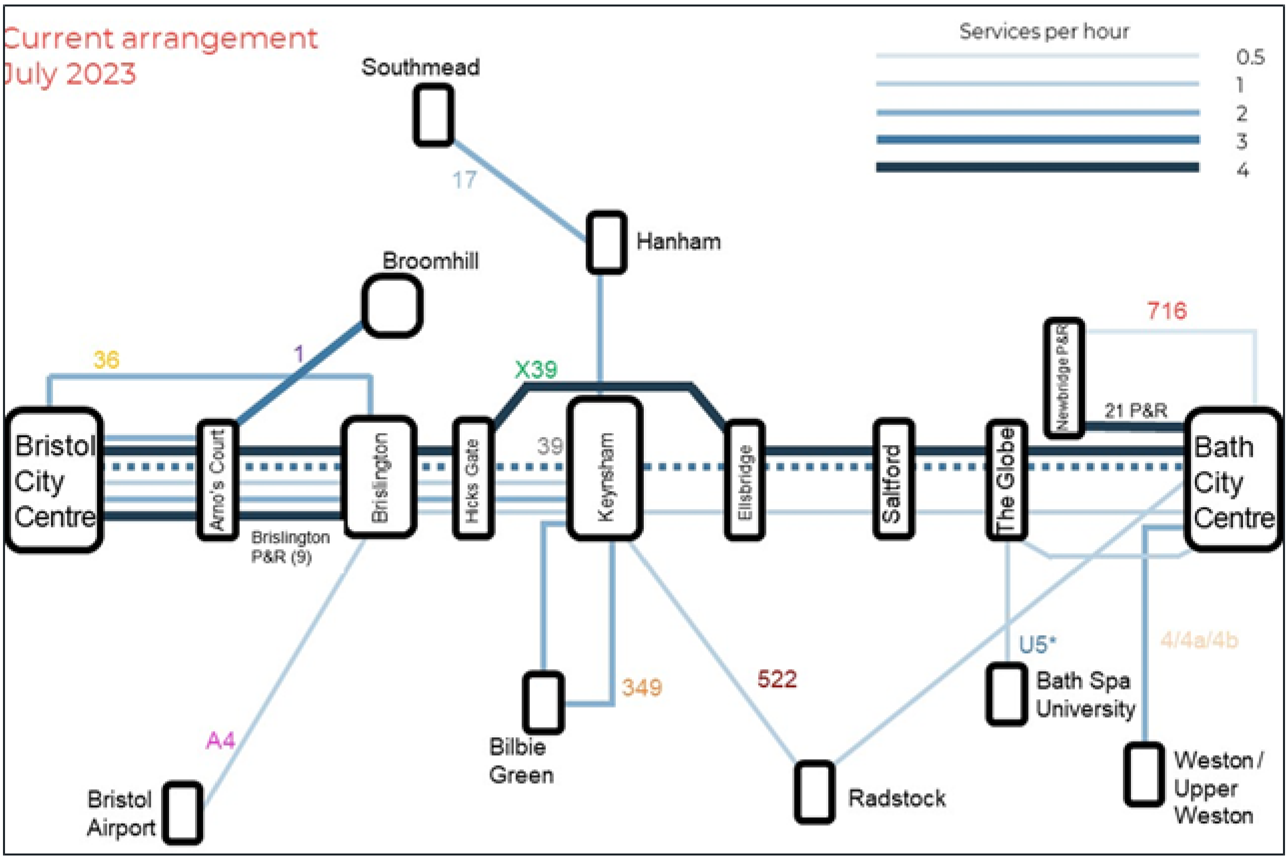
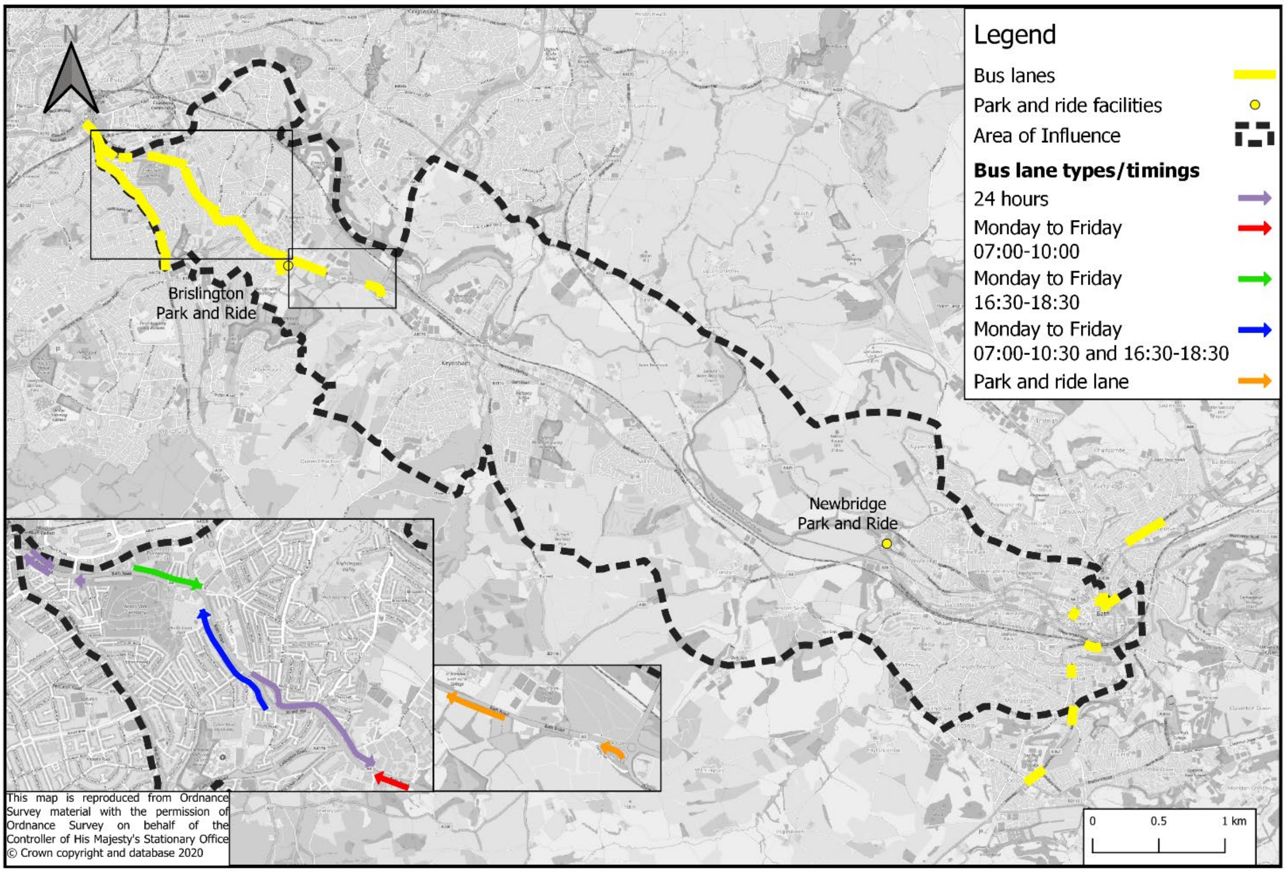


Figure 2-20 – Average Weekday Service Frequency



2.3.62. Bus priority (in the form of bus lanes) is currently provided on only a specific section of the A4 corridor. Additionally, a small number of junctions along the corridor include technology that supports bus priority. The current bus priority provision is shown in **Figure 2-21**.

Figure 2-21 – Existing Bus Lanes and Park & Ride Locations



2.3.63. There are a number of points in the network that result in issues for buses, as reflected in feedback from First Bus drivers. The project team held a workshop with First Bus drivers to gather their views on the network.

2.3.64. Comments from the bus drivers included:

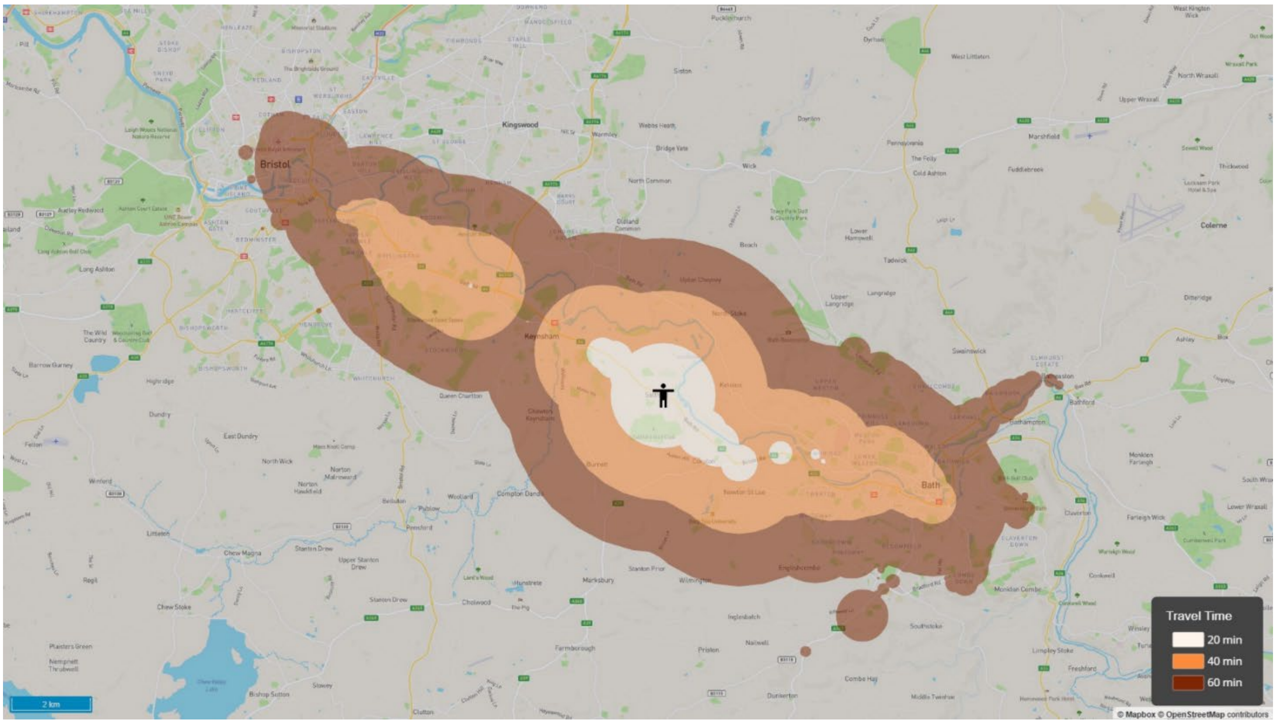
- The X39 bus service could in the past complete the full route consistently in 1 hour which allowed for a 12-minute frequency (using a fleet of 10 buses). However, pre-COVID the run times had increased to such an extent that a 12-minute frequency could no longer be maintained, reducing first to a 20-minute frequency and then to a 15-minute frequency, with an associated 30% increase in operating costs.
- There are various points in the network where queuing traffic delays buses even when buses have access to bus lanes or other priority measures.
- Bus lanes that are too narrow cause issues in some locations.
- A lack of compliance to bus lanes causes issues in some locations.
- In Saltford, traffic light sequencing for pedestrian crossings and cars turning in and out of side roads (particularly where there is not a filter for right-turning vehicles) causes delays.

Access to key destinations via the Bus Network

2.3.65. In the BBSC Stakeholder Engagement held in 2021, 37% of the respondents rated the connections between different bus services along the A4 as "Poor".

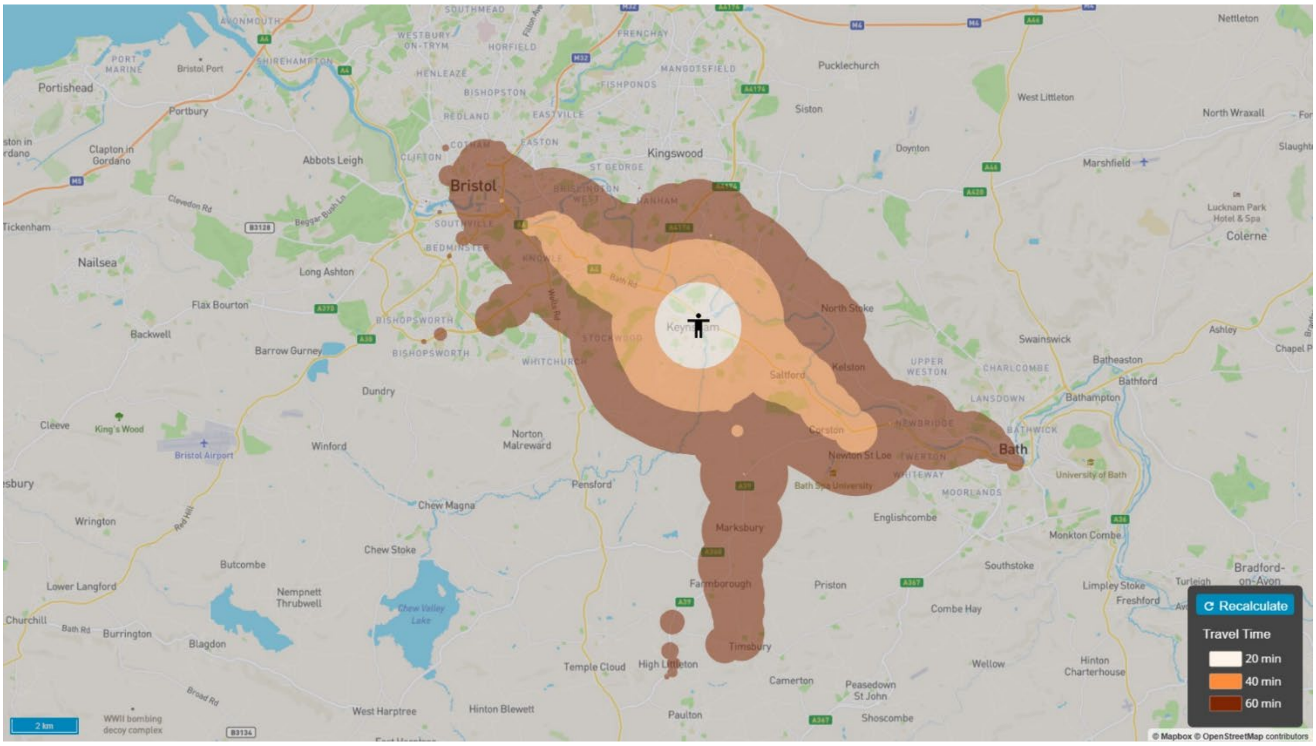
2.3.66. In order to understand the access time to the centre of Bath and Bristol, the Podaris tool has been used to calculate isochrones for 20-, 40- and 60-min time bands. This shows the travel time, based on time to walk to a bus stop, average waiting time at said bus stop and travel time on the bus service. **Figure 2-22** illustrates connectivity from Saltford, from opposite Tesco express on a typical Tuesday at 08:00 am. From Saltford, access to Bath City Centre is possible within 40mins, whereas reaching Bristol City Centre takes up to 60 minutes.

Figure 2-22 – Typical Bus Connectivity from Saltford, extracted from Podaris software



2.3.67. **Figure 2-23** illustrates typical bus connectivity from Keynsham. When considering the same analysis from Keynsham, from opposite the Post Office, reaching either City Centre takes up to 60 minutes. This is due to the fact that the most frequent service (X39) runs along the Keynsham bypass, meaning access to the town centres requires waiting for a less frequent service, a longer walk to a stop served by the X39 or occasionally an interchange.

Figure 2-23 – Typical Bus Connectivity from Keynsham, extracted from Podaris software



Park & Ride Services

2.3.68. There are two Park & Ride (P&R) sites within the Bath to Bristol corridor – the Newbridge P&R serving Bath and the Brislington P&R serving Bristol.

- Newbridge P&R is located to the west of Bath City Centre. The site currently offers 698 spaces and is open Monday to Saturday 06:15-20:30, and on Sundays (and some public holidays) between 09:30-18:00
- Brislington P&R is located to the west of Hicks Gate roundabout. Brislington P&R currently offers 1,300 spaces and is open Monday to Saturday 06:00-22:00, and Sunday 09:30-19:00.

2.3.69. In 2019, the Newbridge P&R site was over-subscribed serving on average 1,346 users per day with an average car occupancy of 1.7 users per car (based on user surveys - the ratio of users to the number of cars parked).

2.3.70. In 2019, the Brislington P&R site served on average 1,762 users per day which is equivalent to an approximate average car parking occupancy level of 80% (if a similar car occupancy is assumed to Newbridge P&R). Whilst patronage at Brislington P&R is high, satisfaction levels in relation to frequency and quality of the service were relatively low in 2015, with only around half of users satisfied with the service (based on a 2015 BCC survey of Brislington P&R users). There has been significant change since 2015 and as such the survey results from 2015 are not likely to be reflective of current conditions.

2.3.71. The Journey to Net Zero Plan for Bath (formerly Transport Delivery Action Plan)[5] found that if the Bath P&R was not available, 58% of people would have driven for their entire trip, demonstrating the role the P&R plays in removing cars from the network, and reducing demand for parking in City Centres.

2.3.72. The high utilisation of existing P&R services along the corridor suggests that there is a need for more P&R capacity and for more reliable bus services to support access into Bath and Bristol City Centres. If people are unable to access the P&R services, and if a reliable and well-connected alternative is not available, then there is a risk of mode shift towards private cars.

Bus Reliability

2.3.73. FirstBus have provided a derivative Automatic Vehicle Location (AVL) data for the X39 service running between Bath and Bristol Bus stations for the full period between 2nd April 2023 until 30th June 2023. The data covers all days of the week, over the entire day and in total covers over 356,000 individual datapoints, but only contains scheduled arrival, actual arrival and actual departure times for each stop.

2.3.74. The dataset has been filtered to derive bus journey times for several different time periods, Monday to Friday AM period (07:00 – 10:00), Interpeak (10:00 – 16:00), PM period (16:00 – 19:00) and 12-hour period (07:00 – 19:00).

2.3.75. The 5th centile stop-to-stop time (i.e., 5% of buses travel in less time) and the 95th centile stop-to-stop time (i.e., 5% of buses travel in more time) have been calculated. Ultimately the 5th and 95th centile were used as they equate to one journey in every 20, or the equivalent to once per month for a commuter using the bus every weekday.

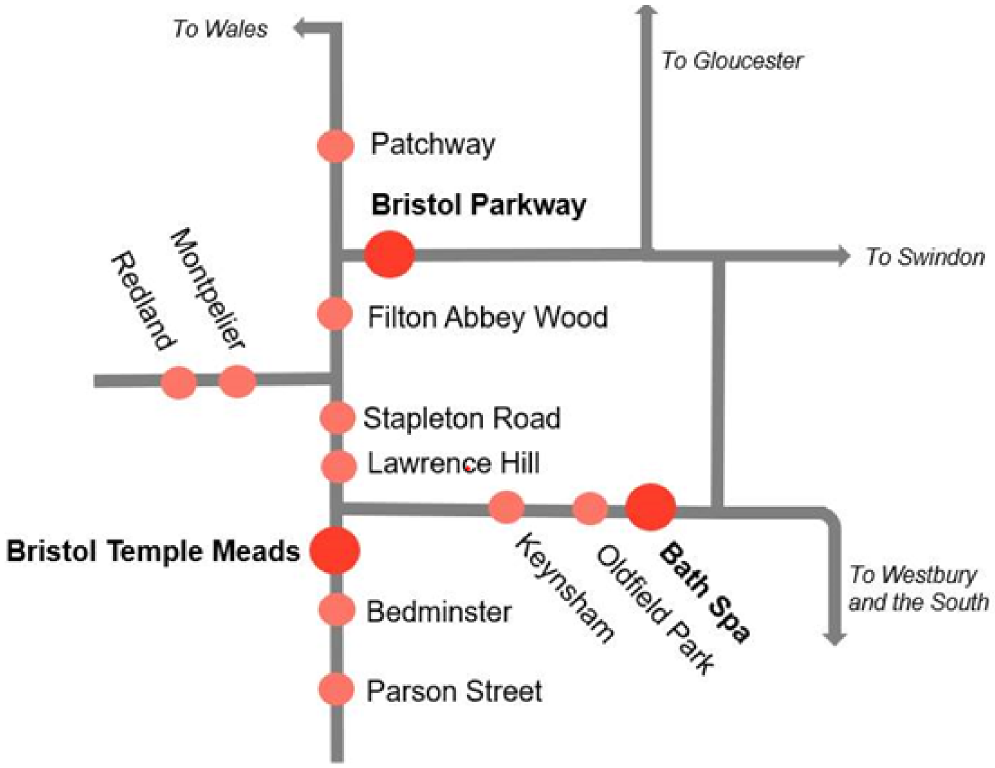
2.3.76. The analysis undertaken shows delay at the same location regardless of time period. Eastbound the main areas for delay were Emery Road to Ellsbridge House (Keynsham) and Normal Road to Dryleaze Road (Saltford), westbound the delays were worst on the section between The Globe to The Shallows (Saltford).

[5] Journey to Net Zero Action Plan for Bath (formerly Transport Delivery Action Plan), Bath & North East Somerset Council, April 2020

Rail Network

2.3.77. There are four rail stations along the corridor – Bristol Temple Meads, Keynsham, Oldfield Park and Bath Spa. The rail network in the region, which shows the onward connections from these stations, is shown in **Figure 2-24.**

Figure 2-24 - Existing Railway Network



2.3.78. There are regular fast services (journey times of 11 to 12 minutes at a frequency of 3 trains per hour (tph)) between Bristol Temple Meads and Bath Spa, with stopping services between the two cities also serving Keynsham and Oldfield Park (between 1tph and 2tph depending on time of day). The journey time for stopping services is approximately 16 to 17 minutes.

2.3.79. Rail services are well used in the area with strong growth in patronage prior to the pandemic. Keynsham station served 532,000 passengers in 2019/20, an increase of 25% since 2015/16. It also experienced a strong post-pandemic recovery, serving 418,000 passengers in 2022/23.

2.3.80. The railway network is difficult to access from communities along the corridor unless residents are in Keynsham or near Oldfield Park to the west of Bath. Accessibility to the railway line is therefore only a viable option for those travelling between Bristol, Bath, Keynsham and Oldfield Park, and excludes other communities and residents along the corridor, for example at Saltford.

Key Summary Points: Bus and Rail Network

- Issues identified by bus drivers raise the risk that there may be a decline in quality and that this may result in mode shift away from bus at a time when the policy aspiration for B&NES and BCC is to increase the bus mode share.
- Bus connectivity between communities on the corridor could be stronger. This is particularly the case for journeys from Saltford to Bath and Bristol, and Keynsham to Bath, due to low frequency and high journey times. This impacts on the attractiveness of bus as an alternative to the car for journeys along the corridor.
- The high utilisation of existing P&R services along the corridor suggests that there is a need for more P&R capacity and for more reliable bus services to support access into Bath and Bristol City Centres. If people are unable to access the P&R services, and if a reliable and well-connected alternative is not available, then there is a risk of mode shift towards private cars.
- Unless resident in the vicinity of a station, the railway network is difficult to access from communities along the corridor, leading to high reliance on the bus network.

Active Travel Modes

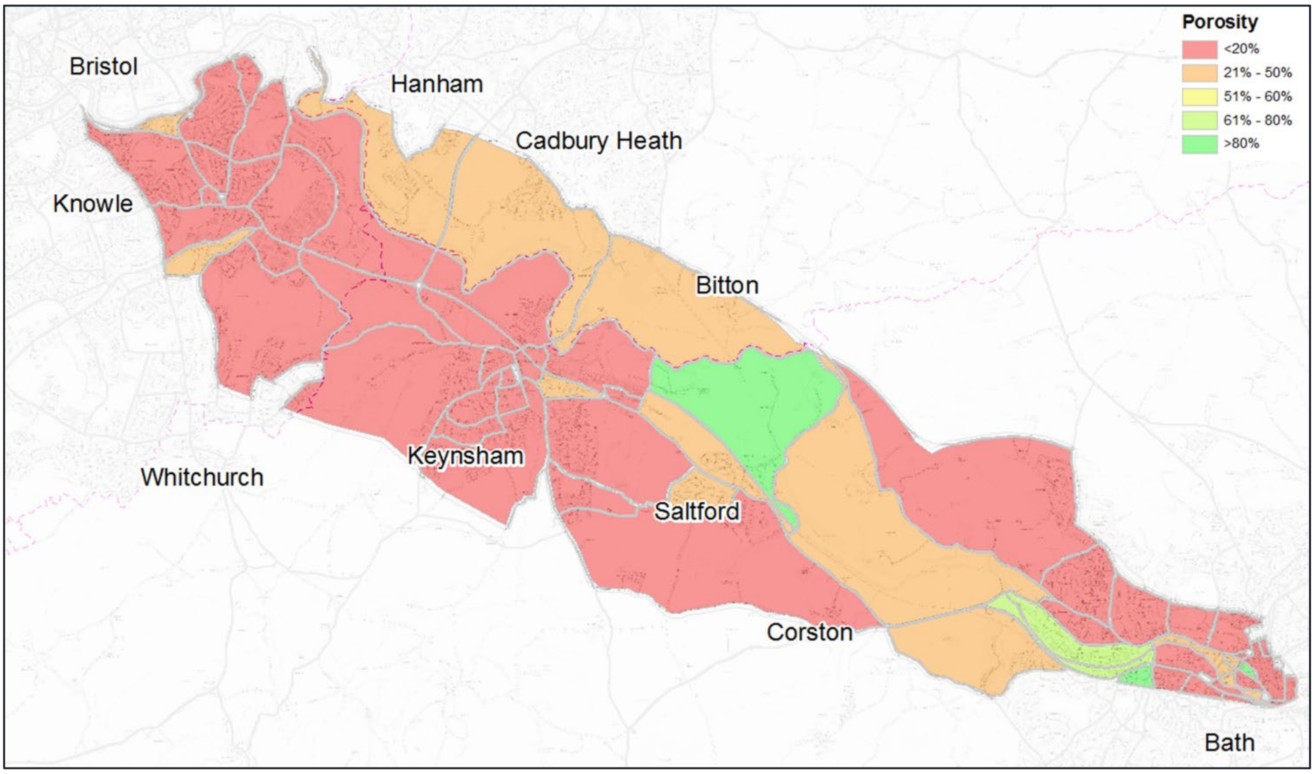
Current Walking, Wheeling, and Cycling Facilities

2.3.81. Existing walking, wheeling, and cycling facilities along the Bristol to Bath corridor, and between the A4 and communities such as Keynsham and Saltford, are generally inconsistent with uneven pavements and a lack of safe and accessible crossings. There are locations where a lack of level access presents accessibility challenges, and the infrastructure is inappropriate for wheelchair users.

2.3.82. The connectivity for neighbourhoods along the A4 is generally poor. A four-step analysis was undertaken to assess the baseline situation, involving accessibility classification (identifying the local quiet streets which are broadly acceptable for cycling and walking and the high traffic roads which create severance), defining the areas bounded by severance lines which are difficult to cross (e.g. high traffic roads, rivers and rail lines), then assessing which of the existing crossings are suitable for most people who cycle. Finally, the area porosity analysis entailed identifying communities with the best and worst connections to neighbouring areas. This step provided an assessment of the existing and potential porosity for each neighbourhood.

2.3.83. The output of the porosity analysis is shown in **Figure 2-25**. The majority of neighbourhoods (including well-populated neighbourhoods in Brislington, Bath and Keynsham) are shown to have a porosity of less than 20%.

Figure 2-25 – Neighborhood porosity for walking and cycling

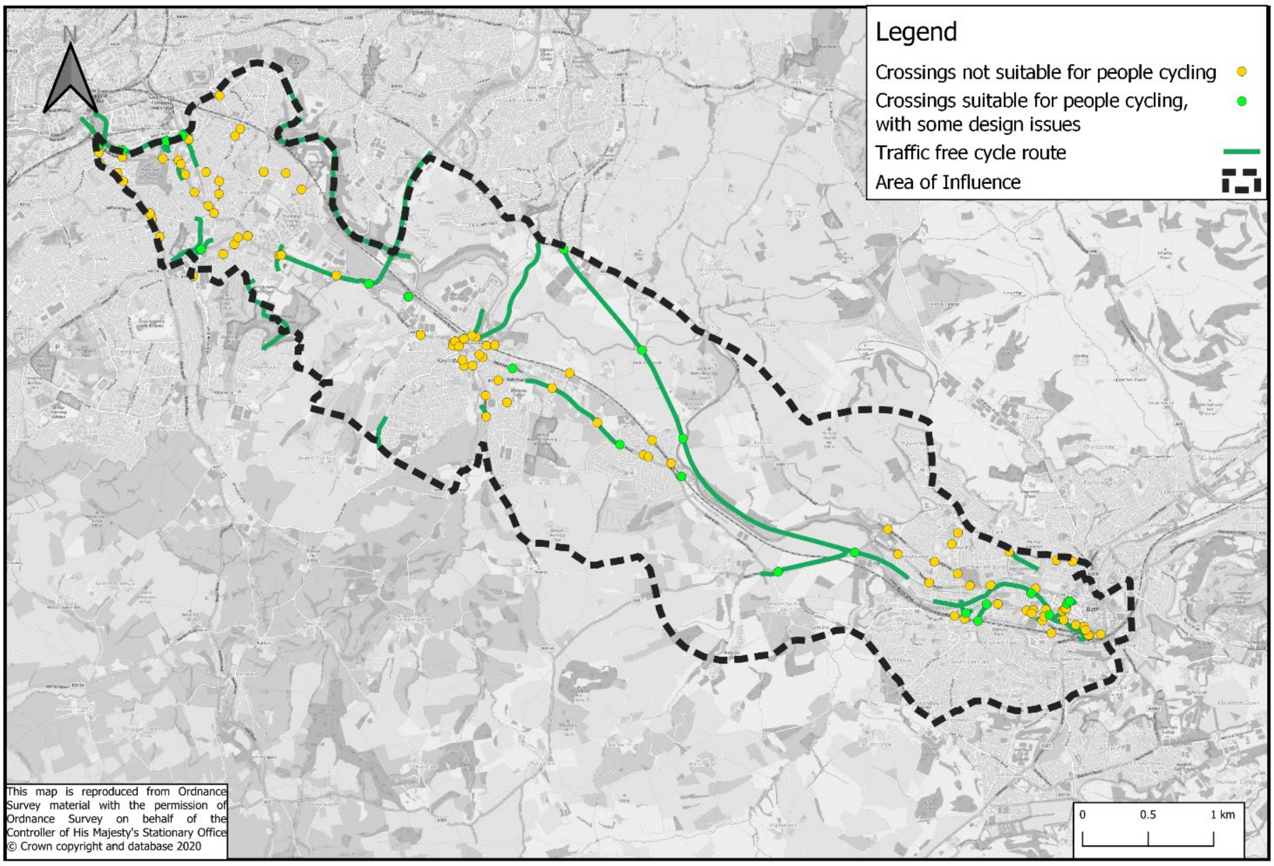


2.3.84. The lack of safe crossing points renders the A4 a barrier to people crossing the road and results in severance between communities. This may further encourage travel by car as people feel safer travelling to neighbouring communities by car than on foot.

2.3.85. Existing cycling facilities along the Bristol to Bath corridor are shown in **Figure 2-26**. The existing facilities are limited and inconsistent along the corridor, with less than 20% of the corridor served by a traffic-free cycle route. There are few safe crossing points along the A4, and crossing points are often indirect and involve several movements. There is little provision for safe cycle parking at facilities along the corridor.

- Cycling improvements along the A4 Bath Road in Bath between Midland Road and Charlotte Street (segregated on-road cycling facilities) funded through the Active Travel Fund have recently been delivered.

Figure 2-26 – Existing Cycling Facilities



2.3.86. The direct distance between Bath and Bristol is 12 miles, but there is no direct off-road cycle facility currently in place. The only consistent route is via the Bristol and Bath Railway Path (BBRP), which is very popular as it is traffic-free, almost entirely flat and surfaced. However, the route is 15 miles long and indirect between Bath and Bristol City Centres, and only runs parallel to the A4 between Bath and Saltford (with access points at Twerton Fork and Saltford) which means it is difficult for residents along the corridor to access this path west of Saltford.

Stakeholder views on walking and cycling facilities

2.3.87. Stakeholders along the corridor have indicated that the lack of facilities and poor air quality (resulting from the high traffic volumes and congestion) influence their decision to not walk or cycle for journeys along the corridor.

- Cycling safety and cycle paths were rated as “Poor” by 60% and 65% of respondents respectively
- 77% of the respondents rated air quality when walking along the A4 as “Poor”
- 42% of the respondents rated the quality of walking routes and public places when walking along the A4 as “Poor”
- 79% of the respondents rated the number of vehicles on the road when cycling along the A4 as “Poor”

- 77% of the respondents rated the amount of segregated cycle lanes when cycling along the A4 as “Poor”
- 76% of the respondents rated sharing the road with other traffic when cycling along the A4 as “Poor”

2.3.88. Respondents indicated that they would be “Very likely” to walk along the A4 more often if the air was cleaner and less polluted along the route (56%), if more green spaces and/or trees were provided (47%), if there was less traffic on the route (44%) and if segregated paths were provided (43%).

2.3.89. Respondents indicated that they would be “Very likely” to cycle more often if segregated cycle lanes were provided (72%), if there was less traffic on the route (66%), and if safer junctions and crossings with priority for cyclists were provided (62%). The importance of cleaner air and less pollution was highlighted by 56% of respondents.

Key Summary Points: Active Travel Network

- Provision for cycling along the A4 is very limited and not continuous and there is no direct off-road cycle facility, with the BBRP forming more of a leisure / recreational route.
- Walking facilities along the A4 corridor and between the A4 and local communities such as Keynsham and Saltford are generally inconsistent with uneven pavements and a lack of accessible crossings.
- There are limited appropriate crossings and connections between neighbourhoods adjacent to the A4 (leading to low neighbourhood porosity) which restricts walking and cycling movements between communities and between communities and the A4.

Trip Patterns and Mode Share

Travel Demand and Trip Patterns

2.3.90. The regional travel to work patterns (based on Census 2021 data) are shown in **Table 2-2.** The regional travel patterns indicate that there is a substantial amount of commuting demand between B&NES and Bristol, and between B&NES and South Gloucestershire, a large proportion of which could use the A4 between Bath and Bristol when travelling by car or public transport.

Table 2-2 - Regional Travel-to-Work Patterns

Origin / Destination	B&NES	Bristol	North Somerset	South Gloucestershire
B&NES	29,279	4,569	853	2,403
Bristol	3,753	83,959	5,011	18,510
North Somerset	898	9,534	35,554	3,647

Origin / Destination	B&NES	Bristol	North Somerset	South Gloucestershire
South Gloucestershire	3,874	22,358	2,048	40,341

2.3.91. The distribution of trips by length along the corridor (based on Census 2021 journey to work data for areas within the Bristol to Bath corridor) is shown in **Table 2-3**. The data shows that more than 58% of journeys made for commuting purposes were less than 5km long, a journey length which could be more sustainably undertaken using walking or cycling modes.

Table 2-3 - Trip Length Distribution (commuter trips from Bath to Bristol corridor)

Trip Length Category	Total	Percentage
Less than 2km	42,269	26%
2km to less than 5km	52,352	32%
5km to less than 10km	32,166	20%
10km to less than 20km	22,284	14%
20km to less than 30km	4,212	3%
30km or more	8,039	5%
Work mainly at or from home / Other	167,000	Not applicable

Mode Choice

2.3.92. **Table 2-4** summarises the 2021 and 2011 Census data for mode used to travel to work (mode share) within each output area in the AoI. It should be noted that 'working from home' has been omitted from the analysis as the census data was collected during the coronavirus pandemic, whereby working from home was much more prevalent, as have those who do not work. As such, the percentages provided in **Table 2-4** are only reflective of those travelling to work.

Table 2-4 – Mode Share

Mode	Percentage (2021)	Percentage (2011)
Train	1.5%	3.7%
Bus, minibus or coach*	7.5%	9.5%
Taxi	0.6%	0.3%
Motorcycle, scooter or moped	1.1%	1.2%

Mode	Percentage (2021)	Percentage (2011)
Driving a car or van	57.8%	54%
Passenger in a car or van	4.7%	5%
Bicycle	5.0%	4.9%
On foot	20.3%	20.7%
Underground, metro, light rail, or tram	0.1%	0.1%
Other method of travel to work	1.4%	0.6%

*Source: 2021 and 2011 Census Data for Method used to Travel to Work. *Bus, minibus or coach would include Park and Ride*

Car Mode Share

2.3.93. The data shows that residents along the Bath to Bristol corridor are heavily reliant on cars, with 57.8% of residents driving to work and a further 4.7% travelling as a passenger in a car or van. As such, the overall car mode share for car trips is 62.5%.

2.3.94. All three local authority districts (Bristol, B&NES and South Gloucestershire) in the AoI have a lower proportion of households with no car or van than the median across England and Wales. Of the three, Bristol has the highest proportion of households with no car or van at 26.2%, followed by B&NES at 19.9%, and South Gloucestershire at 12.3%.

2.3.95. A large proportion of Bath City Centre has a high percentage of households with no car or van, with three output areas having over 70% of households without one. Bristol City Centre has a slightly higher proportion of households with no car or van, with eight output areas having over 70% of households without one including two output areas with over 80% of households without one. Keynsham has 19.7% to 19.8% of households without a car or van.

Walking Mode Share

2.3.96. The mode share for walking was 20.3%. This is likely to be concentrated within each settlement with very little walking between them. There is the potential to increase walking as part of a journey by public transport between settlements, for example walking to and from a bus stop, alongside shorter journeys within urban areas.

Cycling Mode Share

2.3.97. The mode share for cycling was 5%. This could be increased, particularly as cycling is more appropriate for longer trips than walking, so could be viable for commutes between settlements as well as within them. This shows an opportunity to reduce car use along the strategic corridor.

Bus Mode Share

2.3.98. According to 2021 Census data, the area-based mode share for bus, minibus and coach trips (i.e., for all journeys to work within AoI) is 7.5%. Buses can be used for trips within cities as well as between them so there is potential to increase this figure and reduce car use, encouraging more sustainable transport. This figure also includes park and ride use.

Rail Mode Share

2.3.99. The mode share for railway journeys is low at 1.5%. This is despite Bristol having eight railway stations, Bath having two, and Keynsham having one. However, this is likely due to fewer commuter trips as a result of the coronavirus pandemic.

Comparison of Journey Times by Mode

2.3.100. **Table 2-5** shows journey times by mode within different segments of the Bath to Bristol corridor. The journey times for bus and train incorporate the time taken to walk from the start or end point of the trip to the respective bus stop or railway station. Cycle journey times have been estimated based on the assumption that the route taken follows the A4 alignment. Five minutes have been added to car journeys to account for parking and access. The data has been sourced from Google maps for a typical weekday in the morning, evening and inter-peak hour.

Table 2-5 - Journey Times by Travel Mode

Route	Departure Time	Journey times by mode (minutes inc. walk time) Car	Journey times by mode (minutes inc. walk time) Bus	Journey times by mode (minutes inc. walk time) Train	Journey times by mode (minutes inc. walk time) Bicycle
The Centre (Bristol) -Bath Guildhall	d. 08.00hrs	45-90	59	40	74
The Centre (Bristol) -Bath Guildhall	d. 11.00hrs	40-80	58	36	74
The Centre (Bristol) -Bath Guildhall	d. 17.30hrs	45-90	58	40	74
Bath Guildhall - The Centre (Bristol)	d. 08.00hrs	45-90	56	41	70
Bath Guildhall - The Centre (Bristol)	d. 11.00hrs	40-80	59	35	70
Bath Guildhall - The Centre (Bristol)	d. 17.30hrs	45-95	61	33	70
The Centre (Bristol) – Keynsham High Street	d. 08.00hrs	23-40	28	21	32
The Centre (Bristol) – Keynsham High Street	d. 11.00hrs	25-45	27	21	32
The Centre (Bristol) – Keynsham High Street	d. 17.30hrs	27-50	27	21	32
Keynsham High Street – The Centre (Bristol)	d. 08.00hrs	23-45	27	22	32
Keynsham High Street – The Centre (Bristol)	d. 11.00hrs	23-45	29	24	32
Keynsham High Street – The Centre (Bristol)	d. 17.30hrs	23-45	37	47	32
Keynsham High Street – Bath Guildhall	d. 08.00hrs	23-35	37	27	42
Keynsham High Street – Bath Guildhall	d. 11.00hrs	25-40	37	27	42
Keynsham High Street – Bath Guildhall	d. 17.30hrs	23-40	33	27	42
Bath Guildhall – Keynsham High Street	d. 08.00hrs	25-40	41	25	42
Bath Guildhall – Keynsham High Street	d. 11.00hrs	27-45	49	25	42
Bath Guildhall – Keynsham High Street	d. 17.30hrs	25-45	36	25	42
Saltford - Bath Guildhall	d. 08.00hrs	21-29	26	Not applicable	32
Saltford - Bath Guildhall	d. 11.00hrs	21-33	26	Not applicable	32
Saltford - Bath Guildhall	d. 17.30hrs	21-33	26	Not applicable	32
Bath Guildhall - Saltford	d. 08.00hrs	21-29	23	Not applicable	32

Route	Departure Time	Journey times by mode (minutes inc. walk time) Car	Journey times by mode (minutes inc. walk time) Bus	Journey times by mode (minutes inc. walk time) Train	Journey times by mode (minutes inc. walk time) Bicycle
Bath Guildhall - Saltford	d. 11.00hrs	21-35	23	Not applicable	32
Bath Guildhall - Saltford	d. 17.30hrs	21-33	24	Not applicable	32

Note - Based on timetabled bus journey times and does not reflect bus journey time variability

2.3.101. **Table 2-5** shows the variability of car journey times. This variability reflects congestion along the A4 as illustrated in **Figure 2-16**.

2.3.102. Although bus journey times are slower when compared to cars, this mainly pertains to the fastest end of the range of times. At the slower end of the journey time range for cars the timetabled bus journey times tend to be faster. However, as the bus journey times do not account for variations, it is probable that bus trips take longer than car journeys across the day. This is likely because buses, lacking dedicated lanes along the A4, will encounter similar traffic congestion as cars, lengthening their travel times.

2.3.103. End-to-end journey times are the fastest for rail, due to the rail connection between Bath Spa and Bristol Temple Meads, however there is no connectivity to Saltford.

2.3.104. Among all modes, cycling appears to have the slowest journey time. Contributing to the scale of the difference is the limited and fragmented cycling infrastructure along the A4.

Key Summary Points – Trip Patterns and Mode Share

- The highest demand for travel along the Bath to Bristol corridor is between Brislington and Bristol City Centre and between Keynsham and Bath.
- The mode share for car journeys along the Bath to Bristol corridor is high at 62.5% (with 57.8% of residents driving to work and a further 4.7% travelling as a passenger in a car or van).
- Buses are the slowest mode for vehicular journeys along the A4. Car journey times on the A4 vary significantly, yet in traffic-free conditions, cars typically offer the fastest mode of travel. Rail journey times align closely with congestion-free car travel times but necessitate transfers and are restricted to areas accessible via rail stations. Cycle journey times seem to be the slowest among all modes.

Environmental Context

Environmental Constraints

2.3.105. The key environmental constraints plan for the corridor is shown in **Figure 2-27**. The key environmental constraints along the corridor are flood risk zones and heritage assets, including the City of Bath's UNESCO[6] World Heritage and Great Spa Town status.

Landscape and Townscape

2.3.106. The A4 corridor encompasses predominantly residential areas with some industrial and warehousing uses and areas of open space, including ancient woodland and green belt. The A4 runs through the Bath and Bristol Green Belt, and at the eastern side, meets the River Avon Valley setting of the City of Bath World Heritage and Great Spa Town site.

[6] United Nations Educational Scientific and Cultural Organisation

Historic Environment

2.3.107. The heritage assets within the corridor include the World Heritage Site and Great Spa Town (City of Bath), scheduled monuments, more than 400 listed buildings, registered parks and gardens and 11 conservation areas.

Water Environment

2.3.108. Areas adjacent to the River Avon along the corridor are at risk of fluvial and tidal flooding. Current fluvial and tidal flooding risk areas are likely to be exacerbated by climate change in the design life of the scheme, in particular the River Avon, and The Feeder.

Noise

2.3.109. There are 19 Noise Important Areas (NIAs), concentrated towards the north western and south eastern sections of the corridor. These are mostly associated with traffic along the A4 and the A37. The NIAs are shown in **Figure 2-28**.

Figure 2-27 – Environmental Constraints

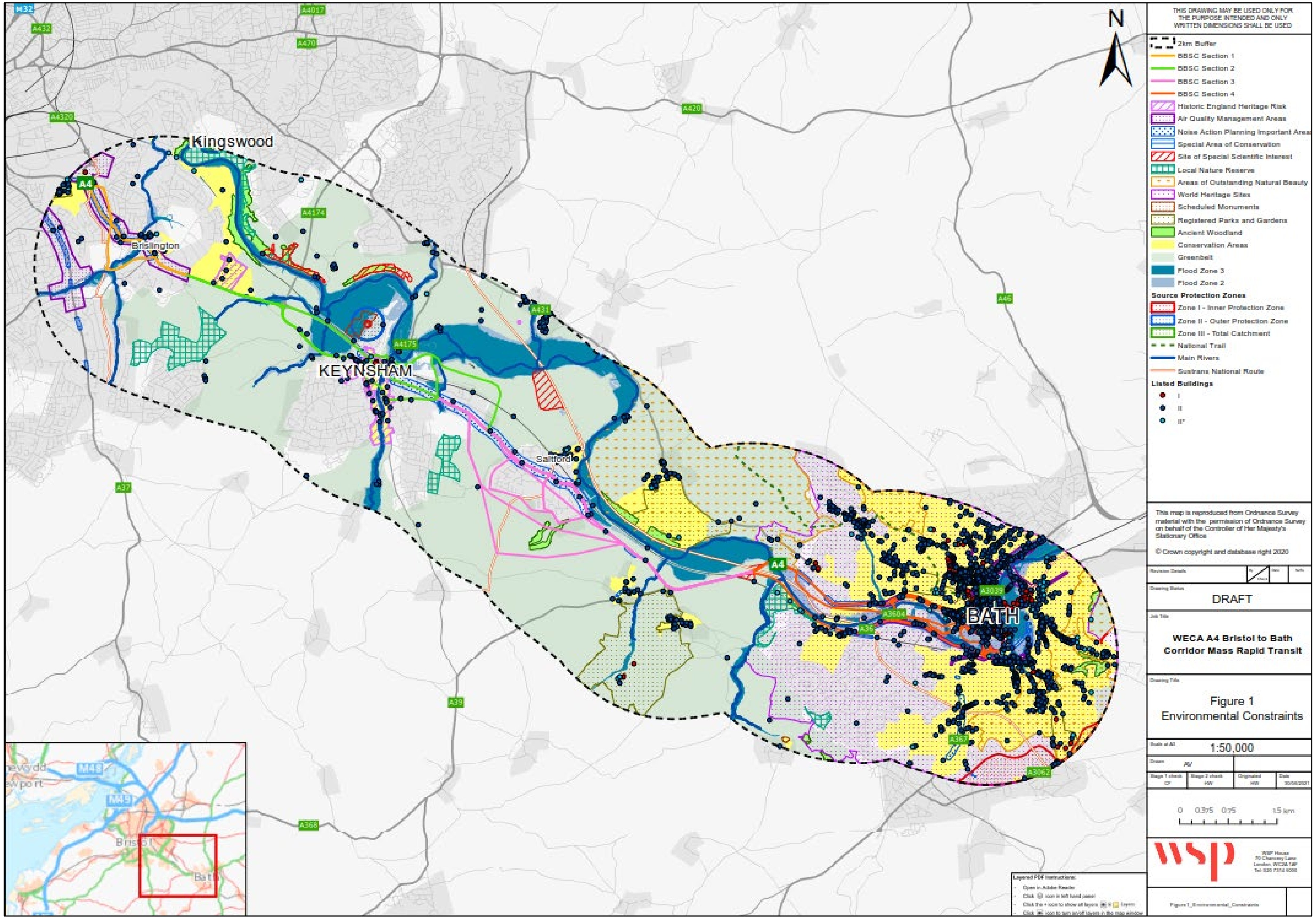
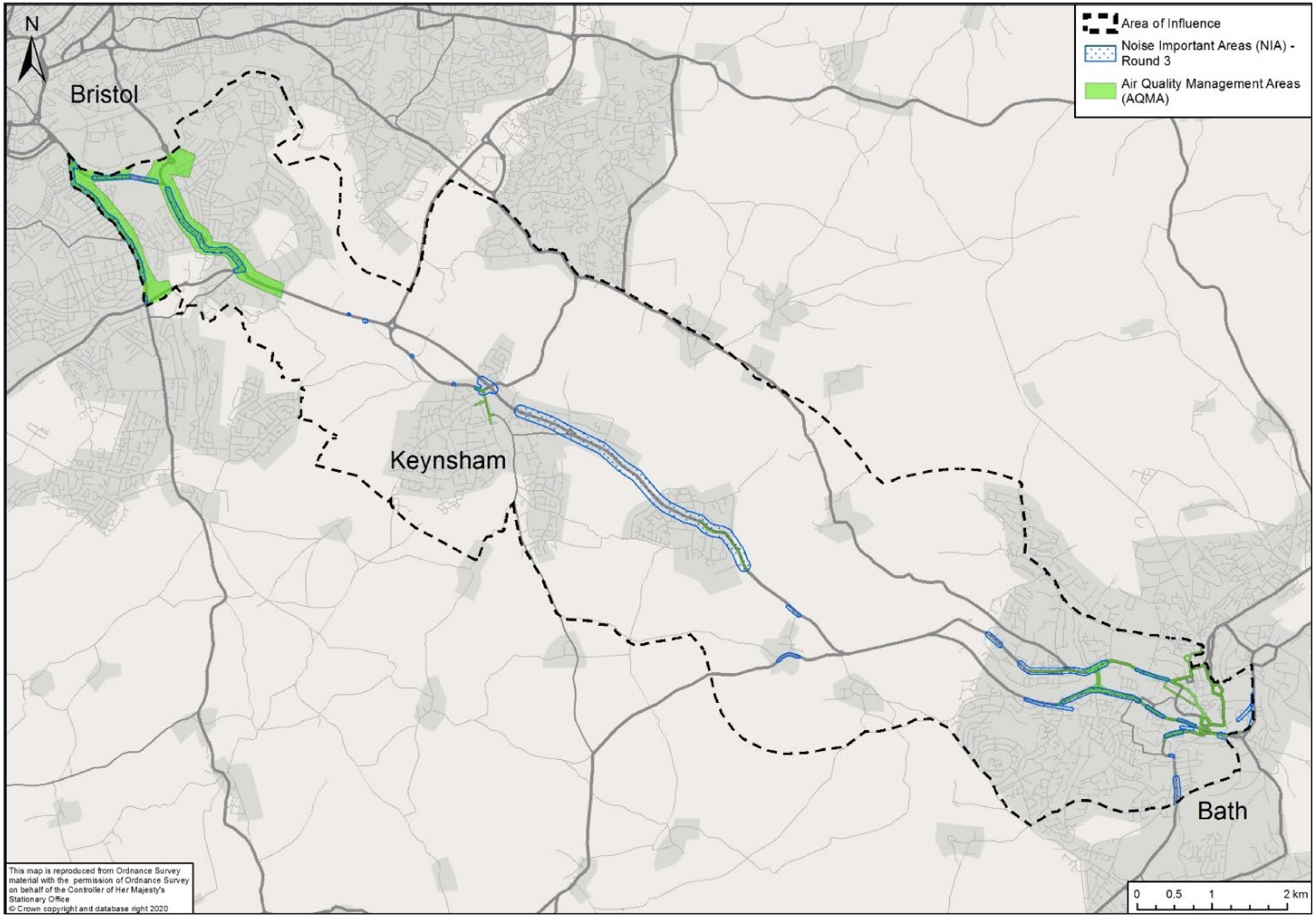


Figure 2-28 – AQMA and NIAs



Air Quality

2.3.110. A large proportion of the A4 route between Bath and Bristol falls within an Air Quality Management Area (AQMA) and/or within a NIA as shown in **Figure 2-28** above. Concentrations of pollutants are most elevated and exceed the annual mean NO2 and PM10 Air Quality Objectives (AQOs) in the Bath and Bristol AQMAs.

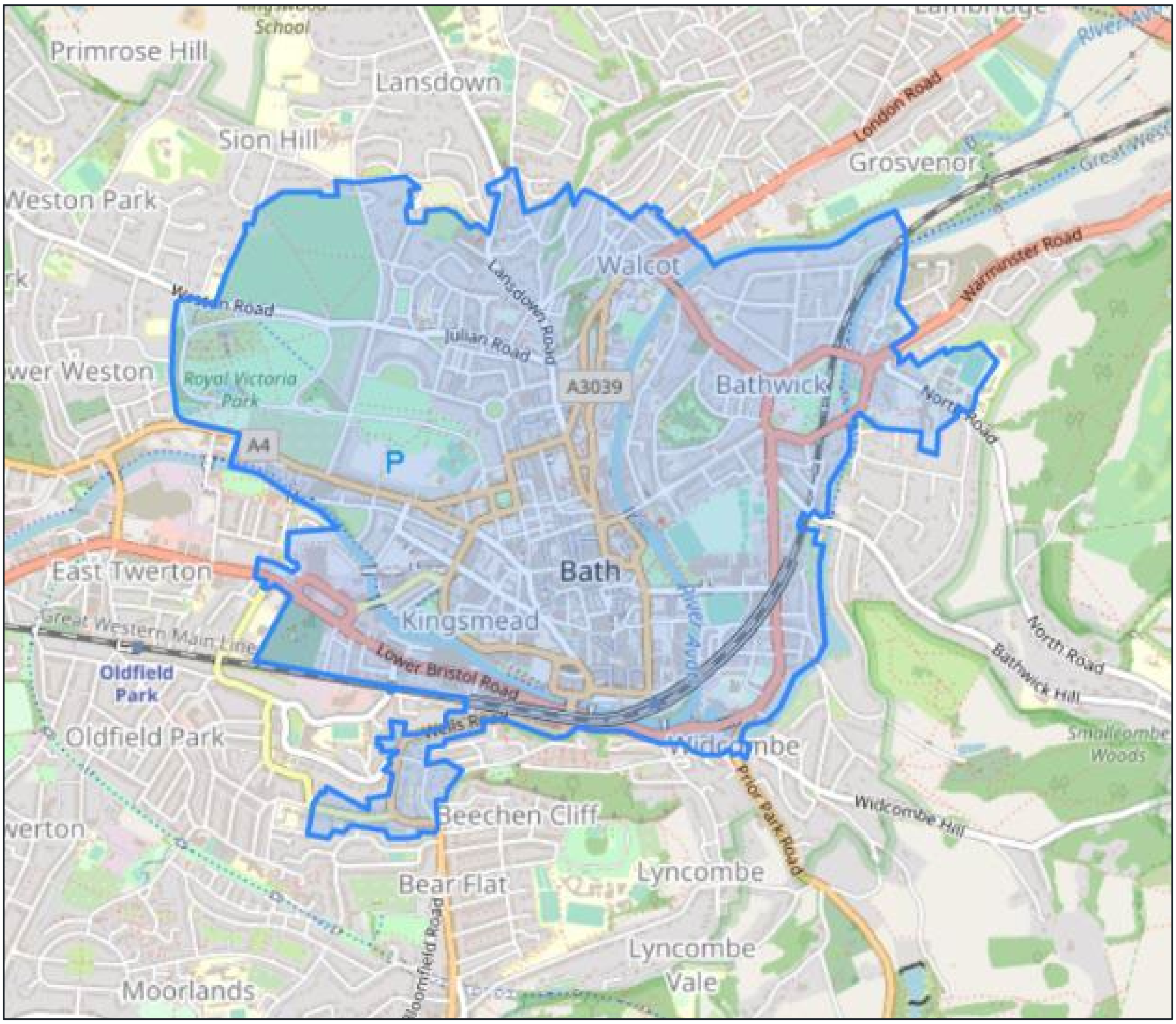
2.3.111. Air quality was highlighted in the BBSC Stakeholder Engagement in 2021 in which 71% of respondents rated air quality along the corridor as ‘poor’, significantly influencing their decisions whether to walk or cycle for journeys along the Bath to Bristol corridor. If mode shift to cycling and walking is to be achieved, then air quality along the corridor will need to be improved.

Clean Air Zone

2.3.112. B&NES and BCC have both developed Clean Air Action Plans, to tackle air pollution through a wide range of measures. These measures include the creation of Clean Air Zones (CAZ) to ensure the cities are meeting legal limits for levels of nitrogen dioxide (NO2).

2.3.113. Bath’s CAZ became operational on 15 March 2021. Bath has a class C clean air zone, which means that charges only apply to taxis, private hire vehicles, vans (including pick-ups and some camper vans), light goods vehicles, buses, coaches and heavy goods vehicles that do not meet the required emission standards. Private cars and motorbikes are not charged in Bath’s CAZ, regardless of emissions. The zone covers the City Centre, as shown in **Figure 2-29**, and the western edge of the Clean Air Zone lies within the Bath to Bristol corridor.

Figure 2-29 – Bath Clean Air Zone



2.3.114. The most recent monitoring report for the Bath CAZ, (2022 Q4 (October – December) highlights good progress in reducing emissions. In 2019 Q4, 46% of the sites measured in the Bath urban area had an average NO2 concentration of >40 µg/m3. In 2022 Q4, this had been reduced to 22%. There has also been a reduction in NO2 concentration in the Bath urban areas outside the zone's boundary, averaging an 18.5% reduction. It is forecast that further emission reductions will be seen once the pandemic's effect on the demand and supply of new compliant vehicles has passed.

2.3.115. Bristol's CAZ became operational in Summer 2022. The location was chosen with the intention of offering a balance between improving air quality, and the need to support businesses as much as possible.

2.3.116. The zone covers the City Centre and Bristol harbour as shown in **Figure 2-30**. Drivers have to pay a daily charge to drive in the zone if their vehicle does not meet required emission standards. The charge applies to all vehicles driving within the zone.

Figure 2-30 – Bristol Clean Air Zone

2.3.117. Analysis undertaken to inform the Bristol CAZ Full Business Case indicates that in all time periods the CAZ is projected to reduce traffic flows along the A4 by approximately 2%, with higher reductions closer to the City Centre along the A4 near Arnos Vale (17% reduction in the AM peak and 8% in the PM peak and interpeak).

2.3.118. The Joint Air Quality Unit (JAQU) is due to publish a Stage 1 report in January 2024. Interim results released prior to this report suggest that clean air is being delivered in Bristol, with data indicating that air quality in the city will not exceed the Government's average annual legal limit this year.

2.3.119. Whilst neither of the Business Cases for the Bristol CAZ or Bath CAZ specifically identify that there will be traffic rerouting onto the A4 as a result of the CAZ introduction, there is the potential that some traffic avoiding the CAZ's may impact on the A4.

Carbon

2.3.120. The West of England region declared a Climate Emergency in 2019, setting a target to be carbon neutral by 2030. To reach this target, there is a need to cut more than 450kt of carbon emissions each year, and transport will need to be a major contributor to this.

2.3.121. The JLTP4 (Joint Local Transport Plan for the West of England Combined Authority) sets out that in the South West of England, the transport sector is the largest single source of carbon emissions at 32%. This figure is expected to rise by 22% by 2036 if no action is taken.

2.3.122. Significant work has already been undertaken in the region across many sectors, and carbon emissions in the region in 2019 (including North Somerset) are 62% of their 2005 figure. Domestic carbon emissions have dropped by more than 50%, while industrial emissions in Bristol are less than a third of their 2005 baseline.

2.3.123. However, progress on reducing transport carbon emissions has been slower. Across the region the average reduction in carbon emissions from transport has been less than 10% since 2005 reflecting some mode shift to cycling and public transport and improved fuel efficiency.

2.3.124. Both the Combined Authority's Climate Emergency Action Plan and Local Industrial Strategy focus on clean, inclusive growth and prioritise the decarbonisation of the transport system. The Climate Emergency Action Plan includes actions to increase the uptake of cycling and walking through the implementation of the Local Cycling and Walking Infrastructure Plan, reductions in car trips and increasing the uptake of public transport.

2.3.125. Bristol was the first UK city to declare a Climate Emergency, and BCC and B&NES were amongst the first authorities in the UK to set mode share targets in response to the Climate Emergency. Both authorities have also declared Ecological Emergencies. B&NES and BCC have published action plans in response which emphasise the role of increased public transport, cycling and walking and wheeling in decarbonising the transport system. The B&NES Climate Emergency Action Plan references a major shift to mass transport, walking and cycling to reduce transport emissions, including progressing the development of mass transit options between Bath and Bristol.

2.3.126. More needs to be done to support the decarbonisation of the transport network along the Bath to Bristol corridor if the targets set by the Combined Authority, BCC and B&NES are to be achieved. This requires an improvement to public transport, walking and cycling networks and services in order to encourage mode shift to sustainable modes.

Key Summary Points: Environmental Context

- Air quality along the Bath to Bristol corridor is poor. This impacts on health in general and on the willingness of people to walk or cycle along the corridor. If mode shift to cycling and walking is to be achieved, then air quality along the corridor will need to be improved.
- The introduction of Clean Air Zones in Bath and Bristol support improvements in air quality within the cities. However, mode shift to sustainable modes will also be required for journeys along the corridor and to/from communities along the corridor if air quality is to be improved.
- More needs to be done to support the decarbonisation of the transport network along the Bath to Bristol corridor if the targets set by the Combined Authority, BCC and B&NES are

to be achieved. This requires an improvement to public transport, walking and cycling networks in order to encourage mode shift to sustainable modes.

Key Challenges

2.3.127. The key challenges identified throughout this chapter are set out below following on from which the key conclusions and implications for the scheme are derived.

Key Summary Points: Socio-Economic Context

- There is a high proportion of residents who are economically active in the areas served by the proposed scheme. As such, there is an opportunity to improve connectivity via sustainable means to better serve current and future users along the corridor.
- There are some areas of deprivation and unemployment along the corridor. The proposed scheme would support these residents by providing improved sustainable transport connections along the corridor, providing better access to employment opportunities.
- There is an opportunity for the existing employment sites along the corridor to support employment for residents in areas of deprivation and for 16- to 24-year-olds through the provision of improved walking and cycling and public transport connectivity.

Key Summary Points: Road Network

- The A4 carries high traffic volumes on sections of the corridor, and between Hicks Gate Roundabout (A4/A4174) and the A4/West Town Lane (A4174) junction the flows exceed the theoretical capacity for the single carriageway sections. This is due to the orbital/radial flow conflict between the A4 and the A4174.
- There is significant congestion along the A4 with hotspots at the Hicks Gate Roundabout (A4/A4174) and the A4/West Town Lane (A4174) junctions and Saltford. This congestion results in delays to journeys by car and buses along the corridor (with associated costs to the economy) and results in additional vehicle-kilometres on the network, which works against the targets set by BCC and B&NES to reduce vehicle-kilometres as part of their responses to the Climate Emergency. The delays due to congestion further impact on commercial vehicles and deliveries.
- Traffic growth is likely to continue (due to planned housing growth in the region) and if sustainable capacity is not provided in the network, then increased demand will result in worsening congestion.
- There is a concentration of workplace parking along the corridor in Keynsham, Bath and Bristol. There is an opportunity to support mode shift by decreasing the amount of workplace parking available in locations served by public transport, and to improve the public transport services themselves, in order to encourage sustainable mode shift.

Key Summary Points: Bus and Rail Network

- Issues identified by bus drivers raise the risk that there may be a decline in service and that this may result in mode shift away from bus at a time when the policy aspiration for B&NES and BCC is to increase the bus mode share.

- There is poor connectivity between bus services and communities along the corridor, particularly connectivity from Saltford to Bath and Bristol and Keynsham to Bath. This impacts on the attractiveness of buses as an alternative to the car for journeys along the corridor.
- The high utilisation of existing P&R services along the corridor suggests that there is a need for more P&R capacity and for more reliable bus services to support access into Bath and Bristol City Centres. If people are unable to access the P&R services, and if a reliable and well-connected alternative is not available, then there is a risk of mode shift towards private cars.
- Unless residents are located in the vicinity of a station, the railway network is difficult to access from communities along the corridor, unless they drive and park at the station car park.

Key Summary Points: Active Travel Network

- Provision for cycling along the A4 is very limited and not continuous and there is no direct off-road cycle facility currently in place, with the BBRP forming more of a leisure / recreational route.
- Walking facilities along the A4 corridor and between the A4 and local communities such as Keynsham and Saltford are generally inconsistent with uneven pavements and a lack of safe and accessible crossings.
- There are limited safe crossings and connections between neighbourhoods adjacent to the A4 (leading to low neighbourhood porosity) which restricts walking and cycling movements between communities and between communities and the A4.

Key Summary Points – Trip Patterns and Mode Share

- The highest demand for travel along the Bath to Bristol corridor is between Brislington and Bristol City Centre and between Keynsham and Bath.
- The mode share for car journeys along the Bath to Bristol corridor is high at 62.5% (with 57.8% of residents driving to work and a further 4.7% travelling as a passenger in a car or van).
- Buses are slower than both trains and cars for journeys along the A4. Car journey times on the A4 vary significantly, yet in traffic-free conditions, cars typically offer the fastest mode of travel. Rail journey times align closely with congestion-free car travel times but necessitate transfers and are restricted to areas accessible via rail stations. Cycle journey times tend to be the slowest among all modes.

Key Summary Points: Environmental Context

- Air quality along the Bath to Bristol corridor is poor. This impacts on health in general and on the willingness of people to walk or cycle along the corridor. If mode shift to cycling and walking is to be achieved, then air quality along the corridor will need to be improved.
- The introduction of Clean Air Zones in Bath and Bristol will support improvements in air quality within the cities. However, mode shift to sustainable modes will also be required

for journeys along the corridor and to/from communities along the corridor if air quality is to be improved.

- More needs to be done to support the decarbonisation of the transport network along the Bath to Bristol corridor if the targets set by the Combined Authority, BCC and B&NES are to be achieved. This requires an improvement to public transport, walking and cycling networks in order to encourage mode shift to sustainable modes.

Conclusions and Key Issues in the Current Situation

2.3.128. The key points identified across the current situation along the Bath to Bristol corridor point to the need for intervention to improve the existing sustainable transport provision along the corridor, and to prevent the decline of bus services.

2.3.129. The key issues identified and their relevance to the scheme are set out in the following paragraphs.

2.3.130. The A4 between Bath and Bristol is congested, with all sections having above 8,000 vehicles per day some having above 15,000 vehicles per day. Traffic congestion results in delays to journeys by car and bus, commercial vehicles, and deliveries along the corridor, with associated costs to the economy and additional vehicle-kilometres due to diversions to the M4. This works against the targets set by Bristol City Council and B&NES Council to reduce vehicle-kilometres as part of their responses to the Climate Emergency. Congestion is expected to worsen as housing growth induces more demand for travel, and worsening congestion will impact negatively upon bus services that use the A4. This brings with it the associated risk of mode shift away from bus, further harming climate objectives.

2.3.131. Bus journeys are slow and connections to other services are poor (influenced by congestion). Long journey times for bus services and poor connections between services mean that buses are not an attractive transport choice for journeys along the corridor. As rail connectivity (along the corridor) is only provided at Keynsham, residents without the option of choosing rail are more likely to drive for journeys from locations along the corridor. This is reflected in the mode share for the corridor. If congestion along the A4 worsens then bus services will be negatively impacted which will make bus an even less attractive choice.

2.3.132. Bus journey times are not reliable. Limited bus priority along the corridor means that congestion along the corridor has a significant impact on the reliability of bus journey times. Unreliable journey times make bus a less attractive mode for residents along the corridor travelling to Bristol or Bath, and this will worsen if congestion increases in the future.

2.3.133. Bus services suffer from inadequate connectivity along the corridor, affecting travel to and from these areas. This lack of connection diminishes the appeal of buses as a viable car alternative, resulting in longer and more complex trips that involve multiple interchanges. Consequently, in certain locations along the corridor bus travel is impractical, leading to increased congestion, poorer air quality, and higher carbon emissions from more reliance on cars.

2.3.134. There is a lack of consistent active travel facilities along the corridor, limiting the accessibility for walking and cycling, both along the corridor and between local communities. This limitation reduces the opportunities for people to opt for healthier, sustainable, and cost-effective travel options. Respondents from the 2021 Stakeholder Engagement event have indicated that this lack of facilities, combined with poor air quality resulting from high traffic volumes and congestion, influences their decision against walking or cycling for journeys along the corridor.

Relevance to the Scheme

2.3.135. If the policy aspirations of mode shift to public transport and active modes are to be achieved, then there is a need for intervention to address the current issues identified.

2.3.136. The scheme represents an opportunity to provide increased bus priority (reducing bus journey times and increasing bus journey time reliability) underpinning a high frequency bus service along the A4. This will support improved connectivity by bus for residents along the corridor, and for buses to become an attractive alternative to the car, which could lead to reduced traffic demand along the A4 and reduced congestion, improved air quality and a smaller carbon footprint for transport.

2.3.137. The scheme further represents an opportunity to address the poor walking, wheeling, and cycling facilities along the corridor and to improve the walking, wheeling, and cycle connections between communities along the corridor and the A4.

2.4 The Future Situation

2.4.1. This section presents the anticipated future context for the corridor within which the identified scheme would be delivered. It details the future context in relation to:

- Future socio-economic context
- Future transport context

2.4.2. Future environmental context

- Potential impacts of the coronavirus pandemic

Socio-Economic Future Context

Population Growth

2.4.3. Population growth and projected demographic changes will impact on future transport demand. Understanding the forecast increase in the working population (16-64 years old) is particularly important as it is this group who will be using the transport system the most for employment purposes. **Table 2-6** shows the percentage change in the working age population between 2019 and the forecast years 2030 and 2040.

Table 2-6 - Working Population Projections (16-64 years old)

Area	2019	2030	2040	2019 - 2030 % difference	2019 - 2040 % difference
Bristol City Council	321,118	345,451	360,714	8%	12%
B&NES	124,871	133,055	136,298	7%	9%
West of England	749,533	807,165	842,192	8%	12%
South-West	3,398,081	3,517,917	3,539,416	4%	4%
England	35,164,130	36,043,209	36,163,365	2%	3%

Source: ONS Working Population Projections

2.4.4. The working age population is predicted to increase significantly in the BCC area by 2030 and 2040, by 8% and 12% respectively. In B&NES the growth over these time periods is 7% and 9% respectively. This is considerably higher than the average for the South-West (4%) and England (2% and 3%). In absolute terms, the working population in Bristol is forecast to grow by almost 40,000 by 2040, for B&NES the equivalent figure is 11,000.

2.4.5. This projected growth is reflected in the emerging requirements for housing in the region. The Combined Authority published the Local Housing Needs Assessment (LHNA) in September 2021[7] which provides an indication of the level of potential growth. The LNHA states an overall need for 99,315 houses in the wider West of England between 2020 and 2035, with 9,720 required in B&NES and 47,940 in Bristol.

Housing and Economic Growth

2.4.6. The West of England Local Industrial Strategy[8] notes that the region is one of Europe's prime city regions, with an economy worth £25.5bn a year.

2.4.7. The West of England Strategic Economic Plan[9] 2015-2030 sets out how the region will stimulate sustainable economic growth by creating 25,500 jobs in the region. The plan focuses on five priority growth sectors, where the region is deemed to have a sustainable comparative advantage: advanced engineering and aerospace, high tech, creative and digital industries, low carbon and professional services.

[7] West of England Local Housing Needs Assessment, Final Report, West of England Combined Authority, September 2021
[8] West of England Local Industry Strategy, Gov.UK, Published 19 July 2019
[9] West of England Strategic Economic Plan 2015 – 2030, West of England LEP

2.4.8. By developing specialisation in these sectors, the strategy expects to drive economic growth in the region. Investments will be targeted to key levers of growth such as infrastructure, people, skills and small and medium-sized enterprise (SME) business support.

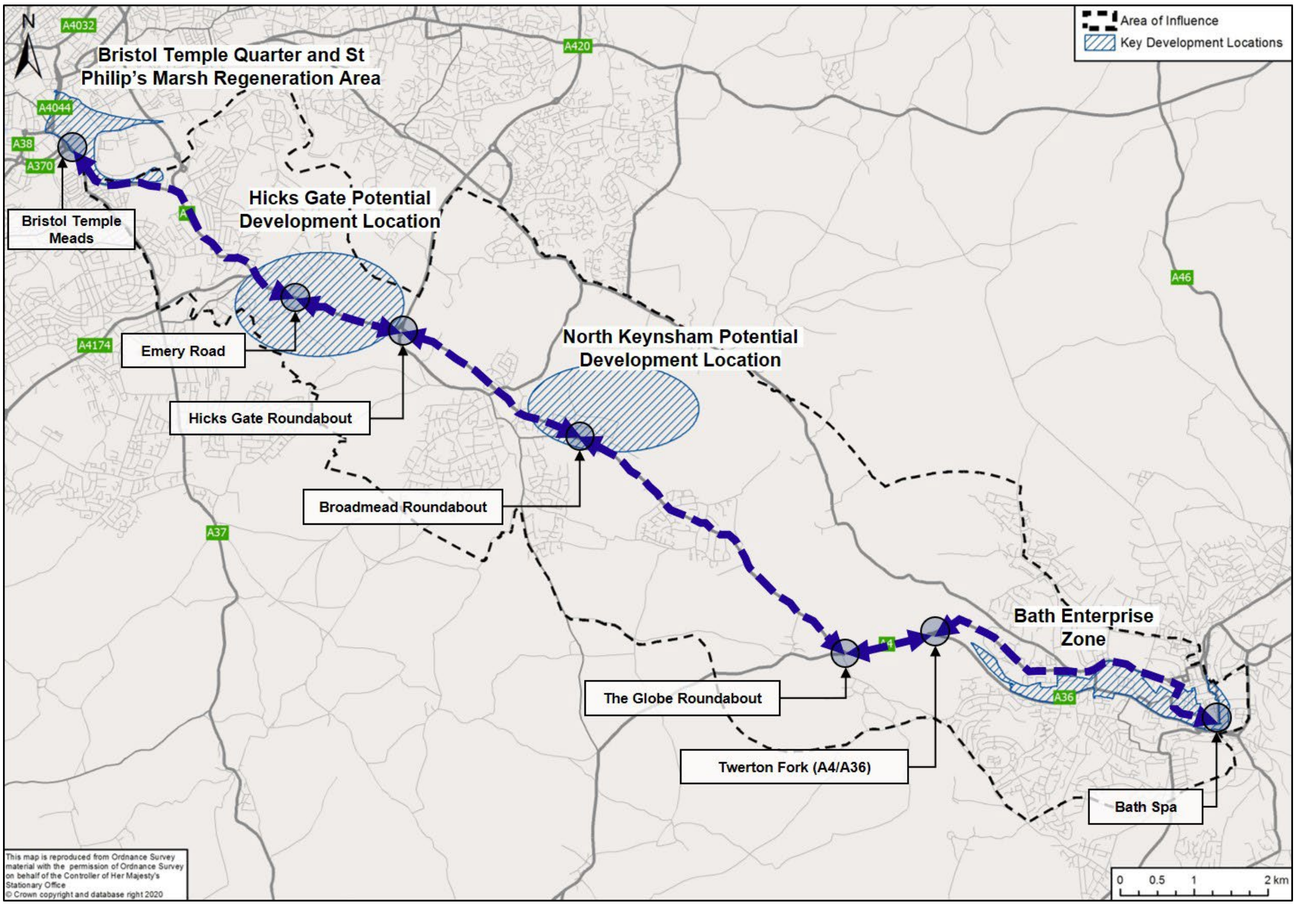
2.4.9. There is the opportunity for growth in employment and leisure along the Bath to Bristol corridor. There are a number of key sites along the corridor that have already been identified and are under development. The sustainable transport provision to these sites needs to be maximised.

2.4.10. Key development locations are summarised below and are shown in **Figure 2.31**:

- **The Temple Quarter Enterprise Zone and St Philip's Marsh**[10] transformation is one of the UK's largest regeneration projects. The Temple Quarter Enterprise Zone (EZ) is targeted to grow from 3,000 to 22,000 jobs and deliver 4,500 new homes by 2036. St. Philip's Marsh will include mixed uses including the provision of new homes in a regenerated area which complements the adjacent Temple Quarter.
- **Hicks Gate Potential Development Location** – an area of interest for developers and may form part of plans for future housing provision. This aligns with draft policy DS12 in the Bristol Local Plan Review.
- **North Keynsham Potential Development Location** – an area of interest for developers and may form part of plans for future housing provision.
- **Bath City Riverside Enterprise Area**[11] - Bath City Riverside is becoming a new commercial quarter and central business district that will offer flexible workspace options including new grade A office space, a residential quarter and leisure facilities. It has the potential to deliver approximately 1 million square feet of employment space and accommodate up to 9,000 new jobs and 3,400 homes within 98 hectares of land along the River Avon corridor in central and western Bath, between Newbridge and Bath Spa Railway Station, where some 36 hectares is developable brownfield land.

[10] Temple Quarter & St Philip's Marsh, A vision for the future, Bristol Temple Quarter, March 2021
[11] Bath City Riverside Enterprise Area Masterplan 2014-2029 Masterplan Vision Report, Bath & North East Somerset Council,

Figure 2-31 – Key Development Sites impacting on the Bath to Bristol corridor



Impact of Future Travel Demand

2.4.11. As shown in **section 2.3** above, residents along the Bath to Bristol corridor are heavily dependent on car as a primary mode of travel to work with an average of 62.5% mode share for car.

2.4.12. The growth in housing, employment and leisure will likely increase travel demand along the corridor, which if not delivered via sustainable modes will also increase journey times, congestion and delay. Based on the current level of car dependence, the JLTP4 projects a potential 9% increase in journey times and 74% increase in time queuing in traffic by 2036 if no action is taken. The JLTP4 estimates that the cost of congestion in the region could increase to £800m a year by 2036.

Future Traffic Flows

2.4.13. **Figure 2-32** and **Figure 2-33** show future travel demand based on "do minimum" (DM) scenarios for 2029 and 2042 respectively. Information has been taken from the WERTM highway assignment model. The WERTM represents a DFT 'core' forecast and includes assumptions about future car and PT costs. Whilst the PT costs are based on local historic trends in bus fares in the West of England, the DfT 'core' forecasts also include current UK government policy that fuel duty is levied on ICE cars and not on electric vehicles. This is unlikely to remain the case and therefore the WERTM is likely to underestimate future car operating costs and therefore overestimate future car use. When comparing **Figure 2-32** and **Figure 2-33** with **Figure 2-14**, congestion worsens though the forecasts are likely to be somewhat conservative and future congestion increase may be slightly over-estimated. Notwithstanding, the proportion of roads with 8,000-15,000 or 15,000-35,000 vehicles per day increases across both DM 2029 and DM 2042..

2.4.14. The most significant changes from 2019 to DM 2029 are increased congestion around Bath City Centre, as well as some arteries such as the A431.

2.4.15. The most significant changes from DM 2029 to DM 2042 are worse congestion around many key arteries approaching the A4, as well as across Keynsham, Bath and Bristol.

2.4.16. From the 2019 baseline to DM 2042, congestion is considerably worse across all three city and town centres (Bristol, Bath and Keynsham) as well as across many feeder roads. This will harm connectivity between the three centres through increasing journey times, as well as potentially making the A4 more difficult and time-consuming to access.

Figure 2-32 - Vehicles per day (DM 2029 scenario)

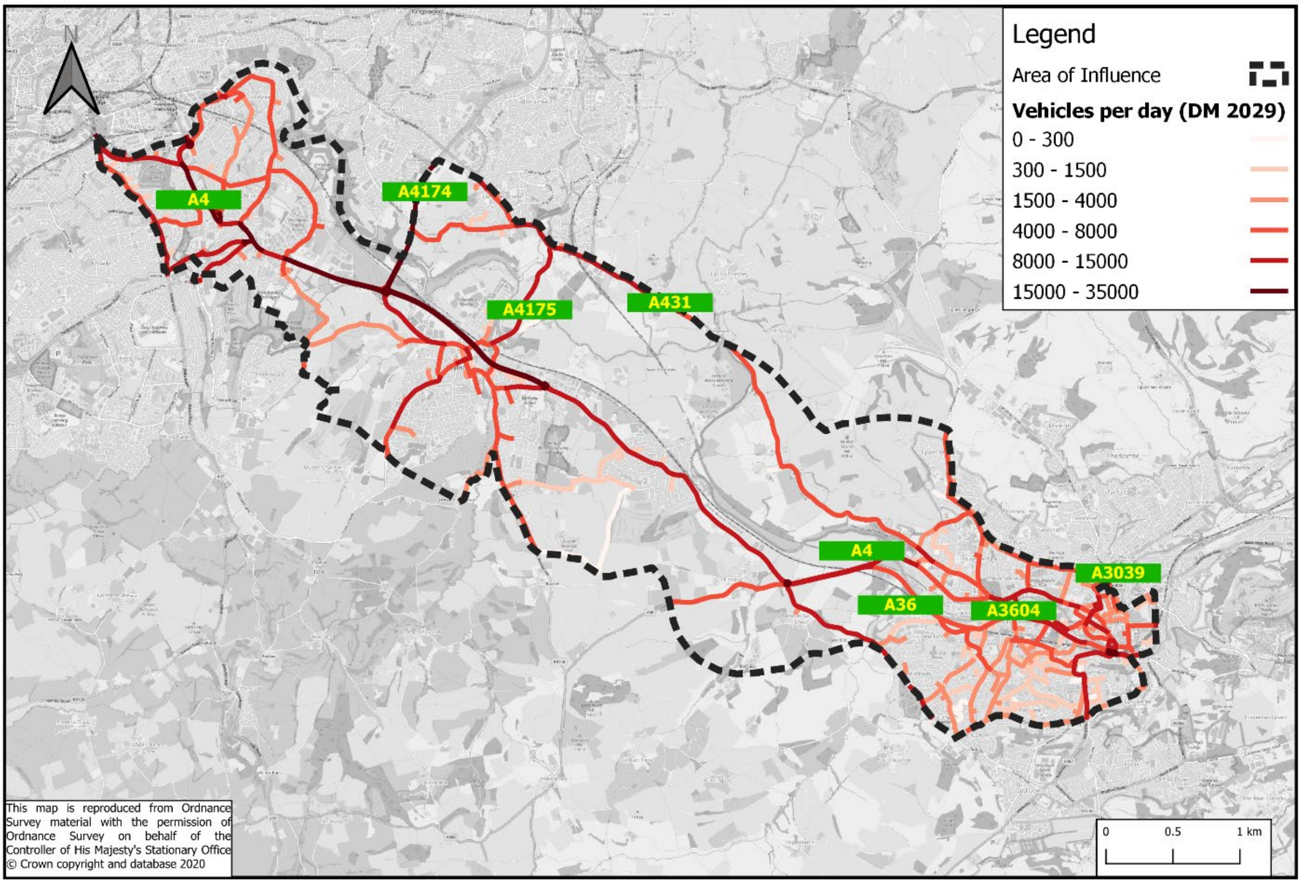
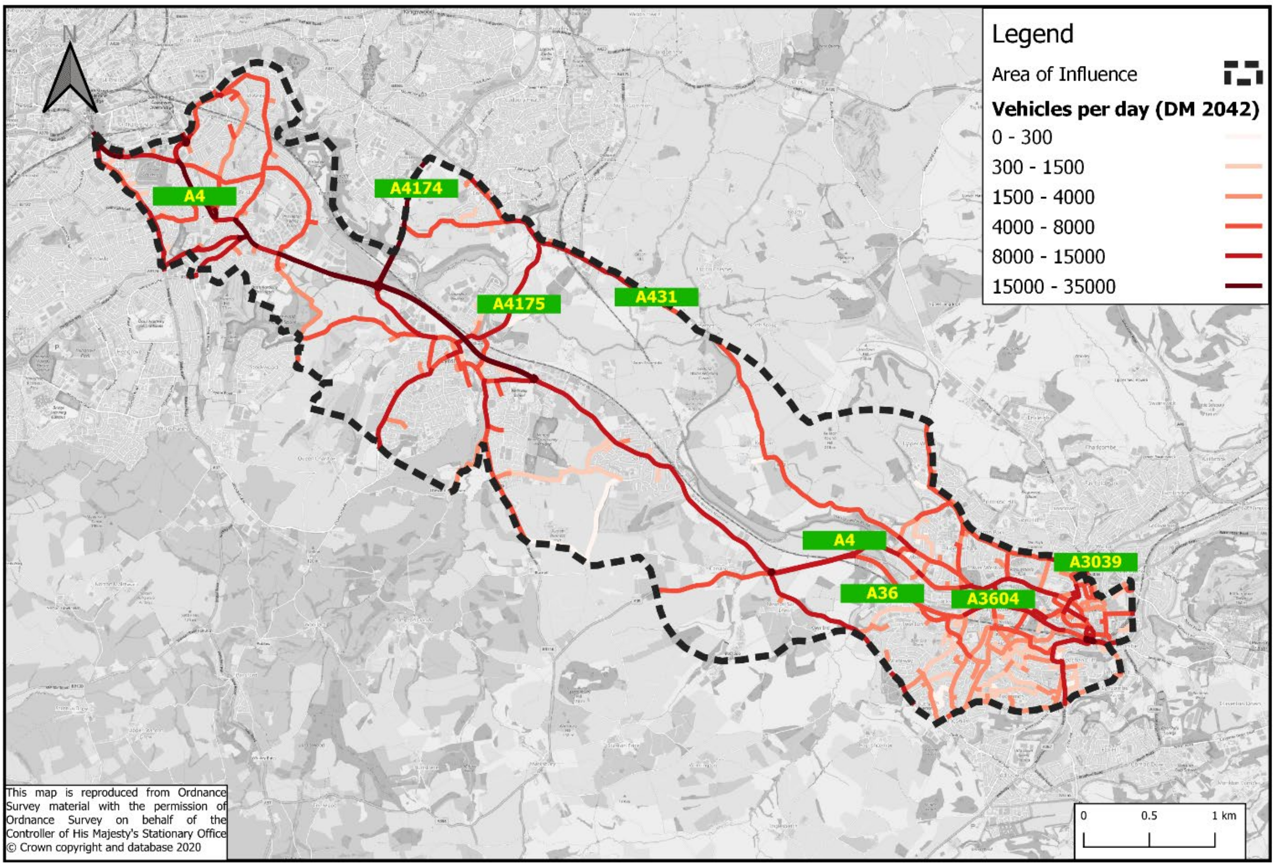


Figure 2-33 - Vehicles per day (DM 2042 scenario)



2.4.17. The costs in the public transport assignment model are calculated as follows. Projected rail fare increase over RPI in nominal terms is converted to real terms using the GDP deflator. The factors from the table are used to reflect the changes in Rail fares between base and forecast year. DfT analysis show that the rail fares increase by 12% between 2019-2029 and 21% between 2019-2042 which is an annual average increase of approximately 1.1% from 2019 to 2029 and 0.8% from 2019 to 2042.

2.4.18. The changes in the bus fares over time in nominal terms were derived using historical fare data taken from DfT's local bus fare index table BUS0405a2. DfT's analysis shows that the bus fares in nominal terms increased by about 43% between 2010 and 2020 in English non-metropolitan areas which is an annual average increase of about 4.1%. This trend in nominal terms is extrapolated for the forecast years 2029 and 2042 and is adjusted using GDP deflator to convert to real terms bus fare index in real terms is summarized in which shows an average annual increase of 1.7% from 2019 to 2029 and 1.8% from 2019 to 2042.'

2.4.19. There is an inverse relationship between demand and costs for each mode, so fare increases above those outlined above will lead to a decreasing PT mode share and vice vera. Similarly, car vehicle operating cost changes which are larger than assumed in the DfT 'core' scenario are likely to reduce car mode share. The PT costs are considered robust, whilst it is recognised that alternative assumptions about car operating costs are likely to yield higher car mode shares than might otherwise be expected.

Transport Future Context

2.4.20. This section describes the planned or identified future transport interventions and their potential impact upon the issues identified in the Current Situation in **Section 2.3**.

Future Workplace Parking Provision

2.4.21. It is an expected outcome of the 2019 Bristol Transport Strategy[12] that “on and off-street parking [be] managed efficiently to encourage use of sustainable transport and tackle congestion, while providing options that support the city’s 24-hour economy”.

2.4.22. The Bath Transport Strategy[13] sets out a parking strategy to support economic growth but at the same time reduce the number of off-street spaces within the City Centre. Policy GABP7 sets out that reducing central area public parking and expanding long stay capacity at P&R sites should continue.

Future Residential Parking Provision

2.4.23. The 2019 Bristol Transport Strategy sets out that parking at new developments will depend on the accessibility of areas by alternative modes of transport. The Joint Local Transport Plan (JLTP4) states that the management of on street, off street, residential and business parking will all need to be considered.

2.4.24. The Bristol Local Plan Site Allocations and Development Management Policies document states that each residential dwelling will have 1 car parking space for each 1 bed dwelling, 1.25 spaces for each 2 bed dwelling, and 1.5 spaces for each 3+ bed dwelling. The Bath & North East Somerset Local Plan has slightly more generous parking allowances, with 1 car parking space for each 1 bed dwelling (plus 1 space per 4 dwellings for visitor parking), 2 car parking spaces for each 2 bed dwelling (plus 1 space per 4 dwellings for visitor parking), 2 car parking spaces for each 3 bed dwelling, and 3 car parking spaces for each 4+ bed dwelling. It is clear that, particular for the Bristol section of the study area, car parking will become increasingly restricted for residents in the future.

2.4.25. **Potential Future Impact**: If future parking provision is reduced through the management approach proposed in the transport strategies it will positively impact on mode share for public transport and cycling. However, if this is not complemented by an improved bus network and services – in order to provide a viable, attractive alternative to car journeys – it risks not achieving its goal of encouraging sustainable transport and reducing congestion.

[12] Bristol transport Strategy, Tackling congestion and making Bristol a better place for all. A vision up to 2036, Adopted 2019
[13] Getting Around Bath, A Transport Strategy for Bath, Bath & North East Somerset Council, November 2014

Planned Improvements to the Highway Network

2.4.26. There are interventions previously identified under the JLTP4, which are being explored as part of the BBSC Programme options. These include the Callington Road Link and Hicks Gate Junction changes, considering the A4 Brislington site relocation to Hicks Gate.

2.4.27. Other highway network improvements identified in the JLTP4 that may impact on the Bath to Bristol corridor are:

- A link from the A4 to Avon Mill Lane, Keynsham: The scheme will help to divert traffic away from Keynsham, unlock road space and deliver highway measures to improve the A4175/ Avon Mill Lane junction to a roundabout with enhanced pedestrian and cycling facilities. This link would also provide access to the potential strategic development location at North Keynsham.
- A scheme to address issues with orbital movements: The Unitary Authorities have identified that there are issues resulting from the demand for orbital movements to the south of Bristol and are agreed in the need to address the issues. Options are yet to be defined but may impact on the travel demand and bus services through the Hicks Gate junction and could remove the orbital traffic from the A4 between Hicks Gate and the A4/West Town Lane junction.

2.4.28. It should be noted that the above highway improvements are not sufficiently certain to be included in the baseline for this scheme.

2.4.29. **Potential Future Impact**: The proposed link road in Keynsham would provide some relief to strategic movements through Keynsham and facilitate the potential development location. However, it would not reduce congestion on the A4 affecting movements along the corridor.

Planned Improvements to the Bus Network

2.4.30. There are existing proposals to improve the bus network in the region in the medium term, these include:

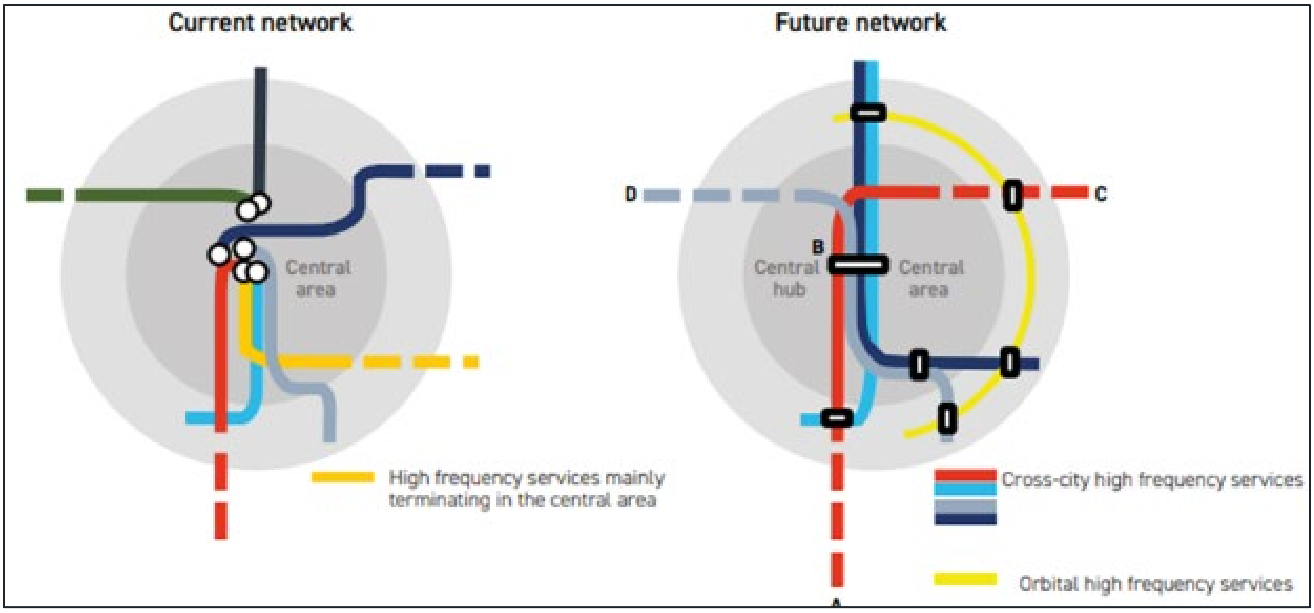
- West of England Bus Strategy
- West of England Bus Service Improvement Plan
- Extension of the existing metrobus network
- West of England Combined Authority Bus Corridors
- Bath Area Bus Network Improvement Scheme (BABNIS)

West of England Bus Strategy

2.4.31. The West of England Bus Strategy (2020) considers options to improve the bus network in the region and sets out how growth in bus usage can be encouraged by delivering faster, more reliable and more accessible services. A key principle of the Bus Strategy is to re-configure (and simplify) the network to facilitate interchange between radial and orbital services to provide new opportunities for bus trips.

2.4.32. To create a comprehensive and joined-up network **(Figure 2-34)** the following principles have been identified; reducing the number of core urban routes but increasing the frequency of the routes; establishing a small number of frequent orbital services; and building well designed neighbourhood bus interchanges. For a well-designed bus interchange to work, the bus strategy requires new bus lane infrastructure. These principles are being incorporated into the BSIP.

Figure 2-34 – Future Bus Network Design, West of England Bus Strategy



West of England Bus Service Improvement Plan (BSIP)

2.4.33. The BSIP was jointly produced in October 2021 by the West of England Combined Authority and North Somerset Council to meet the objectives set out in the National Bus Strategy. In November 2022, BSIP funding to support the delivery of elements of the plan was confirmed and the first year of funding drawn down in February 2023. An update to the BSIP was published in December 2022.

2.4.34. The BSIP Progress Report (July 2023) states that the BSIP sets out the following five key targets:

- **Bus journey time**: reduce average bus journey times on designated corridors by 2% by 2025 and by 10% by 2030
- **Punctuality**: achieve 95% of services running on time, defined as being no more than 1 minute early or 5 minutes late, by 2030
- **Single Passenger Journeys**: return to pre-pandemic patronage levels by 2025 and grow patronage by at least 24% from that level by 2030
- **Passenger Satisfaction**: increase passenger satisfaction to 89% for 2025 and 95% for 2030
- **Bus decarbonisation**: by the end of 2023 all buses operating in BSIP will meet the Euro VI emission standard. By 2030, at least 75% of the local fleet will be either zero-emission or ultra-low emission and by 2035 all buses will be zero emission buses (ZEBs). Subject

to securing funding and working with bus operators to accelerate plans, the ambition is to bring the ZEB ambition forward to 2030.

2.4.35. The original BSIP built on the West of England Bus Strategy (2020) and formed part of a bid to government for funding that would support a programme of work that would deliver long-term benefits to citizens and businesses. In the updated BSIP, initiatives have been revisited to reflect what can be delivered as a priority through the BSIP funding until March 2025 and up to March 2027 through the CRSTS funding, as well as maintaining a vision for the longer term.

2.4.36. Delivering the initiatives outlined in the BSIP is best achieved by collaboration between local transport authorities and operators. That is why the Combined Authority and North Somerset Council are working in partnership with local bus operators and highway authorities to develop an Enhanced Partnership.

2.4.37. Any interventions along the Bath to Bristol corridor (such as the scheme) will need to align with the BSIP but will also be complemented by the outputs of BSIP on other services.

2.4.38. The BBSC Programme assumes any new services on the corridor would be delivered through the Enhanced Partnership. In collaboration, this will support improved connections between services and increased frequencies across the network to create more viable public transport journeys across the network and reduce the need to travel by car.

Bus Corridor Infrastructure Priorities

2.4.39. The Combined Authority Joint Committee approved the development of a coordinated bus infrastructure programme in June 2020[14]. The Bus Infrastructure Working Group, made up of nominated officers from each authority and the Combined Authority, has undertaken a prioritisation exercise based on the alignment with the JLTP4 / Bus Strategy, deliverability of schemes, data availability and initial assessment of value for money.

2.4.40. The corridors listed in **Table 2-7** are priorities for improvement under Phase 1 and Phase 2 which were approved at the West of England Joint Committee. Timescales for improvements to the corridors are evolving.

Transport Corridor Programmes

2.4.41. The Combined Authority are working on projects to improve bus services and walking and cycling opportunities, as part of their vision for a greener, better connected transport network in the West of England. These include:

- A432 and A4174 between Yate / Chipping Sodbury and Bristol. Improving walking, cycling and public transport for people travelling
- Bath to Bristol Corridor. Better bus services and enabling more cycling and walking.
- A37/A4108 corridor. Improving walking, cycling and public transport infrastructure

[14] 19th June CA committee, Item 18, sub item 5. Page 227 of report pack

- A37/A367 Corridor. Improving travel between Midsomer Norton, Radstock, Westfield and Bath via the A367 and Bristol via the A37; through better bus services and enabling more walking and cycling.
- Thornbury, A38 and Bradley Stoke Way corridor. Improving conditions for people walking, cycling and travelling by bus.
- A432/A4174 Corridor
- Bristol City Centre

Table 2-7 – Bus Corridor Phasing

Phase 1	Phase 2
A4 Bath Road (Bristol – Bath Strategic Corridor) A4018/A37 (First Route 2, and Bristol City Centre) A38 North (Bristol City Centre to Thornbury) Bristol City Centre Bristol City wide bus lanes and bus stop upgrades A4174 Ring Road / A432 to Yate A37 (S) – Bristol to Midsomer Norton metrobus consolidation	A38 (S) A4 (Portway) - Including Hotwell Road Bath Park & Ride A367 Bath to Midsomer Norton A4 London Road M32 A370 A36 Lower Bristol Road Bath urban area B&NES other places North West of A4018 Northern orbital route B4465 / Speedwell Road A420 / A431

2.4.42. **Potential Future Impact**: Planned improvements in the regional bus network would complement improvements along the Bath to Bristol corridor by providing improved interchange opportunities and a broader range of destinations connected by the bus network. However, regional improvements on their own are not likely to address the issues identified in the Current Situation along the Bath to Bristol corridor.

Planned Improvements to Park and Ride (P&R) and Interchange Hubs

2.4.43. The proposed future changes to P&Rs or interchange hubs along the Bath to Bristol corridor are captured across a number of policies and projects:

- The JLTP4 confirms P&R will play an important role in the region. In addition, it sets out aspirations for expanding the variety of uses for existing and new P&R sites including Park & Rail and Park & Share. The JLTP4 states:

- Complementary uses for existing and new P&R sites will be explored, with opportunities for sites to provide Park & Cycle or Park & Stride, overnight lorry parking, coach parking, freight consolidation functions, community uses, renewable energy generation, or even acting as bus depots
- Any complementary uses would need to consider potential impacts on local communities and the local environment. Operators would need to be involved, as some proposals may require a parking charge to be introduced
- In the longer-term, exploring the potential of new and expanded P&R sites, as well as exploring the potential for sites to act as transport interchanges which could include improved links to public transport, substantial increases in cycle parking, cycle hire facilities, improved wayfinding infrastructure to facilitate walking, innovative last mile freight solutions and access to electric charging points

- **The West of England Bus Strategy** highlights that sites will be designed to fit the emerging strategic network and operate as transfer locations for connecting bus services and key interchanges between other transport modes
- **Future Transport Zones** – The Combined Authority was successful in receiving £28 million funding to create a West of England Future Transport Zone (FTZ). A key element of the FTZ will be the creation of new “Mobility Stations” which build on the aspirations of the JLTP4 to make better use of P&R sites. Mobility Stations are physical multi-modal interchange points, integrating multiple modes and service offerings for users. They will be aligned with transport hubs on corridors at key locations where interchange between modes and services can be facilitated.

2.4.44. The B&NES vision for P&R locations is considered as part of the Local Plan Partial Update. This considers a series of potential future sites to act as transport interchanges, and could include a series of extra facilities and services including:

- Mobility Stations
- Cycle hubs
- Bicycle lockers
- Bicycle rental
- Bicycle maintenance facilities
- E-scooters / e-bikes / e-cargo bike rentals
- Freight consolidation
- Parcel lockers
- Solar panels
- Electric vehicle charging
- Car share clubs
- Waste facilities
- Shared workspaces
- Open air events spaces

2.4.45. **Potential Future Impact**: As part of the BBSC Programme the relocation and expansion of the A4 Brislington P&R site to Hicks Gate is being explored. This was identified within JLTP4, however in response to the policy position, the relocated P&R will be a multi-modal transport interchange and consideration will be given to include additional facilities and services. Expanding P&R capacity will help to address the current high utilisation of P&R sites and will provide additional travel options by bus through the interchange with other bus services.

Planned Improvements for Walking and Cycling

Committed and Funded Improvements

2.4.46. There is a wide range of identified proposals to improve walking and cycling across the scheme AoI but very few of these are currently funded.

- Bath Sustainable Walking and Cycling Links (BSWCL) scheme. Walking and cycling improvements across the city to enhance connectivity, including off road, segregated routes and cycle parking spaces.
- Liveable Neighbourhoods. Improvements to walking and cycling routes, such as through improved crossings, alongside local enhancements like tree planting, as part of the council's Liveable neighbourhoods programme, which is currently being implemented in 15 local communities

Identified but not Funded Improvements

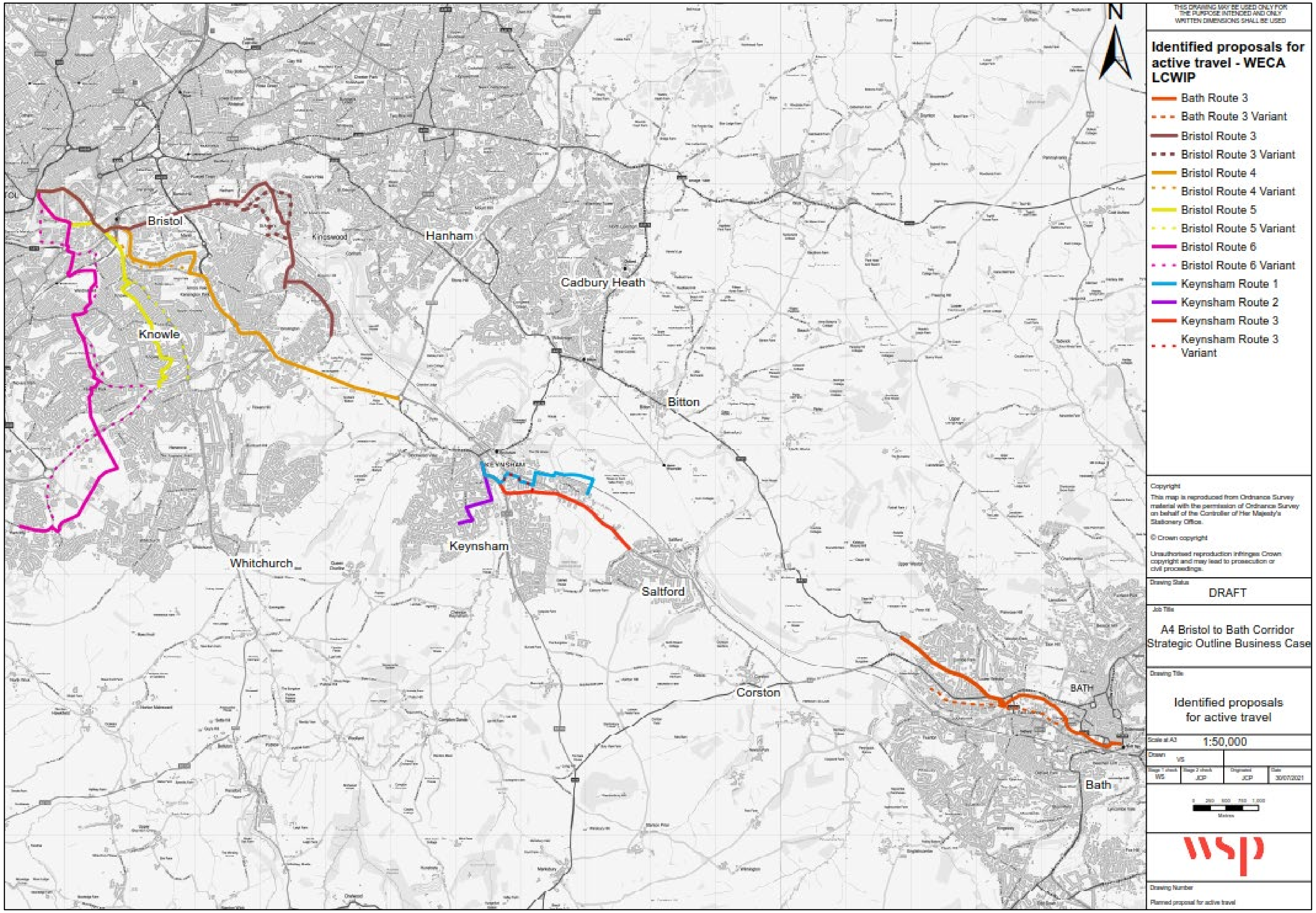
2.4.47. Identified (but not funded) proposals include those put forward by the West of England Local Cycling and Walking Infrastructure Plan[15] (LCWIP).

2.4.48. The LCWIP sets out a series of proposals (at a total estimated cost of £411m) to improve the environment for cyclists and pedestrians. The proposals are not, however, funded and hence represent a plan (but not a commitment) for improvements that needs to be funded. The approach has been taken to include all of these plans as part of the potential package of interventions that should be considered to address the issues in the Current Situation.

2.4.49. The proposed improvements within the LCWIP are focused on 30 local high streets and 55 continuous cycle routes. The routes proposed in the LCWIP of relevance to the Bath to Bristol corridor are shown in **Figure 2-35** and are included in **Appendix B**.

[15] West of England Local Cycling and Walking Infrastructure Plan 2020-2036, Travelwest,

Figure 2-35 – Planned proposals for active travel (LCWIP)



Liveable Neighbourhoods

2.4.50. Liveable Neighbourhoods are an important part of BCC and B&NES plan to tackle the climate and ecological emergency and improve health across the area. The aim of a Liveable Neighbourhood is to reduce the dominance of vehicles in residential areas - particularly through-traffic - while maintaining vehicle access to homes and businesses. This can be done through a range of measures including vehicle restrictions, traffic calming, one-way streets and residents' parking zones.

2.4.51. With fewer vehicles, more road space can be used to create safer opportunities for walking and cycling, ensuring fairer access to roads and encouraging more active, sustainable travel. Consideration can also be given to on-street electric vehicle charging to encourage the use of electric vehicles.

2.4.52. The consultation on the Liveable Neighbourhoods principles in B&NES in 2020 showed that more than 79% of respondents agreed or strongly agreed with the Liveable Neighbourhood principles (reducing the dominance of vehicles in residential areas / encouraging active travel).

2.4.53. The specific locations and form of Liveable Neighbourhoods in B&NES is still under development, but the Liveable Neighbourhoods programme will complement the proposed active travel improvements and create a network in which people can safely and confidently travel from their homes to destinations by walking and cycling.

2.4.54. **Potential Future Impact**: Whilst the West of England LCWIP identified more than £400m in improvements to walking and cycling infrastructure, very little of the identified improvements are funded. Hence, existing planned investment is not likely to address the issues identified in the Current Situation.

2.4.55. Improving the walking and cycling network in future will encourage mode shift for shorter journeys. If this can be complemented with an improved public transport network with high frequency services (minimising the interchange time between walking/cycling and bus or rail journeys) and services providing for safe cycle parking and/or taking bicycles onto trains or buses, it would enable a wider range of journeys to be made sustainably and encourage mode shift.

Planned Improvements to the Rail Network

2.4.56. Planned investment in the rail network through the MetroWest programme will enable an increased frequency of services through Keynsham and Oldfield Park rail stations when Phase 1 is completed.

2.4.57. There have been long-standing plans for a potential new rail station at Saltford. A bid was submitted to the DfT's Restoring Your Railway Fund for re-opening a Saltford station, however it was unsuccessful.

2.4.58. **Potential Future Impact**: Improving the frequency of services to Keynsham would make rail journeys marginally quicker (with reduced waiting time) for residents with access to

Keynsham station. If a new station is implemented in Saltford it would create a new transport mode choice for residents with access to the new station, which may detract from demand for bus services to/from Saltford. However, as the new station at Saltford is not committed it is concluded that the proposed rail improvements are not likely to address the issues identified in the Current Situation.

Summary: Future Transport Context

2.4.59. **Workplace parking provision:** If future parking provision is reduced through the management approach proposed in the transport strategies it will positively impact on mode share for public transport and cycling. However, if this is not complemented by an improved bus network and services – in order to provide a viable, attractive alternative to car journeys – it risks not achieving its goal of encouraging sustainable transport and reducing congestion.

2.4.60. **Planned improvements to the highway network**: The proposed link road in Keynsham would provide some relief to strategic movements through Keynsham and facilitate the potential development location. However, it would not reduce congestion on the A4 affecting movements along the corridor.

2.4.61. **Planned bus network improvements**: Planned improvements in the regional bus network would complement improvements along the Bath to Bristol corridor by providing improved interchange opportunities and a broader range of destinations connected by the bus network. However, regional improvements on their own are not likely to address the issues identified in the Current Situation along the Bath to Bristol corridor.

2.4.62. **Changes to P&R sites:** The relocation and expansion of the A4 Brislington site to Hicks Gate (identified in the JLTP4) is included within the scope of the BBSC Programme. Expanding P&R capacity will help to address the current high utilisation of P&R and will provide additional travel options by bus through the interchange with other bus services.

2.4.63. **Walking and cycling improvements**: Whilst the West of England Local Cycling and Walking Infrastructure Plan (LCWIP) and emerging proposals from the Journey to Net Zero Action Plan for Bath (formerly Transport Delivery Action Plan) have identified more than £400m in improvements to walking and cycling infrastructure, very little of the identified improvements are funded. Hence, existing planned investment is not likely to address the issues identified in the Current Situation.

2.4.64. **Rail improvements**: The proposed rail improvements (including improved service frequencies to Keynsham resulting from MetroWest Phase 1) will not address the issues identified in the Current Situation.

Environment Future Context

Climate Change

2.4.65. Extreme weather events attributed to climate change are likely to become more commonplace in the future, with the South West being vulnerable to flooding and extreme storms. These events will impact the reliability and resilience of transport, digital, and energy networks and services, with exacerbated impacts on vulnerable areas.

2.4.66. Modelling undertaken as part of the Bristol One City Plan highlights that climate change is likely to have a notable impact on flood risk across the region. Major transport hubs such as Bath Spa and Bristol Temple Meads railway stations are projected to be impacted by floods by 2080.

2.4.67. The relationship between weather and transport network operations is well established, but designing-in greater resilience will be required to avoid increasing disruption and closures of key links in the future. Hard infrastructure, as well as softer measures including design measures and management of catchments through tree planting, are essential in supporting vulnerable areas within the region by reducing the environmental, social and economic costs of such events in the future. Any future interventions will need to account for extreme weather events both in terms of mitigating their impact and reacting to events as they happen.

Carbon Emissions and Air Quality

2.4.68. *Carbon Emissions*: As set out in the Current Situation, transport accounts for a high percentage of the carbon emissions in the West of England. Without significant modal shift away from the private car, the impact of transport on the environment will continue to be a problem, exacerbating existing issues of poor air quality and its impacts on the health and well-being of residents.

2.4.69. Mass behavioural change is required to achieve net zero by 2030. Without a shift from private car use, more than 30% of carbon emissions in the region will continue to come from transport. This will not align with national goals for Carbon Net Zero, or with the declaration of Climate Emergencies by the Combined Authority, B&NES and BCC.

2.4.70. *Air Quality*: Air quality along the Bath to Bristol corridor is poor and will continue to be poor unless action is taken to reduce vehicular traffic and to change the vehicle mix to lower-emission vehicles. The introduction of Clean Air Zones in Bath and Bristol will support improvements in air quality within the cities and are likely to reduce traffic flows along the A4 to a small degree.

2.4.71. However, mode shift to sustainable modes will also be required for journeys along the corridor and to/from communities along the corridor if air quality is to be improved. A result of improved air quality and contributing to its further improvement will be mode shift to cycling and walking, as air quality is a key factor identified through stakeholder engagement as influencing the decision to walk or cycle along the A4.

2.4.72. **Potential Future Impact**: The targets of reducing vehicle mileage by 40% by 2030 (set in the Bristol One City Climate Strategy) and of 25% by 2030 (set in the Journey to Net Zero Plan for Bath Phase 1 – formerly Transport Delivery Action Plan) will not be achieved if action is not taken to facilitate and encourage sustainable mode shift. If these targets are not achieved the wider policy aspiration of achieving net zero by 2050 will not be achieved. There is a need for demand management of less sustainable modes of transport in order to achieve the scale of mode shift required to achieve these targets.

2.4.73. The current poor air quality along the corridor will worsen if congestion increases. If air quality along the A4 is not improved, it will discourage mode shift to walking and cycling which will counteract any investment in active travel modes along the corridor.

Potential impact of Covid-19

2.4.74. The National Infrastructure Commission (NIC) published a report in May 2021[16] titled 'Behaviour change and infrastructure beyond Covid-19'. Quantitative analysis undertaken for the Commission suggests that the difference in average annual public transport trips between possible future scenarios with the highest and lowest levels of behaviour change could be as high as 25% over the next 30 years.

2.4.75. The report identifies five potential future scenarios as a result of the pandemic. These are:

1. **Reversion and reaction**: limited change where behaviours adopted during the pandemic are not maintained
2. **A more flexible future**: Flexible working is adopted by employers and employees, higher demand to live in suburban areas and existing trends accelerate (increase in virtual activities)
3. **Low social contact urban living**: behaviours adopted during the pandemic are maintained, less socialising and significant increase in virtual activities
4. **Social Cities**: home working is adopted at a high level, existing trends accelerate (increase in virtual activities)
5. **Virtual local reality**: home working is adopted at a high level, behaviours developed during the pandemic are maintained, high demand to move to rural areas and a significant increase in virtual activities

2.4.76. It is uncertain whether the impacts of the pandemic on travel behaviour change will be adopted long-term. Evidence from the Office of National Statistics showed that by June 2022 current bus passenger journeys were still well below (27% lower) pre-COVID-19 levels (2019) in England. The lower levels were broadly consistent across different areas, with current bus passenger journeys 29% lower in non-metropolitan areas, and 28% lower in metropolitan areas. Without an attractive public transport network to give people the option to travel sustainably, the likelihood of public transport use returning to pre-COVID levels in the near future is reduced significantly. It should be noted, however, that recent statistics

[16] Behaviour change and infrastructure beyond Covid-19, National Infrastructure Commission, May 20201

indicate further recovery in bus passenger numbers to about 20% lower than pre-COVID levels.

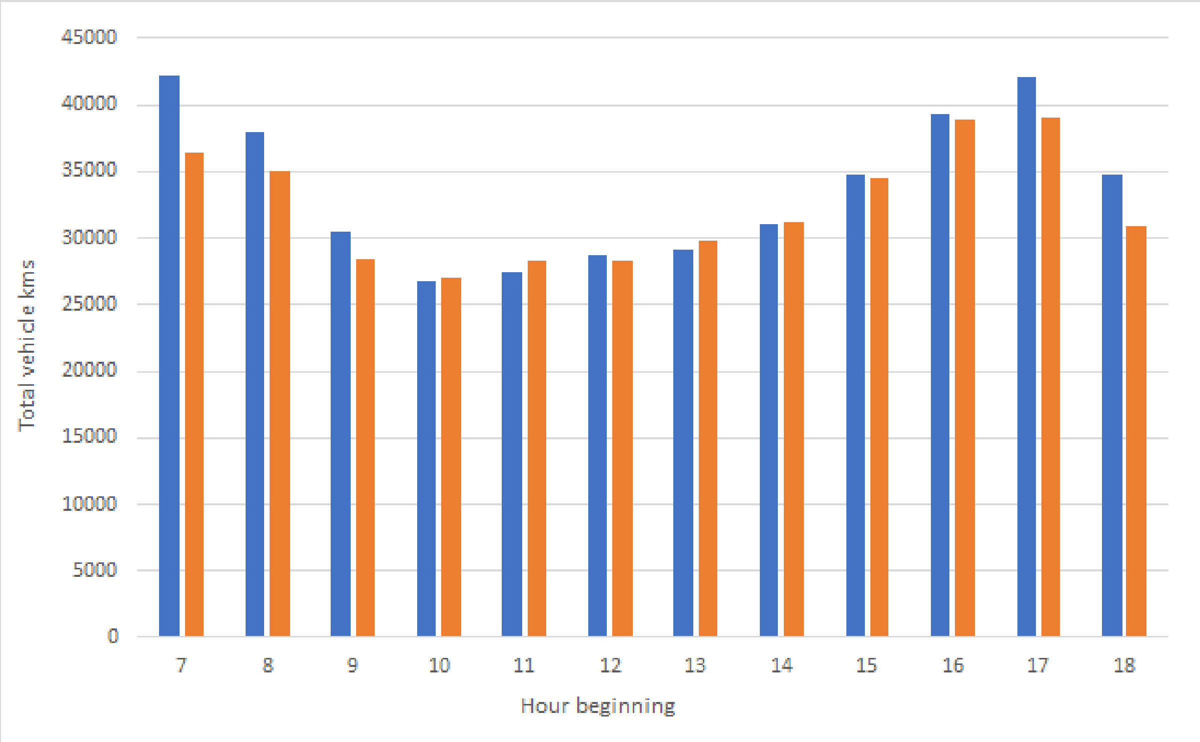
2.4.77. DfT road traffic statistics suggest that for the City of Bristol, total million vehicle kilometres fell from 1,494.6 to 1,403.7 between 2019 and 2022. This represents a 6.1% drop in total vehicle kilometres.

2.4.78. Data on bus usage is limited so the impacts of the coronavirus pandemic are not fully understood.

2.4.79. At Keynsham rail station between April 2019 and March 2020 there were 532,966 passenger entries and exits. Between April 2022 to March 2023 there were 418,586 passenger entries and exits (21% decrease).

2.4.80. Analysis of total vehicle kilometres at DfT count sites in Bristol by hour shown in **Figure 2-36**.(2019 in blue, 2022 in orange).

Figure 2-36 – Total Vehicle Kilometers at DfT Count Sites in Bristol by Hour)



2.4.81. **Potential Future Impact**: Whilst there are indications that transport demand is recovering back to pre-COVID levels, there remains uncertainty as to what the longer-term impacts of the pandemic will be on travel behaviour. However, without an attractive public transport network to provide people with sustainable transport options, the likelihood of increased public transport use in future as part of the recovery is reduced significantly.

Summary of the Future Situation

2.4.82. Key points identified from the Future Situation are set out as below following on from which the key conclusions and implications for the scheme are derived.

The Future Impact of Growth

2.4.83. The West of England has grown more than the national average and is projected to continue to do so. There is planned housing and employment growth along the Bath to Bristol corridor, with potentially more than 50,000 houses required across BCC and B&NES by 2035 based on the previous projections for the Spatial Development Strategy. It should be noted that further work on the spatial Development Strategy has been halted. The emerging B&NES Local Plan, due to be adopted in 2025, is likely to call for development along the corridor including in Brislington and Keynsham.

2.4.84. The projected housing and economic growth in the West of England and along the Bath to Bristol corridor will lead to additional travel demand, including journeys to and from work, business travel, deliveries and servicing traffic and leisure journeys. Without intervention, this will lead to increased congestion and poorer air quality along the Bath to Bristol corridor by 2036, and to more short journeys (less than 5km) which generate proportionally more carbon emissions.

2.4.85. The issues identified in the Current Situation will continue and become worse (with greater impacts on people and the environment) if no action is taken. This may contribute towards those communities in areas of higher deprivation becoming even more deprived with the gap between disadvantaged and advantaged residents widening.

2.4.86. The JLTP4 states that “We know the levels of car traffic and freight are high and that current travel habits need to change in order to accommodate the growth that will be seen across our region. We also know that this growth is needed to continue to support our economy and that even the most sustainable growth may create some car and freight trips.”

2.4.87. Economic growth will be restricted if additional trips cannot be facilitated sustainably, and current trips continue to have a high car mode share.

2.4.88. Further, there is an opportunity to “lock in” sustainable travel choices for the key development sites identified if the bus, walking and cycling infrastructure and services can be provided to serve these sites and links between the sites and the communities along the Bath to Bristol corridor.

The Future Impact of Other Planned Transport Interventions

2.4.89. **Workplace parking provision:** If future parking provision is reduced through the management approach proposed in the transport strategies it will positively impact on mode share for public transport and cycling. However, if this is not complemented by an improved bus network and services – in order to provide a viable, attractive alternative to car journeys – it risks not achieving its goal of encouraging sustainable transport and reducing congestion.

2.4.90. **Planned improvements to the highway network**: The proposed link road in Keynsham would provide some relief to strategic movements through Keynsham and facilitate the potential development location. However, it would not reduce congestion on the A4 affecting movements along the corridor.

2.4.91. **Planned bus network improvements**: Planned improvements in the regional bus network would complement improvements along the Bath to Bristol corridor by providing improved interchange opportunities and a broader range of destinations connected by the bus network. However, regional improvements on their own are not likely to address the issues identified in the Current Situation along the Bath to Bristol corridor.

2.4.92. **Changes to P&R sites:** The relocation and expansion of the A4 Brislington site to Hicks Gate (identified in the JLTP4) is included within the scope of the BBSC Programme, but not until phase 2 (post 2027). Expanding P&R capacity will help to address the current high utilisation of P&R and will provide additional travel options by bus through the interchange with other bus services.

2.4.93. **Walking and cycling improvements**: Whilst the West of England Local Cycling and Walking Infrastructure Plan (LCWIP) and emerging proposals from the Journey to Net Zero Action Plan for Bath (formerly Transport Delivery Action Plan) have identified more than £400m in improvements to walking and cycling infrastructure, very little of the identified improvements are funded. Hence, existing planned investment is not likely to address the issues identified in the Current Situation.

2.4.94. **Rail improvements**: The proposed rail improvements (including improved service frequencies to Keynsham resulting from MetroWest Phase 1) will not address the issues identified in the Current Situation.

The Future Impact on The Environment

2.4.95. **Targets to reduce vehicle-kilometres**: The targets of reducing vehicle mileage by 40% by 2030 (set in the Bristol One City Climate Strategy) and of 25% by 2030 (set in the Journey to Net Zero Action Plan for Bath Phase 1 – formerly Transport Delivery Action Plan) will not be achieved if action is not taken to facilitate and encourage sustainable mode shift. If these targets are not achieved the wider policy aspiration of achieving net zero by 2050 will not be achieved.

2.4.96. **Air quality**: The current poor air quality along the corridor will worsen if congestion increases. If air quality along the A4 is not improved it will discourage mode shift to walking and cycling which will counteract any investment in active travel modes along the corridor.

2.4.97. **The future impact on transport demand from the pandemic**: Whilst there are indications that transport demand is recovering back to pre-COVID levels (with the November 2021 statistics indicating that demand for travel for bus is at 80% and rail is at 74% for weekday trips compared to pre-COVID levels) there remains uncertainty as to what the longer-term impacts of the pandemic will be on travel behaviour. However, without an attractive public transport network to provide people with sustainable transport options, the likelihood of increased public transport use in future as part of the recovery is reduced significantly.

2.5 Problem Identified

Key Drivers for Change

2.5.1. When the transport problems and issues are considered collectively, a clear need for intervention is evident. The key identified drivers of change are:

- **The government's Major Route Network (MRN) objectives**

  The need to deliver the government's objectives for the MRN (reduce congestion, support economic growth, support housing development, support all users and support the Strategic Route Network (SRN)).

- **Housing and employment targets**

  The need to deliver local targets for housing and employment growth in line with planning and economic strategies.

- **Economy**

  The need to support the local and regional economy by improving connectivity and reducing congestion to improve accessibility to employment and education; as well as the need to improve journey times and journey time reliability.

- **Community**

  The need to ensure a good quality of life for people living and working along the corridor, by reducing congestion, contributing to improving air quality and safety.

- **Active travel**

  The need to enhance active travel provision to improve choice of transport modes for those travelling in B&NES, helping to reduce transport emissions and provide a safe choice of travel for all, whilst providing associated health and wellbeing benefits associated with active travel.

The Case for Change

2.5.2. The BBSC Programme is needed because:

- There is a significant reliance upon car use for travel along the A4 and it is frequently heavily congested
- 50% of the corridor has issues related to poor air quality
- Opportunities for walking and cycling are limited – most of the A4 has no segregated or well-lit cycle infrastructure
- Prior to the coronavirus pandemic, both the Brislington and Newbridge Park and Ride sites (P&R) were oversubscribed
- Poor accessibility to Bath and Saltford from Keynsham by bus
- It can take over 30 mins to walk to a bus stop (from the outskirts of Keynsham and Saltford) and then bus journeys into either City Centre can take up to 50 minutes
- Bus stop facilities in some locations along the corridor are poor, with no real time information, poor crossing facilities to access bus stops, no shelter, and poor lighting

2.5.3. The mode share for car journeys along the Bath to Bristol corridor is very high – 76% of commuter journeys from communities along the corridor (Keynsham/Saltford) to Bristol or Bath are made by car. The high mode share for car indicates a significant opportunity to alter travel behaviours, with improved public transport and active transport infrastructure encouraging greater modal shift to these sustainable forms of travel.

2.5.4. The data suggests that there are established commuting patterns by bus from Keynsham to Bristol, and by rail from Keynsham to Bath. These patterns could be further built upon through improved interchange between modes in Keynsham and an improved bus offer from Keynsham to Bristol.

2.5.5. Buses can be a major part of the solution to improving air quality. Real world testing of modern diesel buses shows a 95% reduction in NOx emissions compared to older models, with modern diesel buses producing fewer emissions than modern diesel cars despite having 15 to 20 times the carrying capacity[17]. These benefits exist before the mass roll-out of zero emission buses which will play a key role in transport decarbonisation and reduce harmful emissions into the atmosphere even further.

2.6 Impact of Not Changing

2.6.1. The most significant future aspect impacting on the Bath to Bristol corridor is planned housing and economic growth, which will result in an increase in population and in the demand for travel along the corridor.

2.6.2. As a result, the issues identified in the Current Situation will continue and become worse (with greater impacts on people and the environment) if no action is taken. Congestion and poor air quality will worsen which will make active travel and public transport even more

[17] Greener Journeys (2017a) Tackling Pollution and Congestion: Why congestion must be reduced if air quality is to improve, London

unattractive, with congestion increasing further, economic growth will be constrained and the health of communities along the corridor may decline.

2.6.3. The impact of planned future transport interventions has been considered and there are no planned interventions (outside the scope of the scheme) that are likely to address the range of issues identified in the Current Situation.

2.6.4. Hence the conclusion is that without intervention the Future Situation would be worse than the Current Situation and that as a result economic growth along the Bath to Bristol corridor is likely to be constrained.

Relevance to the scheme

2.6.5. The JLTP4 states that "for population and economic growth to occur sustainably and be carbon neutral, connectivity across the region needs to be transformed".

2.6.6. If the policy aspirations of future mode shift to public transport and active modes are to be achieved (in order to address the declared Climate Emergency) then there is a need for intervention to address the Future Situation and to provide the required connectivity. This includes the need for demand management to influence travel choice and raise revenue.

2.6.7. The scheme represents an opportunity to help deliver the future housing and economic growth in a sustainable manner by providing improved walking, cycling and bus connectivity along the Bath to Bristol corridor. This would help to provide the sustainable capacity for future trips to, from and along the corridor and to support the shift of existing trips from car to sustainable modes.

2.6.8. The scheme would support the aspirations of the West of England, B&NES and BCC Climate Emergency Action Plans by supporting mode shift from cars and reducing car and light goods vehicle-kilometres.

2.7 Policy Context

2.7.1. This section describes the strategic aims and responsibilities of the organisations that are promoting the scheme and shows how the scheme aligns with these. It reviews relevant national, regional and local strategies and policies and how the BBSC will contribute to the strategic objectives.

2.7.2. There are a significant number of national, regional, and local policies and strategic plans of relevance to the strategic context.

National Strategies and Plans

2.7.3. National policy highlights the shift towards providing sustainable transport, with an aim to encourage a switch from private car use to public and more active transport modes. It sets out that economic growth must go hand-in-hand with clean growth in order to reach net zero emissions. There are overall national targets committed to making buses 'more frequent, more reliable, more comprehensive, easier to understand and use, better co-ordinated and cheaper'. These targets are set out in the following national policies:

- Decarbonising all sectors of the UK economy to meet net zero target by 2050 as set by the Climate Change Act (source: Transport Decarbonisation Plan, 2021)
- Half of all journeys in towns and cities to be cycled or walked by 2030 (source: Transport Decarbonisation Plan, 2021)
- Double cycling activity by 2025 (source: Transport Decarbonisation Plan, 2021)

National Bus Strategy (DfT, 2021)

2.7.4. At a national level, the National Bus Strategy notes that better buses will be key to delivering key government objectives such as levelling up and decarbonisation. This means making buses more frequent, offering ‘turn up and go’ services, faster and more reliable, cheaper, comprehensive and easier to understand in terms of branding and ticketing. The strategy states that bus service improvements should be part of a whole corridor approach, including other physical measures such as:

- Traffic signal priority
- Bus gates, which allow buses to enter a road that prohibits access to other traffic
- Clear and consistent signage

Department for Transport (DfT) Transport Decarbonisation Plan (DfT, 2021).

2.7.5. Under this plan, the DfT aims to support delivery of 4,000 new zero emission buses and the infrastructure needed to support them. It also sets out an investment aim of £3 billion to provide improved and lower emission bus services.

2.7.6. The DfT aims to invest £2 billion over five years with the objective that half of all journeys in towns and cities will be cycled or walked by 2030, and that cycling activities double by 2025 (compared to 2013 levels).

Net Zero Strategy: Build Back Greener (BEIS, 2021)

2.7.7. This sets out the government’s commitment to providing greener, faster, and more efficient transport and sets out a vision for the UK’s Net Zero Future, with journeys made in zero emission vehicles and towns and cities having cleaner air. The Strategy aims to increase the share of journeys taken by public transport, cycling and walking, and sets out key commitments for greener, better transport, including investment in cycling and walking and in public transport to create (amongst other things) segregated cycle lanes and bus lanes. It aims to increase the share of journeys taken by public transport, cycling and walking.

National Planning Policy Framework (NPPF) (UK Government, 2021)

2.7.8. The NPPF (UK Government, 2021) states that in order to achieve sustainable growth, new development has an economic objective to ensure sufficient land is available in the right place, at the right time to support growth and by providing infrastructure to do so.

2.7.9. The NPPF (2021) makes a presumption in favour of sustainable development, which has good design at its centre. Creating better places to live and work in helps to ensure that development is acceptable for communities.

Gear Change: A Bold Vision for Walking and Cycling (DfT, 2020)

2.7.10. This sets out the actions required at all levels of government to make England an active travel nation, aiming to double cycling activity by 2025. The actions are grouped under four themes:

- Better streets for cycling and people
- Putting cycling and walking at the heart of transport, place-making, and health policy
- Empowering and encouraging local authorities
- Enable people to cycle and protect them when they cycle

2.7.11. The Gear Change policy indicates that strong national support will be offered for the active travel considerations incorporated into the A4 scheme. Increased Local Authority enforcement powers and improved capacity will broaden the decision-making extent for BCC & B&NES on the implementation of the active travel measures as part of the scheme.

Local Transport Note (LTN) 1/20 Cycle Infrastructure Design (DfT, 2020)

2.7.12. This document sets out design guidance for cycling. It notes that planning for cycling should be based around providing a network of on- and/or off-carriageway routes that are suitable for all abilities.

National Infrastructure Strategy (NIS), (HM Treasury, 2020)

2.7.13. The NIS sets out the government's plans to transform infrastructure across the UK by 2050 by focusing on four overarching themes, including transforming infrastructure to decarbonise the UK's power, heat and transport networks, and adapting to the risks posed by climate change. The NIS fully reflects the Ten Point Plan for a Green Industrial Revolution.

Ten Point Plan for a Green Industrial Revolution (HM Government, 2020)

2.7.14. The ten points cover ways to decarbonise the UK across the sectors of energy, buildings, transport, innovation and the natural environment, while also striving to transform the economy, creating new (green) jobs and delivering growth. Points 4 and 5 of the plans relate to transport infrastructure, referencing an acceleration of the shift to zero emissions vehicles and green public transport, cycling and walking. It identifies that delivery of mass transit systems (such as a bus rapid transit corridor) will drive modal shift to sustainable modes, directly supporting national level policies to achieve carbon net zero.

Building Our Industrial Strategy – Clean Growth Strategy (UK Government, 2018)

2.7.15. The Clean Growth Strategy (UK Government, 2017) notes that economic growth must go hand-in-hand with clean growth to reach net zero emissions. Clean growth in the transport sector provides an opportunity to help boost productivity and investment through designing a more inclusive transport system, attracting investment and creating jobs[18]. Ensuring economic growth is at the heart of the West of England's ambition and vision for the region's

[18] The Future of Mobility, January 2019

future. The Local Industrial Strategy (July 2019) notes that physical infrastructure will be required to better connect people to opportunities.

Inclusive Transport Strategy: Achieving Equal Access for Disabled People (DfT, 2018)

2.7.16. The Inclusive Transport Strategy (DfT, 2018) highlights the importance of travel in promoting self-esteem and well-being through visits for leisure, travelling and leaving the house for its own sake. It notes a gap in travel provision that is accessible for all users, including those with a disability, currently affecting around 14 million people in the UK. The strategy aims to increase levels of employment for disabled people, reduce loneliness in society, and to support independent living.

Future of Mobility: Urban Strategy (Department for Transport, 2019)

2.7.17. The 'Future of mobility: urban strategy' outlines the government's approach to maximising the benefits from transport innovation in cities and towns. It sets out the principles that will guide government's response to emerging transport technologies and business models. The document outlines the benefits mobility innovation can deliver, and the principles by which to achieve them. The nine principles discussed in the document are as follows:

- New modes of transport and new mobility services must be safe and secure by design
- The benefits of innovation in mobility must be available to all parts of the UK and all segments of society.
- Walking, cycling and active travel must remain the best options for short urban journeys
- Mass transit must remain fundamental to an efficient transport system
- New mobility services must lead the transition to zero emissions
- Mobility innovation must help to reduce congestion through more efficient use of limited road space, for example through sharing rides, increasing occupancy or consolidating freight
- The marketplace for mobility must be open to stimulate innovation and give the best deal to consumers
- New mobility services must be designed to operate as part of an integrated transport system combining public, private and multiple modes for transport users
- Data from new mobility services must be shared where appropriate to improve choice and the operation of the transport system.

2.7.18. The Strategy also identifies the need for an innovative and flexible regulatory framework for a thriving mobility sector. There are existing regulatory programmes for:

- Zero emission vehicles
- Self-driving vehicles
- Drones and future flight
- Maritime autonomy

2.7.19. Alongside this, the document launches initiating four new areas of focus for regulatory review:

- Micromobility vehicles and their trial

- Mobility as a Service
- Transport data
- Bus, taxi and private hire vehicle legislation

2.7.20. The Strategy also establishes a wide programme of work to meet the challenge. Alongside this document the Government has:

- Launched a £90 million competition for cities to deliver future mobility zones, which follows £60 million awarded to ten cities across the UK via the transforming cities fund
- Published a response to the last mile call for evidence they conducted in Summer 2019
- Outlined next steps on the e-cargo bike grant

Transport Investment Strategy (DfT, 2017)

2.7.21. The Transport Investment Strategy sets out how the Government will respond to challenges. It sets out that through investment in transport, the following four goals are achievable:

- **Create a more reliable, less congested, and better-connected transport network that works for the users who rely on it**; intensively used networks are ageing and face increasing demands, creating delays and undermining reliability. In places they do not provide the connections people and businesses need
- **Build a stronger, more balanced economy by enhancing productivity and responding to local growth priorities**; national productivity lags behind other countries and prosperity has not been shared evenly between different places, leaving some communities feeling left behind
- **Enhance our global competitiveness by making Britain a more attractive place to trade and invest**; long-term success in a globalised world will depend on our ability to attract job creating investment in our industrial strengths and to trade as frictionlessly as possible with partners old and new
- **Support the creation of new housing**: there is an immense challenge to provide the houses that people need in the places they need them. As the Government's Housing White Paper recognises, transport infrastructure is one of the keys to unlocking development and delivering places people want to live

Planning for The Future: A Guide to Working with National Highways on Planning Matters (National Highways, 2023)

2.7.22. This document describes how Highways England engages with the planning system and the issues considered when analysing planning application documents. It gives advice on the information to be included in a planning proposal and gives advice on decision making regarding land close to the strategic road network (SRN). This document gives the incentive for the local planning authority to engage in early conversations with Highways England regarding a planning application based on the following planning values:

- Engage early
- Work openly

- Share evidence
- Share knowledge
- Work collaboratively

2.7.23. National Highways manages the SRN which in the West of England is the M4, M5 and M32 motorways, and the A46 and A36 to the east of (and not including those sections in) Bath. This document states that: "*the principal purpose of the SRN is to enable safe, reliable, predictable, efficient, often long-distance journeys of both people (whether as drivers or passengers) and goods in England between:*

- *main centres of population*
- *major ports, airports and rail terminals*
- *geographically peripheral regions of England*
- *chief cross-border routes to Scotland and Wales*".

Regional Strategies and Plans

2.7.24. Regional policy highlights the aspiration for improved bus and active travel infrastructure to support an enhanced sustainable transport network, resulting in an increase in the uptake of bus use, walking and cycling.

West of England Climate and Ecological Strategy and Action Plan 2023

2.7.25. The Combined Authority has set six priorities where action is needed and where the region will deliver tangible progress to tackle the climate and ecological emergency. The six themes are priority areas that have been developed in collaboration between the Combined Authority and partners across the region.

2.7.26. The six themes are:

- Transport - Decarbonise the transport system; reduce car dependency; manage demand; increase cycling, walking, wheeling and public transport; embed nature recovery within transport capital projects
- Buildings & places - Increase the energy performance, climate resilience and environmental benefits of buildings and places
- Nature Recovery - Wildlife and the natural environment are in recovery, with their decline halted and in line with the West of England Nature Partnership the abundance of wildlife has increased by 30%.
- Business & Skills Help - all businesses become more sustainable and resilient to meet our 2030 objectives; help low carbon sector businesses and ensure local people benefit from growth in the green economy.
- Net Zero Energy - Work to decarbonise the energy system and increase local renewable energy
- Climate Resilience - Take action to accelerate and ensure we are adapting to a changing climate and increase climate resilience across our region

2.7.27. The Combined Authority's ambition is that in 2030:

- The West of England is net zero carbon
- Wildlife and the natural environment are in recovery, with their decline halted and the abundance of wildlife increased by 30%
- The region has built its economic, social and natural environment resilience to the impacts of climate change.

2.7.28. To reach the target, there is a need to cut more than 450kt of CO2 emissions each year, and transport will need to be a major contributor to this. A report by Friends of the Earth published in 2019 notes that the decarbonisation of surface transport through the petrol and diesel car ban would not be enough on its own. It estimates that even if all new cars were electric by 2030, there would still be a requirement for a 10-20% cut in car mileage by 2030. Whilst electric vehicles have zero exhaust emissions at street level, they still 'emit' particulate matter from road, tyre and brake wear. Mass behavioural change is required, which an attractive bus-based solution will help to achieve.

2.7.29. Regional leaders from across the UK have committed to going further and faster than central Government in their efforts to achieve net zero by pledging to eliminate carbon emissions in their communities at least five years earlier than central Government. Coordinated by the UK100 non-governmental group, a group of 38 city mayors and council leaders – including the Combined Authority, BCC and B&NES - have signed the UK100 Net Zero Pledge, which commits to neutralising emissions by 2030 and those of their residents and businesses by 2045.

West of England's City Region Sustainable Transport Settlement (CRSTS) programme 2022

2.7.30. The programme aims to deliver growth and productivity within the region by targeting strategic transport corridors with investment in public transport, cycling and walking thereby improving connectivity between people and businesses to support the economy; level up areas of deprivation by improving access to jobs, education and services and improving air quality of these areas; and decarbonise transport by enhancing public transport services, walking and cycling to reduce car dependency and deliver sustainable travel. The programme attempts to address stalled productivity growth of the region resulting from an inadequate local transport network with challenges such as low bus frequencies, poor reliability, congested road network and lack of infrastructure to provide for further expected population growth.

2.7.31. The CRSTS programme demonstrates a strategic case for the BBSC Programme and positions it as part of a wider portfolio of programmes across the region focussed on achieving sustainable mode shift to public transport and addressing the Climate Emergency. As a result of alignment of objectives under both programmes, the BBSC programme will be funded under the CRSTS programme to carry forward the delivery of objectives within the larger region.

West of England's Bus Service Improvement Plan (BSIP) (2021 update 2022)

2.7.32. The BSIP submitted to the DfT on 31 October 2021, sets out the Combined Authority's ambitions to get back to the strong, steady growth in the number of passengers travelling by bus that the West of England had before the pandemic struck, and to move forward on decarbonising the region's transport system as part of the region's commitment to addressing the Climate Emergency.

2.7.33. The BSIP sets out the ambition to make travelling by bus the natural and first choice for passengers with:

- Convenient services taking residents where they want to go at times they need to travel
- Reliable bus journey times that get you to your destination as quickly or quicker than by car
- Good value for money with tap in, tap off ticketing and capped daily prices
- First-class bus stops where you can wait in comfort and safety with all the information you need
- A coordinated public transport network with a recognisable local brand: West of England Sustainable Transport (WEST)

2.7.34. The BSIP sets a number of targets for bus service improvement and delivery plans for achieving these targets. Two notable targets are to reduce average bus journey times on designated corridors by 2% by 2025 and by 10% by 2030, and to achieve 95% of services running on time, defined as being no more than 1 minute early or 5 minutes late, by 2030.

2.7.35. Enhanced Partnerships (EP) will be a key function of how the Combined Authority will work with operators under BSIP.

2.7.36. The BSIP also sets out three principles for its bus networks:

- Reducing the number of core urban routes but increasing the frequency of the routes;
- Establishing a small number of frequent orbital services; and
- Building well designed neighbourhood bus interchanges.

West of England Joint Local Transport Plan (JLTP4) (2020)

2.7.37. JLTP4 is the key policy document, setting out the long-term strategy for transport in the region. It built on the Joint Transport Strategy published in 2017 and was adopted in March 2020 covering the period to 2036. It is soon to be replaced by JLTP5.

- The JLTP4 objectives reflect those of national policy with a key objective to take action against climate change and address poor air quality. It aims to ensure that transport in the region is carbon neutral by 2030 and sets out a vision under 'Improving Connectivity' for a well-connected sustainable transport network that offers greater, realistic travel choice and makes walking, cycling and public transport the natural way to travel.
- The JLTP4 strategy for achieving this includes the reallocation of road space to sustainable and active modes of transport (where appropriate) and the introduction of Park & Ride sites on radial routes.

- JLTP4 sets out an ambitious package of interventions – including a major scheme programme with a focus on the promotion of public transport, walking and cycling including bus route infrastructure, Park & Ride and extensions to the metrobus network. It is supported by the West of England Bus Strategy 2 adopted in June 2020, which focuses on the region's long-term plans for the bus network, setting out an ambitious intention to restructure the local bus network around a system of hubs and interchanges.
- JLTP4 sets an initial priority for a metrobus corridor between Bath and Bristol with the longer-term ambition for a high-frequency mass transit solution.
- JLTP4 sets out a vision for a significant reduction in car use, and an increase in electric vehicles where cars are still used, in order to mitigate the impacts of climate change.

2.7.38. At a regional level, JLTP4 aims to provide more public transport options, improve service quality, and provide for journeys where public transport is not an option.

2.7.39. JLTP4 references the proposed extension to the Bus Rapid Transit network in the form of the "A4 metrobus and the Callington Road Link".

West of England Bus Strategy (2020)

2.7.40. The Strategy aims to create a bus network that people want and can use. The objectives set out in the strategy include:

- Developing a comprehensive and joined-up bus network
- Maximising bus service reliability and reducing journey times
- Providing simplified ticketing
- Addressing congestion
- Developing accessible passenger waiting facilities and continuing to improve passenger satisfaction

2.7.41. The West of England Bus Strategy 2020 references the expansion of Park & Ride provision and the expansion of the metrobus network.

West of England Local Cycling and Walking Infrastructure Plan (LCWIP, 2020-36) (2020)

2.7.42. At a regional level, the LCWIP sets out West of England Combined Authority's approach to support DfT's national policy aspiration to double cycling activity by 2025. The LCWIP aims to ensure that cycling and walking are the preferred choices for shorter trips and to access public transport in the West of England.

Climate Emergency Action Plan (September 2020)

2.7.43. Regionally, the West of England declared a Climate Emergency in 2019, setting a target to be carbon neutral by 2030. The Action Plan sets out how the region aims to become carbon neutral by the year 2030. It includes a focus on developing a low carbon transport system, increasing cycling and walking and the use of public transport, and building on positive behaviour change following the coronavirus pandemic lockdown period.

Local Strategies and Plans

2.7.44. Under local policy, B&NES and BCC have declared climate and ecological emergencies and have published action plans in response that emphasise the role of increased public transport, cycling and walking in decarbonising the transport system.

2.7.45. Local policy sets a clear aspiration for reduced vehicle mileage and increased public transport and active travel use by residents of BCC and B&NES.

B&NES Core Strategy, Placemaking Plan and Local Plan Partial Update (2023)

2.7.46. The B&NES Core Strategy references investment in public transport infrastructure and walking and cycling routes to keep the city moving and enable more sustainable travel choices to be made. The draft B&NES Local Plan Partial Update (consultation documents) is an update of the Core Strategy and Placemaking Plan and includes policy amendments supporting the planning and design of infrastructure to support mode shift (as a priority over traffic capacity) and the development of transport interchanges. The Local Plan Partial Update has been examined by the Planning Inspector and following recommended modifications of the Council's priorities around climate and ecological emergencies, it was adopted at a Special Council Meeting on 19 January 2023.

2.7.47. It sets out the safeguarding of the disused rail line between Brassmill Lane and Windsor Bridge in Bath as a sustainable transport route for non-motorised forms of transport (with the exception of mobility scooters). This route will provide a high quality and safe cycling and pedestrian route through to Western Riverside that extends the Bristol to Bath Railway path, the Two Tunnels Greenway, and provides a wider choice of sustainable transport routes for local communities to efficiently connect to the City Centre and to Bath's Enterprise Area.

The Bristol Local Plan (2011-2026)/ Bristol Local Plan Review (Regulation 19 version, 2023)

2.7.48. The new local plan sets out how Bristol will develop up to 2040. It will help deliver the new homes and jobs needed and safeguard the environment.

2.7.49. The new local plan has the objective of taking the city's development forward by:

- Setting out an approach to inclusive and sustainable growth and development, addressing the needs of everyone in all parts of the city
- Enabling delivery of at least 1,925 new homes a year in Bristol up to 2040 including affordable housing and homes to meet a range of needs
- Aiming to exceed our housing target where new infrastructure can unlock additional potential
- Tackling the climate and ecological emergencies as we meet our needs for sustainable development

2.7.50. The Local plan identifies the development of a new neighbourhood of residential led mixed-use development at Bath Road Brislington (west of Hicks Gate)

2.7.51. The Bristol Local Plan Review contains an update to the plan vision; a suite of updated draft policies pertaining to Transport (T1-T6), Housing need targets (1,925 new homes to be delivered by 2040), Net zero and climate (NZC1-NZC5), Biodiversity and green infrastructure (BG1-BG7), Food sustainability (FS1-FS3) and Centres, shopping services and evening economy (SSE1-SSE7); and an update of the development locations and allocations including changes to the Green Belt boundary to accommodate new development.

2.7.52. The strategy includes policies to support the delivery of transport infrastructure improvements including the provision of rapid transit, expanded P&R sites and the Callington Road Link. Policy BCS10 (DM24 - Transport Schemes) sets out that land for the Callington Road Link (and associated highway improvements) and for A4 Bath Road Improvements will be safeguarded.

2.7.53. Policy CP7 underlines the importance of maintaining the integrity and connectivity of the strategic green infrastructure network across Bristol. This policy specifies that individual green assets should be retained where possible and integrated into new development, with loss of green infrastructure only acceptable where it is necessary to achieve the policy aims of the Core Strategy.

Journey to Net Zero for Bath 2023 (formerly Transport Delivery Action Plan for Bath Phase 1 2020)

2.7.54. In March 2019, B&NES declared a Climate Emergency, which included a commitment to become carbon neutral by 2030. Transport currently accounts for 29% of carbon emissions in the B&NES area. The Journey to Net Zero plan provides a holistic approach for meeting the transport needs of those living, working and visiting Bath from 2020 onwards. The plan identifies how transport will respond to and support delivery of the targets set out in the Climate Emergency.

2.7.55. Its vision is "*Bath will enhance its unique status by adopting measures that promote sustainable transport and decision making, whilst reducing carbon dioxide emissions and the intrusion of vehicles, particularly in the historic core. This will improve the quality of life for local people, enable more economic activity and growth, while enhancing the special character and environment of the city*".

2.7.56. The objectives to meet this vision are:

- Reducing vehicle carbon emissions to achieve carbon neutrality by 2030
- Improving air quality and health
- Promoting sustainable mobility
- Supporting and enabling economic growth, competitiveness, and jobs
- Widening travel choice
- Widening access to opportunities: jobs/learning/training
- Safeguarding and enhancing the unique historic environment and World Heritage Site status

- Improving quality of life in the city.

One Shared Vision (2021)

2.7.57. As part of B&NES response to the coronavirus impacts across communities, B&NES consulted on a 'One Shared Vision' in January 2021, which involved a series of 'stories' on potential future changes to the working environment, focusing on more localised working, reducing the need to travel by creating 15-minute neighbourhoods. The vision aims to ensure that recovery and rebuilding from the pandemic is stronger, more resilient, fairer, greener, and, by 2030, net zero. It also links to the B&NES Low Traffic Neighbourhoods Strategy, which promotes modal shift to more active modes by increasing walking and cycling uptake of residents for local trips.

Bristol One City Plan (2021)

2.7.58. The Bristol One City Plan (2021) aims to develop a comprehensive cycling and pedestrian network to encourage the shift from car-based travel and provide better connectivity across the public transport network.

City Centre Framework (BCC 2020)

2.7.59. The City Centre Framework aims to encourage more people to travel by bus. This includes completing bus lanes and implementing other ways to make sure buses can move more freely and be more reliable (run on time).

Bristol One City Climate Strategy 2020

2.7.60. B&NES and BCC have also declared climate and ecological emergencies and published action plans in response. These emphasise the role of increased public transport, cycling and walking in decarbonising the transport system. The Bristol One City Climate Strategy 2020 sets a target of reducing vehicle miles by 40% by 2030.

B&NES Economic Strategy (2014-2030)

2.7.61. The Strategy sets out that the provision of an affordable, low carbon, accessible, integrated and reliable transport network which allows people to get around is essential to support economic growth in B&NES. The B&NES Economic Strategy includes an action to improve public transport links between Bath and market towns.

BCC One City Economic Recovery Plan (2020)

2.7.62. The BCC One City Economic Recovery Plan sets out a priority to improve transport infrastructure and the efficiency of public transport and support a modal shift to walking and cycling – improving accessibility of place for communities and the workforce.

Bristol One City Economic Recovery Statement of Intent19 (2020)

2.7.63. This is a recognition of the way Bristol wants to rebuild after the coronavirus crisis. The two strategies within the statement most relevant to this study are:

- **Climate Change**: the recovery plan will be informed by and be consistent with Bristol's One City Climate Strategy and 2030 carbon neutrality goal, helping drive forward a £1 billion programme of investment in cleaner, greener energy
- **Connectivity**: the ability to connect citizens across the city will be critical for recovery. The city's digital and transport plans including mass transit and active travel will be essential for building back better

2.7.64. By tackling key transport issues as part of the regional recovery, there is an opportunity to deliver short, medium and long-term plans that offer improved inclusivity, air quality, health, carbon neutrality and connectivity for all.

Transport Strategy for Bath (2014)

2.7.65. The Transport Strategy for Bath (2014) contains a policy (GABP9) to create improved bus services, with ticketing and other improvements and measures designed to improve reliability and provide alternative travel options to car use.

Emerging Policies

2.7.66. Strategic priorities set out in emerging National/Regional/Local Policies, which have not yet been formally released / adopted, but which are likely to have an impact on the development of the proposed scheme are summarised in the following sections.

National Policies

Biodiversity Net Gain (Environment Bill)

2.7.67. The UK Government has confirmed that it will use the forthcoming Environment Bill to mandate Biodiversity Net Gain (BNG) for development and will commit to delivering 10% net gain in biodiversity. The Bill will also introduce new duties to support better spatial planning for nature through the creation of Local Nature Recovery Strategies. This will put BNG at the heart of all planning decisions.

2.7.68. The forthcoming Bill indicates the importance of considering the climate and ecological aspects of any projects.

Regional and Local

B&NES Biodiversity Supplementary Planning Document[20] (SPD)

2.7.69. Work is underway on the Bath and North East Somerset Biodiversity Supplementary Planning Document (SPD), which will specify local requirements for delivering biodiversity net gain. The Council is considering how mandatory net gain will apply to different sites and

[19] A One City economic renewal, Bristol One City, 2020
[20] Local Plan Core Strategy and Placemaking Plan Partial Update, Bath & North East Somerset Council, 2019

how BNG will apply to minor development schemes, including whether they are subject to a lower net gain requirement. Some brownfield sites, sites with specific ownership characteristics such as self-build schemes, and householder development (such as extensions) may qualify for exemption.

2.7.70. The B&NES Ecological Emergency declaration also proposes an increase in the percentage of BNG through the Local Plan Partial Update beyond the requirement of the new Environment Bill.

2.7.71. **Conclusion - alignment between scheme and emerging policy:** The scheme will support the increase in biodiversity by increasing the amount of green infrastructure along the corridor as part of the design cross-section of the corridor, and by providing new green spaces.

Scheme Alignment with Strategies and Plans

2.7.72. The scheme aligns with the national, regional and local policy in that it seeks to improve the public transport and active travel network, thereby encouraging mode shift, reducing annual vehicle-kilometres and supporting the decarbonisation of the transport network.

2.8 Stakeholder Engagement

Overview of Stakeholder Engagement to date

2.8.1. The development of the scheme has drawn on the views of stakeholders on the existing problems and challenges encountered along the route and on ideas proposed to address the problems.

2.8.2. Stakeholder views have been drawn from the following sources.

- BBSC Programme Engagement (Summer 2021): Public engagement to gather the views of the public on the current challenges and issues affecting travel along the A4 corridor between Bath and Bristol
- BBSC Engagement Summer 2023: Public engagement to gather the views of the public on the proposed interventions along the corridor

BBSC Programme Engagement (Summer 2021)

2.8.3. Public engagement was undertaken between July and September 2021 to gather the views of the public on the current challenges and issues affecting travel along the A4 corridor between Bath and Bristol.

2.8.4. The engagement took the form of a survey and an interactive map to which comments could be added. Views were sought on the A4 between Bath and Bristol around the themes of:

- current travel choices
- factors affecting travel choices along the corridor
- factors affecting bus travel, cycling and walking and suggested improvements that would encourage bus travel, cycling and walking

2.8.5. People responding to the survey were able to comment on improvement themes and provide further ideas for improvements along the Bath to Bristol corridor.

2.8.6. Key highlights from the engagement are as follows:

- More than 1,300 survey responses were received
- Travel patterns following the lifting of COVID-19 restrictions:
  - The majority of respondents expect to travel regularly along the corridor once or twice a week (including for commuting purposes)
  - The largest proportion of journeys made regularly (either weekday or once or twice a week) are made by car (as driver or passenger) followed by walking and then cycling
  - 21% of respondents indicated regular travel by bus
- General factors affecting travel choices along the corridor
  - 75% of respondents rated traffic flow along the A4 as “Poor”
  - 71% of respondents rated air quality along the A4 as "Poor"
  - 65% of respondents rated traffic noise along the A4 as "Poor"
  - Cycling safety and cycle paths were rated as “Poor” by 60% and 65% of respondents respectively
- Factors affecting bus travel and suggested improvements that would encourage bus travel
  - 50% of respondents rated the cost of using bus along the A4 as "Poor"
  - 37% of respondents rated the connections between different bus services along the A4 as "Poor" and 26% as “Average”. Only 12% rated the connections as “Good” or “Excellent”
  - 59% of respondents indicated that a bus waiting time of 6 to 10 minutes was acceptable. 14% indicated that only less than 5 minutes waiting time would be acceptable
  - 62% of respondents indicated that they would be “Very likely” to use the bus often if the bus services were more reliable, and the bus fares were lower. 56% of the respondents indicated that they would be “Very likely” to use the bus often if the bus services were more frequent. 35% of the respondents indicated that they would be “Very likely” to use the bus often if space for bicycles were provided on buses
  - Respondents who do not regularly use the bus indicated that they would be “Very likely” to use the bus if bus fares were lower (59%), bus services were more reliable (58%) and if bus services were more frequent (50%). More than 80% indicated that they would be “Very likely” or “Likely” to use the bus if bus journey times were quicker, more frequent services were provided and services were more reliable
- Factors affecting cycling and suggested improvements that would encourage cycling
  - The majority of the respondents gave a “Poor” rating for the number of vehicles on the road (79%), sharing the road with other traffic (76%), the amount of segregated cycle

  - lanes (77%), feeling safe along the route (72%) and the number of cycle priorities at junctions (63%)
  - Respondents indicated that they would be “Very likely” to cycle more often if separate cycle lanes were provided (72%), if there was less traffic on the route (66%), and if safer junctions and crossings with priority for cyclists were provided (62%). The importance of cleaner air and less pollution was highlighted by 56% of respondents

- Factors affecting walking and suggested improvements that would encourage walking
  - 77% of respondents rated air quality when walking along the A4 as “Poor”
  - Other factors rated as “Poor” are the quality of walking routes and public places (42%), the number of crossing points (37%) and pavement quality (31%)
  - Respondents indicated that they would be “Very likely” to walk along the A4 more often if the air was cleaner and less polluted along the route (56%), if more green spaces and/or trees were provided (47%), if there was less traffic on the route (44%) and if segregated paths were provided (43%)

2.8.7. Respondents provided a range of suggested improvements with the largest number of responses as follows:

- Cycling improvements (407 responses included reference to this topic):
  - Segregated cycle lanes / segregated from pedestrians/safe cycle lane
  - Cycle lanes separated from bus lanes / traffic
  - Improve cycling infrastructure (including pavement quality / drainage /vegetation overgrowth / kerb drops / widening of paths / regular maintenance)
  - Turning disused railway paths into cycle paths
- Traffic improvements (329 responses included reference to this topic):
  - Reducing congestion and traffic flows through parking charges/congestion charges / other suggestions to reduce car usage
  - Redesign of the existing infrastructure including junction designs, widening of roads, as well as comments highlighting that new roads are not the solution
  - Reducing speed limits
  - Providing separate cycle lanes
  - More than 80 respondents suggested demand management measures such as temporary car bans on weekends and congestion charging)
- Bus and Rail improvements (300 responses included reference to this topic):
  - More frequent bus services needed / more reliable services
  - A new mass transit system (suggestions include a new carbon neutral mass transit system or a new tram service)
  - Lower cost fares for bus service
  - Segregation of bus lanes
  - Improved connections to other bus services / other public transport

- Environmental improvements (165 responses included reference to this topic):
  - Providing more trees and greenery
  - Reducing noise and air pollution
- Pedestrian improvements (150 responses included reference to this topic):
  - Introducing more walking facilities / infrastructure and improving the quality of walking facilities in terms of pavement quality, drainage, footway widths, vegetation clearance, regular maintenance and removing advertising boards restricting widths
  - Separating pedestrians from traffic and buses

Conclusions from BBSC Programme Engagement (Summer 2021)

2.8.8. The responses received to the BBSC Programme Engagement have informed the identified problems and challenges along the Bath to Bristol corridor set out in **section 2.12**.

2.8.9. The responses to the BBSC Programme Engagement indicate that the public have concerns about the existing walking and cycling provision along the corridor, and about the level of traffic and congestion along the A4. There was support for the introduction of a range of improvements including cycling improvements (including the provision of segregated cycle lanes) and bus and rail improvements (including more frequent services and segregation of bus lanes).

BBSC Programme Engagement (Summer 2023)

2.8.10. The Combined Authority held the six-week public engagement between Monday 21 August 2023 and Sunday 1 October 2023. Feedback from the community and stakeholders was collected using several channels and methods throughout the engagement period including Questionnaire responses, Paper copies of the questionnaire and Correspondence (Letters and Emails).

2.8.11. The public engagement was publicised via local media. The engagement website utilised interactive maps with labelled keys to make the proposals clearer. It also showed 'before' and 'after' images of what the proposals could do, and how the improvements would be made. The Combined Authority made use of social media advertising (Facebook and Instagram) during the engagement period. They garnered 330,064 impressions and received 3,108 link clicks. They also tweeted several times using the official account and had over 8,300 impressions across eight tweets. Bath & North East Somerset separately shared their press releases and then re-shared this information via the Combined Authority.

2.8.12. There was a combination of engagement events hosted in-person and online, meaning there were opportunities to engage with people using methods that suited them. All in-person venues were selected to ensure that they were accessible to all and had accessible facilities (such as toilets) to ensure the widest possible attendance. Events were advertised by the Combined Authority on their channels, in local print media, and were also included on the engagement webpage.

2.8.13. Due to the congestion that currently exists on the A4, the proposals engaged on in 2023 are focused on investing in better infrastructure (a requirement of CRSTS) to create an improved network to deliver more frequent and reliable bus services, and increase attractiveness for walking, wheeling, and cycling along the corridor. The proposals could deliver more than nine miles of new cycle lanes, six miles of new bus lanes, and increase greenery and community space across the proposed area.

2.8.14. **Table 2-8** presents the key findings made throughout the analysis.

Table 2-8 – Summary of Key Findings

Selection of Route	Key Findings
A4 Brislington Park and Ride to Hicks Gate roundabout	Overall, respondents were mostly in disagreement with the proposed elements on this section of the route. The segregated cycle track had a larger amount of support among respondents. Respondents within the BS31 postcode were generally more opposed to the proposals on this section of route than those from other postcodes. The larger proportion of respondents did not agree with the impacts of the proposals in this area, although there did appear to be a greater proportion of agreement of the safety benefits for cyclists. The most frequently occurring issues in the comments was a concern that the proposals in this area would increase congestion, followed by a related concern that there would be a negative impact on air quality (e.g., idling engines of stationary traffic).
Keynsham Bypass: Hicks Gate roundabout to Broadmead roundabout	The elements of the proposals for the Keynsham bypass were strongly opposed by over half of respondents in all cases. There was limited evidence that the segregated cycle path along the Keynsham bypass was more popular – a larger proportion supporting this element compared to the other options. The level of support for the proposed elements of the Keynsham bypass proposals is significantly greater among those respondents outside the BS31 postcode, compared to those respondents within the BS31 postcode (Keynsham and Saltford). The majority of respondents did not agree with the impacts of the proposals in this area, although there did appear to be a greater proportion of agreement for the safety benefits for cyclists. The most frequently occurring issues in the received comments was a concern that the proposals in this area would increase congestion, followed by a related concern that there would be a negative impact on air quality (e.g., idling engines of stationary traffic).

Selection of Route	Key Findings
Saltford: Broadmead roundabout to The Globe roundabout	Overall, respondents were in the majority in disagreement with the proposed elements on this section of the route. The proposed segregated cycle track appeared to have more support compared to the other elements on the Broadmead to The Globe section. For each of the proposed elements, the proportion of respondents that disagree with the proposed element is greater inside the BS31 postcode compared to respondents outside that postcode. The level of support for the proposals depended on whether the respondent is from within the BS31 postcode or outside of it. In all but one of the predicted potential impacts, more than half of the respondents strongly disagree that these will take place. The exception being improved safety for those walking or cycling along the route. The most frequently occurring issues in the received comments was a concern that the proposals in this area would increase congestion, followed by a related concern that there would be a negative impact on air quality (e.g., idling engines of stationary traffic).
Keynsham Mobility Hub	The majority of respondents oppose the Keynsham Mobility Hub. Levels of opposition to the elements of the Keynsham Mobility hub are higher in the BS31 postcode compared to elsewhere. Respondents listed features that would encourage them to use the Keynsham Mobility Hub and these included requests for inclusion of toilets and information on transport services, as well as enclosed cycle parking and sheltered waiting areas. Over half of respondents did not agree with the potential impacts of the Keynsham Mobility Hub. In the received comments, the most frequent issues raised were comments opposing the Keynsham Mobility Hub, followed by those with no comment to add.
Bristol and Bath Railway Path in Saltford area	The proposals resulted in supportive attitudes among respondents. In all cases, the largest proportion of respondents were in favour of the proposals. There was particular support for providing better off road cycle provision. Respondents outside the BS31 postcode are more supportive of the proposals. Respondents overall agree that there will be improvements to safety for pedestrians and cyclists and that more people will be encouraged to do these activities. Of the comments received, the most commonly mentioned issue was to suggest focus on improving safety, followed by concerns about the use of shared space within the scheme.

Selection of Route	Key Findings
Bath	There was a majority of opposing responses in relation to the elements of the proposed scheme. However, there was a majority of support for the proposals to improve crossing points around The Globe Roundabout. Whether a respondent was inside or outside the BA1/BA2 postcode did not seem to have a consistent effect. Implementing a bus lane between Newbridge P&R and Windsor Bridge Road has the highest level of strong opposition among those living in the BA1/BA2 postcode. Improved crossings around The Globe roundabout are supported to a greater extent by those within the BA1/BA2 postcode, compared to elsewhere. A larger proportion of respondents disagree with the suggested impacts of the proposals in the Bath area. The main issue raised in comments was to express concern about the loss of parking in this area, followed by views that the scheme would increase congestion.
Bristol and Bath Railway Path in Bath area	The majority of respondents support the elements proposed in this section. The proposed extension of the Railway Path along the disused railway line was especially supported with close to half of respondents strongly agreeing with this element. Those inside the BA1/BA2 postcode are more likely to agree with the elements being proposed. The majority of respondents agree that both specified impacts will occur as a result of the proposal. The main issue raised in comments was to support the proposed cycle lane and cycle infrastructure, followed by those that support the proposals generally. Concern was raised regarding the safety of shared space.

Summary of 2021 and 2023 Engagement

2.8.15. Across both engagement exercises there is support for the proposed walking, wheeling, and cycling improvements. The proposed improvements to bus infrastructure including the Keynsham Mobility Hub, was less supported in the recent engagement exercise.

Future Engagement

2.8.16. As part of the further development of the proposed scheme, further public engagement and consultation will be undertaken.

2.9 Objectives

2.9.1. The BBSC Programme specific objectives were reviewed and revised in Winter 2022/2023 and the revised objectives were agreed by the Combined Authority, BCC and B&NES. They are for the whole corridor and are as follows:

- To facilitate economic growth along the corridor by improving the public and active travel opportunities. This includes delivering infrastructure which improves access for existing communities and also infrastructure that unlocks new opportunities for sustainable growth.
  - Support the delivery of new housing and job creation through the provision of high-quality public transport that serves existing and future housing. This should include safeguarding the potential for a mass transit solution along the corridor.
  - Unlocking housing growth and enhancing sustainable transport connectivity though the re-provision and enhancement of the Brislington Park and Ride to Hicks Gate.
- Improve public transport infrastructure in the study area to increase the number of people who have access to and use buses to contribute to growing patronage of the X39 (or increase in equivalent new service/bus rapid transit service along the corridor) by at least 24% by 2030
  - To provide the infrastructure required to enable operators to deliver a fast, reliable, high-frequency bus service between Three Lamps Junction and Bath City Centre.
  - To deliver high-quality, safe and recognisable bus stops (comparable to the existing MetroBus service standards stops)
  - To provide the high-quality bus infrastructure necessary to sustain economic growth and improve the lives of residents of B&NES and BCC
- Improve walking, wheeling and cycling infrastructure in the study area to contribute to increasing the number of people using the corridor for active travel modes including to increase the number of people commuting by walking, cycling and wheeling modes to 25% of total modal share by 2036.
  - To enable continuous, safe and legible active travel journeys end-to-end and to the corridor for those living and working along the corridor.
  - To improve access by active travel modes to public transport along the corridor

- To reduce severance for cyclist, walkers, wheelers and other active travel modes.

2.9.2. The objectives for the BBSC Programme were developed by the project team with input from the Combined Authority, BCC and B&NES.

2.9.3. The agreed objectives were then ratified by Senior Responsible Officers (SROs) and approved by the Board in April 2023.

Operational Objectives

2.9.4. The following operational objectives have been set for the BBSC project. The operational objectives are considered in two phases: Phase 1 elements are to be completed within the CRSTS phase of the programme (completed by March 2027), Phase 2 elements require additional funding and delivery time to be complete, which extend beyond the CRSTS programme and costs. The operational objectives include those of Phase 1 and 2 to show the scale of ambition for the corridor.

- A fully segregated, end to end bi-directional bus lane (from Three Lamps Junction to the boundary with the Bath City Centre Project) (Phase 1 & 2)
- An end-to-end LTN 1/20 walking and cycling route (from Three Lamps Junction to the boundary with the Bath City Centre Project) (Phase 1)
- Community connections within the study area including within the towns, villages and suburbs of Brislington, Keynsham, Saltford and Bath (Phase 1)
- The relocation of the Bath Road, Brislington Park and Ride to Hicks Gate and the delivery of a new Transport Hub at Hicks Gate (Phase 2).
- A new Transport Hub at Keynsham (Phase1)
- Complementary measures required to make the project, or schemes within the project, deliverable. For example (but not limited to), biodiversity enhancements, tree planting, placemaking, transport hubs, cycle parking, signage etc. (Phase 1 & 2)
- Provide the infrastructure required to contribute towards achieving a 10% end to end (between Three Lamps Bristol and Bath City Centre) bus journey time reduction by 2030
- Provide the infrastructure required to contribute towards achieving 95% of services running on time, defined as being no more than 1 minute early or 5 minutes late, by 2030.

2.9.5. These objectives will be underpinned by the following design criteria:

- The design scope includes routes linking main corridor to key adjacent destinations via active travel.
- A maximum of 400m between bus stops served by the X39 (or equivalent stopping service), apart from in circumstances where the population yield (and future population yield) is not sufficient to accommodate a bus stop.
- Bus stops adhere to the agreed design standard. This will include agreement on appropriate style of bus stop along the route.
- Walking and cycling routes must be improved to relevant standards, including LTN 1/20, particularly with regard to safe, and direct provision.

- That the intervention delivered in the study area provide a 10% uplift in biodiversity net gain with a development first approach. This should include no net loss of trees.
- That due regard of embodied carbon is considered at the option shortlisting and design process.
- To not inhibit and to contribute to the delivery of a future Mass Transit solution along the corridor.
- Practical completion of this phase of the project by March 2027.
- That the scheme falls within the available funding allocation, or that additional funding allocations can be secured.

2.10 Scope

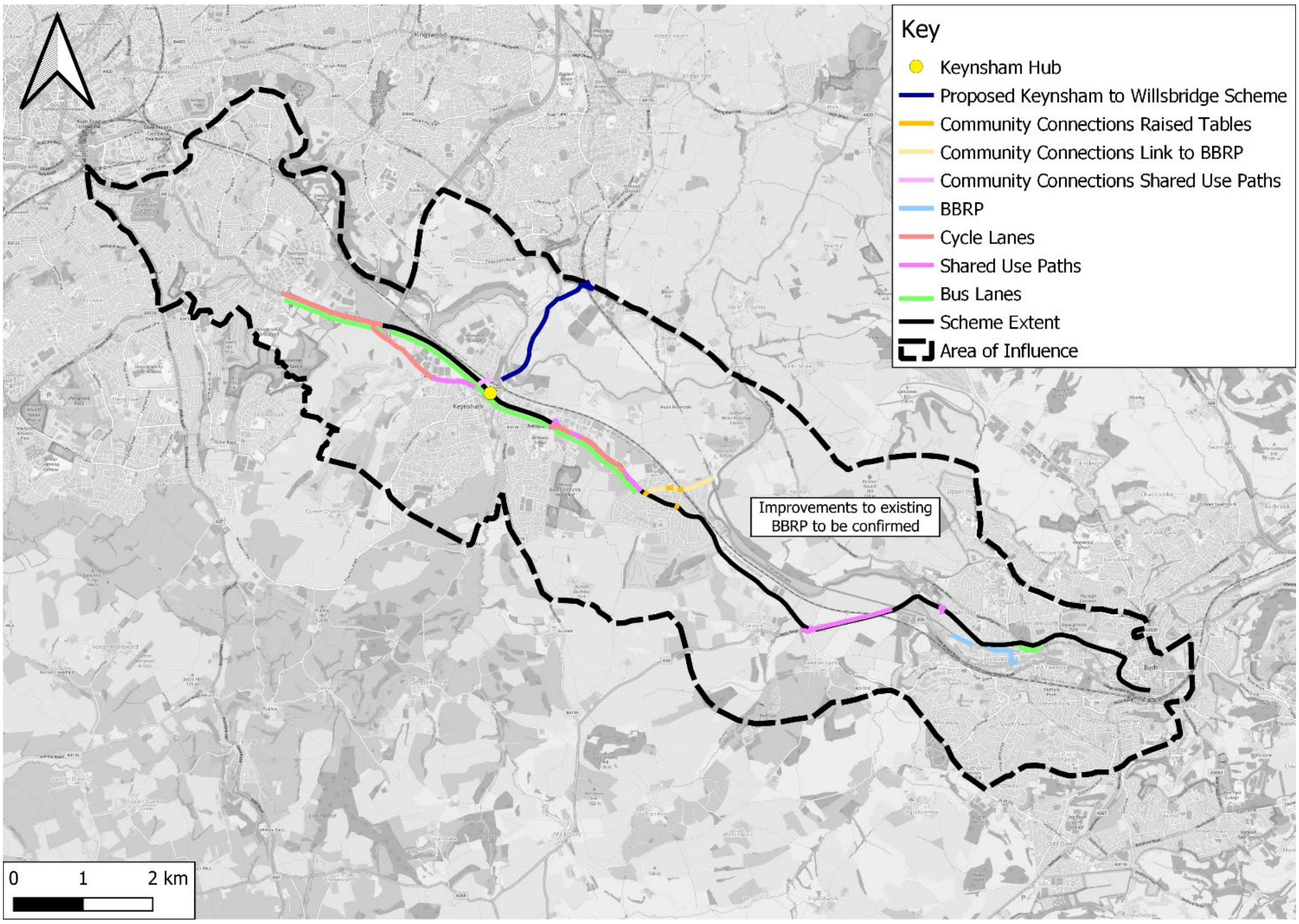
2.10.1. The scheme has changed since the SOC and now covers the BBSC corridor within B&NES between Emery Road in Brislington and Midland Road in Bath. The proposed scheme consists of:

- Project 2:
  - Section 4 Broadmead roundabout to Globe roundabout: bus lane between Broadmead to Grange Road, with an improved shared use path/segregated cycleway provided on the southern side.
  - Section 5 Globe roundabout to Twerton Fork (Newbridge): Improved shared use path provided between Globe Roundabout and Newbridge Road ties into existing connection to BBRP.
  - Section 6 Twerton Fork (Newbridge) to Bath centre: Bus Lane between Rosslyn Road and Hungerford Road eastbound only.
  - Bristol to Bath Railway Path (BBRP) Saltford Section: Upgrade of existing connections (Norman Road & High Street), potential walking/cycling crossing upgrades.
  - Keynsham Centre and connection to train station: Junction upgrades, connections to proposed Keynsham Transport Hub.
  - BBRP Extension, Bath: an off-road route along the western section between Brassmill Lane and Station Road, subsequently routeing along Station Road down the hill and re-joining the existing route along the river.
  - BBRP Bird in Hand, Saltford: upgrade the existing connection between the BBRP in Saltford at the Bird in Hand.
- Project 3:
  - Section 2 Emery Road to Hicks Gate: Segregated bi-directional cycle lane provided on southern side, continuous bus lanes both directions from P&R junction to Hicks Gate.
  - Section 3 Hicks Gate to Broadmead roundabout: Continuous bus lanes both sides along Keynsham Bypass and a reduced speed limit. Segregated bi-directional cycle lane provided along Durley Hill between Hicks Gate and Station Road in Keynsham.

- Keynsham Hub: Transport Hub with on carriageway bus stops and at grade crossing of A4, bus shelters provided along with walking/cycling connections to Keynsham town centre and train station.
- Hicks Gate: Bus Stop Enhancement on Corridor and improved access to bus stops.

2.10.2. **Figure 2-37** shows an overall scheme plan showing how the interventions in the different section fit together.

Figure 2-37 – Overall Scheme Plan



2.11 Strategic Benefits

2.11.1. The scheme proposals include new bus lanes along the corridor, mostly delivered through road space reallocation. This is not possible to be provided along the whole of the scheme corridor due to existing constraints. Where it is provided it has the ability to reduce congestion for buses and improve their journey time reliability. The aim for the corridor is a 10% journey time reduction, and the interventions have been developed so that the B&NES section can contribute to this aim.

2.11.2. The improvement in journey time for the existing services has the ability to reduce the amount of time it takes to operate them. BSIP has identified bus priority infrastructure schemes, where small time savings in each location add up to very significant impacts on the long-term bus service operating costs along whole corridors.

2.11.3. Reliability of bus services is the main priority for the communities. The BSIP target is 95% by 2027, whilst performance is currently at 80% - bus priority schemes will support this. Incremental changes to the network are an important way to deliver this improvement.

2.11.4. The proposed hub at Keynsham will improve access to Saltford and Bath from Keynsham itself. During the day there are very few frequent services from Keynsham town centre providing connections to Bath as the X39 travels along the bypass. The hub will provide access to the X39 service connecting to Bristol, Saltford and Bath. This will improve access to services for Keynsham residents by providing an alternative mode of travel, it will also improve access to employment for Keynsham residents, especially for those who do not have access to a vehicle. In the future the hub could be used as an interchange point for WESTlink.

2.11.5. The proposed active travel improvements, including end to end segregation, have the ability to encourage people to travel by walking and cycling. The segregated facilities make walking and cycling safer and more attractive, including by reducing the distance needed to cycle, and will increase the number of people benefitting from the health and wellbeing effects of walking and cycling. When combined with the Keynsham hub, this gives people the opportunities to make multi-modal journeys. As a standalone intervention, it offers a realistic opportunity for many people to cycle between settlements.

2.11.6. It should be noted that the scheme only seeks to provide the infrastructure required to improve public transport and active travel measures. It does not include any changes to the bus service operation that may be due to the improvement in bus journey times and reliability. The *Bus Operational Model Report* (Appendix X) details the improvements to the bus network that could be achieved once the infrastructure is in place.

2.11.7. This scheme provides the foundation for the broader proposals on the Bath to Bristol Corridor. This scheme itself does not serve central Bath or Bristol, nor does it deliver a change in frequency of bus services on the corridor (which is being managed through the BSIP and the Enhanced Partnership). This scheme is part of a series of interventions planned along the corridor which when viewed holistically will provide a range of beneficial impacts that will exceed those for each isolated section of the scheme

2.11.8. Communities along the corridor between Bath and Bristol have a requirement to be connected by sustainable modes to travel to key places of employment and study as well as having the opportunity to enhance the social side of their lives positively through increased levels of accessibility over longer periods of the day.

2.11.9. The Combined Authority has a target to significantly increase the use of buses and views improvements to public transport infrastructure as essential to increase the accessibility to the network and the attractiveness of bus.

2.11.10. Good levels of bus punctuality and reliability are important for residents along the corridor and bus priority schemes can support in enhancing the network with several small changes creating a cumulative long-term improvement.

2.11.11. Based on analysis of performance data across the corridor between Bath and Bristol it is concluded that small time savings achieved by bus priority measures in each critical location where buses experience journey time delays will add up to attractive levels of journey time savings.

2.11.12. The net result of these savings would see reduced journey times and increased punctuality and reliability for all bus services. This will not only meet the Combined Authority's target for on-time performance but will also afford local bus operators the opportunity to reinvest these time savings positively into increased levels of service frequency.

2.11.13. The strategic outcomes in the logic map are: reduced constraints for economic growth; increased walking and cycling trips; improved quality of life; 10% end to end journey time reduction and 95% of all services running on time.

2.11.14. The interventions taken in regards to the bus infrastructure, new bus lanes, will enable the 10% journey time and the 95% reliability objectives to be met along this section of the corridor.

2.11.15. The improved accessibility to sustainable travel will help to reduce the constraints on economic growth by opening open sustainable travel to more people along the corridor, this reducing reliance on travelling by private vehicle.

2.11.16. The increase in walking and cycling facilities should encourage more people to travel by these modes or as part of a multi modal journey, thus offering an improved quality of life to local residents.

2.11.17. As the scheme progresses to the FBC stage, a full Monitoring and Evaluation Plan will be developed. Additional detail on the metrics can be found in section 6.17.7 of the Management Dimension. It is expected that the Monitoring and Evaluation Plan will consider the overall impact on different user classes of the network.

2.12 Measures for success

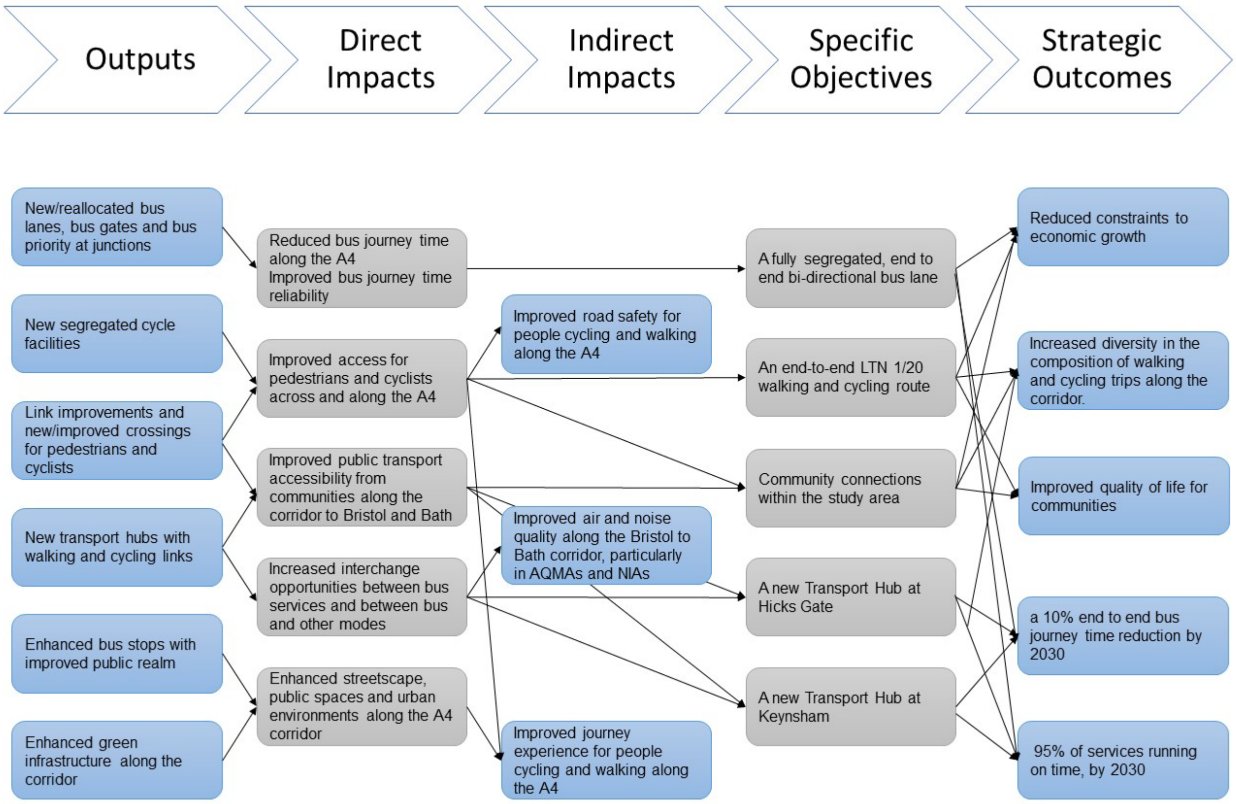
2.12.1. In alignment with the objectives identified within **section 2.9**, measurable outcomes are to be developed using the ‘SMART’ target methodology. This involves the development of Specific, Measurable, Attainable, Realistic and Time bound targets, which provide a structured approach to measuring the success of the scheme. These are outlined in **Table 2-9**.

Table 2-9 – Scheme impacts

Objective	Impacts
A fully segregated, end to end bi-directional bus lane (from Three Lamps Junction to the boundary with the Bath City Centre Project).	Reduced bus journey time along the A4 Improved bus journey time reliability
An end-to-end LTN 1/20 walking and cycling route (from Three Lamps Junction to the boundary with the Bath City Centre Project)	Improved access for pedestrians and cyclists Improved road safety for people walking or cycling along the A4
Community connections within the study area including within the towns, villages and suburbs	Improved access for pedestrians and cyclists Improved public transport accessibility from the communities along the Bath to Bristol corridor
A new Transport Hub at Keynsham	Increased interchange opportunities Improved public transport accessibility

2.12.2. The strategic benefits of the proposed scheme are set out in the Logic Map diagram in **Figure 2-38**.

Figure 2-38 – Logic Map for the proposed scheme



2.13 Risks and Constraints

Risks

2.13.1. There are key strategic risks to the scheme that could impact delivery and the operational success of the scheme. These are set out in the following paragraphs along with any mitigations proposed.

2.13.2. Public support for intervention is a key risk, some of the scheme interventions involve road-space reallocation where we are removing traffic lanes and replacing them with bus lanes or adding parking restrictions to enable delivery of the bus lanes. This was a particular issue in Bath where the houses affected had no other parking provision available. In light of this the scheme at this location has been refined to reduce the length of the bus length and the number of spaces affected.

2.13.3. While the scheme itself is not dependent on the separate delivery of the Bristol section and bus service enhancements, these will affect the overall delivery of the corridor objectives. Within the Combined Authority members of the project team are having regular discussions with members of both the Bristol section and BSIP project teams to keep informed on their progression.

2.13.4. Future trends in travel behaviour are unknown and present a risk to the operational success of the scheme.

2.13.5. The CRSTS funding end date of March 2027 is a key risk and constraint. The delivery timescale is very tight and is being managed the project team. The delivery date will be set in the construction contract with the pain/gain mechanism included.

Constraints

2.13.6. Various constraints have been identified at OBC stage in relation to the scheme that could potentially affect other aspects along the corridor and in the surrounding area, as well as the delivery of the scheme.

2.13.7. Further constraints work is being undertaken to mitigate any constraints and potential negative impacts resulting in the scheme. This will be detailed in the FBC.

2.13.8. The key constraints for the scheme include:

- Environmental - flood risk zones and heritage assets, including the City of Bath's UNESCO[21] World Heritage and Great Spa Town status. Along with Sites of Special Scientific Interest (SSSIs) and Local Nature Reserves, Areas of Outstanding Natural Beauty (AONB)/National Landscape, habitats and species (e.g., bats) which are all recorded close to the corridor.
- Land Issues - some land outside of the highway boundary may be required for the proposed scheme.
- Deliverability – some elements of the scheme require widening of the existing highway which is located within cuttings and along embankments on some sections.
- Tie-ins with adjacent schemes – ensuring separate schemes match up.
- Statutory process – some elements of the scheme (Keynsham Hub and BBRP extension) will require planning applications. Traffic Regulation Orders will be required both temporary and permanently.
- Sensitivity and attitudes around road space reallocation.

2.14 Interdependencies

2.14.1. There are a number of major schemes and emerging strategies in progress in the region which need to be considered as part of the development of the proposed scheme. The proposed scheme is, however, not dependent on any other schemes coming forward in order to progress.

2.14.2. Related projects with potential interdependency with the proposed scheme are:

- West of England Future4WEST Programme

[21] United Nations Educational Scientific and Cultural Organisation

- Bath Journey to Net Zero Plan
- UA Local Plans (which are in development)
- West of England Future Transport Zone (FTZ)
- Bus Service Improvement Plan (BSIP)
- Bath City Centre CRSTS Project
- Bristol City Centre CRSTS Project
- Keynsham-Willsbridge Active Travel Route (connecting to the Bristol and Bath Railway Path at Bitton Station.)
- WaterSpace Connected (Somerdale Bridge)
- Bath River Line (creating a level accessible active travel route from Newbridge to Batheaston)
- Bath Sustainable Walking and Cycling Links (BSWCL) CRSTS Project
- B&NES Liveable Neighbourhoods, in particular Charmouth Road and Lyme Gardens area, and Chelsea Road

2.14.3. A Dependencies Register has been developed which is a live document recording other schemes, projects and developments which may impact, or be impacted by, the proposed scheme.

2.15 Option Development

2.15.1. As part of the development of the BBSC Option Assessment Report (OAR) (submitted to the Combined Authority in late 2021) a robust and extensive optioneering process was undertaken. As part of this the scheme was considered in terms of four ‘themes’:

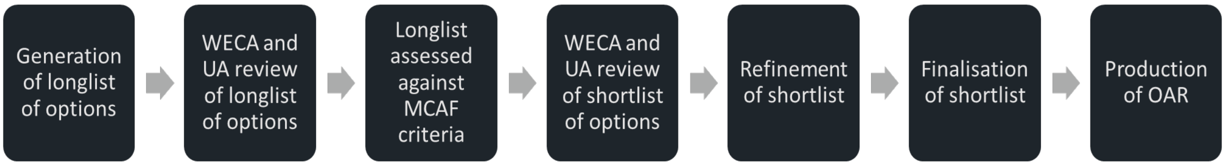
- Bus Priority Infrastructure
- Strategic Cycling Infrastructure
- Community Connections
- Bus Operational Model

2.15.2. In addition to these themes, the Proposed Scheme now includes improvements and extension to the Bristol to Bath Railway Path (BBRP). The OAR for the Bristol to Bath Cycle Path was submitted to Bath and North East Somerset (B&NES) in early 2023. This sets out the optioneering process with longlisting, sifting and shortlisting.

2.15.3. Further detail around the option generation and assessment process is set out in both OARs. The following sections summarise the results presented in the OAR and longlisting and sifting process.

2.15.4. **Figure 2-39** shows the process that was followed in the OAR.

Figure 2-39 - Options Assessment Approach*



** the Combined Authority and UA review of the shortlist of options included consideration of inputs from the stakeholder engagement*

2.15.5. The MCAF provided a proportionate and staged sifting process to effectively and efficiently reduce the number of options under consideration and, in doing so, identify those which were most likely to meet the requirements for the scheme.

2.15.6. The MCAF addresses three themes, which have been considered in turn. The themes, (shown in **Figure 2-40**) are Suitability, Feasibility and Acceptability. Options have been assessed on a seven-point scale for each assessment sub-criteria, as shown in **Table 2-10**.

2.15.7. The MCAF tool, setting out the assessment themes, criteria and sub-criteria, was used to record the assessment scores of the options and the gateway decisions to proceed with or to discount options.

Figure 2-40 - Assessment Themes

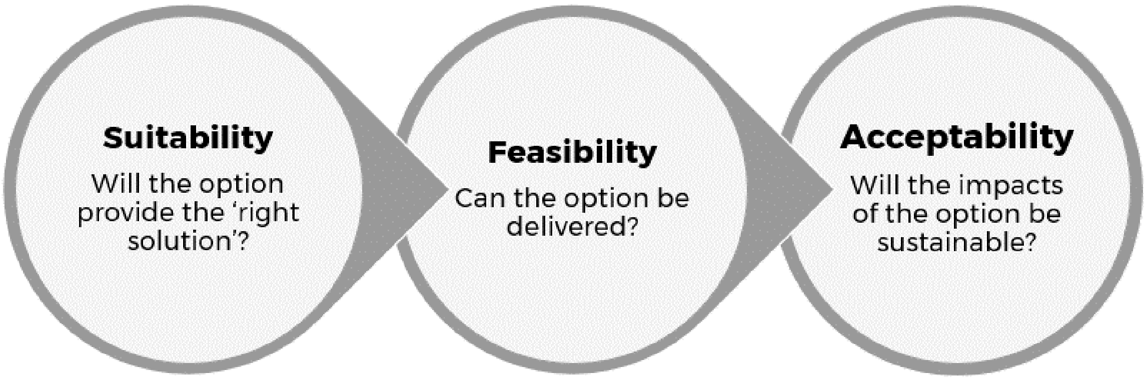


Table 2-10 - Assessment Scoring

Description	**Score**
Large Adverse (LA)	-3
Moderate Adverse (MA)	-2
Slight Adverse (SA)	-1
Neutral (N)	0
Slight Beneficial (SB)	+1
Moderate Beneficial (MB)	+2

Description	Score
Large Beneficial (LB)	+3

2.15.8. The suitability assessment involved the assessment of each option against the Operational and Specific objectives of the programme. The suitability, feasibility and acceptability criteria applied are set out in the following tables.

Table 2-11 – Suitability Criteria

Criteria	Objectives
BBSC Operational Objectives *To what extent will the option help to achieve…*	A fast, at least five-minute frequency, reliable, high quality, zero-emission turn up & go bus service between Bristol Temple Meads and Bath bus station with 24-hour bus priority (where appropriate).
BBSC Operational Objectives *To what extent will the option help to achieve…*	A BBSC route with high quality bus stops (in line with the Combined Authority bus stop specifications) and good interchange with other modes and services
BBSC Operational Objectives *To what extent will the option help to achieve…*	A simple, fast and convenient off-board ticketing system for the service
BBSC Operational Objectives *To what extent will the option help to achieve…*	A simple, coherent and efficient bus network that links local communities along the A4 with consistent marketing and branding
BBSC Operational Objectives *To what extent will the option help to achieve…*	A continuous, direct, high-quality cycle route between Bath and Bristol which is segregated from general traffic and buses
BBSC Specific Objectives *To what extent will the option help to…*	To increase bus patronage and contribute to the Bus Strategy ambition of doubling bus passenger numbers by 2036

Criteria	Objectives
BBSC Specific Objectives *To what extent will the option help to*	To improve the user experience for communities accessing Bristol or Bath by bus along the corridor
BBSC Specific Objectives *To what extent will the option help to*	To increase the number of, and diversify the composition of, pedestrians, walking and cycling trips along the corridor through the creation of new and improved crossings and segregated cycle infrastructure in line with LTN 1/20 to improve access to bus stops and amenities for communities along the corridor
BBSC Specific Objectives *To what extent will the option help to*	To enhance streetscape, public spaces and urban environments along the A4 corridor
BBSC Specific Objectives *To what extent will the option help to*	To improve air quality along the BBSC route, particularly in Air Quality Management Areas (AQMAs)
BBSC Specific Objectives *To what extent will the option help to*	To minimise noise along the BBCS route, particularly in Noise Important Areas (NIAs)
BBSC Specific Objectives *To what extent will the option help to*	To reduce the carbon footprint arising from transport along the corridor
BBSC Specific Objectives *To what extent will the option help to*	To protect and enhance biodiversity and natural capital and increase the amount of green infrastructure along the BBSC route to contribute to Biodiversity net gain

Table 2-12 – Feasibility Criteria

Criteria	Measure
Viability	The extent of physical and environmental constraints
Viability	The quality of supporting evidence and potential impact on viability
Viability	The extent of external dependencies beyond the scope and control of the scheme
Viability	The ability to be implemented within 5 years
Viability	Affordability (capital and operational/maintenance costs)
Viability	Affordability (revenue - operating costs for bus services and availability of operational funding)
Support	The alignment with local and regional policy
Support	The likelihood of local political and stakeholder support
Support	The likelihood of public support
Future proofing	The extent to which the option remains flexible to future uncertainty including climate change resilience

Table 2-13 – Acceptability Criteria

Criteria	Measure
Economy and Growth *What is the contribution to...* Improving connectivity between businesses and their suppliers and markets	Increasing labour market catchments
Economy and Growth *What is the contribution to...* Improving connectivity between businesses and their suppliers and markets	Unlocking employment growth

Criteria	Measure
Economy and Growth *What is the contribution to...* Improving connectivity between businesses and their suppliers and markets	Unlocking housing growth
Economy and Growth *What is the contribution to...* Improving connectivity between businesses and their suppliers and markets	Improving journey time reliability
Social *What is the contribution to...*	Improving access to employment, health, education, retail and social facilities
Social *What is the contribution to...* Environment *What is the contribution to...*	Realising health benefits through the promotion of active travel
Social *What is the contribution to...* Environment *What is the contribution to...*	Improving safety and well-being through improved quality of place
Social *What is the contribution to...* Environment *What is the contribution to...*	Improving mobility by providing an accessible and seamless transport offer (physical access, interchange, wider network integration, affordability)

Criteria	Measure
Social *What is the contribution to...* Environment *What is the contribution to...*	Addressing accessibility barriers for those in areas of deprivations or members of protected groups
Social *What is the contribution to...* Environment *What is the contribution to...*	Minimising the contribution of transport to climate change through reducing whole-life carbon emissions
Environment *What is the contribution to...*	Improving local air quality
Environment *What is the contribution to...*	Protecting and enhancing the natural capital (biodiversity, habitat)
Environment *What is the contribution to...*	Protecting and enhancing surface and groundwater quality, reducing and managing flood risk
Environment *What is the contribution to...*	Protecting and enhancing the built environment (heritage, townscape)
Environment *What is the contribution to...*	

Bus priority infrastructure

2.15.9. This aspect refers to the introduction of bus priority measures to reduce bus journey times and increase bus journey time reliability. Options for the relocation and expansion of the Brislington Park & Ride (P&R) to Hicks Gate and the associated transport hub are considered.

2.15.10. A long list of 34 bus priority infrastructure options was developed. The options were developed in accordance with each of the five corridor sections. These included:

- Reallocating road space for bus lanes
- Provision of new bus lanes
- Lining and signing along A4 only
- New bypass around Saltford
- Route bus services on local roads
- New tunnel underneath Saltford
- Bus gates
- Bi-direction bus lanes
- Junction improvements and restrictions in Saltford
- Convert Bristol to Bath Railway Path to carry buses
- One-way loop from Twerton Fork to City Centre using A4 and A36
- Bus priority between Twerton Fork and Newbridge P&R

2.15.11. Following the sifting 17 options were shortlisted to be taken forward.

2.15.12. Apart from the bus priority options, considerations were given to the P&R facility and Transport Hub locations. The transport hubs will serve as an interchange between services along the corridor and other bus services, P&R services and active travel connections in the vicinity. There were nine longlisted options for the Hicks Gate P&R and Transport Hub: following the sift two options were shortlisted. Only one location was identified for the Keynsham Transport Hub.

Strategic cycling infrastructure

2.15.13. A long list of 19 options was developed across five sections of the corridor for the strategic cycling infrastructure. These included:

- Segregated cycle facilities
- New traffic-free cycle link.
- Cycle route through Keynsham town centre (along High Street) making use of existing facilities (where appropriate) and introduced LTN1/20-compliant facilities where required (such as the route along Durley Hill).
- Route from Broadmead Roundabout through possible North Keynsham development area, with new cycle facility linking to the Bristol to Bath Railway Path (to Saltford and Bath).
- New on-street routes
- Improvement to existing segregated cycle facilities

2.15.14. Of the 19 longlisted options 12 were shortlisted to be taken forward.

Community Connections

2.15.15. Options were developed for improving Community Connections in alignment with the JLTP4 Neighbourhood Connectivity policies and interventions. The objective was to develop a dense network of direct, safe and comfortable routes for cycling and walking. The potential interventions considered at the edges of neighbourhoods included:

- Upgrade existing crossings to create safer crossings and a more suitable cycling and walking environment
- Create segregated cycle tracks to connect quiet streets with the existing and proposed crossing points
- Introduce modal filters to improve on-carriageway cycling

2.15.16. In total this identified 61 new crossing and 71.83kms of new cycle links.

Bus operational model

2.15.17. Bus operational model options were developed to identify the most efficient means to deliver a high-frequency service along the Bath to Bristol corridor.

2.15.18. Three potential options were identified after engaging First Bus through information requests and workshops. These options include:

- Retain the existing network arrangements and services but with Brislington P&R relocated to Hicks Gate
- Introduce a new metrobus service, segregated from traffic, running at a 10-minute headway with reduced stops, with the existing X39 amended to a 10-minute headway local stopping service
- Introduce a new metrobus service running at a 5-minute headway with reduced stops, with existing X39 amended to a 10-minute headway local stopping service and the Hicks Gate P&R service replaced by the metrobus service.

2.15.19. Option 1 was discounted as this option would not meet the operational objectives of the BBSC Programme as it would not provide an increased service frequency. Options 2 and 3 were taken forward into the shortlist. Of these options, Option 3 represents the option that best fits with the Operational Objectives of the BBSC Programme

BBRP improvements and Extension

2.15.20. An initial long list of 19 options was provided after site visits, stakeholder meetings and study of the area. These options, mainly with minor variations, were assessed against three main criteria, including cost, deliverability, and alignment with the proposed objectives.

2.15.21. The long list was then refined, with three options being put forward to form a short list.

Further Development of Options

2.15.22. The shortlisted options identified in the BBSC OAR were further developed and assessed as part of the Strategic Outline Case (SOC). The options across the four themes were considered to determine four packages of measures that were assessed as part of the SOC.

Bus and Cycle Infrastructure Options

2.15.1. The options development process considered options across a range of measures to support the achievement of the objectives. A matrix approach was adopted to optioneering and for each section of the corridor options were developed for:

- **Bus Priority Infrastructure** (i.e., introducing bus priority measures to reduce bus journey times and increase bus journey time reliability)
- **Strategic Cycling Infrastructure** (i.e., introducing a continuous segregated cycling corridor between Bath and Bristol)

Hicks Gate Park and Ride and Transport Hubs

2.15.2. Section 2 of the corridor includes the relocated and potentially expanded Hicks Gate P&R and Transport Hub. At the OAR stage two locations were shortlisted for the new P&R site, in order to better intercept traffic entering into Bristol from the east:

- Option 4: To the south west of the Hicks Gate junction
- Option 8: Within the Hicks Gate Junction (with the Hub located within the roundabout)

2.15.3. In the SOC the Hicks Gate roundabout was assumed to be unchanged (with access to the P&R and Hub assumed to be from Durley Hill). However, it is anticipated that to better facilitate access for buses between the Hicks Gate and the P&R/Transport Hub that the configuration of the junction will need to be amended.

2.15.4. The Keynsham Hub is assumed to be a bus interchange with a building providing heated waiting facilities, toilets, ticketing machines, CCTV, cycle storage and opportunities for other mobility hub elements (such as e-cargo bikes). This transport hub was also shortlisted for inclusion.

Community Connections Shortlist

2.15.5. As part of the SOC, the range of potential interventions to support Community Connections (i.e., linking communities served by the corridor to the proposed strategic bus and cycling infrastructure through active travel links and crossings) was identified as part of the OAR and allocated to the four packages as follows:

- Smaller Intervention: only includes interventions along the A4 (within 50m of A4)
- Medium 1 Intervention: only includes interventions within 400m of A4
- Medium 2 Intervention: only includes interventions within 400m of A4
- Larger Intervention: includes all proposed interventions

Bus Operational Model

2.15.6. The same bus operational model was assumed across the four packages within the SOC. Based on the assessment undertaken as part of the OAR it was decided that Option 3 (the introduction of a new metrobus service running at a 5-minute headway with reduced stops, with the existing X39 amended to a 10-minute headway local stopping service and the existing Brislington P&R service replaced by the metrobus service) was the most suitable to use. This was chosen as it represents the option that best fits with the Operational Objectives of the BBSC Programme.

Shortlist of Options for the SOC

2.15.7. There were four packages of options assessed as part of the BBSC SOC, these were:

- Smaller intervention - For the majority of the route, this option makes use of existing bus priority and only adds in new bus priority where there is existing road space that can be reallocated. In locations where this provides no improvements to buses, one-way traffic restrictions are added to the A4 to reduce general traffic and prioritise buses, and new routes are provided to compensate for the closed routes. Provides segregated cycle facilities along the majority of the corridor.
- Medium 1 Intervention - This option provides bus priority in both directions if the land take impacts are not overly significant, or in one direction only. In locations where land take is not an option, alternative routes for buses are used and 2-way traffic restrictions are added to the A4 to reduce general traffic and prioritise buses. New routes are provided to compensate for the closed routes. Provides segregated cycle facilities along the length of the corridor
- Medium 2 Intervention - The same as Medium 1 for the majority of the route. In locations where land take is not an option changes are made within the highway boundary. Provides segregated cycle facilities along the majority of the corridor.
- Larger Intervention - Provides full continuous bus priority in both directions along the length of the route. Provides segregated cycle facilities along the length of the corridor with additional ‘green’ routes (for less confident / leisure users) where possible.

2.15.8. For the B&NES sections of the corridor there was no difference between Medium Intervention 1 and 2, therefore the three packages of interventions were considered within the SOC.

BBRP Improvements and Extension

2.15.9. There were three options on the short list. One of the options included three sub-options, depending on the future land ownership in the area.

2.15.10. Option 1 was a detailed improvement of the infrastructure along the existing route, without physical realignment. The Bath River line project will be delivering these improvements and therefore there is no need for further investment along this path. Stakeholders suggested this option to be discounted as the improved route would fail to meet LTN 1/20 (cycling infrastructure design) standards. It will not be able to address a majority of the identified issues with the existing route.

2.15.11. Option 2 is an option with three sub-options with the intention of a phased implementation progressing from 2a to either 2b or 2c. This option is in alignment with future developments but considering the land ownership barriers in future phases.

2.15.12. Option 3 was proposed as the more ambitious option. It was considered to be a potential future active travel network connection. Some potential feasibility issues were raised, such as dense woodland and steep slopes. There are also concerns around land ownership issues which may impact it from being delivered in time.

2.15.13. Concept designs were developed for the four shortlisted options including:

- Option 2a Disused Railway Alignment/Station Road/Existing BBRP

- Option 2b Disused Railway Alignment/Station Road/Locksbrook Road/Volkswagen Land
- Option 2c Disused Railway Alignment/Station Road/Locksbrook Road/Kelson's Field
- Option 3 Entire railway alignment

2.15.14. These options have been assessed against the Active Mode Appraisal Tool (AMAT) Assessment. It has been estimated that all of the options would bring significant benefits that outweigh the costs. The options offered a high value for money. The costs for these options range from £0.88m to £2.29m.

2.15.15. The result of Option 3 when assessed with AMAT showed the highest scale of benefits and quantified value for money, despite the cost being significantly higher than for the other options. However, the issues with land ownership meant that the option is unlikely to be deliverable within the set timescales. Option 2a has the second highest score with lower costs compared to 2b and 2c.

2.15.16. Option 2a is the recommended option for further design and appraisal. It makes use of the disused railway alignment path to the east of Station Road and connects it to the existing shared used path alongside the river after reaching Station Road. It also provides future opportunity to allow tie-in with an active travel route across Locksbrook Bridge, delivering a comprehensive east-west active travel route to the centre of Bath. This is part of Policy ST2/ST2A in the Local Plan, identified in the LCWIP, and is highlighted as a key route in the Bath City Riverside Enterprise Zone masterplan.

2.15.17. Option 2a provides an off-road route along the western section between Brassmill Lane and Station Road. The intention is to provide a safer route to encourage modal shift and improve journey quality. The route along Station Road includes on-street traffic calming measures including replacing the centreline with a median strip to lower the speed of the motor vehicles. The route continues further downhill and re-joins the BBRP after reaching Station Road.

Outline Business Case Option Development

2.15.18. The scheme proposals have changed between the SOC and the OBC. At the SOC stage bus service improvements were included. It was decided as part of the OBC that the detailed consideration of the bus operational model would be taken forward as part of the development and planning of the West of England Enhanced Partnership under the BSIP.

2.15.19. The option development for the OBC focuses on the Strategic Corridor including bus and cycle infrastructure along the A4 corridor, Keynsham Hub, the Hick's Gate P&R and Transport Hub and the Community Connections interventions. The OAR Addendum (Appendix T) sets out the scheme option development progression since the SOC.

2.15.20. A public engagement exercise was conducted (21st August until 1st October 2023) to provide feedback on the scheme and help inform the design.

Strategic Corridor including hubs

2.15.21. For the OBC, both the smaller intervention and the medium intervention packages identified at the SOC were taken forward for further design development. The larger intervention package was discounted at this point as it was considered that it was not deliverable in terms of timescales or funding within the existing CRSTS funding window.

2.15.22. The design work undertaken on the smaller and medium intervention packages was focused on the following factors:

- Deliverability within timescale and funding envelope
- Areas with greatest opportunity to improve public realm, active travel and bus journey times
- Minimising the carbon impacts of the scheme

2.15.23. Option development and design focussed on those elements that could be completed with minimum land take (predominately within the existing highway boundary) and within the programme timeframes. Any elements that required changes to existing structures, such as bridges and retaining walls, were discounted at this point as these would be unlikely to be deliverable within the existing delivery timeframes and would have an adverse effect on the scheme costs.

2.15.24. Automatic Vehicle Locator (AVL) data, along with Google traffic data, was interrogated to identify those areas of the route where the greatest delay occurred for public transport, and where the interventions would have the greatest impact on journey time for buses to ensure that the scheme met the 10% journey time reduction.

2.15.25. The OBC designs were developed considering the PAS 2080 carbon reduction hierarchy, which utilises the carbon reduction curve (Build nothing à Build less à Build clever à Build efficiently) and the IEMA Greenhouse Gas Management Hierarchy (Eliminate à Reduce à Substitute à Compensate).

2.15.26. As the designs developed certain aspects of these interventions were discounted as not being deliverable within the scheme timescale and funding window. This was either due to land take required, work to existing structures such as bridges and retaining walls and removal of existing established trees.

2.15.27. A more in-depth constraints review was undertaken alongside identifying which options would be likely to deliver the 10% reduction in travel time as set out in the objectives and identifying those options likely to offer the best value for money. Based on this review a preferred option was identified for each section.

2.15.28. These options have been taken forward for further assessment in the OBC following the public engagement exercise and any revision of designs following the feedback received.

Community Connections

2.15.29. For the longlist of options for the Community Connections, a sifting process took place using an MCAF, considering the option against a range of indicators including level of deprivation, proximity and connections to existing cycle network, access to public transport, education and employment, barriers to delivery and any permissions, approvals or legal powers required.

2.15.30. As the result of the MCAF process, a shortlist of eight schemes was identified to be taken forward for further design. A small number of the options identified in the longlist were along the Strategic Corridor and therefore have been included in the Strategic Corridor designs.

2.15.31. These options have been taken forward for further design work and further assessment as part of the OBC process. As with the strategic corridor interventions the community connections interventions were designed in collaboration with the Combined Authority and B&NES and were included in the public engagement exercise which took place between 21st August and 1st October 2023

Options Identified for appraisal at OBC

2.15.32. The preferred options that were identified for appraisal at OBC were taken forward for public engagement. Following the 2023 public engagement exercise and the feedback received some sections previously identified for appraisal were removed. The options identified for appraisal at OBC were:

- Section 2 Emery Road to Hicks Gate: Segregated bi-directional cycle lane to south of carriageway with crossing facilities, continuous bus lanes eastbound and southbound from P&R junction to Hicks Gate, not Emery Road due to tie into Bristol section proposals and traffic constraints.
- Section 3 Hicks Gate to Broadmead roundabout: Continuous bus lane eastbound and westbound along Keynsham Bypass, continuous segregated shared use path to south of carriageway.
- Section 4 Broadmead roundabout to Globe roundabout: Eastbound bus lane Broadmead to Grange Road, shared use path/segregated cycleway provided to south of carriageway. Within Saltford there is limited room for provision of bus lanes or segregated cycling infrastructure.
- Section 5 Globe roundabout to Twerton Fork (Newbridge): Shared use path provided to north of carriageway between Globe Roundabout and Newbridge Road ties into existing connection to BBRP. Constraints at bridges mean full segregated walking/cycling provision is unlikely to be achievable.
- Section 6 Twerton Fork (Newbridge) to Bath centre: Eastbound bus lane between Newbridge P&R and Midland Road.
- Hicks Gate: Bus Stop Enhancement on Corridor and improved access to bus stops.
- Keynsham Hub: Transport Hub with on carriageway bus stops and at grade crossing of A4, bus shelters provided along with walking/cycling connections to Keynsham town centre and train station.
- Bristol to Bath Railway Path (BBRP) Saltford Section: Upgrade of existing connections (Norman Road & High Street), potential walking/cycling crossing upgrades.

- Keynsham Centre and connection to train station: Junction upgrades, connections to proposed Keynsham Transport Hub.
- BBRP Extension, Bath: an off-road route along the western section between Brassmill Lane and Station Road, travels along Station Road down the hill and re-joins the existing route along the river.

2.15.33. The options no longer taken forward following public engagement are:

- Saltford, Manor Road: walking/cycling provision and crossing upgrades (removed following engagement, limited parish council support).
- Bath Road, Keynsham: Broadmead roundabout access to Wellsway sports centre and onward to the west (removed as being delivered by developer).
- Grange Road Saltford: Junction improvements and cycleway (removed following engagement, limited parish council support).
- Osborne Road, Bath: Connecting A4 to BBRP, possible Modal Filter at this location (removed following engagement, small scheme with limited predicted demand).
- Globe Roundabout to Bath Spa Campus: Upgrade existing shared use facility along A39 Wells Road from Globe Roundabout to Corston Drive, facility is currently substandard (removed following engagement, limited support).

Scheme Changes since Public Engagement

2.15.34. Some changes to the scheme design were highlighted as required following the public engagement and these design changes were not sufficiently progressed at the time of the December submission to be included. At the outset of FBC these changes will be reevaluated against the strategic objectives of the scheme. These changes are.

2.15.35. Section 3, removing the segregated cycleway/walkway from along the bypass between Hicks Gate and Broadmead roundabout. As this section runs through cuttings and across bridges the widening of the carriageway incurred significant costs, while the demand shown for this route based on existing survey data was shown to be minimal. A different route for the segregated cycleway was identified along Durley Hill connecting Hicks Gate to Keynsham Town Centre. There are existing cycling facilities along Durley Hill, however they do not meet current standards and the revised design proposes upgrading these facilities to meet current standards. The changes to the carriageway are now just to accommodate the bus lanes and at the roundabouts at either end.

2.15.36. Section six was changed to have a shortened bus lane eastbound, this was in response to feedback at the public engagement. The eastbound bus lane will start at Rosslyn Road and continue until Hungerford Lane.

2.16 Summary of the Strategic Dimension

2.16.1. The scheme aligns with the national, regional and local policy in that it seeks to improve the public transport and active travel network, thereby encouraging mode shift, reducing annual vehicle-kilometres and supporting the decarbonisation of the transport network.

2.16.2. The key issues identified and their relevance to the scheme are set out in the following paragraphs.

2.16.3. The A4 between Bath and Bristol is congested, with all sections having above 8,000 vehicles per day some having above 15,000 vehicles per day. Traffic congestion results in delays to journeys by car and bus, commercial vehicles, and deliveries along the corridor, with associated costs to the economy and additional vehicle-kilometres due to diversions to the M4. This works against the targets set by Bristol City Council and B&NES Council to reduce vehicle-kilometres as part of their responses to the Climate Emergency. Congestion is expected to worsen as housing growth induces more demand for travel, and worsening congestion will impact negatively upon bus services that use the A4. This brings with it the associated risk of mode shift away from bus, further harming climate objectives.

2.16.4. Bus journeys are slow and connections to other services are poor (influenced by congestion). Long journey times for bus services and poor connections between services mean that buses are not an attractive transport choice for journeys along the corridor. As rail connectivity (along the corridor) is only provided at Keynsham, residents without the option of choosing rail are more likely to drive for journeys from locations along the corridor. This is reflected in the mode share for the corridor. If congestion along the A4 worsens then bus services will be negatively impacted which will make bus an even less attractive choice.

2.16.5. Bus journey times are not reliable. Limited bus priority along the corridor means that congestion along the corridor has a significant impact on the reliability of bus journey times. Unreliable journey times make bus a less attractive mode for residents along the corridor travelling to Bristol or Bath, and this will worsen if congestion increases in the future.

2.16.6. Bus services suffer from inadequate connectivity along the corridor, affecting travel to and from these areas. This lack of connection diminishes the appeal of buses as a viable car alternative, resulting in longer and more complex trips that involve multiple interchanges. Consequently, in certain locations along the corridor bus travel is impractical, leading to increased congestion, poorer air quality, and higher carbon emissions from more reliance on cars.

2.16.7. There is a lack of consistent active travel facilities along the corridor, limiting the accessibility for walking and cycling, both along the corridor and between local communities. This limitation reduces the opportunities for people to opt for healthier, sustainable, and cost-effective travel options. Respondents from the 2021 Stakeholder Engagement event have indicated that this lack of facilities, combined with poor air quality resulting from high traffic volumes and congestion, influences their decision against walking or cycling for journeys along the corridor.

2.16.8. The West of England has grown more than the national average and is projected to continue to do so. There is planned housing and employment growth along the Bath to Bristol corridor, with potentially more than 50,000 houses required across BCC and B&NES by 2035 based on the previous projections for the Spatial Development Strategy. It should be noted that further work on the spatial Development Strategy has been halted.

2.16.9. The projected housing and economic growth in the West of England and along the Bath to Bristol corridor will lead to additional travel demand, including journeys to and from work, business travel, deliveries and servicing traffic and leisure journeys. Without intervention, this will lead to increased congestion and poorer air quality along the Bath to Bristol corridor by 2036, and to more short journeys (less than 5km) which generate proportionally more carbon emissions.

2.16.10. The issues identified in the Current Situation will continue and become worse (with greater impacts on people and the environment) if no action is taken. This may contribute towards those communities in areas of higher deprivation becoming even more deprived with the gap between disadvantaged and advantaged residents widening.

2.16.11. The JLTP4 states that "We know the levels of car traffic and freight are high and that current travel habits need to change in order to accommodate the growth that will be seen across our region. We also know that this growth is needed to continue to support our economy and that even the most sustainable growth may create some car and freight trips."

2.16.12. Economic growth will be restricted if additional trips cannot be facilitated sustainably, and current trips continue to have a high car mode share.

2.16.13. Further, there is an opportunity to "lock in" sustainable travel choices for the key development sites identified if the bus, walking and cycling infrastructure and services can be provided to serve these sites and links between the sites and the communities along the Bath to Bristol corridor.

2.16.14. The development of the scheme has drawn on the views of stakeholders on the existing problems and challenges encountered along the route and on ideas proposed to address the problems.

2.16.15. Stakeholder views have been drawn from the following sources.

2.16.16. BBSC Programme Engagement (Summer 2021): Public engagement to gather the views of the public on the current challenges and issues affecting travel along the A4 corridor between Bath and Bristol

2.16.17. BBSC Engagement Summer 2023: Public engagement to gather the views of the public on the proposed interventions along the corridor

2.16.18. Across both engagement exercises there is support for the proposed walking, wheeling, and cycling improvements. The proposed improvements to bus infrastructure including the Keynsham Mobility Hub, was less supported in the recent engagement exercise.

2.16.19. A comprehensive selection process was adopted to assess options for the scheme. This went from the OAR, through to the SOC to define options to be taken forward to the OBC for further assessment. Following the 2023 public engagement exercise some of the previously identified interventions were removed to leave us with the final list to assess.

2.16.20. The proposed scheme consists of:

- Project 2:
  - Section 4 Broadmead roundabout to Globe roundabout: bus lane Broadmead to Grange Road, improved shared use path/segregated cycleway.
  - Section 5 Globe roundabout to Twerton Fork (Newbridge): Improved shared use path provided between Globe Roundabout and Newbridge Road ties into existing connection to BBRP.
  - Section 6 Twerton Fork (Newbridge) to Bath centre: Bus lane between Rosslyn Road and Hungerford Road.
  - Bristol to Bath Railway Path (BBRP) Saltford Section: Upgrade of existing connections (Norman Road & High Street), potential walking/cycling crossing upgrades.
  - Keynsham Centre and connection to train station: Junction upgrades, connections to proposed Keynsham Transport Hub.
  - BBRP Extension, Bath: an off-road route along the western section between Brassmill Lane and Station Road, subsequently routeing along Station Road down the hill and re-joining the existing route along the river.
  - BBRP Bird in Hand, Saltford: upgrade the existing connection between the BBRP in Saltford at the Bird in Hand.
- Project 3:
  - Section 2 Emery Road to Hicks Gate: Segregated bi-directional cycle lane provided on southern side, continuous bus lanes both directions from P&R junction to Hicks Gate.
  - Section 3 Hicks Gate to Broadmead roundabout: Continuous bus lanes both sides along Keynsham Bypass and a reduced speed limit. Segregated bi-directional cycle lane provided along Durley Hill between Hicks Gate and Station Road in Keynsham
  - Keynsham Hub: Transport Hub with on carriageway bus stops and at grade crossing of A4, bus shelters provided along with walking/cycling connections to Keynsham town centre and train station.
  - Hicks Gate: Bus Stop Enhancement on Corridor and improved access to bus stops.

3 Economic Dimension

3.1 Introduction

3.1.1. The Economic Dimension sets out the impacts of a scheme to inform the assessment of its Value for Money (VfM) to justify the use of taxpayers' money.

3.1.2. This chapter has been developed following the relevant guidance from the Department for Transport's (DfT) Transport Analysis Guidance (TAG), the DfT's Value for Money Framework and the Combined Authority Local Assurance Framework. The impacts considered are not limited to those directly impacting the economy, nor those that can be monetised. The economic, environmental and social impacts of the scheme are all examined, using qualitative, quantitative and monetised information that is reflective of the stage of development of the scheme. In line with the DfT Value for Money Framework, in assessing VfM, all of these impacts are consolidated to determine the extent to which the scheme's benefits outweigh the costs.

3.2 Options Appraised

3.2.1. The scheme option development process and the assessment of options was summarised in **section 2.15** of the Strategic Dimension and described more fully in the Options Assessment Report (OAR) and the OAR Addendum Report. The scheme which has been assessed within this Economic Dimension consists of:

- Project 2:
  - Section 4 Broadmead roundabout to Globe roundabout: bus lane Broadmead to Grange Road, improved shared use path/segregated cycleway.
  - Section 5 Globe roundabout to Twerton Fork (Newbridge): Improved shared use path provided between Globe Roundabout and Newbridge Road ties into existing connection to BBRP.
  - Section 6 Twerton Fork (Newbridge) to Bath centre: Bus lane between Rosslyn Road and Hungerford Road.
  - Bristol to Bath Railway Path (BBRP) Saltford Section: Upgrade of existing connections (Norman Road & High Street), potential walking/cycling crossing upgrades.
  - Keynsham Centre and connection to train station: Junction upgrades, connections to proposed Keynsham Transport Hub.
  - BBRP Extension, Bath: an off-road route along the western section between Brassmill Lane and Station Road, subsequently routeing along Station Road down the hill and re-joining the existing route along the river.
  - BBRP Bird in Hand, Saltford: upgrade the existing connection between the BBRP in Saltford at the Bird in Hand.
- Project 3:

- Section 2 Emery Road to Hicks Gate: Segregated bi-directional cycle lane provided on southern side, continuous bus lanes both directions from P&R junction to Hicks Gate.
- Section 3 Hicks Gate to Broadmead roundabout: Continuous bus lanes both sides along Keynsham Bypass and a reduced speed limit. Segregated bi-directional cycle lane provided along Durley Hill between Hicks Gate and Station Road in Keynsham
- Keynsham Hub: Transport Hub with on carriageway bus stops and at grade crossing of A4, bus shelters provided along with walking/cycling connections to Keynsham town centre and train station.
- Hicks Gate: Bus Stop Enhancement on Corridor and improved access to bus stops.

3.2.2. Whilst the two projects have separate identified funding streams within the West of England Combined Authority CRSTS allocation, they have been considered as a single scheme for the purposes of the economic appraisal. Therefore, the Do Something scenario considers the scope of both Projects 2 and 3. Within the economic appraisal, the Do Something scenario is compared to the Do Minimum. This is the without scheme scenario and the underlying assumptions of this are detailed within the Overview of Transport Modelling section of this Economic Dimension.

3.3 Economic Appraisal Methodology

Overview of Economic Assessment

3.3.1. The economic assessment identifies and appraises the impacts over an appraisal period to determine the scheme's overall VfM. It takes account of the costs of developing, building and maintaining the scheme over the agreed lifetime of the asset.

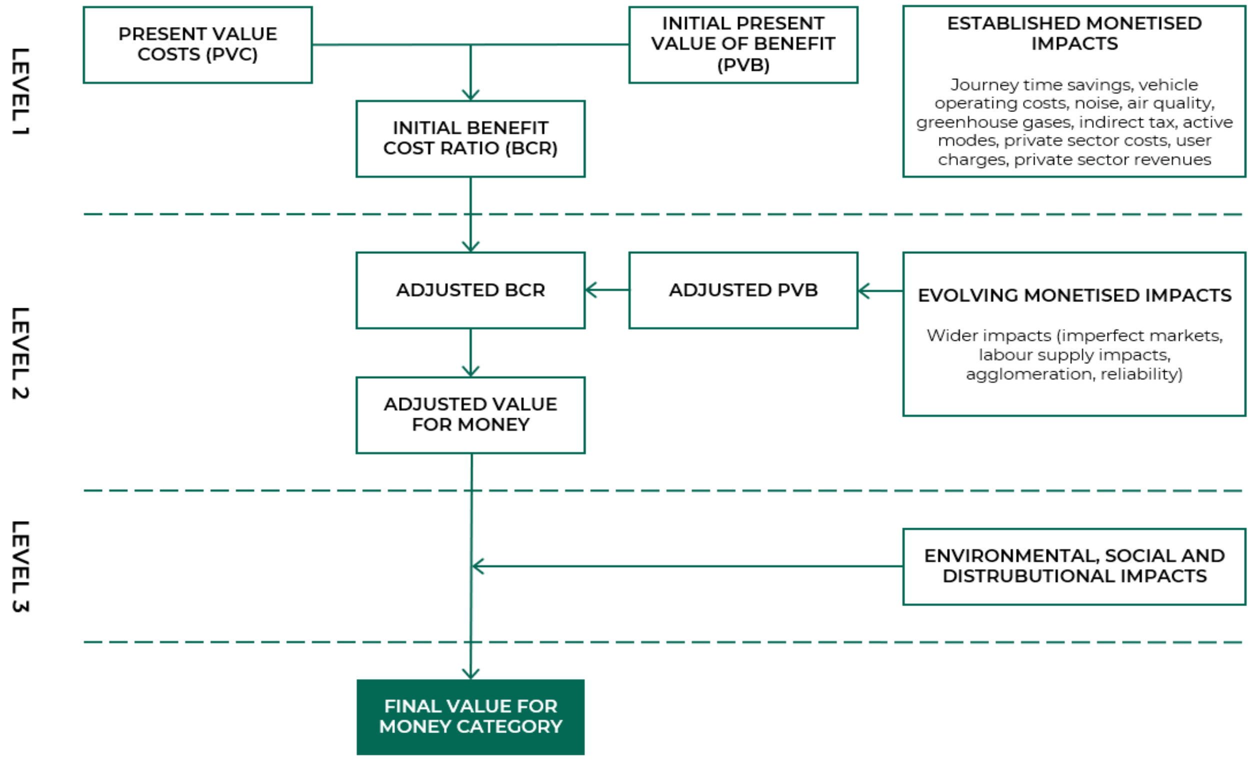
3.3.2. The appraisal has been undertaken in alignment with DfT's TAG and Value for Money Framework.

3.3.3. The DfT's Value for Money Framework sets out three levels of impacts of a transport proposal:

- Level 1 - Established Monetised Impacts - the impacts include user and non-user benefits of the scheme. These impacts form the initial Benefit Cost Ratio (BCR).
- Level 2 - Evolving Monetised Impacts - these impacts include reliability and wider economic impacts and form the adjusted BCR.
- Level 3 - Indicative Monetised Impacts and Non-Monetised Impacts - these impacts include induced investment and non-monetised environmental and social impacts. These impacts can be used as switching values for the change in VfM categorisation

3.3.4. It is the consideration of these three levels of impact which inform the overall VfM assessment. **Figure 3-1** shows an overview of the economic appraisal process that has been followed to inform the VfM assessment. The following sections of this chapter set out the approach to estimating the benefits and costs within each of the three stages.

Figure 3-1 - Process to derive BCR and Value for Money Category



3.3.5. The economic, environmental, social and distributional impacts of the scheme have all been examined, using qualitative, quantitative and monetised information as appropriate and proportional to the stage of development and the scale of the scheme.

3.3.6. Within the appraisal, benefits have been considered over an appraisal period from scheme opening in 2027, and design and construction costs are considered prior to scheme opening. The appraisal period reflects the asset life of the infrastructure and so for the public transport/highway elements of the scheme (captured in transport model) this is assumed to be 60-years, whilst for the active mode measures (captured in the Active Mode Appraisal Toolkit) a shorter period of 40-years has been used. This is in line with standard practice and guidance from Active Travel England (ATE) and DfT.

3.3.7. A number of tools have been used to estimate the benefits associated with the scheme, these are discussed in the sections below. The outputs of the tools have been brought together, alongside the costs, in a spreadsheet economic appraisal model. The economic appraisal model ensures all costs and benefits are in a consistent price base and allows the Present Value of Benefits (PVB), Present Value of Costs (PVC), Net Present Value (NPV) and Benefit Cost Ratio (BCR) to be calculated.

3.3.8. All costs and benefits within the appraisal are presented in the DfT's base year (2010) Present Values (PV), market prices (TAG Unit A1-1). Monetised impacts have been rebased to 2010 prices using Gross Domestic Product (GDP) Deflator forecasts from the TAG Data Book (v1.21 May 2023). Impacts have been converted to PV using social or health discount rates as set out in the TAG Data Book. Where required, impacts have been adjusted to market prices from the factor unit of account using the adjustment factor within the TAG Data Book.

Anticipated Impacts

3.3.9. The scheme is expected to promote a change in public transport, cycling and walking and wheeling connectivity for local communities along the A4. It aims to make sustainable transport the preferred option for short and medium journeys. This includes increasing the level of bus ridership and use of active modes for those who are able to use these forms of transport.

3.3.10. The impacts of the scheme include:

- Mode shift to bus, i.e., increases to the number of bus journeys
- Mode shift to walking and cycling, i.e., increases to the number of walking and cycling journeys
- Impacts on bus journey times along the A4 for all affected services
- Impacts on bus journey time reliability along the A4
- Impacts on cycling connectivity along the A4, and associated cycling journey times
- Impacts on cycling and walking and wheeling accessibility between communities along the A4, and from communities to the A4
- Impacts on general traffic journey times along the A4
- Impacts on public realm at bus stops and interchanges along the A4
- Impacts on green infrastructure along the A4
- Impacts on health and wellbeing for local residents
- Impacts on air quality, noise and carbon emissions along the A4
- Impacts on accidents along the A4

3.3.11. An Economic Narrative has been prepared to set out the economic context which underpins the anticipated scheme impacts. This Economic Narrative is included in **Appendix C**.

Overview of Transport Modelling

3.3.12. The West of England Regional Transport Model (WERTM) has been used to capture the highway and public transport impacts of the scheme. Both the Highway Assignment Model (HAM) and Public Transport Assignment Model (PTAM) have been used.

3.3.13. The available WERTM forecast years are 2029 and 2042. For the purposes of appraisal, it was considered that 2029 will align with the scheme opening year (2027). As it is within two years of the scheme opening year and the growth across this period is unlikely to be material. A second forecast year of 2042 has also been used as it is considered that this falls far enough into the future for the impacts of longer-term growth to be understood. This also fulfils the 15-year post-opening requirements of the 'Forecast Year' as defined in DMRB LA111 for Noise and Vibration assessments

3.3.14. Future year forecast scenarios have been prepared in line with the methodology set out in TAG Unit M4 and align with the TAG Data Book v1.21 Current version at the time of appraisal.

3.3.15. The forecasts developed for the OBC include a variable demand response, reflecting changes in travel cost between the base and forecast year brought about by economic, demand, and network changes. The demand response is modelled separately for the Do Minimum and the Do Something scenarios. The impact of the Variable Demand Model (VDM) on the forecasts is described in the Traffic Forecasting Report (**Appendix U**). It should be noted that the VDM while it does have walking and cycling demand it won't robustly capture modal shift to active modes, it will capture the change between highway and public transport. Mode shift to active modes will be assessed through the DfT's Active Mode Appraisal Toolkit (AMAT).

3.3.16. The WERTM VDM was updated to reflect the May 2023 TAG Databook (v1.21) in the refined HAM and PTAM. The values of time, and fuel and non-fuel operating costs applied in the VDM were updated to align to the values in the May 2023 TAG Databook (v1.21). No other updates were made to the VDM. The performance of the VDM, in replicating the observed base demand patterns and in responding to changes in travel costs, is reported in the WERTM Model Update report (**Appendix V**). The report details the difficulty in meeting TAG realism tests and how the PT fare elasticities fall outside of the prescribed elasticities prescribed by the DfT. The model is therefore not sufficiently sensitive to changing travel costs. With reference to earlier observations that 'DfT core' forecasts do not realistically represent future changes in private vehicle operating costs, it is currently difficult to predict the overall effect on forecasts once these two deficiencies are corrected. When introduced, larger increases to private vehicle operating costs are likely to reduce car mode shares. However a fully calibrated demand model is likely to reduce the shift to private vehicles which already feature in the model forecasts.

Demand Growth and Uncertainty

3.3.17. All assumptions for developing forecasts have been based on the current WERTM uncertainty log which was developed using data provided by each of the unitary authorities (UAs) during the forecasting stage (c2022). The Uncertainty Log assumptions for the project included the Bath Quays North development site and removed the Hicks Gate roundabout proposals and the A4 bus assumptions from the supply assumptions in the Do Minimum scenario.

3.3.18. This uncertainty log reflects all development sites and potential transport infrastructure schemes and assesses the level of certainty against the TAG levels. It also sets out the timeframe for developments and delivery of infrastructure schemes so that each site/scheme can be allocated to a suitable forecast year.

3.3.19. As per TAG, the core scenario reference case forecasts only include developments that are rated as 'Near Certain' or 'More Than Likely' in the uncertainty log. These sites have been point loaded as new zones in WERTM. No further growth has been added to the demand matrices, however the overall growth for cars, private LGV and public transport users across the West of England region has been controlled to match the unadjusted growth rates in NTEM at the local authority level. Under the core scenario, goods vehicles have been uplifted in line with projections provided by DfT's 2022 National Road Traffic Projections.

Active modes

3.3.20. In line with TAG Unit 5-1, the DfT’s Active Mode Appraisal Toolkit (AMAT) has been used to assess the benefits and costs of proposed walking and cycling interventions that form part of the scheme. The AMAT captures the impacts of the scheme in terms of journey quality to active mode users, health impacts from more people travelling by cycling or walking and decongestion impacts associated with modal shift from private car. Active mode impacts have been considered over a 40-year period from scheme opening in 2027. The May 2023 AMAT has been used within the appraisal. It is understood that the valuation of active mode benefits is higher within the November 2023 release of the AMAT, and so a sensitivity test has been undertaken to understand the impacts of transitioning to this later release. This is not the core scenario to ensure consistency with the remainder of the appraisal.

3.3.21. The AMAT requires inputs in terms of existing and anticipated demand, as well as changes in infrastructure provision, to evaluate these benefits. The AMAT combines the benefits linked to the intervention by integrating a set of assumptions from the National Travel Survey (NTS) concerning travel distance, travel speed, distribution of travel purposes, and factors affecting the diversion to active modes.

3.3.22. Benefits associated with the provision of dedicated cycling routes and facilities as part of the scheme have been considered. Two elements of the scheme have been appraised using the AMAT:

- Benefits associated with the strategic cycling corridor between Bristol and Bath
- Benefits associated with community connections, i.e., linking local communities along the A4 with the scheme through improved walking and cycling links

3.3.23. For each section of the corridor where there are proposals to improve the provision for active modes, the Do Minimum and Do Something infrastructure has been identified and considered against the input selections within the AMAT. Within the AMAT it is not possible to quantify the impacts of some elements of the scheme i.e., crossings/junction treatments.

3.3.24. The Appraisal Specification Report (ASR) stated that the TfL Ambience Benefit Calculator tool would also be used to estimate the benefits associated with improved active mode infrastructure. However, based on an initial assessment of the scale of the impacts, it was not considered proportionate to include this within the economic appraisal. Therefore, no further journey quality impacts to cyclists or pedestrians have been estimated beyond those within the AMAT. Therefore, it should be noted that what we are stating quantitatively for Active Modes is likely to be a conservative assessment

Infrastructure provision

3.3.25. **Table 3-1** shows the with and without scheme infrastructure selections used within the AMATs for each section of the corridor.

Table 3-1 - AMAT infrastructure selections

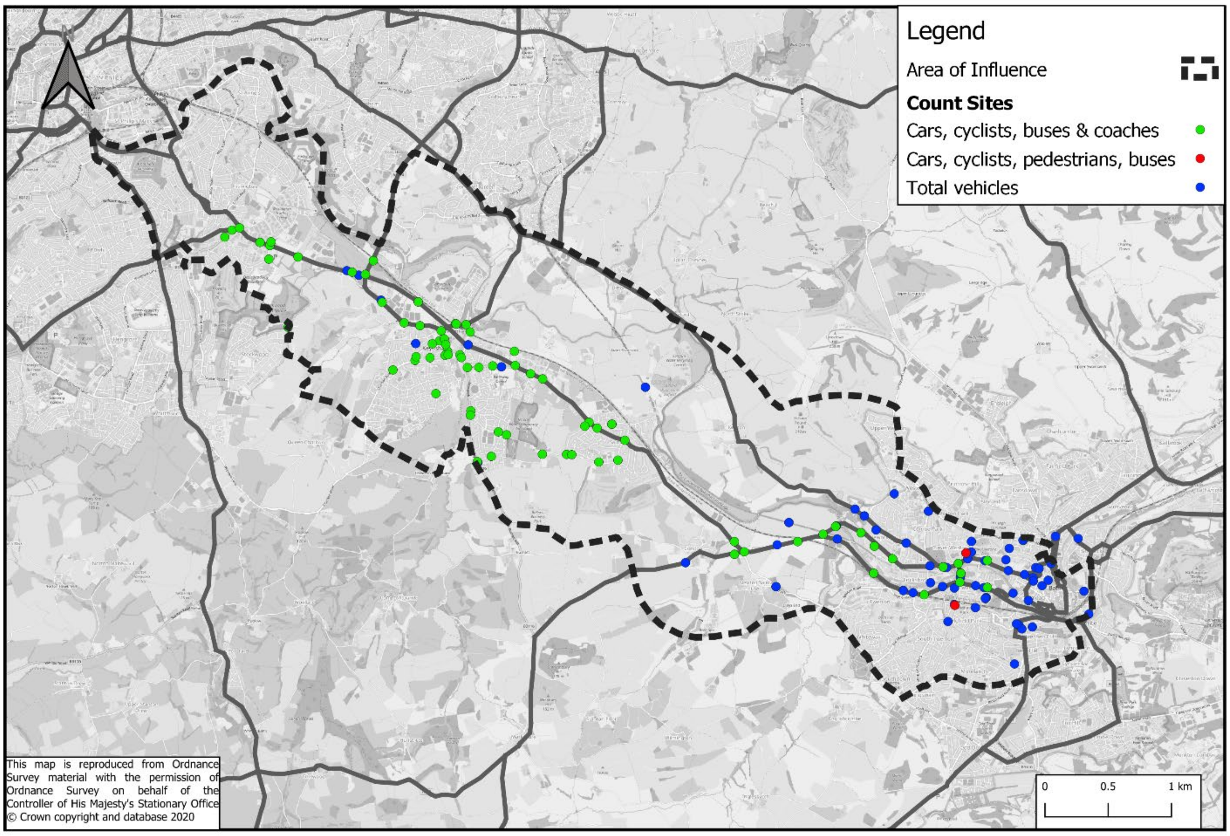
Area	Current infrastructure	With scheme infrastructure
Section 2 Emery Road to Hicks Gate Roundabout	On-road non-segregated cycle lane	Off-road segregated cycle track
Section 3 Durley Hill	On-road segregated cycle lane	Off-road segregated cycle track
Section 4 Broadmead roundabout to Saltford	On-road non-segregated cycle lane	Off-road segregated cycle track
Section 5 Globe roundabout to Twerton Fork	Off-road segregated cycle track	Off-road segregated cycle track
Section 6 Twerton Fork to Bath centre	On-road non-segregated cycle lane	On-road non-segregated cycle lane
Community Connections - Area 1 - Saltford, Norman Road and High Street	No provision	On-road non-segregated cycle lane
Community Connections - Area 3 Station Road	No provision	Off-road segregated cycle track
Community Connections - Area 3 High Street	No provision	On-road non-segregated cycle lane
BBRP Extension Railway Route	On-road non-segregated cycle lane	Off-road segregated cycle track
BBRP Extension Station Road	On-road non-segregated cycle lane	On-road non-segregated cycle lane

Current Demand

3.3.26. Current demand for cycling on the network was determined using existing survey data collected by B&NES between 2019 and 2023. The surveys were conducted in neutral months as specified by TAG Unit M1-2 and no adjustments were applied. Where the cycle intervention area contained more than one count site, an average of the counts across the intervention area was taken.

3.3.27. All the count data covered a 12-hour period between 7am and 7pm. Where count data was available for numerous years the latest available data was used. We used data outside the covid affected years (2020 -2021). **Figure 3-2** shows the sites with available count data. Only those sites that were directly on the route to be assessed were used.

Figure 3-2 – Map of count sites



3.3.28. Only one survey site included pedestrian count data therefore, to determine the walking demand, data from the NTS was used to provide a proportion uplift from cycling to walking demand for the relevant survey year (2019 and 2022). The proportion of trips made by walking and cycling was calculated. As we had survey count data for cyclists, this was divided by the cycling proportion and then multiplied by the walking proportion to give the walking baseline demand at that location.

3.3.29. Based on the NTS in 2019 2% of trips were made by cycle while 26% were made by walking, in 2022 2% of trips were made by cycle while 31% were made by walking.

3.3.30. **Table 3-2** shows the baseline demand for each section of the corridor where active mode infrastructure is proposed. The baseline demand is based on the 12-hour survey data which was used a proxy for the daily flows within the AMAT. The count data used is reflective of an average weekday. To account for this within the annualisation process, data collected on the A4 near the Globe Roundabout has been used to compare the demand on an average weekday compared to an average weekend day. Reviewing data for the month of June 2023, it was found that, on average, cycle demand on a weekend day was 78% of a weekday. Therefore, within the AMAT an annualisation factor of 340 has been used to expand from an average weekday demand input to an annual total.

Table 3-2 – Do Minimum (baseline) active mode trips

Area	Cycling	Walking
Section 2 Emery Road to Hicks Gate Roundabout	54	132
Section 3 Durley Hill	121	596
Section 4 Broadmead roundabout to Saltford	48	238
Section 5 Globe roundabout to Twerton Fork	75	156
Section 6 Twerton Fork to Bath centre	206	2,384
Community Connections - Area 1 - Saltford, Norman Road and High Street	90	2,119
Community Connections - Area 3 Station Road	205	3,569
Community Connections - Area 3 High Street	205	3,569
BBRP Extension Railway Route	588	182
BBRP Extension Station Road	588	182

3.3.31. For the BBRP extension no existing survey data exists. A nearby count taken on the existing BBRP off Locksbrook Road by Bath Spa campus was used to represent the demand along the on-road section of the BBRP along Brassmill Lane that the extension would replace. The survey recorded 728 pedestrians. There is already an informal path that is well used by locals along the old railway line, however the number of users is unknown. Based on the existing count data an assumption has been made that circa 25% would currently use the existing path along the old railway line.

The infrastructure to be provided is a cycle route which will be used by pedestrians along the old railway route. While there will be some pedestrians using the route it is considered that this will not be significant as there are other walking facilities in the area.

With Scheme Demand

3.3.32. The impact of the scheme on the number of cycle and walking scheme trips has been estimated using the DfT Uplift Tool.

3.3.33. The Uplift Tool uses the cost of the scheme, as well as type of intervention, as the basis on which the forecast cycling usage will increase when a scheme is delivered. A range of potential increases is given across low, medium and high scenarios with the most likely highlighted dependent on the type of intervention chosen.

3.3.34. **Table 3-3** shows the with scheme demand based on the Uplift Tool. Overall, this gives a higher with scheme demand than the comparative study uplift.

Table 3-3 - Do Something active mode trips

Area	Cycling	Walking
Section 2 Emery Road to Hicks Gate Roundabout	154	396
Section 3 Durley Hill	233	737
Section 4 Broadmead roundabout to Saltford	90	529
Section 5 Globe roundabout to Twerton Fork	130	362
Section 6 Twerton Fork to Bath centre	213	2,414

Area	Cycling	Walking
Community Connections - Area 1 - Saltford, Norman Road and High Street	124	2,162
Community Connections - Area 3 Station Road	370	3,864
Community Connections - Area 3 High Street	370	3,569
BBRP Extension Railway Route	655	210
BBRP Extension Station Road	655	210

3.3.35. Sensitivity tests have been undertaken assuming different approaches to the estimation of the with scheme cycling and pedestrian demand. These approaches include:

- Achieving the CRSTS modal share target
- Using comparative case studies

CRSTS modal share target

3.3.36. A sensitivity test has been undertaken assuming that the proportion of people travelling to work (commuting trips) by active travel measures accounts for 25% of the journeys made. This is in line with one of the objectives for the scheme. Census journey to work data along the route has been interrogated to supply the current modal share for travel to work journeys this is 3.4% for cycling and 19% for walking. Currently the overall active mode share is 22.5%, the uplift required to meet the 25% active mode share would be minimal a change of 2.5% over both modes. The Do Minimum baseline flows have been adjusted according to reflect this.

3.3.37. **Table 3-4** shows the with scheme demand based on the assumption that 25% of trips are via active modes.

Table 3-4 - Do Something active mode trips (sensitivity test)

Area	Cycling	Walking
Section 2 Emery Road to Hicks Gate Roundabout	56	125
Section 3 Durley Hill	126	620

Area	Cycling	Walking
Section 4 Broadmead roundabout to Saltford	40	247
Section 5 Globe roundabout to Twerton Fork	78	162
Section 6 Twerton Fork to Bath centre	214	2,478
Community Connections - Area 1 - Saltford, Norman Road and High Street	93	2,203
Community Connections - Area 3 Station Road	214	3,710
Community Connections - Area 3 High Street	214	3,710
BBRP Extension Railway Route	612	189
BBRP Extension Station Road	612	189

3.3.38. As stated previously the BBRP Extension infrastructure to be provided is a cycle route only along the old railway route, while there will be some pedestrians using the route it is considered that this will not be significant as there are other walking facilities in the area.

Comparative case studies

3.3.39. In order to estimate the uplift in demand resulting from the implementation of the scheme, a desktop research exercise reviewing comparative studies was conducted. This sought to find appropriate and comparable packages of interventions that had been implemented in other relevant locations in order to gauge the level of uptake that may be possible following such interventions.

3.3.40. A summary of the findings of the desk-based research into cycling and walking interventions are:

Sustainable Travel Towns

3.3.41. In 2004, three towns - Darlington, Peterborough and Worcester – jointly received £10 million funding from the DfT for the implementation of large-scale ‘smarter choice’ programmes over a five-year period, as part of the ‘Sustainable Travel Towns’ (STT) demonstration project. All three programmes put in place a range of initiatives aiming to encourage more use of non-car options – in particular, bus use, cycling and walking – and to discourage single-occupancy car use.

3.3.42. Evaluation of the Government's Sustainable Travel Towns project showed an increase in cycling trips between 26% and 30% resulting from improved infrastructure across the three towns. The evaluation showed a 10% to 13% increase in walking trips as a result of improved pedestrian facilities.

Cycling City and Towns Initiative

3.3.43. The Cycling City and Towns initiative evaluation indicated an overall increase in cycling trips from the baseline cycling numbers of 27%, and a 4% increase per annum. The Cycling City and Towns initiative sprang out of the Six Cycling Demonstration Towns which began receiving funding in 2005. The Cycling Demonstration Towns (CDT) programme ran from October 2005 to March 2011, and involved six medium-sized towns, with populations of between 65,000 and 245,000 people. The partly concurrent Cycling City and Towns (CCT) programme ran from July 2008 to March 2011. It involved one substantially larger city (Greater Bristol), one significantly smaller town (Leighton Linslade) and a further ten towns of medium size, with populations ranging from 75,000 to 240,000.

3.3.44. In all 18 towns and cities, the focus of the programme was on encouraging more cycling for short 'everyday' urban trips – that is, those trips which when made by car contribute disproportionately to congestion. Cycling trips increased across both programmes overall, and also individually in all 18 towns and cities, by different amounts. From automatic count data, there was an overall increase of 29% for the six CDTs in 5.5 years (range across towns: 6% - 59%); and an overall increase of 24% for the 12 CCTs over three years (range across towns: 9% - 62%).

3.3.45. The two studies detailed, which both aimed to reduce car journeys and improve journeys by sustainable means (bus, walking and cycling) showed an overall increase of 24% (CCT), 26% - 30% (STT) and 29% (CDT). It is considered that the scheme will lead to an 25% increase in cycle usage accrued as a result of the changes to cycling infrastructure.

3.3.46. The STT provide a good indicator of the likely walking uplifts associated with the scheme interventions, as the interventions were aimed at reducing car journeys and improving journeys by sustainable means not just at walking infrastructure in isolation. The range given for the SST is 10% to 13%, it is therefore considered that the uplift to be applied to the scheme is 10% where the infrastructure improvements include elements to be used by pedestrians.

3.3.47. **Table 3-5** shows the with scheme demand based on the evidence from the comparative studies.

Table 3-5 - Do Something active mode trips (sensitivity test)

Area	Cycling	Walking
Section 2 Emery Road to Hicks Gate Roundabout	68	132
Section 3 Durley Hill	151	656
Section 4 Broadmead roundabout to Saltford	48	262
Section 5 Globe roundabout to Twerton Fork	94	172
Section 6 Twerton Fork to Bath centre	258	2,622
Community Connections - Area 1 - Saltford, Norman Road and High Street	113	2,119
Community Connections - Area 3 Station Road	256	3,569
Community Connections - Area 3 High Street	256	3,569
BBRP Extension Railway Route	735	217
BBRP Extension Station Road	735	217

3.4 Scheme Costs

3.4.1. This section details the various costs associated with delivering and maintaining the scheme, and how these have been estimated and accounted for within the economic appraisal. The following cost lines have been considered for the OBC appraisal:

- Investment costs
- Maintenance and renewal costs, to estimate the whole life costs for the scheme

3.4.2. As the OBC is centred around the infrastructure requirements on the corridor the costs of this only will be included within the Financial Dimension and the economic appraisal. Improvements to the operating model of the service(s) on this corridor are being considered as part of the BSIP and therefore the costs (and benefits) will be captured as part of this workstream as opposed to this scheme. The impact of the scheme on transport operator revenue as a result of modal shift has been discussed in **Section 3.5.22**.

Capital Expenditure

3.4.3. At the OBC stage, scheme infrastructure costs were based on the available design information and applying unit rates to the bill of quantities. These costs have then been uplifted for indirect costs (STATS, preliminaries, professional fees, traffic management) using different percentage rates based on standard industry rates and benchmarks from other schemes of a similar nature.

3.4.4. These costs were profiled over the delivery period (2023-2027) and adjusted for inflation. Inflation has been applied in line with the latest Building Cost Information Service (BCIS) Tender Price Index (TPI) forecast at the time of preparing the costs (Q2 2023). Risk has been estimated based on a Quantified Risk Assessment (QRA).

3.4.5. Given the focus of the infrastructure delivered is on highway measures, TAG Unit A1-2 states that at the OBC stage, a 23% level of optimism bias should be applied to the base costs. The guidance states that this level of optimism bias is also applicable to active mode schemes. A comparison was made between the base costs adjusted for optimism bias and the risk-adjusted scheme costs to ensure that the scale of costs under these two approaches was similar. The optimism bias scheme costs were higher than the risk-adjusted scheme costs and as such the costs including optimism bias were used for the economic assessment of the scheme. The Financial Dimension shows the build-up of the scheme costs including the base cost and uplifts for indirect costs, risk and inflation.

3.4.6. Within the appraisal, costs have been adjusted to 2010 PV, in-line with guidance. **Table 3-6** shows the adjustments made to the capital costs within the economic appraisal.

Table 3-6 – Capital expenditure appraisal cost adjustments

Capital expenditure excluding risk (£m, nominal)	Application of optimism bias (£m, nominal)	Deflate to 2010 prices (£m, 2010)	Discount to 2010 values (£m, 2010 PV)	Adjust to market prices (£m, 2010 PV)
35.18	43.28	31.27	18.18	21.63

3.4.7. The scheme will be funded through CRSTS funds and local contributions.

Maintenance and renewal costs

3.4.8. In addition to the costs of delivering the scheme, there will also be costs associated with maintaining and renewing the infrastructure. These have been calculated over a 40 or 60 year appraisal period.

3.4.9. The maintenance and renewal costs have been estimated based on the required frequency of works, with further details provided in the Financial Dimension. Within the appraisal these costs are converted to 2010 PV.

3.4.10. In addition, the AMAT estimates the impact on infrastructure maintenance costs associated with modal shift to active modes from private car. This cost saving has been included within the PVC calculation. The scale of infrastructure cost saving estimated within the AMAT is suitably small such that it doesn't bias the appraisal by not including the maintenance and renewal costs of the new infrastructure.

3.4.11. **Table 3-7** shows the total maintenance and renewal costs over the appraisal period.

Table 3-7 - Maintenance and renewal costs

Cost Item	£m, 2010 PV
Maintenance and renewal costs	3.37
Maintenance and renewal savings (from AMAT)	-0.01

3.5 Economic Impact

Business users and transport providers

3.5.1. The principles behind the valuation of transport user costs are based upon monetising the changes in:

- Travel time, disaggregated into public transport user and highway user impacts
- User charges, including changes in fares, tariffs and tolls
- Vehicle operating costs met by the user (applicable to highway journeys only)
- Transport operator revenues

Travel Times

3.5.2. WERTM has been used to capture journey time changes to public transport and highway users as a result of the scheme. The DfT's Transport User Benefit Appraisal (TUBA) software has been used to calculate and monetise these impacts. The appraisal has made use of the current version of TUBA (v1.9.17) at the time when the modelling is undertaken. The outputs from TUBA are in 2010 Present Value, market prices (2010 PV).

3.5.3. Within TUBA, the outputs by modelled hour have been expanded to represent an annual value.

3.5.4. The factors to expand from modelled hour to modelled time period have been derived using count data from the local area. B&NES have a number of count sites located on the A4; this data was analysed to determine the factors used to expand from peak hour to peak period. These daily modelled periods have been annualised using a factor of 253 working days per year. The factors used are 708, 1,518, 733 and 1038 for the AM, Inter-Peak, PM peak and weekend periods respectively for the highway model. The weekend time period uses the Inter-Peak assignment model to provide inputs for time, distance and trip matrices. All factors have been derived from available ATC data in the study area.

3.5.5. The PTAM uses 759, 1,518, 759 and 655 for the annualisation factors based on 3, 6 and 3 times the annualisation factor of 253 for AM peak, interpeak and PM peak respectively. The weekend annualisation factor has been estimated from data provided by the DfT (Use of public buses Personal Travel Factsheet - March 2010). This suggests that passenger demand on a Saturday is on average 75% of the demand for a weekday interpeak and Sunday demand is 30% of the demand for a weekday interpeak.

3.5.6. Further detail of the approach to TUBA and its outputs are included within the Economic Appraisal Report (**Appendix W**).

3.5.7. Travel time benefits have been analysed to ensure that the level of benefit derived in each modelled year and time period is comparable and sensible. Travel time benefits have been analysed using a suitable sector system to better understand where benefits are generated and to identify any anomalies.

3.5.8. The first forecast year for WERTM is 2029, however it is currently assumed that the scheme will open in 2027. For the purposes of the OBC appraisal, the 2029 forecast has been used as a proxy for the opening year as it is only within two years of the opening year and the growth over this period is unlikely to be significant.

3.5.9. The monetised travel time impacts of the scheme, to bus and rail users, are shown in **Table 3-8**. The monetary values are presented in 2010 PV. The impacts are disaggregated into journey purpose and time period. Over the appraisal period, the overall travel time impacts of the scheme for public transport users is £7.04m in 2010 PV. The scale of the public transport journey time impacts is reflective that there is no change to the service operation of the X39 as part of the scheme as this is being considered as part of the BSIP. A sensitivity test has been undertaken which seeks to capture the potential uplift in impacts if there was a frequency upgrade also. This test is reported in **section 3.12** of the Economic Dimension.

Table 3-8 – PT passenger travel time impacts by time period (£m, 2010 PV)

Mode	User	AM	IP	PM	Weekend	Total
Bus	Commuting	0.94	0.39	1.11	0.16	2.60
Bus	Other	0.97	1.30	0.89	0.57	3.73
Bus	Business	0.12	0.08	0.23	0.01	0.44
Rail	Commuting	0.08	0.01	0.00	0.00	0.09
Rail	Other	0.09	0.03	0.04	0.01	0.17

Mode	User	AM	IP	PM	Weekend	Total
Rail	Business	0.01	0.00	0.00	0.00	0.01
Total		**2.20**	**1.81**	**2.28**	**0.75**	**7.04**

3.5.10. The majority (96%) of the public transport travel time impacts accrue to bus users. Of this, 38% of impacts accrue to those commuting whilst 55% of impacts accrue to users travelling for purposes other than commuting or business (i.e., leisure trips). The impact on travel times by rail is a very small element of the overall travel time impacts and arise due to improved access to rail, via bus, along the A4 corridor.

3.5.11. The highway user impacts of the scheme are presented in **Table 3-9**. User benefits are sub-divided into the journey purpose of road users. The introduction of the scheme results in a positive travel time impact for commuting purposes. However, for users travelling for business or other purposes (i.e., not commuting), the scheme results in disbenefits, resulting in an overall adverse impact on travel times for highway users.

3.5.12. These results derive from the fact that the scheme seeks to reallocate capacity where it can be afforded and where it would not have significant detrimental impact. The slight positive impacts for commuting arises due to the tidality of flows into Bristol and the shift away from car (and hence lower) demand along the A4 corridor.

Table 3-9 – Highway travel time impacts (£m, 2010 PV)

Road User	Travel Time
Commuting	1.39
Other	-4.97
Business (Personal)	-1.22
Business (Freight)	-0.26
Total	**-5.06**

User charges

3.5.13. There were no changes to the assumed public transport fares within the Do Something or Do Minimum scenarios. Therefore, user charge impacts will arise where the boarding or alighting stops have changed sufficiently to cause a change in the fare paid, i.e., a bus passenger boarding or alighting a bus service in a different fare zone or a rail passenger boarding or alighting a train at a different station. There may also be user charge impacts where trips which were previously by car are now by bus, or that were by rail and are now by bus and this has resulted in a different cost of journey.

3.5.14. **Table 3-10** shows the user charge impacts of the scheme, disaggregated into bus and rail users and by journey purpose, in 2010 PV. The overall monetary value of the user charge impacts of the scheme is £0.02m.

Table 3-10 – User charge impacts (£m, 2010 PV)

Mode	User	AM	IP	PM	Weekend	Total
Bus	Commuting	0.00	0.00	0.00	0.00	**-0.01**
Bus	Other	0.00	-0.01	-0.01	-0.01	**-0.02**
Bus	Business	0.00	0.00	0.00	0.00	**0.00**
Rail	Commuting	0.01	0.00	0.01	0.00	**0.02**
Rail	Other	0.00	0.01	0.02	0.00	**0.03**
Rail	Business	0.00	0.00	0.00	0.00	**0.01**
Total	**No data**	**0.00**	**-0.01**	**0.02**	**0.00**	**0.02**

Vehicle operating costs

3.5.15. Similarly, to the travel time impacts, for highway users the impact of the scheme on fuel and non-fuel Vehicle Operating Costs (VOCs) has been estimated using WERTM. TUBA has then been used to calculate, and monetise, these impacts. The outputs from TUBA are in 2010 PV. The VOC's related to the HAM are reported in **Table 3-11**.

3.5.16. The vehicle operating costs give an overall disbenfit. This suggests that this has been caused by longer journeys within the model with more travel time and fuel being used.

Table 3-11 – Transport User Benefits (VOCs) (£m)

Road User	Fuel	Non-fuel
Consumer User Benefits - Commuting	-0.04	-0.15
Consumer User Benefits - Other	-0.89	-0.01
Net Consumer Benefits	***-0.93***	***-0.17***
Business User Benefits - Business Personal	-0.03	-0.07
Business User Benefits - Business Freight	0.03	0.01
Net Business Impact	***-0.00***	***-0.05***
Present Value of Transport Economic Efficiency Benefits (PVB)	**-0.93**	**-0.22**

3.5.17. Impacts of the scheme on bus driver travel times, and fuel and non-fuel vehicle operating costs, which will be presented as changes in bus operator costs, have been estimated using the future year without-scheme and with-scheme HAM forecasts. The use of the HAM to estimate bus driver time impacts is in-line with guidance in the TUBA manual. The scheme has no impact on rail driver travel times.

Bus driver time and operating cost impacts

3.5.18. Bus travel times between Emery Road and Bath City Centre are forecast to reduce as a result of the bus priority provided as part of the scheme. This reduction in travel time is experienced by both the passengers travelling on buses on the corridor, as discussed in the previous section, and the drivers of those buses. Changes in bus travel times, and therefore speeds, does also impact the fuel and non-fuel costs of journeys.

3.5.19. Both the bus driver travel time and operating cost impacts accrue to the bus operators and are considered as part of the TEE table. The impacts were estimated in TUBA by using the bus route information extracted from the future year HAM SATURN assignments, as set out in the TUBA guidance.

3.5.20. **Table 3-12** shows the impacts of the scheme on bus driver time and operating cost in 2010 PV. The overall monetary value of the bus driver impacts of the scheme is £0.80m. These impacts have not been considered over the weekend period.

Table 3-12 – Bus driver impacts (£m, 2010 PV)

Element	**Total**
Travel time	**0.56**
Operating cost saving	**0.23**
Total	**0.79**

Transport operator revenues

3.5.21. Whilst there are negligible impacts on user charges perceived by passengers (presented in **Table 3-10**), operators of public transport services are expected to see changes in their revenues due to mode shift, especially from bus to rail, as a result of the scheme.

3.5.22. Reduced travel times will lead to increases in bus use, and therefore bus farebox revenues. Where travellers are now choosing to use buses along the A4 rather than the competing rail line, this will lead to a reduction in rail farebox revenues.

3.5.23. **Table 3-13** shows the estimated operator revenue impacts as a result of the scheme. It should be noted that these have been estimated through TUBA using outputs from the future-year PTAM forecasts at an appropriate level of detail for economic appraisal at OBC. They are not detailed operational revenue forecasts from a financial perspective.

3.5.24. Overall, there is a net reduction in operator revenue across all public transport modes over the appraisal period, amounting to just over -£0.34m in 2010 PV. This consists of an increase in bus operator revenue of £5.28m and a decrease in rail operator revenue of -£5.62m. The decrease in rail operator revenue is larger than the increase in bus operator revenue due to the price differential between rail and bus tickets, where bus fares are, generally, lower than rail fares.

Table 3-13 – Public transport operator revenue impacts (£m, 2010 PV)

Mode	Total
Bus	5.28
Rail	-5.62
Total	**-0.34**

Indirect Tax Revenues

3.5.25. The scheme will impact on indirect tax revenues accrued to the government due to:

- Changes in spend on public transport fares, fares are not subject to Value Added Tax (VAT), therefore an increase in expenditure on transport is offset by a decrease in expenditure elsewhere in the economy (and vice versa)
- Changes in bus operator (or driver) fuel and non-fuel VOCs
- Changes in highway user fuel and non-fuel VOCs

3.5.26. These impacts have been estimated in WERTM and TUBA.

3.5.27. The total monetary value of the change in indirect tax revenues is shown in **Table 3-14**, in 2010 PV.

3.5.28. It should be noted that the values in **Table 3-14** reflect the change in revenue as they would be presented in the Analysis of Monetised Costs and Benefits (AMCB) table. Therefore, positive numbers are benefits (or increases in revenue) to the government, whilst negative numbers are costs (or decreases in revenue).

Table 3-14 – Indirect tax revenue impacts (£m, 2010 PV)

Category	Indirect tax revenue
Bus fares	-0.71
Rail fares	0.91
Highway user VOCs	0.04
Total	**0.24**

Construction and Maintenance Impacts

3.5.29. As set out in the Appraisal Specification Report, until detailed design is underway and a contractor is appointed, the extent and duration of construction impacts are not yet fully known. Therefore, a quantified assessment of the potential construction and maintenance impacts on transport users has not been undertaken at this stage. The Construction Phasing Strategy (Appendix Y) provides an overview of the potential temporary traffic management measures for each section of the corridor based on the anticipated proposed works. It also provides the approximate construction duration. For most sections the likely impacts during construction include:

- Temporary traffic regulation orders for reduction in speed limit
- Temporary traffic lights
- Reduction in number of lanes that are open for use
- Management of non-motorised users
- Management of bus services

3.5.30. As the construction strategy is considered in more detail at the FBC stage, the impacts on transport users and local residents would look to be minimised or mitigated wherever possible.

Reliability

3.5.31. One of the operational objectives is that 95% of bus services run on time by 2030. The proposed infrastructure will support the realisation of this objective through improving the reliability of services on those sections where it is implemented.

3.5.32. Reliability has been assessed using information from AVL data and stop-to-stop demand matrices WERTM. The methodology used aligns with the guidance given in DfT TAG Unit A1.3.

3.5.33. AVL data has been used to calculate standard deviations for stop-to-stop delay. Delay is defined as the difference between the timetabled departure time and the actual arrival time with all negative values set to zero. The Do Minimum delays have been calculated directly from the AVL data. The Do Something delays have been estimated from an updated set of bus journey times where delays are reduced by 90% on sections where bus lanes are proposed with the scheme in place. The delays calculated are assumed to be representative of conditions in 2029 and 2042. TUBA has been used to monetise these impacts.

Over the 60-year appraisal period, there are estimated to be £2.67m of reliability benefits as a result of the scheme.. The impacts have been included in the Adjusted BCR, which is reported in **section 3.11** of this Economic Dimension.

3.6 Wider Impacts

3.6.1. As set out in the Economic Narrative the assessment of wider impacts is not included in the scheme assessment. Agglomeration is the main contributor to the wider economic impacts.

It attracts businesses and industries to be in close proximity. TAG measures effective density as a proxy for agglomeration and it seeks to measure the impact of changes in generalised travel costs and employment location. This is done using outputs from a transport model calculating generalised travel costs for each journey for all modes and journey purposes.

3.6.2. As the scheme seeks to improve sustainable transport facilities along the corridor, reallocating road space on the existing road network in some locations, the agglomeration impacts are likely to be skewed as the benefits accrued to the improved accessibility for public transport will be offset by the capacity reduction for private vehicular transport. Also, the transport model will not assess the impacts of the improved accessibility for the walking and cycling aspects. Based on this, it is not considered proportionate to undertake the appraisal productivity impacts of the scheme.

3.7 Environmental Appraisal

3.7.1. The process followed for the environmental appraisal aligns with the guidance presented within TAG Unit A3 Environmental Impact Appraisal and the Combined Authority Transport Appraisal Guidance.

3.7.2. The following impacts have been considered within the environmental appraisal:

- Noise
- Air quality
- Greenhouse gases
- Landscape
- Townscape
- Historic environment
- Biodiversity
- Water environment

3.7.3. Within TAG environmental impact appraisal, environmental impacts in the context of road transport is divided into two main categories:

- Traffic related environmental impacts (quantitative) – those that arise from changes in traffic characteristics (three topics – noise, air pollution and greenhouse gases); and
- Non-traffic related environmental impacts (qualitative) – those that arise from physical changes to the environmental brought about by proposed transport infrastructure (five topics – landscape, townscape, biodiversity, historic environment and water environment).

3.7.4. The appraisal results for each relevant environment topic are presented in the appropriate TAG worksheets provided in **Appendix D** which have then been used to complete Appraisal Summary Tables (AST) in **Appendix E**.

3.7.5. The appraisal has also been informed by the following documents:

- An Environmental Features Report (70093741-WSP-ENV-0001) which provides information on the environmental baseline and potential constraints to help inform the options appraisal process and the OBC for the project. It provides a high-level desk top study of existing information from desk top sources to identify potential environmental impacts that may constrain development or will need to be addressed during the design process and determines where further information, specialist studies or surveys may be required to further understand and manage those risks.
- A Biodiversity Net Gain (BNG) Assessment Report (**Appendix Z**) which provides the results of a BNG assessment using the Biodiversity Metric 4.0 Tool, to quantify losses and gains resulting from the proposed scheme and associated transport hub. The report also covers compensation scenarios for those areas of the Proposed Scheme which do not meet the required target of 10% BNG gain for the Proposed Scheme.
- A Natural Capital Assessment Report **(Appendix AA)** which provides the results of a natural capital assessment using the NATURE Tool, which shows changes in natural capital performance and benefits for the proposed Scheme and its associated transport hubs. The report also provides recommendations and opportunities for enhancement for natural capital within areas of the proposed Scheme.

Noise

3.7.6. The impact of the scheme on noise has been estimated using two approaches with the outputs combined in the spreadsheet economic appraisal model:

- Using outputs from the WERTM model to capture impacts due to changes in highway and public transport movements
- AMAT to capture impacts due to changes in highway movements as a result of modal shift to active modes

3.7.7. The methodology references the Design Manual for Roads and Bridges (DMRB) LA 111 Noise and vibration guidance where appropriate, however, this is not a full assessment under DMRB LA 111, as a proportionate appraisal has been undertaken, with the scope and methodology being tailored to support the OBC.

3.7.8. With regards to noise impacts, TAG Unit A3 impact appraisal previously focussed on annoyance; however, this emphasis has now shifted in light of growing evidence on the links between environmental noise and health outcomes. DEFRA has produced guidance on transport-related noise using an ‘impact pathway’ approach to include:

- Annoyance
- Sleep disturbance
- Health impact, including heart disease (acute myocardial infarction, or AMI), stress and dementia

3.7.9. These impact pathways are reflected in the TAG Workbook, with monetised values assigned to each based on the noise levels predicted under the Do Minimum and Do Something scenarios.

3.7.10. The TAG A3 methodology includes five steps as follows:

- Scoping
- Quantification of noise impacts
- Estimation of the affected population
- Monetary valuation of changes in noise impact
- Consideration of the distributional impacts of changes in noise

3.7.11. In order to quantify the noise level changes at each property, receptor specific noise level calculations have been undertaken for the following scenarios:

- 2027 Do Minimum
- 2027 Do Something
- 2042 Do Minimum
- 2042 Do Something

3.7.12. Noise levels have been calculated at each façade of each residential building in the study area (assumed to be an area 100m from the scheme). The façade subject to the greatest magnitude of change has been used in the analysis in line with the guidance in DMRB LA 111. Noise levels have been calculated in the 3D modelling software Canda adopting the methodology set out within the Calculation of Road Traffic Noise (CRTN) document.

3.7.13. The study area has been based on an area 100m from the scheme. Existing residential receptors within the study area have been identified using OS AddressBase® data. A total number of 1,382 dwellings are located within the main study area and have, therefore, been included within the assessment.

3.7.14. The existing baseline noise climate will consist of mainly road traffic noise from the existing roads along the scheme corridor.

3.7.15. The results of the noise appraisal are summarised:

- In the forecast year (2042), 12 households would experience an increase in daytime noise, whilst 882 households would experience a decrease in daytime noise.
- In the forecast year, 6 households would experience an increase in night-time noise, whilst 578 households would experience a decrease in night-time noise.

3.7.16. The appraisal indicates that the scheme is likely to have a beneficial impact on noise. Over the appraisal period this is estimated to be £5.53m (2010 PV).

3.7.17. The impact pathways described earlier in this section have been assessed. The following net present values have been calculated for all pathways:

- Sleep disturbance: £2.4m
- Amenity: £2.1m
- AMI: £0.57m
- Stroke: £0.18m
- Dementia: £0.28

3.7.18. Paragraph 2.2.7 of TAG Unit A3 states “As well as through the monetisation process described in step three below, night noise impacts should be assessed by determining the number of households where the WHO Interim Night Noise Target of 55 dB L_{night} noise level is exceeded for the last forecast year in the with and without scheme cases”.

3.7.19. In the Do Minimum forecast year, 285 receptors are predicted to exceed the target value of 55 dB L_{night}. In the Do Something forecast year, 291 receptors are predicted to exceed the target value of 55 dB L_{night}.

Air Quality

3.7.20. The impact of the scheme on air quality has been estimated using two approaches with the outputs combined in the spreadsheet economic appraisal model:

- Using outputs from the WERTM model to capture impacts due to changes in highway and public transport movements
- AMAT to capture impacts due to changes in highway movements as a result of modal shift to active modes

3.7.21. A quantitative appraisal of air quality impacts has been undertaken in accordance with TAG Unit A3, Section 3, and the appraisal includes:

- Scoping to determine the study area for assessment
- Quantification of air quality impacts
- Appraisal of local air quality impacts
- Appraisal of regional air quality impacts
- Monetary valuation of air quality impacts

3.7.22. The appraisal considers the effect of the scheme on the surrounding area during the operational phases.

3.7.23. The air quality appraisal used WERTM to determine the appraisal area, where traffic flows are predicted to undergo significant change due to the scheme. The traffic change criteria are any of the following:

- Annual average daily traffic (AADT) >=1,000
- Heavy duty vehicle (HDV) AADT >=200
- a change in speed band
- a change in carriageway alignment by >=5m

3.7.24. The study area over which air quality impacts have been considered is limited to corridors extending 200m either side of the potential Affected Road Network (ARN). The ARN is defined in accordance with TAG Unit A3. The quantification of changes in concentrations at properties within the study area due to the scheme has been calculated.

3.7.25. Air quality modelling was utilised to predict the potential impact of changes to vehicle emissions on air pollutant concentrations (NO_2 and $PM_{2.5}$) at the identified sensitive receptors. A summary of the modelled impacts in the scheme opening and forecast years is provided in **Table 3-15**.

Table 3-15 – Summary of potential impact on air pollutant concentration at identified sensitive receptors, No. of receptors

Year	**2029**	**2029**	**2042**	**2042**
Pollutant	**NO_2**	**$PM_{2.5}$**	**NO_2**	**$PM_{2.5}$**
Improvement	3,533	2,782	3,549	2,754
Worsening	725	809	723	838
No change	143	810	129	809

3.7.26. The local air quality modelling forecast that annual mean concentrations of NO_2 would improve (decrease) at 80% (2029) and 81% (2042) of the 4,401 identified receptors, worsen (increase) at 16% (2029) and 16% (2042), with no change at 3% (2029) and 3% (2042) of receptors. With respect to $PM_{2.5}$, annual mean concentrations are forecast to improve at 63% (2029) and 63% (2042) of receptors, worsen at 18% (2029) and 19% (2042), with no change at 18% (2029) and 18% (2042) of receptors, with the scheme in operation.

3.7.27. The local air quality assessment has demonstrated that more sensitive receptors would benefit from reduced concentrations of key pollutants (NO_2 and $PM_{2.5}$) compared to those that would experience increases in concentrations, as a result of implementing the scheme. This is predominantly attributed to the scheme reduction in traffic from the existing A4 road and associated link roads, thereby reducing vehicle emissions on these roads. Therefore, more receptors will experience an air quality benefit than those that will experience a worsening.

3.7.28. The change in total mass emissions of vehicle pollutants resulting from the scheme has been assessed, focussed on emissions of NO_x, PM_{10}, and $PM_{2.5}$, which can have air quality impacts on a regional, national, or international scale. The results of the assessment are summarised in **Table 3-16**.

Table 3-16 – Regional air pollutant emissions impacts (tonnes /year)

Pollutant	**NO_x**	**PM_{10}**	**$PM_{2.5}$**
DM (2029)	13.1	2.9	1.6
DS (2029)	11.4	2.7	1.5

Pollutant	NO_x	PM_{10}	$PM_{2.5}$
Change (2029)	-1.69	-0.25	-0.14
% Change (2029)	*-12.90%*	*-8.61%*	*-8.46%*
DM (2042)	12.3	3.0	1.7
DS (2042)	10.8	2.7	1.5
Change (2042)	-1.50	-0.25	-0.14
% Change (2042)	*-12.23%*	*-8.29%*	*-8.14%*

3.7.29. The regional emissions assessment has demonstrated that emissions of NO_x and particulate matter would decrease as a result of implementing the scheme. The predicted decrease in total mass emissions is attributed to the reduced number of vehicles travelling on the road network, with the scheme in operation.

3.7.30. The value of change in air quality for the scheme is calculated to be £0.21m (2010 PV), thus representing a slight improvement in air quality with the scheme being implemented.

Greenhouse Gas

3.7.31. For the purposes of this assessment, capital and user carbon have been assessed.

Capital Carbon

3.7.32. The capital carbon assessment includes Product, Construction, and End-of-Life Stages.

3.7.33. Emissions calculations for the materials required for the construction phase of the scheme have been completed by multiplying quantities of material by the relevant emissions factors to give the estimated greenhouse gas emissions (tCO_2e). In this assessment the emission factors were selected from the Bath ICE V3 database.

3.7.34. The emissions from the transport of materials and waste were calculated using assumed local (50km) and national (300km) transport distances. The tonnage of the materials and waste transported was multiplied by the distance travelled and by an appropriate emissions factor, selected from the UK Government emissions factors.

3.7.35. In the absence of information on the types of fuels used to operate the construction plant, the emissions from plant and equipment used during construction (A5) have been estimated based on the total construction cost, using best practice methods from the Royal Institution of Chartered Surveyors (RICS).

3.7.36. In addition to construction (A1-A5), emissions calculations for the use of materials required for the repair and maintenance of the scheme have been calculated using industry standard replacement intervals.

3.7.37. End of life impacts have also been considered by multiplying the quantity of material to be recovered or disposed by the relevant emissions factors to give the estimated greenhouse gas emissions (tCO_2e). For end of life, emissions from the transport of waste from site was also calculated assuming a local (50km) transport distance. The tonnage of waste transported was multiplied by the distance travelled and by an appropriate emissions factor, selected from the UK Government emissions factors.

User Emissions

3.7.38. The impact of the scheme on greenhouse gas emissions has been estimated using outputs from WERTM to capture impacts due to changes in highway and public transport movements.

3.7.39. End-user vehicle emissions were calculated in accordance with DMRB Volume 11, Section 3, Part 14 Climate; LA114. Emissions were quantified using TAG data (v1.21 - May 23) from the DfT. This considered the vehicle type, fuel type, forecast fuel consumption parameters and the appropriate emission factors. The project lifespan is assumed to be 60 years, in line with DMRB LA114 guidance. From this, emissions were quantified for each year over the lifetime of the scheme.

3.7.40. Please refer to the Methodology Report (which can be found in **Appendix B** of the Carbon Management Plan) for further detail.

3.7.41. **Table 3-17** shows the whole life impacts of the scheme.

Table 3-17 – Baseline carbon breakdown

Key modules/Impacts	**tCO2e**
A1-A3 (Product)	5,581
A4 (Product transport to site)	897
A5 (waste)	417
A5 (construction)	303
B3 & B4 (Repair & replacement)	3,679
B1 (Traffic + modal shift)	- 58,971
C1 (End of Life (EOL) waste)	227
C2 (Transport of EOL waste)	768

Key modules/Impacts	tCO2e
C3 & C4 (Recovery & Disposal)	152
Total	**- 46,948**

*Total values may vary slightly from the sum of values due to rounding errors.

3.7.42. The scheme is forecast to result in a carbon reduction of 58,971 tCO_2e associated with general traffic changes and modal-shift to bus and active travel, and a carbon impact of 12,023 tCO_2e associated with infrastructure. This equates to a net reduction of 46,948 tCO_2e over the 60-year appraisal period, with a monetary value of £5.10m (2010 PV, market prices). This valuation of carbon includes only non-traded emissions, and does not reflect changes in guidance in November 2023, as this was issued post appraisal of the scheme.

Landscape and Townscape

3.7.43. Landscape and townscape have been appraised qualitatively based on the environmental resources that they each represent and their attributes such as character, distinctiveness, sensitivity and value in line with the TAG Unit A3, sections 6 and 7.

3.7.44. A study area of 500m from the scheme was adopted for this appraisal. Within this area, the appraisal included a review of National Character Areas, landscape features (i.e., Public Rights of Way, Cycle Routes, National Trails and statutory and non-statutory designated features) and sensitive visual receptors (i.e., residential development and users of outdoor recreational facilities).

3.7.45. The key data sources for the appraisal are listed below:

- Natural England National Landscape Character Area Profiles
- DEFRA, MAGIC Maps
- Bing Maps, Ordnance Survey, and Aerial Mapping
- Sustrans, National Cycle Network Map
- National Trust, National Trails
- Long Distance Walkers Association, Long Distance Paths Map

3.7.46. The appraisal has followed the following methodology as required by TAG Unit A3 Chapters 5 and 6. This follows the five-step approach to appraising ‘environmental capital’:

- Step 1: Scoping and identification of study area (as detailed above).
- Step 2: The key landscape environmental resources have been identified and their features described as per the requirements of TAG Unit A3 Chapter 6, in terms of their pattern, tranquillity, cultural, landcover and summary of character.
- Step 3: The appraisal has been undertaken against the following set of indicators to establish the significance of the key landscape environmental resources in question; the scale at which it matters, rarity, importance, and substitutability.

- Step 4: An impact assessment has been undertaken of the schemes impact on the landscape in assessing the impact importance and substitutability will be particularly relevant.
- Step 5: An assessment of the significance of all impacts on the receptors has been undertaken to determine the overall appraisal score using the definitions for overall impact outlined in TAG Unit A3 Table 4. The significant impacts on the landscape have been summarised on the landscape Worksheets.

3.7.47. The study area falls within National Character Area (NCA) 107: Cotswolds and NCA 118: Bristol, Avon Valleys and Ridges.

3.7.48. There are a number of statutory designations within the 500m study area:

- Cotswolds AONB (now Natural Landscape)
- Two SSSIs (Newton St. Loe and Stidham Farm).
- The Great Spa Towns of Europe World Heritage Site
- City of Bath World Heritage Site.

3.7.49. There are many local and non-statutory designations within the 500m study area:

- Bristol and Bath Greenbelt
- Four areas of Ancient and Semi-Natural Woodland
- Four Registered Parks and Gardens (Brislington House, Newton Park, Kelston Park and Royal Victoria Park)
- Three LNRs (Stockwood Open Space, Manor Road Community Woodland and Carrs Woodland).

3.7.50. Several of the above designations are covered in the Biodiversity and Heritage sections (including further information on Conservation Areas and Scheduled Monuments). They are mentioned here as they are an attribute of the landscape and townscape character.

3.7.51. The National Cycle Network (NCN) Routes 4 and 16 are located within the 500m study area. NCN Route 16 and the Sustrans Avon Cycleway directly connect with the scheme.

3.7.52. There is one National Trail within the 500m study area (i.e., Cotswold Way) and eight Long Distance Paths within the 500m study area, namely:

- River Avon Trail
- BBRP
- Kennet and Avon Canal Walk
- Forest of Avon Community Forest Path
- Two Rivers Way
- Monarch’s Way
- Cotswold Round
- Circuit of Bath

3.7.53. In addition to the above designations, there are several sport and recreational grounds near to the scheme, from which visual receptors using them may have the potential to experience views of the scheme. Furthermore, the scheme is surrounded by many high sensitivity residential receptors. Of particular note, sections of the scheme are located within the settlements of Keynsham and Saltford.

3.7.54. The scheme as a whole includes proposals to expand the existing A4 carriageway boundary (i.e., widening both to the north and south), to create space for bus stops, bus shelters, shared paths, dedicated cycle lanes, and pedestrian footpath access, as well as many facilities that would be found in a new transport hub (i.e., cafe, toilets, bike storage). These newly introduced elements are considered to have significant impacts on localised landscape character and visual amenity. This is due to the extent of mature tree loss, possible damage to retained trees/vegetation (i.e., construction within Root Protection Area), and required earthworks. These effects are more apparent in more rural areas, or where increased visibility of the carriageway is apparent for residential receptors in close proximity. The proposal includes wildflower seeding as well as new tree and shrub planting which would help provide mitigation for this loss.

3.7.55. The proposed interventions along the BBRP are assessed to have the following impacts:

- "Pattern: Major impact - due to operation of lighting and its installation requiring removal of large areas of mature vegetation.
- Tranquillity: Major impact - due to removal of areas of mature vegetation and the potential installation of a raised walkway in Saltford.
- Cultural: Slight impact due to the removal of vegetation within the Kelston Park Registered Park / Garden.
- Landcover: Major impact - due to significant loss of mature vegetation and priority habitat.
- Character: Major impact via increases in both noise and light pollution, the removal of mature, priority habitat, and visual changes due to the potential installation of a raised walkway."

3.7.56. Overall, the impact of the scheme is assessed to be Moderate Adverse. This assessment is made in line with the criteria with TAG Unit A3. This is due to the extent of mature tree loss and required earthworks and retaining structures in close proximity to valued green space and cultural features (i.e., Keynsham Memorial Park), which would open up views of the carriageway for users of the local green space and some local residential properties.

3.7.57. Impacts on landscape can be managed and mitigated by abiding by measures recommended in a Construction Environmental Management Plan (CEMP), minimising access roads, compounds and diversions (during construction), minimising vegetation clearance wherever possible and providing mature enhancement planting to retain screening. The proposal to light a stretch of the BBRP could be revisited, as this has the potential to cause significant impacts to local landscape during operation.

3.7.58. It should also be noted that the BBRP design is not currently finalised. It is possible that, following revision to those proposals, that major adverse impacts could be avoided, from a reduction in lighting or an alteration to the new Saltford access point.

Historic Environment

3.7.59. The study area adopted for this assessment includes the following:

- Designated heritage assets within 100m of the scheme for sections 2-6
- Designated heritage assets within 25m of the Community Connection routes connecting to the A4 Bath Road
- Any locally listed and non-designated assets will be included at later stages of assessment

3.7.60. The key data sources used are:

- Historic England National Heritage List for England (NHLE) - statutory designations (Scheduled Monuments; statutorily listed buildings; Registered Parks and Gardens; Registered Battlefields) can provide a significant constraint to development.
- Local Planning Authorities (BCC and B&NES Council): data on Conservation Areas. These are areas of special architectural or historic interest, the character or appearance of which it is desirable to preserve or enhance.

3.7.61. The appraisal has followed the assessment methodology as required by TAG Unit A3 Chapters 5 and 8. This follows the five-step approach to appraising 'environmental capital':

- Step 1: Scoping and identification of study area
- Step 2: the key environmental resources have been identified and their features described as per the requirements of TAG Unit A3 Chapter 8, in terms of their form, survival, condition, complexity, context and period
- Step 3: The appraisal has been undertaken against the following set of indicators to establish the significance of each key historic environmental resource in question; the scale at which it matters, significance (value) and rarity
- Step 4: An impact assessment has been undertaken of the options on the historic environmental resources in terms of seriousness and scale. Incremental, secondary and cumulative impacts have also been considered. The extent to which resource is adversely affected or enhanced will be described
- Step 5: An assessment of the significance of all impacts on the receptors has been undertaken to determine the overall appraisal score using the definitions for overall impact outlined in TAG Unit A3 Table 8. The significant impacts on the historic environment have been summarised on the Historic Environment Worksheets for inclusion in the ASTs.

3.7.62. There are two World Heritage Sites within the study area:

- City of Bath
- The Great Spa Towns of Europe

3.7.63. There are no Registered Battlefields associated with any of the study areas of the scheme. Three Registered Parks and Gardens are within the study area of the scheme:

- Grade II* listed park and garden to Brislington House (known as Long Fox Manor) Registered Park and Garden (NHLE ref: 1001529) is located along the boundary of the scheme within the study area of section 2
- Grade I listed Royal Victoria Park Registered Park and Garden (NHLE ref: 1001257) is located 36m to the north of the southern extent of the study area for section 6
- Grade II* listed Newton Park Registered Park and Garden (NHLE ref: 1000567) along Bristol Road, A39 Wells Road, and Pennyquick road junction is located within the western extent of the study area of section 5

3.7.64. There are three Scheduled Monuments within the study areas of the scheme:

- The Abbey (NHLE ref: 1005416), a later medieval monastic abbey approximately 2m to the north of the study area near section 3, and the Keynsham Hub.
- Roman Settlement at Keynsham Hams, former Cadbury's Factory (NHLE ref: 1416459), buried remains of the core of the Roman town, possibly Traiectus. This asset is spread across approximately eight hectares and surrounded by ditches, approximately 90m to the north of the study areas near section 3.
- The Saltford Brass Battery Mill (NHLE ref: 1004607), a post medieval brass mill located adjacent to the study area extent for the Saltford section of the BBRP Community Connection.

3.7.65. The scheme passes through four Conservation Areas:

- Avon Valley Conservation Area – The study area for section 2 is located within the northernmost part of the Conservation Area.
- Keynsham Conservation Area - The study areas near section 3, the Keynsham Hub, and the Keynsham Centre Community Connection all are located within the northernmost part of the Conservation Area.
- Saltford Conservation Area - The study area near section 4 and the Saltford section of the BBRP Community Connection are located within the southernmost part of the Conservation Area.
- Bath Conservation Area - The study area near section 6 and the Bath Section of the BBRP Community Connection are located within the western part of the Conservation Area.

3.7.66. Multiple listed buildings are within the study area of the scheme:

- Within the study area near section 2 there is one Grade II listed building.
- Within the study area near section 3 there are two Grade I listed buildings, two Grade II* listed buildings and four Grade II listed buildings.
- Within the study area near section 4 there are 11 Grade II listed buildings.
- Within the study area of section 5 there is one Grade II* listed building and two Grade II listed buildings.
- Within the study area for section 6 there are 15 Grade II listed buildings.

- Within the study area for the Keynsham Hub there are two Grade I listed buildings, two Grade II* listed buildings and one Grade II listed building.
- Within the study area for the Keynsham Centre Community Connections there is one Grade II* listed building and 42 Grade II listed buildings.
- Within the study area for the Saltford section of the BBRP Community Connections there is one Grade II* listed building and 15 Grade II listed buildings.
- Within the study area for the Bath section of the BBRP Community Connections there are 23 Grade II listed buildings.

3.7.67. There are no heritage or archaeological assets in the study areas of the South-Western Keynsham Community Connections.

3.7.68. Within the scheme, there will be a negligible effect on two World Heritage Sites of the City of Bath and The Great Spa Towns of Europe, a major adverse impact on the Keynsham Conservation Area, a negligible impact on the Bath Conservation Areas, and a minor adverse effect to the settings of Grade II* registered park and garden, Newton Park.

3.7.69. Outside the scheme boundary, within the 100m study area, there would be a minor adverse effect on the Avon Valley Conservation Area, a minor adverse effect to the setting of Grade II* registered park and garden, the park and garden to Brislington House (known as Long Fox Manor), minor adverse effect on the scheduled monument of Roman Settlement at Keynsham Hams, former Cadbury's Factory, minor adverse effect on three Grade II listed buildings, neutral effect on the scheduled monument of Saltford brass battery mill, Saltford Conservation Area, one Grade II* and 17 Grade II listed buildings.

3.7.70. The Community Connection areas within the scheme would have a negligible effect on the two World Heritage Sites of the City of Bath and The Great Spa Towns of Europe, a minor adverse effect on the Keynsham Conservation Area, a negligible effect on the Saltford and Bath Conservation Area, minor adverse effect to the setting of Grade II* registered park and garden, Newton Park, minor adverse effect to Grade II* listed, Archway on Street at the Entrance to Park House (Park House not included) (NHLE ref: 1384632) and neutral effect on the Grade II listed building, Gateway, and Railings to Numbers 31, 33, and 35 (Keynsham House) (NHLE ref: 1384588). Outside the scheme boundary, within the 25m study area, there would be a neutral effect on the 30 Grade II listed buildings.

3.7.71. The extent of survival and potential of the Non-designated Archaeological Remains is unknown and would require further detailed assessment.

3.7.72. There is one scheduled monument and five listed buildings (two Grade I, two Grade II* and one Grade I) within the 100m study area of Keynsham Hub. It is likely that there is the potential for major adverse impact to the Keynsham conservation area owing to the introduction of new built forms within the scheme extent of the conservation area, there is likely minor adverse impact to the setting of the scheduled monument and the two Grade I listed buildings, because of the close proximity of the scheme to the asset and neutral impacts to the remaining three listed buildings (two Grade II* and one Grade I) within the study area. Within the scheme area, there will be a major adverse impact on the Keynsham Conservation Area.

3.7.73. Outside the scheme area, within the 100m study area, there would be minor adverse impact on the scheduled monument (The Abbey) and the two Grade I listed buildings (Keynsham Abbey Pier Base in the Garden of Number 3 (NHLE ref: 1384576) and Keynsham Abbey remains to the south of Number 3 (NHLE ref: 1384577) located within the scheduled monument constraint area, and neutral impacts on the Keynsham Conservation Area and three listed buildings (two Grade II* - Church of St John the Baptist (NHLE ref: 1384628) and Archway on street at the entrance to Park House (NHLE ref: 1384632) and one Grade II - Precinct wall to Keynsham Abbey (NHLE ref: 1392955)). There is an uncertain impact upon the non-designated archaeological remains within the scheme extent and study area.

3.7.74. There will be minor physical impact on two World Heritage Sites (City of Bath and Great Spa Towns of Europe) and one Conservation Area (Saltford) with the proposed interventions along the BBRP. There will be minor setting impact on two World Heritage Sites (City of Bath and Great Spa Towns of Europe), one Registered Parks & Gardens (Kelston Park) and three Conservation Areas (Saltford, Kelston and Bath). There will be minor settings impact on two Grade II* (NHLE ref: 1384672, 1384676) and three Grade II (NHLE ref: 1384677, 1384665, 1384664) Listed Buildings. The potential to impact upon buried archaeological remains would be dependent upon the nature of any ground disturbance proposed, the details of which are currently unknown. The proposed construction of elevated wooden ramps, retaining walls, or extension of the existing pathway might impact the potential archaeological remains.

3.7.75. **Table 3-18** shows the summary results of the qualitative assessment for the scheme and associated transport hub by TAG indicator.

3.7.76. Despite the anticipated impacts to the Keynsham Conservation Area, the overall impact of the scheme on the historic environment is considered to be slight, as other impacts throughout the scheme's layout are slight or negligible.

3.7.77. Impacts on the Keynsham Conservation Area, as well as the other impacted heritage assets, can be managed and mitigated by following best practice (via the adoption of a CEMP) during construction, consultation with groups such as Historic England, B&NES and local archaeological advisors, considering the setting of the assets during detailed design, and following any advice given from a Historic Environment Desk Based Assessment (HEDBA). This will be considered further as part of the next stages of scheme development.

Biodiversity

3.7.78. The study area adopted for this assessment includes the following:

- Habitats and species recorded in publicly available information within 500m of the scheme
- Statutory and non-statutory designated sites within 2km of the scheme

3.7.79. The appraisal has followed the assessment methodology as required by TAG Unit A3 Chapters 5 and 9. This follows the five-step approach to appraising ‘environmental capital’:

- Step 1: Scoping and identification of study area (as detailed above)
- Step 2: the key environmental resources have been identified and their features described as per the requirements of TAG Unit A3 Chapter 9, in terms of their area and features.
- Step 3: The appraisal has been undertaken against the following set of indicators to establish the significance of the key biodiversity environmental resource in question; the scale at which it matters, Importance, trend, substitution possibilities and value of features.
- Step 4: An impact assessment has been undertaken of the biodiversity resources in terms of magnitude of Impact. Mitigation is also considered in this step.
- Step 5: An assessment of the significance of all impacts on the receptors has been undertaken to determine the overall appraisal score using the definitions for overall impact outlined in TAG Unit A3 Table 9. The significant impacts on biodiversity have been summarised on the Biodiversity Worksheets.

3.7.80. Between Emery Road, Brislington and Royal Victoria Park, Bath, the BBSC passes through large swathes of agricultural land, with managed grassland fields and arable land bordered by a network of hedgerows and treelines. Large, mature, scattered trees are also present within the immediate landscape. Some, more routinely managed, landscapes are present along the length of the scheme and is associated with residential, commercial and recreational land uses.

3.7.81. The proposed BBRP improvements also pass through large swathes of agricultural land, but for a significant proportion of its length, is bounded on either side by deciduous woodland, which in portions is considered to be priority habitat, and may be considered Ancient Woodland if / when it is resurveyed. The easternmost section of the BBRP is within the city limits of Bath.

3.7.82. The River Avon flows westwards along the north of the scheme for much of the stretch of road, although Newbridge Road, within the eastern extent of the scheme, crosses the River Avon. The scheme also crosses several smaller watercourses at various points which feed into the River Avon, including the River Chew at Keynsham. The Great Western Main Line (GWML) railway lies between the River Avon and the scheme for much of the route. The BBRP element of the scheme also runs parallel to the River Avon for a length, crossing it twice.

3.7.83. Although there are no European or International designated sites (Ramsar, Special Area of Conservation (SAC), or Special Protection Area (SPA)) within 2km of the scheme, both the Avon Gorge Woodlands SAC and the Bath and Bradford-on-Avon Bats SAC lie within the wider landscape (within 10km of the scheme).

3.7.84. Multiple SSSIs and LNRs are present within the 2km buffer. The scheme and the 2km study area are within SSSI Impact Risk Zones (IRZ). Natural England will need to be consulted on the likely risks from the scheme within this risk zone.

3.7.85. The design of the BBRP improvements are still to be finalised. However, given its close proximity to deciduous woodland, there is the potential for major adverse effects upon the biodiversity of that area. Sections of the woodland is priority habitat and may be Ancient Woodland. Also, a range of protected species are anticipated to, or have been confirmed to, use this area, including bat species, badger, otter and protected invertebrates. As the BBRP designs are still to be finalised, it is possible that these effects do not come to pass, or are less severe, if, for example, a Saltford access does not result in vegetation clearance, or the lighting of Enhancement Area 2 is revisited.

Table 3-18 – Qualitative assessment of Historic Environment

Consideration	Preferred Option (Inc. Community Connections)	Keynsham Transport Hub
Form	Negligible Impact for the World heritage Sites, Negligible Impact on the Conservation Areas, Minor to Neutral Impact on Grade II* and Grade II buildings, Major to Minor Impact on Registered Park and Garden.	Direct Impact on the Conservation Area, No Direct Impact on Scheduled Monument, No Direct Physical Impact on Grade II* and Grade II buildings, Negligible to Minor Impact on Grade I building
Survival	Neutral Impact on all designated assets.	Direct Impact on Conservation Area, Neutral Impact on all other designated assets.
Condition	Neutral Impact on all designated assets.	Direct Physical Impact on Conservation Area, Neutral Impact on all other designated assets.
Complexity	Neutral Impact on all designated assets	Direct Physical Impact on Conservation Area, Neutral Impact on all other designated assets.
Context	Negligible Impact for the World Heritage Assets, Minor Impact on the Conservation Areas, Neutral Impact on Grade II* and Grade II buildings, Minor Impact on Registered Park and Garden	Direct Impact on the Conservation Area, Minor Impact on Scheduled Monument, Minor Impact on Grade II* and Grade II buildings, Minor Adverse Impact on Grade I building.
Period	Neutral Impact on all designated assets	Neutral Impact on all designated assets

3.7.86. There are multiple habitat types in multiple areas that are identified as Habitats of Principal Importance (HPIs) in accordance with Section 41 of the NERC Act 2006. Under Section 40 of the NERC Act 2006, every public body (including planning authorities) must, ‘in exercising its functions, have regard so far as it consistent with the proper exercise of those functions, to the purpose of conserving biodiversity’.

3.7.87. European Protected Species Licences (EPSLs) were returned for several sections of the scheme.

3.7.88. The scheme will impact areas of semi-natural habitat across the A4 corridor. The majority of the work will impact existing infrastructure however slithers and small areas of habitat will be impacted resulting in impacts to biodiversity. Areas of woodland, scrub and grassland habitats are expected to be impacted. Areas of habitat which lie within or in proximity to important sites for nature, such as designated sites, watercourses and connected habitat corridors will be affected. There is potential for priority habitats to also be impacted.

3.7.89. There are habitats that have the potential to support protected and notable species throughout the corridor. Additional field surveys are required to confirm habitat allocation and potential to support protected and notable species. The results of these surveys will inform the requirement for additional phase 2 surveys, licensing, mitigation and compensation. A biodiversity net gain assessment will quantify changes in biodiversity value using a metric. These assessments can inform requirements for ecological mitigation spaces, including areas for habitat creation and enhancement. Any requirements for offsetting will be identified and explored. Opportunities lie across the scheme to identify spaces for nature, mitigation and to tie into green infrastructure priorities and public access to green space.

3.7.90. The Keynsham Hub element of the scheme will impact areas of grassland and mature trees and woodland belts. The scheme has the potential to impact on connectivity of habitat. In proximity to the scheme to the east lies the River Chew, its woodland corridor, connecting the scheme to the River Avon in the north.

3.7.91. Habitats within the site will have potential to support protected and notable species. Subsequent field surveys will be carried out to confirm the potential presence of these species, additional surveys required, mitigation, licensing or compensation. Biodiversity net gain assessments will be required to quantify the changes in biodiversity value and look at any required additional measures to offset impacts.

3.7.92. Opportunities to enhance the local area, connect to wider landscapes and develop designs with benefit to nature are to be explored.

3.7.93. The overall assessment of the scheme has been classed as slight to moderate adverse. Areas of some habitats will be removed as part of the proposed scheme which could include areas of HPI woodland, scrub and grassland habitats. This removal has the potential to cause a Moderate Adverse impact in relation to HPI woodland. Trees may have potential to support roosting bats, impacts on these features are precautionarily assessed as having the potential to cause a Moderate Adverse impact.

3.7.94. The impacts to biodiversity due to the scheme can be managed or mitigated by detailed design being considerate to the impacts on biodiversity. A Habitats Regulations Screening Assessment (HRSA) and a Preliminary Ecological Appraisal (PEA) should both be undertaken. These may recommend mitigation and/or further survey work and the recommendations should be followed. Enhancement planting should be carefully considered, which would also help to obtain 10% BNG.

Biodiversity Net Gain (BNG)

3.7.95. The BNG assessments are a major step in determining whether the proposed scheme's design could achieve a quantitative BNG and compliance with the BNG Good Practice Principles (Construction Industry Research and Information Association (CIRIA), Chartered Institute for Ecology and Environmental Management (CIEEM) and the Institute of Environmental Management and Assessment (IEMA), (2019)).

3.7.96. BNG is the end result of a process applied to development so that, overall, there is a positive outcome for biodiversity. The process itself follows the mitigation hierarchy and sets out what must be done to firstly avoid, secondly minimise and thirdly restore/rehabilitate losses of biodiversity on-site, before compensating for residual losses off-site.

3.7.97. BNG is a specific assessment term which relates to a new and emerging process by which biodiversity is given a proxy numerical value (biodiversity units) and a metric quantifies a percentage change in those units. A series of qualitative principles underpin the BNG process.

3.7.98. BNG is mandatory for all Town and Country Planning Act and non-permitted development (with a couple of minor additional exclusions) from November 2023.

3.7.99. A BNG assessment has been included as part of the OBC appraisal, this outlines potential impacts on broad habitats, likely BNG deficits and opportunities to enhance and create habitats to meet an overall BNG outcome.

3.7.100. The BNG assessment is reported in the Biodiversity Net Gain Feasibility Assessment Report (ref 70093741-WSP-BNG-0001) which has been developed alongside the OBC.

3.7.101. The BNG assessments quantitative outcomes for area-based habitats and the resulting compensation area requirements are summarised in **Table 3-19**.

Table 3-19 – BNG quantitative area-based habitat outcomes

Route Option	Baseline BU	Post-development BU	Total compensation requirement (ha)
Bristol – Bath Corridor	39.99 -52.81	39.58 - 42.13	2.39 – 4.00
Keynsham Hub – Option 1 & 2	3.94	2.52	1.2

BU: Biodiversity Units

3.7.102. For linear habitats, it was identified that additional hedgerow compensation was needed for route wide BNG assessments. These linear habitats could be delivered through a combination of on site design and offset site compensation and will be explored further at the detailed design stage.

3.7.103. For the Keynsham transport hub there are relatively large losses of woodland which would result in larger overall requirements for compensation land. It would be beneficial to see if impacts to this broad habitat type could be reduced as the scheme develops.

3.7.104. Nonetheless, the design options for route wide and the transport hub have the potential to achieve 10% BNG. This would allow the scheme to align with National Legislation and Regional/local policy.

Water Environment

3.7.105. The study area adopted for this assessment was:

- Water features hydraulically linked within 1km of the scheme

3.7.106. The key data sources used in the appraisal include:

- Ordnance Survey Mapping
- Environment Agency Catchment Data Explorer
- MAGIC
- Bristol Avon Catchment Plan 2022-2027
- Environment Agency Flood Map for Planning
- Environment Agency Long Term Flood Risk mapping

3.7.107. The appraisal has followed the assessment methodology as required by TAG Unit A3 Chapters 5 and 10. This follows the five-step approach to appraising 'environmental capital':

- Step 1: Scoping and identification of study area
- Step 2: the key environmental resources have been identified and their features described as per the requirements of TAG Unit A3 Chapter 10, in terms of features against each brief descriptive text characteristics.

- Step 3: The appraisal has been undertaken against the following set of indicators to establish the significance of the key water environmental resource in question; the quality, scale, rarity and substitutability.
- Step 4: An impact assessment has been undertaken of the water environment feature in terms of magnitude of Impact.
- Step 5: An assessment of the significance of all impacts on the receptors has been undertaken to determine the overall appraisal score using the definitions for overall impact outlined in TAG Unit A3 Table 14. The significant impacts on the water environment have been summarised on the Water Worksheets for inclusion in the ASTs.

3.7.108. There are numerous watercourses within the study area of the scheme. Some of the watercourses are classed as Main Rivers (e.g., the River Avon) by the Environment Agency, while others are classed as Ordinary Watercourses (e.g., West Brook) by the Lead Local Flood Authorities (LLFA), B&NES Council, BCC, and South Gloucestershire Council.

3.7.109. The River Avon is a Main River. It flows in a south-east to north-west direction, predominantly on the north side of the scheme. The River Avon is crossed by the scheme immediately east of the Twerton Fork.

3.7.110. Brislington Brook is a Main River that flows in a south to north direction approximately 800m to the west of the A4 junction with Emery Road, joining the River Avon approximately 3km north of its crossing with the A4.

3.7.111. Scotland Bottom Watercourse is a Main River that flows in a west to east direction. The scheme crosses the river near Hicks Gate Farm on the A4 over an existing road bridge. Scotland Bottom flows to the north of the A4 before joining the River Avon.

3.7.112. Charlton Bottom Watercourse in a Main River that flows in a south-west to north-east direction. The scheme crosses the river on an existing road bridge on the A4, north-west of Keynsham.

3.7.113. The River Chew is a Main River that flows from Chew Valley Lake to Keynsham, where it joins with the River Avon. The scheme crosses the River Chew on an existing bridge on the A4 at Keynsham.

3.7.114. Broadmead Watercourse is a Main River flowing northwards. It is crossed by the scheme east of Keynsham at the A4/B3116 roundabout before joining the River Avon.

3.7.115. Corston Brook is a Main River flowing northwards to the River Avon. The scheme crosses Corston Brook on an existing road bridge on the A4, north-east of Corston.

3.7.116. Newton Brook is a main River flowing northwards to the River Avon, approximately 200m south of the scheme. The Newton Brook is crossed by the A36 at Twerton Fork on an existing road bridge.

3.7.117. The scheme is not within any Source Protection Zones (SPZ).

3.7.118. A small area of SPZ 1 and 2 is located approximately 100 m north-east of the A4 at Keynsham.

3.7.119. The majority of the scheme is located within Flood Zone 1 with a less than 0.1% annual probability of fluvial flooding. All sections of the scheme also contain areas of Flood Zone 2 (0.1% to 1% annual probability of fluvial flooding) and Flood Zone 3 (greater than 1% annual probability of fluvial flooding) in the land adjacent to the Main Rivers identified above.

3.7.120. The majority of the scheme has a very low risk of surface water flooding (less than 0.1% annual probability of surface water flooding). All sections of the scheme also contain areas at higher risk of surface water flooding, with these flood risk extents being broadly similar to those indicated to be at fluvial flood risk above. Areas of surface water ponding are also present adjacent to the A4 along all sections of the scheme.

3.7.121. All sections of the scheme, except Section 2, are at risk of reservoir flooding. In most instances, the extent of these at-risk areas is similar to those identified as of fluvial flood risk above, although often to a slightly greater extent and depth.

3.7.122. The scheme includes embedded mitigation, including a surface water drainage strategy which ensures that the potential impacts on the water environment will be insignificant. No increase in fluvial flood risk to any upstream or downstream receptors as a result of the scheme is foreseen. Sections of the scheme are at high, medium and low risk of flooding from surface water sources, and existing surface water flow paths have been incorporated into the scheme. The proposed surface water drainage system will provide appropriate treatment prior to discharge, and the re-purposing of the road has considered any hydromorphological and ecological considerations.

3.7.123. By Keynsham hub the Scheme may increase surface water flood risk due to an increase in impermeable area and an increase in fluvial flood risk due to a decrease in floodplain storage. However, these impacts are considered Negligible as they can be mitigated. Sections of the Scheme are at high, medium and low risk of flooding from surface water sources, and existing surface water flow paths have been incorporated into the Scheme. The proposed surface water drainage system will provide appropriate treatment prior to discharge, and the re-purposing of the road has considered any hydromorphological and ecological considerations.

3.7.124. Overall, the impact of the scheme on the water environment is considered to be Neutral.

Summary

3.7.125. **Table 3-20** summarises the environmental appraisal of the scheme, based on the current level of detail of the design and prior to identification of suitable mitigation measures.

Table 3-20 - Environmental appraisal summary

Impact	Assessment
Noise	£5.53m (2010 PV)
Air quality	£0.21m (2010 PV)
Greenhouse gases	£5.10m (2010 PV)
Landscape & townscape	Moderate Adverse
Historic environment	Slight Adverse
Biodiversity	Moderate Adverse
Water environment	Neutral

3.8 Social, Distributional and Place Based impact appraisal

3.8.1. The social, distributional and place-based impact appraisal has been undertaken in line with the guidance set out by DfT in TAG Units A4.1 Social Impact Appraisal, A4.2 Distributional Impact Assessment and A4.3 Place Based Analysis.

3.8.2. The full Social and Distributional Impact (SDI) report is attached in **Appendix F**, the following sections set out a summary of the report.

Social Impacts

Commuting and Other Users

3.8.3. The appraisal of commuting and other users has been undertaken through TUBA as detailed for **business users and transport providers.**

Physical Activity

3.8.4. The appraisal of the physical activity impacts has been undertaken in accordance with TAG Unit A5.1 Active Travel Mode Appraisal. DfT's AMAT has been used to assess the impact of the proposed cycling and walking interventions. As set out in **section 3.3** there are eight sections where an AMAT has been undertaken. The individual AMAT outputs are attached at **Appendix H**, and the monetised impact across the various elements of the AST have been set out in the appropriate sections of this Economic Dimension. **Table 3-21** shows the impact on physical activity of increased active travel. Over the 40-year appraisal period this equates to £18.73m (2010 PV).

Table 3-21 – Physical Activity Impacts

Analysis of Monetised Costs and Benefits (in £m, 2010 PV)	Analysis of Monetised Costs and Benefits (in £m, 2010 PV)
Reduced risk of premature death	16.13
Absenteeism	2.61

Journey Quality

3.8.5. Journey quality refers to the real and perceived physical and social environment experienced while traveling. It encompasses various factors that can affect the quality of a journey, including cleanliness, facilities, information provision, safety perceptions, accessibility, crowding, and more. Journey quality can be influenced by both travellers themselves and network providers/operators.

3.8.6. For the scheme journey quality has been considered in terms of the impact on bus users of improved waiting facilities, and journey quality impacts to active mode users of improved quality of infrastructure.

Bus User Impacts User Experience

3.8.7. As part of the scheme, aligned with the emerging proposals from the Combined Authority BSIP, some bus stop facilities serving the A4 corridor will be improved, and a transport hub will be delivered in Keynsham.

3.8.8. To measure the benefits of the improved waiting environment, generalised minute values for a series of 'soft factors', displayed in **Table 3-22** and taken from TAG Data Book section M3.2.1, have been applied to forecast bus demand at specific stop locations which are proposed to be upgraded. These include Keynsham Hub (CCTV at bus stop, climate control, new bus shelters, new interchange facilities, on-screen displays, RTPI), Hicks Gate (new bus shelter and RTPI), Ellsbridge House (RTPI), Tyning Road Saltford (RTPI) and Globe roundabout (RTPI).

Table 3-22 – Soft Factors: Generalised Minute Values

Soft Measure	Bus Users	Car Users	Overall
CCTV at Bus Stops	3.70	2.49	2.91
Climate Control	1.24	Not applicable	Not applicable
New Bus Shelters	1.08	Not applicable	Not applicable
New Bus with Low	1.19	2.23	1.78

Soft Measure	Bus Users	Car Users	Overall
New Interchange	1.27	Not applicable	Not applicable
On-Screen Displays	1.90	0.89	1.29
RTPI (at bus stops)	1.47	1.74	1.69
Simplified Ticketing	0.84	2.06	1.43

3.8.9. For most of the locations, it has assumed that only boarding passengers benefit from the proposed improvements, i.e., whilst waiting at a bus stop. However, at Keynsham Hub, alighting travellers may also benefit from some of the proposed improvements, namely CCTV, as it has been recognised that under the proposed scheme, Keynsham Hub would become a Transport Hub.

3.8.10. Only the appropriate measures have been included within the analysis where they align to the scheme. Boarding and alighting information from the WERTM PTAM model has been used to inform the demand at these locations. AM, IP and PM peak boarding and alighting have been annualised following the methodology set in the analysis of travel time changes. Similarly, 2029 and 2042 are the two forecast years in WERTM with the scheme opening year of 2027. It has been assumed that the 2029 demand forecast can be used as a proxy for 2027 demand. Between 2029 and 2042, the demand has been extrapolated, using an assumption of linear growth. Post-2042, the demand has been kept constant.

3.8.11. To consider the different nature of the quality improvements, the benefit per boarding and alighting as well as the appropriate appraisal periods have been selected individually for each of the locations with a 60-year appraisal period for Keynsham Hub and a 20-year appraisal period for the remaining locations. This is to represent the longer life cycle of the proposed transport hubs as compared to standard bus stops.

3.8.12. In line with the appraisal guidelines, the rule of a half has been applied, assuming that current users benefit fully from the proposed changes whilst the new user's benefit equals to half of the existing user's benefit. It has been noted that for some of the locations, the Do Something demand is lower than Do Minimum demand, what can be explained by some of the Keynsham Hub's demand being abstracted from the existing bus stops.

3.8.13. The impacts have been monetised over the aforementioned appraisal periods using values of time sourced from TAG Data Book section A1.3.2 and an assumed all week average PSV journey purpose split and have been estimated to be £1.33m (2010 PV, market prices) across all the locations.

Active Mode Journey Quality

3.8.14. Journey quality benefits to active mode users have been quantified and monetised within the AMAT, capturing where improvements to the infrastructure results in a monetised benefit. Over the 40-year appraisal period the impact on journey quality for cyclists and pedestrians is estimated to be £2.77m (2010 PV).

3.8.15. At this time no further urban realm impact analysis has been undertaken. This is a change to the ASR where we stated that we would use TfL's Ambience Benefit calculator for the assessment. However, this is no longer considered proportionate given the likely scale of the benefit.

Accidents

3.8.16. The proposed scheme is likely to result in impacts on accidents from two perspectives:

- Changes in number of vehicle accidents through changes in use of the highway network
- Changes in number of pedestrian and cyclist accidents through provision of improved infrastructure

The impact of the scheme on accidents has been quantified using the DfT's accident appraisal software, Cost and Benefit to Accidents - Light Touch (COBALT)

3.8.17. COBA-LT is the DfT's program for calculating the cost benefit analysis from changes in the number of road traffic accidents. The appraisal used COBA-LT version 2.5 and the parameter file associated with version 1.21 of the TAG Data Book (released in May 2023).

3.8.18. COBA-LT assesses the safety aspects of schemes by calculating the number of accidents on each highway link in each year of the evaluation period under the Do Minimum and Do Something scenarios. COBA-LT can either calculate accidents for road links and road junctions separately or combined. For the appraisal of the scheme the combined link and junction accidents were assessed using assignment results from WERTM as inputs. Annual Average Daily Traffic (AADT) flows were derived from WERTM for the forecast years.

3.8.19. The COBA-LT program was run using the links of A4. the accident benefits were calculated over the 60-year appraisal period.

3.8.20. The projected changes in the numbers of accidents, over the appraisal period for the scheme are presented in **Table 3-23.** The COBA-LT analysis estimates that over the 60-year appraisal period, 71.2 accidents would be avoided as a result of the scheme compared to the Do Minimum.

Table 3-23 – Accident Savings Over Appraisal Period

Year	Accident Summary (PIAs) Do Minimum Accidents	Accident Summary (PIAs) Do Something Accidents	Accident Summary (PIAs) Reduction in accidents
Total for all Years	2,440	2,369	71
2026	46	46	0
2041	40	39	1

3.8.21. COBA-LT provides a summary of the predicted number of casualties saved as a result of the scheme. This is presented in **Table 3-24**. The data indicates a significant reduction in Slight and Serious Casualties, with a slight increase of 0.3 in fatal casualties over a 60-year period following the implementation of the scheme.

Table 3-24 – Casualty Summary Over 60 Years

Scenarios	Casually Category	Total for all Years	2026	2041
Do Minimum	**Fatal**	20.1	0.4	0.3
Do Minimum	**Serious**	282.5	5.4	4.6
Do Minimum	**Slight**	2,983.00	56.6	49
Do Something	**Fatal**	20.5	0.4	0.3
Do Something	**Serious**	278.4	5.3	4.6
Do Something	**Slight**	2,898.80	56.1	47.6
Change	**Fatal**	-0.3	0	0
Change	**Serious**	4.2	0	0.1
Change	**Slight**	84.2	0.5	1.4

3.8.22. The economic benefit of the accident savings was calculated by comparing the cost of accidents over the 60-year appraisal period, under the Do Minimum and Do Something scenarios. The benefits arising from the overall accident savings are summarised in **Table 3.25**.

Table 3-25 – Present Value of Accident Savings Over 60 Years

Year	Do Minimum Accident Costs (£m)	Do Something Accident Costs (£m)	Impact of scheme (£m)
Total for all Years	92.66	90.88	1.78
2026	2.71	2.69	0.02
2041	1.82	1.80	0.04

3.8.23. Over the 60-year appraisal period the impact on accidents is estimated to be £1.78m (2010 PV).

Security

3.8.24. The delivery of transport schemes and interventions may affect the level of both real and perceived security for transport users. In line with TAG Unit A4.1, a qualitative assessment has been undertaken to consider the changes in security due to the scheme and the likely number of users affected. Since the scheme is focused towards improving the public transport infrastructure, a slight benefit in security for the public transport (PT) users are anticipated as compared to the existing scenario. The impact has been assessed as Slight Beneficial as population affected is less than 500.

Accessibility

3.8.25. As recommended in TAG Unit A4.1, to assess the impact on accessibility a screening of accessibility and a Distributional Impact Analysis has been undertaken. The latter identifies the impacts on different groups of people considering different elements of a journey.

3.8.26. The schedule of the existing bus route X39 is modified to meet the existing and future demand of the users. But there are no new routes proposed along the corridor. The active travel infrastructure is expected to increase accessibility along the corridor. The transport intervention has a beneficial effect on both households with and without a car, however the impacts are slightly more beneficial for households without a car. Hence, the social impact is scored as ‘Slight Beneficial’.

Personal affordability

3.8.27. As recommended in TAG Unit A4.1, to assess the impact on affordability a screening of impacts and a Distributional Impact Analysis has been undertaken. The latter identifies the impacts on different groups of people considering different elements of a journey.

3.8.28. The only element assessed for the affordability impact appraisal was fuel and non-fuel operating costs, as the other impacts were not considered to be relevant (or would occur) as a result of the scheme. As there are no proposed changes to PT fares, car parking fees or any other vehicle costs. A full Distributional appraisal of fuel and non-fuel costs were however required, due to the vehicle operating costs as shown in the TUBA outputs. Personal affordability is scored as a Neutral impact.

Severance

3.8.29. To assess the impact of the scheme on severance, a qualitative assessment of the difference in the level of severance in the Do Minimum and Do Something scenarios has been reviewed in line with TAG Unit A4.1. The assessment considered the nature of any change in severance and the number of people potentially impacted.

3.8.30. The scheme is expected to decrease the private car traffic between the town centres of Bristol and Bath. The new active travel infrastructure and improved connections to public transport facilities will reduce the severance of vulnerable groups to access the amenities like bus stops, community centres, hospital etc.

3.8.31. Considering the extent of the scheme and the number of people affected, Severance is scored as Moderate Beneficial.

Option and non-use values

3.8.32. TAG Unit A4.1 states that option and non-use values should be 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). As the intention of the scheme is to provide the infrastructure to enable an *improved* service to run between Bath and Bristol, it is not considered that there will be any significant impact on option and non-use values. Therefore, no assessment has been undertaken as part of the OBC.

Summary

3.8.33. **Table 3-26** summarises the social appraisal of the scheme, based on the current level of detail of the design.

Table 3-26 - Social appraisal summary

Impact	Assessment
Physical activity	£18.73m (2010 PV)
Journey quality	£4.10m (2010 PV)
Accidents	£1.78m (2010 PV)
Security	Slight Beneficial
Accessibility	Slight Beneficial
Personal affordability	Neutral
Severance	Moderate Beneficial
Option and non-use values	Not assessed

3.8.34. The purpose of Distributional Impact (DI) analysis is to determine how different social groups are impacted by proposed infrastructure (and investment), positively or negatively. The DfT's TAG Unit A4.2, provides the guidance to be used and within that contains eight appraisal indicators which should be considered. These relate to different appraisal categories typically found within an appraisal of scheme impacts, namely:

- User benefits
- Noise
- Air quality
- Accidents
- Security
- Severance
- Accessibility
- Personal affordability

3.8.35. The social groups focus on vulnerable groups identified within the Equalities Act, and relate to age, ethnicity, those with disabilities, gender, and economic categories.

3.8.36. The distribution of impacts amongst different social groups is important due to the way they experience transport investment in infrastructure and services differently. For example, people with access to a car may experience fewer benefits to those without a car for an intervention that improves local public transport services. It is important to consider vulnerable groups and demonstrate that they are not disadvantaged further by receiving a disproportionately low share of the scheme's benefits, or a disproportionately high share of the disbenefits.

3.8.37. The assessment follows a three-step approach for each indicator:

- Step 1 – Screening Process:
  - Identification of likely impacts for each indicator
- Step 2 – Assessment:
  - Confirmation of the area impacted by the transport intervention (impact area)
  - Identification of social groups in the impact area
  - Identification of amenities in the impact area
- Step 3 – Appraisal of Impacts:
  - Core analysis of the impacts
  - Full appraisal of DIs and input into AST

3.8.38. **Table 3-27** is a summary of the assessment undertaken while **Table 3-28** is the output summary table proforma from the assessment, with full details provided in the SDI Report.

Table 3-27 – DI Summary

Impact	Seven Point Scale assessment	Summary
User Benefits	Slight Beneficial	For highway users, the scheme proposal will generate some disbenefits to the highway users as the scheme focuses on enhancing the public transport and active travel connections. Therefore, highway users will experience slight severance associated with these improvements leading to more travel time. The adverse impact is primarily felt by residents in the most economically deprived areas (Quintile 1 with 76% disbenefits), as they will face greater challenges in affording a car journey. For PT users. all the quintiles experience a benefit from the scheme. The majority of the benefits (33%) are accrued by people within the mid-income quintile (Quintile 3) within the impact area followed by quintile 2 (24%), whereas those in the most deprived areas (Quintile 1) and the least deprived areas (Quintile 4 and 5) experience a smaller than expected proportion of benefits. DI in overall appraised as Slight Beneficial as the drawbacks related to the highway users are expected to be counterbalanced by the scheme's positive impacts on public transportation (PT), with PT user benefits estimated at £6 million. The implementation of bus priority measures aims to reduce travel time for buses commuting from Bath to Bristol. Furthermore, there are secondary effects on overall journey time, as alterations in travel times along the A4 corridor may influence interconnectivity with other services, reducing interchange times.
Noise	Moderate Beneficial	In the forecast year, 12 households would experience an increase in daytime noise, whilst 882 households would experience a decrease in daytime noise and 6 households would experience an increase in night-time noise, whilst 578 households would experience a decrease in night-time noise. The overall appraisal indicates that the operation of the Proposed Scheme is likely to generate a beneficial noise impact and indicated that noise levels are predicted to improve in each of the income domains for the forecast year of the Proposed Scheme (2042). This includes a moderate beneficial change in the two most deprived areas.
Air Quality	NO_2:- Moderate Beneficial $PM_{2.5}$: Large Beneficial	The local air quality assessment has demonstrated that more sensitive receptors would benefit from reduced concentrations of key pollutants (NO2 and PM2.5) compared to those that would experience increases in concentrations, as a result of implementing the Proposed Scheme. This is predominantly attributed to the Proposed Scheme reducing traffic from the existing A4 road and associated link roads, thereby reducing vehicle emissions from the existing A4 Therefore, more receptors will experience an air quality benefit than those that will experience a worsening. NO_2:- The results of the assessment indicate that local air quality, with respect to concentrations of annual mean NO2, is predicted to improve in each of the income domains for the opening year of the Proposed Scheme (2029). This includes a slight beneficial change in the most deprived areas; and a large beneficial change in the second most deprived area. The least deprived area likely to have a moderate beneficial change. $PM_{2.5}$: The results of the PM2.5 assessment indicate that air quality, with respect to concentrations of annual mean PM2.5, is predicted to improve in each of the income domain quintiles for the opening year of the Proposed Scheme (2029), except the most deprived domain, which has predicted to experience a large adverse change. All other income groups will experience a moderate to large beneficial change.
Accidents	Slight Beneficial	It is expected that the accident rate will be reduced significantly (>10% reduction) on the vulnerable stretch of A4 section like Keynsham Bypass and the South Section of A4 Bath Road, where maximum number of accidents were reported. Proposed infrastructure improvements like continuous segregated cycling corridor between Bristol and Bath, cycling and walking connections between local communities and BBRP enhancements along the A4 between Bristol and Bath reduces the risk of accidents involving the vulnerable groups like Children below 16 years, pedestrians, cyclists and Motorcyclists. As such, the DI is assessed as '**Slight Beneficial**' for these categories of population. Other social groups like older people above 70 years and Young Male drivers were assessed to have a Neutral impact.

Impact	Seven Point Scale assessment	Summary
Affordability	Slight Adverse	From the DI analysis of affordability, it can be concluded that all income quintiles receive a disbenefit in affordability due to an increase in the vehicle operating costs with the Scheme in place. • The vehicle operating cost dis-benefits are mainly distributed among the Quintile 5 with 58%. • Around 6% and 8% of the disbenefits (i.e., increase in costs) are forecast to be experienced by people living in the most deprived category (Quintile 1 and Quintile 2 respectively). • The 14% of disbenefits are forecast to be experienced by people living in Quintile 3 which is in proportion to the share of the population. • Quintile 4 receive a disbenefit of 15%. Also, all the quintiles are anticipated to experience dis-benefits which are 5% or more lower than the proportion of the group in the total population, the user benefit DI has been appraised as **Slight Adverse**.
Severance	Moderate Beneficial	The road network experiences significant changes (>10%) in traffic in the 1km impact area The section between the Hicks Gate roundabout and the A39/A4 Bristol Road junction experiences a >10% reduction in the AADT due to the introduction of the scheme. All the other key locations Bath Road/ Stockwood Road Junction, Keynsham Train Station and Saltford Library and Post Office are expected a reduction of 5%-10% in AADT for all the vulnerable groups. The overall DI assessment on severance is considered to be '**Moderate Beneficial**' due to the positive impacts of the new interventions of the scheme
Security	Slight Beneficial	The lack of existing facilities, along with concerns about the walking and cycle safety, is putting people off choosing to walk or cycle along the corridor. There are improvements proposed for public transport facilities along the corridor along with the interchanges and connections to bus stops. Along with the public transport, the cycle tracks and footpaths are also proposed with better connectivity and improved quality thus enhancing the security measures of the users and commuters along the corridor. Therefore, security is scored as '**Slight Beneficial'**.
Accessibility	Slight Beneficial	A high frequency bus priority corridor that provides reliable journey times and consistent performance gives the opportunity to address the existing identified issues with the Bath to Bristol movements and has the potential to deliver modal shift from the high levels of intra and inter-urban travel by private car. The scheme connects the town centres of Keynsham and Saltford along the corridor with special enhancements routes such as Community Connections and BBRP, which improve the accessibility of the corridor giving a **Slight Beneficial'** impact for the users accessing the route.

Table 3-28 – DI Output Summary Table

Within impact area	Social group and amenities indicators	Range or Population	User Benefits	Noise	Air Quality	Accidents	Security	Severance	Accessibility	Affordability	Local Authority	England
Resident population	Income distribution quintile 1	0-20%	17%	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	17%	15%	20%
Resident population	Income distribution quintile 2	20-40%	14%	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	14%	16%	20%
Resident population	Income distribution quintile 3	40-60%	18%	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	18%	16%	20%
Resident population	Income distribution quintile 4	60-80%	23%	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	23%	23%	20%
Resident population	Income distribution quintile 5	80-100%	28%	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	28%	29%	20%
Resident population	Children (<16 years)	Not applicable	Not applicable	Not applicable	Not applicable	49%	Not applicable	21%	Not applicable	Not applicable	23%	23.1%
Resident population	Young people	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	14%	11.7%
Resident population	Older people	Not applicable	Not applicable	Not applicable	Not applicable	23%	Not applicable	13%	Not applicable	Not applicable	13%	13.6%
Resident population	People with a disability	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	17%	Not applicable	Not applicable	17%	17.5%
Resident population	Black Minority Ethnic	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	3%	4%
Resident population	No car households	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	10%	Not applicable	Not applicable	20%	23.3%
Resident population	Households with dependent children	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	42%	29%
Resident population	Indicator population in the impact area	336,260	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	336,260	1,173,065	59,597,611
Amenities present	Schools / nurseries	Not applicable	Not applicable	Yes	Yes	Yes	Not applicable	Yes	Not applicable	Yes	Not applicable	Not applicable
Amenities present	Playgrounds	Not applicable	Not applicable	Yes	No	Yes	Not applicable	Yes	Not applicable	Yes	Not applicable	Not applicable
Amenities present	Parks and open spaces	Not applicable	Not applicable	Yes	No	Yes	Not applicable	Yes	Not applicable	Yes	Not applicable	Not applicable
Amenities present	Hospitals	Not applicable	Not applicable	No	Yes	Yes	Not applicable	Yes	Not applicable	Yes	Not applicable	Not applicable
Amenities present	Care homes / day centres	Not applicable	Not applicable	Yes	Yes	No	Not applicable	No	Not applicable	No	Not applicable	Not applicable
Amenities present	Community centre	Not applicable	Not applicable	Yes	Yes	Yes	Not applicable	Yes	Not applicable	Yes	Not applicable	Not applicable

Place Based Impacts

3.8.39. A place-based impact assessment was conducted alongside the SDI and full details of the assessment are reported in the Place Based Analysis (**Appendix G**).

3.8.40. The report looks at the spatial disaggregation of impacts of the scheme. As per guidance, the high-level methodology for spatial disaggregation of impacts is categorised into five major impact components. These components, alongside an overview of the methodology used, are detailed in **Table 3-29**.

Table 3-29 – High level methodology of place-based analysis

Impact	High level methodology for achieving a place-based disaggregation of impacts	Recommended TAG Unit
User benefits	▪ Assess the feasibility of deriving area-level estimates based on available appraisal outputs and underlying model data. ▪ Identify broad areas affected by the intervention. ▪ Within the affected areas, obtain estimates of each impact by relevant geography, making sure to document methods and assumptions. ▪ Map impacts and datasets using Geographic Information Systems (GIS).	TAG Unit A1-3 TAG Unit A4-2
Temporary construction impacts	▪ See TAG A1-3 guidance on methodology	TAG Unit A1-3
Wider Economic Impacts (WEIs)	▪ Transport external costs (TECs) refer to costs imposed by 'dependent' transport users on all other users. ▪ The assessment of TECs of the dependent development requires two model runs. Each model run includes the transport scheme both with and without new housing that is deemed dependent on the transport scheme. ▪ Appraisal and PBA may want to consider other Wider Economic Impacts (WEIs). ▪ WEIs may not be relevant for all schemes and must be justified in the economic narrative. ▪ The full methodology for each impact can be found in the relevant TAG unit.	TAG Unit A2-1 TAG Unit A2-2 TAG Unit A2-3 TAG Unit A2-4 TAG Unit M5-3
Social impacts	**Accidents** ▪ Take accident outputs by link and junction from COBA-LT. ▪ Map impacts and datasets using GIS. **Affordability** ▪ Develop and synthesise evidence on how the cost of travel for users differs spatially. This includes: • Absolute costs • Costs relative to income (before and after housing costs). Analysis of costs can be informed by transport modelling outputs around vehicle operating costs and user charges, as well as additional empirical evidence. ▪ Map onto a GIS dataset. For instance, producing choropleth maps to show spatial variations in absolute and relative travel costs. **Severance** ▪ Conduct a qualitative assessment of how Severance impacts vary spatially (see TAG Unit A4-2) ▪ Assign separate assessment categories against the TAG 7-point scale for each spatial area considered. ▪ As such, they should be assessed qualitatively and presented in a map using the standard TAG scale. However, note that TAG states that Severance impacts should only be assigned a neutral or adverse (slight, moderate, or large) score. ▪ Map impacts onto a GIS dataset e.g., a choropleth map showing how the TAG qualitative assessment score varies across spatial areas.	TAG Unit A4-1 TAG Unit A4-2 COBA-LT user guidance

Impact	High level methodology for achieving a place-based disaggregation of impacts	Recommended TAG Unit
Environmental impacts	**Air quality and Noise** ▪ Disaggregate impacts spatially -see TAG unit A4-2 for guidance on the methodological approach. ▪ Map onto a GIS dataset to show how impacts vary spatially. **Landscape, Townscape, Historic Environment, Biodiversity and Water Environment** ▪ Conduct a qualitative assessment of how impacts vary spatially (see TAG Unit A4-2) ▪ Assign separate assessment categories against the TAG 7-point scale for each spatial area considered. ▪ Map impacts onto a GIS dataset e.g., a choropleth map showing how the TAG qualitative assessment score varies across spatial areas.	TAG Unit A3 TAG Unit A4-2

3.8.41. A summary of the place-based analysis is shown in **Table 3-30**.

Table 3-30 – Place Based Analysis Assessment Summary

Impact	Summary
User Benefits	For PT users, the maximum benefit is seen around Keynsham as the bus travel times along the A4 corridor, between Emery Road and Bath City Centre, are forecast to reduce. In addition, the scheme introduces a new 'hub' stop on the Keynsham Bypass, which improves accessibility to the bus network for travellers within Keynsham. Furthermore, there are benefits reported in Bath and Bristol as the journey time of the X39 bus service connecting Bath to Bristol will be reduced due to the scheme proposal. For highway users, the scheme will result in transport user disbenefits as the scheme results in a longer journey time with more travel time and fuel being used. Trips destined to the south of Bath are expected to experience the most user disbenefits in comparison to the other geographical areas in scope, because its population has a large proportion of other and business users. The map indicates that disbenefits may also be relatively larger in Keynsham East, Saltford and Bristol. This is due to the increased journey times when travelling from north to south due to severance effects associated with the new bus priority improvement and other sustainable connections. There are positive user benefits reported in the north of Bath and Keynsham West. It is also likely that there will also be some indirect impacts of the scheme where the changes in travel times on services travelling along the A4 corridor impact inter-connectivity with other services by reducing interchange times. There are slight benefits observed in other areas in scope like including Saltford, Corston, and Compton Dando due to the forecast mode shift to public transport, due to the bus travel time improvements along the A4 corridor and the introduction of the active travel community connections.
Construction Impacts	Until the construction and traffic management plans are developed in more detail this will not be assessed. This will be further investigated and appraised at the FBC stage.
Wider Economic benefits	Wider economic impacts have not been quantified as part of the scheme.
Accidents	There were 280 casualties recorded from 2016-2022 (excluding 2020 and 2021), with concentration of incidents predominantly in the vicinity of Bristol and Bath. The COBA-LT assessment conducted on the A4 links near these areas anticipates a marginal decrease (less than 5%) in the accident rate, resulting in minimal overall benefits around this area. The primary benefits are concentrated in the Keynsham and Saltford areas, where the scheme is expected to enhance the appeal of bus transportation as a viable alternative to car journeys to Bath and Bristol. This shift in mode has the potential to contribute to a reduction in the accidents. The proposed improvements in active travel infrastructure also aim to create a secure environment for walking and cycling in key areas such as Bath, Bristol, Brislington, Saltford, and Keynsham, particularly benefiting residents engaged in short-distance local movements.
Affordability	The benefits are concentrated most strongly around Keynsham due to the proposed Keynsham Hub and proposed bus corridor, which will result in less car journeys, leading to fuel and non-fuel benefits. The scheme aims to decrease existing travel time from Keynsham to Bath and Bristol, thereby incentivising a greater number of individuals to transition from private cars to public transport. With Keynsham already equipped with a rail station, the enhanced bus and active travel connectivity will contribute to a well-integrated transport network around Keynsham. Analysis shows benefits are also distributed around North East Bristol, Kelston and Brislington. The scheme will result in disbenefits in Saltford, Bristol and Bath due to severance effects associated with the new bus priority improvement and other sustainable connections leading to an increase in journey time and an increase in associated fuel costs for vehicles.
Severance	Keynsham is scored as 'Moderate Beneficial' as the proposed Keynsham Hub and associated last mile active travel connectivity improvements anticipated to be a part of the scheme can significantly reduce the severance associated with vulnerable groups accessing Keynsham station and Keynsham town centre. Other areas in the vicinity like Saltford, Bath and Brislington are scored as Slight Beneficial as the scheme has the potential to bring benefits to people residing in the immediate neighbourhood because of the mode shift and reduced traffic volumes.
Accessibility	A high frequency bus priority corridor that provides reliable journey times and consistent performance gives the opportunity to address the existing identified issues with the Bath to Bristol movements and has the potential to deliver modal shift from the high levels of intra and inter-urban travel by private car. The scheme will deliver a strong public transport connectivity to and from the areas in scope like Brislington, Keynsham and Saltford along the corridor, giving a beneficial impact for the residents accessing the route. Furthermore, with enhancements such as Community Connections and Bristol and to Bath Railway Path (BBRP), there will be a safer, more direct accessibility to bus stops and other amenities.

Impact	Summary
Environmental Impacts	**Noise:** The scheme would generate a reduction in noise levels for many existing properties along the corridor within the immediate geographic areas in scope like Keynsham, Brislington, Bath, Central Bristol and Saltford with expected decrease in private vehicles. Overall, it is anticipated the scheme would generate a positive monetised impact for noise. **Air Quality:** The regional emissions assessment has demonstrated that emissions of NOx and particulate matter would decrease as a result of implementing the scheme (Do Something relative to the Do Minimum scenario). The predicted decrease in total mass emissions is attributed to the reduced number of vehicles travelled on the road network with the proposed scheme is in operation. Three schools in Keynsham, three in Bath and one in Saltford were identified within the areas in scope. None of the identified nurseries/schools are expected to experience an adverse change in levels of NO_2 and $PM_{2.5}$. **Landscape and Townscape:** Qualitative assessment on Landscape parameter undertaken at the Keynsham Transport Hub indicated that the scheme as a whole includes proposals to expand some areas in the existing A4 carriageway boundary (i.e. widening both to the north and south), to create space for bus stops, bus shelters, shared paths, dedicated cycle lanes, and pedestrian footpath access, as well as many facilities that would be found in a new transport hub (i.e. cafe, toilets, bike storage). These newly introduced elements are considered to have an adverse impact on localised landscape character and visual amenity. This is due to the extent of mature tree loss, possible damage to retained trees/vegetation (i.e., construction within Root Protection Area), and required earthworks. These effects are more apparent, in more rural areas, or where increased visibility of the carriageway is apparent for residential receptors in close proximity. This adverse impact can be mitigated by minimising the footprint of the proposed A4 carriageway widening, and by incorporating significant mitigative planting into the scheme (i.e. replacement of removed mature trees that currently line much of the scheme with new planting that closely matches both the size and density of the existing trees). **Historic Environment:** Within the scheme, there will be a negligible effect on two World Heritage Sites of the City of Bath and The Great Spa Towns of Europe, a large adverse effect on the Keynsham Bath Conservation Area, a negligible impact on the Bath Conservation Area, and a minor adverse effect to the settings of Grade II* registered park and garden, Newton Park. Overall, the impact of the scheme is considered to be slight adverse. Outside the scheme boundary, within the 100m study area, there would be a minor adverse effect on the Avon Valley Conservation Area, a minor adverse effect to the setting of Grade II* registered park and garden, the park and garden to Brislington House (known as Long Fox Manor), minor adverse effect on the scheduled monument of Roman Settlement at Keynsham Hams, former Cadbury's Factory, minor adverse effect on three Grade II listed buildings, neutral effect on the scheduled monument of Saltford brass battery mill, Salford Conservation Area, one Grade II* and 17 Grade II listed buildings. **Biodiversity:** The scheme will impact areas of grassland and mature trees and woodland belts. The scheme has the potential to impact on connectivity of habitat. In proximity to the scheme to the east lies the River Chew, its woodland corridor, connecting the scheme to the River Avon in the north. Habitats within the scheme's site will have potential to support protected and notable species. Subsequent field surveys will be carried out to confirm the potential presence of these species, additional surveys required, mitigation, licensing or compensation. Biodiversity net gain assessments will be required to quantify the changes in biodiversity value and look at any required additional measures to offset impacts. **Water:** At the key areas in the immediate vicinity like Keynsham, the scheme may increase surface water flood risk due to an increase in impermeable area and an increase in fluvial flood risk due to a decrease in floodplain storage. However, these impacts are considered negligible as they can be mitigated. Sections of the scheme are at high, medium and low risk of flooding from surface water sources, and existing surface water flow paths have been incorporated into the scheme. The proposed surface water drainage system will provide appropriate treatment prior to discharge, and the re-purposing of the road has considered any hydro morphological and ecological considerations.

3.9 Equality Impact Assessment

3.9.1. The Equality Impact Assessment (EQIA) has been undertaken using an evidence-based approach to assess the impact of the scheme proposals on specific groups and further analysing distribution impacts.

3.9.2. The assessment is reported in the *EQIA report* attached in **Appendix I**.

3.9.3. The report summarises that low level, likely reversible negative impacts are anticipated in the short-term during construction on six protected groups: age, disability, sex and gender, pregnancy and maternity, religion and belief, and deprivation. During the operational phase there is the potential for minor negative impacts on four protected groups: age, disability, sex and gender, and pregnancy and maternity if design standards are not met fully. Positive impacts are anticipated on most protected characteristics including age, disability, sex and gender, pregnancy and maternity, gender identity and deprivation when design standards are met, and a neutral impact is anticipated for religion and belief.

3.10 Initial BCR

3.10.1. The above costs and benefits have been combined to form the Present Value of Costs (PVC), Present Value of Benefits (PVB), Net Present Value (NPV) and the initial Benefit Cost Ratio (BCR). **Table 3-31** shows the quantum of the various benefit and cost streams and the PVB, PVC, NPV and BCR. The initial BCR is 1.5 placing it in the Medium VfM category.

3.10.2. This scheme provides the foundation for the broader proposals on the Bath to Bristol Corridor. This scheme itself does not serve central Bath or Bristol, nor does it deliver a change in frequency of bus services on the corridor (which is being managed through the BSIP and the Enhanced Partnership). This scheme is part of a series of interventions planned along the corridor which when viewed holistically will provide a range of beneficial impacts that will exceed those for each isolated section of the scheme.

3.10.3. The scale of public transport benefits attributed directly to this scheme do not reflect the wider opportunity unlocked through this scheme. The *Case for Change* note (70093741-WSP-OPM-002) notes that should all the bus priority measures be implemented along the A4 Corridor between Bath and Bristol then service provision could be improved to 5 or 6 buses per hour utilising the same number of buses and drivers. With the associated journey time savings for passengers and an increase in passenger numbers due to the improved service provision. The sensitivity testing set out in **section 3.12** shows the potential impact of these wider benefits.

3.10.4. The following DfT appraisal outputs tables are included within **Appendix J**:

- Transport Economic Efficiency (TEE) table
- Public Accounts (PA) table
- Analysis of Monetised Costs and Benefits (AMCB) table

3.10.5. An Appraisal Summary Table (AST) is included in **Appendix E**.

Table 3-31 – Analysis of Monetised Costs and Benefits (£m, 2010 PV)

Indicator	Impacts
Noise	5.53
Air Quality	0.21
Greenhouse Gases	5.10
Journey Quality	4.10
Physical Activity	18.73
Accidents	1.78
Economic Efficiency: Consumer Users (Commuting)	3.90
Economic Efficiency: Consumer Users (Other)	-1.97
Economic Efficiency: Business Users and Providers	-0.64
Wider Public Finances (Indirect Taxes)	0.24
Initial Present Value of Benefits (PVB)	**36.99**
Present Value of Costs (PVC)	**25.00**
Net Present Value (NPV)	11.99
Initial Benefit Cost Ratio (BCR)	**1.5**

3.11 Adjusted BCR

3.11.1. The reliability analysis resulted in benefits of £2.67m over the appraisal period. Including this in the analysis increases the PVB to £39.66m, returning an Adjusted BCR of 1.6.

3.12 Uncertainty Analysis

3.12.1. Uncertainty analysis has been undertaken from two perspectives:

- Testing of specific parameters within the modelling and appraisal to understand the sensitivity of the Adjusted BCR to changes in these inputs/assumptions
- Switching value analysis of the required change in levels of benefits and costs to change the VfM category
- Qualitative assessment of the DfT's Common Analytical Scenarios

Sensitivity Tests

3.12.2. A series of tests have been run to understand the sensitivity of the expected outcomes to changes in inputs, and the potential impact of future uncertainty. The following sensitivity tests have been carried out, drawing on the key assumptions made in the core scenario:

- Test 1: High growth test within WERTM
- Test 2: Low growth test within WERTM
- Test 3: Using the CRSTS target for modal shift/percentage increase of cycling within the AMAT (25% active travel modal share for commuting)
- Test 4: Using comparative case study evidence for the Do Something cycling and walking demand within the AMAT
- Test 5: Using Stage 1 allowance for optimism bias (46%)
- Test 6: Using Stage 3 allowance for optimism bias (20%)
- Test 7: Using the risk adjusted cost in place of the optimism bias adjusted cost within the appraisal
- Test 8: Estimating the impact on VfM if a frequency increase of the X39 service were included as part of the scheme (currently this forms part of the BSIP, but this scheme would unlock the opportunity for this)
- Test 9: November 2023 AMATs
- Test 10: Upside scenario, combining the following tests:
  - Test 1: High growth test within WERTM for public transport, no monetised highway impacts included within the appraisal
  - Test 8: Frequency increase of X39 service

3.12.3. In accordance with advice in TAG Unit M4, low and high growth forecasts (for Tests 1 and 2) were prepared by increasing the forecast demand matrix by a proportion of the base year matrix which for highway demand is defined as:

$\pm 2.5 * \sqrt{N}$ % where N represents the number of years into the future with respect to the base year.

3.12.4. Test 8 seeks to capture the benefits associated with a frequency increase of the X39 service which the BSIP would look to deliver building on the infrastructure delivered as part of this scheme. AVL data analysed in 2023, highlighted that end-to-end bus journey times for the X39 typically extended beyond an hour in the peak periods. It was also apparent that a 10% journey time saving would bring the end-to-end journey times below an hour and would also mean the existing fleet could be used to run an additional service. With negligible changes to bus operating costs, the current five services per hour per direction (12-minute headway) could be increased to six services per hour (10-minute headway). For each passenger this would represent a one minute journey time saving attributable to the scheme.

3.12.5. The TUBA software has been used to estimate the monetised journey time savings that would arise from a one minute journey time saving to each passenger boarding the bus over the B&NES section of the BBSC corridor. Trip matrices have been taken from WERTM for 2029 and 2042, and flat 12-minute (Do Minimum) and 10-minute (Do Something) journey time matrix produced. As the benefits are only unlocked once the full corridor is delivered and the 10% end-to-end journey time savings are achieved, these benefits have not been included within the Initial or Adjusted BCR, and instead form a sensitivity test.

3.12.6. **Table 3-32** shows the resultant PVB, PVC, NPV and BCR for the above tests compared to the core scenario.

Table 3-32 - Sensitivity tests

Test	**£m, 2010 PV over appraisal period**	**£m, 2010 PV over appraisal period**	**£m, 2010 PV over appraisal period**	**£m, 2010 PV over appraisal period**
Test	**PVB**	**PVC**	**NPV**	**BCR**
Core scenario Adjusted BCR	*39.66*	*25.00*	*14.66*	*1.6*
Test 1: High Growth	40.92	25.00	15.92	1.6
Test 2: Low Growth	41.97	25.00	16.97	1.7
Test 3: 25% Active Travel Mode share for commuting	25.68	25.00	0.68	1.0
Test 4: Comparative case study evidence	31.06	25.00	6.06	1.2
Test 5: Optimism Bias 46%	39.66	29.05	10.61	1.4
Test 6: Optimism Bias 20%	40.46	24.47	15.99	1.7
Test 7: Risk Adjusted Cost	39.66	25.97	13.68	1.5
Test 8: X39 Service frequency increase	40.46	25.00	15.46	1.6
Test 9: November 2023 TAG	43.46	25.00	18.46	1.7
Test 10: Upside scenario	45.72	25.00	20.72	1.8

3.12.7. These tests show that the BCR is most sensitive to changes in the increase in active mode users as a result of the scheme. Assuming more modest increases in demand, as in Tests 3 and 4, results in the value for money category reducing to Low. The high and low growth tests (Tests 1 and 2) have limited impact on the Adjusted BCR, with it remaining in the Medium value for money category. Test 5 shows that increasing the optimism bias from 23% in the core to 46% reduces the Adjusted BCR to 1.4, just below the threshold for Medium value for money. Conversely, reducing the optimism bias to 20% increases the BCR slightly to 1.7. Using the risk-adjusted cost in place of optimism bias within the appraisal has a limited impact where the level of risk and optimism bias are relatively similar. Test 8 seeks to capture the impact of the frequency upgrades unlock by the scheme (which are not formally part of this schemes scope). This increases the PVB, and the resultant BCR is 1.7. This test still does not reflect the wider benefits of the BBSC

Programme including the section being developed by Bristol City Council and schemes within central Bath. Test 9 shows that changes in guidance related to the valuation of active mode benefits will have a beneficial impact on the value for money of the scheme, increasing the Adjusted BCR to 1.7.

3.12.8. The upside sensitivity (Test 10) shows the impacts of assuming high public transport growth, no highway impacts and the service frequency increase. Under this test the Adjusted BCR increases to 1.8.

Switching Value Analysis

3.12.9. Switching value analysis has been undertaken to determine how a change in costs or benefits would alter the VfM category. The starting point for this analysis is the Adjusted BCR. For the core scenario this is 08:1, demonstrated Poor VfM.

3.12.10. **Table 3-33** provides the changes that would be required, either in scheme costs or benefits, for the scheme to achieve an Adjusted BCR in the Low, Medium or High VfM categories.

Table 3-33 - Switching Value Analysis

Change type	Required change (in £m, 2010 PV and as a percentage)
Change in benefits to reach Low value for Money	32% decrease
Change in costs to reach Low Value for Money	48% increase
Change in benefits to achieve Medium Value for Money	35% increase
Change in costs to achieve Medium Value for Money	26% decrease

Common Analytical Scenarios

3.12.11. In May 2022, the DfT announced fundamental changes to TAG, which have implications for how forecast demand in transport models should be derived, ensuring that a greater appreciation and consideration of uncertainty is included. In particular, the Uncertainty Toolkit released as TAG Supplementary Guidance outlined the release of a set of Common Analytical Scenarios (CAS).

3.12.12. The DfT's Uncertainty Toolkit sets out that forecast travel demand is a key driver of benefits across transport schemes, and that there is a need to consider seven standard CAS as part of the development of a scheme. The seven scenarios are as follows:

- High economy: productivity growth returns to its long-term trend, and people become richer than we currently expect. Migration, and population in general, increases above official forecasts

- Low economy: productivity growth fails to return to historic levels and inward migration is subdued, causing low levels of population growth
- Regional: people leave London, the South East and the East of England in search of more affordable housing. As a result, there is lower employment and population growth in these regions relative to the rest of the country, Areas outside of the south increase their relative competitiveness through an increase in productivity
- Behavioural change: people embrace new ways of working, shopping and travelling. Important behavioural trends which have emerged in recent years accelerate, in part because of the coronavirus pandemic, which include changes in the travel behaviour of young people; increased flexible working; and increased online shopping
- Technology: road travel becomes far more attractive and accessible to road users because of a high take-up of connected autonomous vehicles (CAVs), which enter the fleet in 2020 and make up to 50% of it by 2047
- Vehicle-led decarbonisation: there is a high take-up of electric and zero-emission vehicles (ZEVs). Tailpipe emissions fall. There is no intervention by government to increase electric vehicle costs, resulting in increasing road traffic
- Mode-balanced decarbonisation: there is a high take-up of electric and ZEVs. Tailpipe emissions fall. An unspecified intervention leads to electric vehicle costs being equalised with petrol and diesel costs, so that public transport modal share is maintained

3.12.13. The Uncertainty Toolkit provides a grading of projects in terms of whether they are considered low, medium or high impact. The gradings is based on the costs to the public sector, corporate risk, VfM and level of uncertainty.

3.12.14. Three broad categories of impacts are identified in Table 3 of the Uncertainty Toolkit. (replicated in **Table 3-34**).

Table 3-34 - Table of indicative impact

Category	Low	Medium	High
Impact on public finances through budget cost or revenue risk	Tier 3 e.g., <£50m	Tier 2 e.g., £50 - £500m	Tier 1 e.g., > £500m
Corporate risk	Limited/risk of minor embarrassment	Risk of minor loss in confidence	Risk of major loss in confidence
Portfolio project	Local Transport schemes	DfT approved or sponsored	Investment Programme / Strategy
Level of uncertainty	Input assumptions low range of uncertainty. Short lifetime e.g., <5 years.	Input assumptions medium range of uncertainty. Medium lifetimes 5 – 50 years.	Input assumptions high level of uncertainty. Long lifetimes e.g., > 50 years.

Source: Table 3 Table of indicative impact - TAG Uncertainty Toolkit

3.12.15. Based on the table, the scheme is classified as having medium impact, the budget cost is towards the bottom of the range (£45.23m), the corporate risk is minor loss of confidence, and it is a local transport scheme albeit funded through CRSTS which is overseen by DfT. The modelled years are opening year and future year, which is 15 years after opening, no growth is assumed after this period, therefore the scheme falls within the medium lifetimes range of 5 – 50 years.

3.12.16. Based on the guidance set out for a proportional approach to selecting scenarios and considering that the indicative impact of the scheme is Medium then the following scenarios will need developing.

- Critical Common Analytical Scenarios or
- TAG Unit M4 High and Low Scenarios and
- Key Sensitivities/local scenarios

3.12.17. Therefore, the high and low growth tests and a range of sensitivity tests have been undertaken to understand the impact on the value for money.

3.13 Spending Objective Analysis

3.13.1. In November 2023, the DfT released guidance on undertaking spending objective analysis. This guidance reinforced the importance of demonstrating the link between the objectives of the scheme and the outputs of the appraisal. **Table 3-35** shows the objectives of the scheme alongside the relevant outputs of the appraisal, to demonstrate that the scheme is supporting delivery of the overarching aims and ambitions. It should be noted that these objectives are for the full corridor between Bristol and Bath, of which this scheme forms a part.

Table 3-35 - Spending objective analysis

Objective	Appraisal output
To facilitate economic growth along the corridor by improving the public and active travel opportunities. This includes delivering infrastructure which improves access for existing communities and also infrastructure that unlocks new opportunities for sustainable growth	Improved public transport offer through improved journey times and reliability on the X39, seen with £7.60m (2010 PV) public transport journey time benefits (includes driver impacts) Improved active model offer through improved infrastructure, seen with £2.77m of journey quality benefits and £18.73m health benefits associated with new active mode users Slight Beneficial impact on accessibility
Improve public transport infrastructure in the study area to increase the number of people who have access to and use buses to contribute to growing patronage of the X39 (or increase in equivalent new service/bus rapid transit service along the corridor) by at least 24% by 2030	Improved public transport offer through improved journey times and reliability on the X39, seen £7.60m (2010 PV) public transport user benefits (includes driver impacts)
Improve walking, wheeling and cycling infrastructure in the study area to contribute to increasing the number of people using the corridor for active travel modes including to increase the number of people commuting by walking, cycling and wheeling modes to 25% of total modal share by 2036.	Improved active model offer through improved infrastructure, seen with £2.77m of journey quality benefits and £18.73m health benefits associated with new active mode users

3.14 Value for Money Statement

3.14.1. The initial BCR for the scheme is 1.5, suggesting it delivers Medium VfM. The BCR calculation is based on the monetised impacts alone. The main sources of benefits contributing to the PVB include health benefits associated with increased physical activity, noise and carbon impacts, transport user benefits to bus and rail users and journey quality impacts to active mode and public transport users. There are also negative impacts to highway users as a result of the scheme. The PVB is £36.98m. This also includes the change in public transport revenue as a result of the scheme.

3.14.2. The PVC of the scheme is £25.00m. This includes the costs associated with development and construction as well as maintenance and renewals. This includes optimism bias at 23%. The scheme will be funded wholly by the public sector, through CRSTS funding and local contribution. Therefore, all scheme costs form the PVC.

3.14.3. The scheme is anticipated to result in reliability benefits to public transport users through improved priority infrastructure for buses along the route. These impacts have been quantified and over the appraisal period amount to £2.67m of benefits. Combining these benefits to initial PVB results in an Adjusted BCR of 1.6:1, indicating Medium VfM. Given the scale of the transport user benefits, it was not considered proportionate to quantify the wider economic impacts of the scheme.

3.14.4. In addition to the monetised impacts, there is also the potential for other impacts not currently quantified within the appraisal to impact on the scheme benefits. From an environmental perspective, the vicinity of the scheme to the Keynsham Conservation Area has the potential for adverse impacts on the historic environment. However, further option development and design would seek to minimise and mitigate these impacts. It is also noted that these impacts would be relatively localised and so the overall assessment of the impacts of the scheme on the historic environment is slight adverse. The BBRP is a sensitive ecological corridor, the scheme has the potential to result in adverse impacts on landscape and biodiversity as a result of lighting and changes to the setting. However, option development on this section is ongoing and it will be sought to minimise and mitigate these impacts as part of the next design stages. From a social perspective, the scheme is anticipated to have a moderate beneficial impact on severance as a result of the improved infrastructure for pedestrians reducing the intrusion of traffic. There are also anticipated to be beneficial impacts in relation to security and accessibility, in particular with improved public transport interchange and waiting facilities.

3.14.5. Distributional Impacts have been assessed across the eight appraisal categories; the results range from Slight Adverse (Affordability) to Moderate Beneficial (Air Quality). Place Based analysis has also been undertaken to look at the spatial disaggregation of impacts of the scheme.

3.14.6. A range of sensitivity tests have been undertaken to understand the potential for a change in the VfM category depending on different assumptions within the modelling and appraisal.

These tests showed that the VfM category was most sensitive to the assumed uplift in active mode users as a result of the scheme. Under less optimistic scenarios, the value for money category could reduce to Low. The scheme is less sensitive to high and low growth tests within WERTM. The scheme provides the infrastructure required to improve public transport and active travel measures, it does not include any changes to the bus service operation that may be due to the improvement in bus journey times and reliability. A test was undertaken which captured the benefits of the increased service frequency of the X39 which the scheme unlocks but is not formally part of the scope of this scheme as is being considered within the BSIP. Under this test the BCR remained unchanged, but it is noted that this only reflects a service frequency increase on the B&NES section of the corridor and not the benefits within Bristol. A further test was undertaken that was reflective of a high growth/ambitious scenario for a public transport scheme. This test formed a combination of the sensitivity tests and sought to capture a scenario where public transport usage is high, car usage is low and the X39 frequency upgrades are realised. Under this test the Adjusted BCR increased to 1.8. Combining the results of the sensitivity tests 9 and 10, which both reflect upside sensitivities, shows that under optimistic assumptions the scheme could demonstrate High VfM.

3.14.7. Switching value analysis shows that monetised costs could increase by 48% or the benefits could decrease by 32% before the Adjusted BCR reduced to the Low value for money category. Conversely, if the monetised benefits increased by 35% or the costs reduced by 26% the Adjusted BCR would increase to 2.0, suggesting High value for money.

3.14.8. Overall, it is considered that the scheme has the potential to deliver Medium value for money. Whilst it is acknowledged that there are some environmental impacts requiring considered minimisation and mitigation at the next design stages, there are also a number of wider benefits associated with this scheme which are not currently captured within this scheme appraisal. This scheme forms the foundation of the BBSC Programme, with additional measures being considered within the Bristol section, Bath City Centre and the BSIP. The overall impacts to transport users of these schemes is not captured within the appraisal of just Projects 2 and 3.

3.15 Summary Of the Economic Dimension

3.15.1. This Economic Dimension sets out the impacts of the scheme to inform the assessment of its Value for Money (VfM) to justify the use of taxpayers' money.

3.15.2. The scheme which has been assessed within this Economic Dimension consists of:

- Project 2:
  - Section 4 Broadmead roundabout to Globe roundabout: bus lane Broadmead to Grange Road, improved shared use path/segregated cycleway.
  - Section 5 Globe roundabout to Twerton Fork (Newbridge): Improved shared use path provided between Globe Roundabout and Newbridge Road ties into existing connection to BBRP.

- Section 6 Twerton Fork (Newbridge) to Bath centre: Bus lane between Rosslyn Road and Hungerford Road.
- Bristol to Bath Railway Path (BBRP) Saltford Section: Upgrade of existing connections (Norman Road & High Street), potential walking/cycling crossing upgrades.
- Keynsham Centre and connection to train station: Junction upgrades, connections to proposed Keynsham Transport Hub.
- BBRP Extension, Bath: an off-road route along the western section between Brassmill Lane and Station Road, subsequently routeing along Station Road down the hill and re-joining the existing route along the river.
- BBRP Bird in Hand, Saltford: upgrade the existing connection between the BBRP in Saltford at the Bird in Hand.

- Project 3:
  - Section 2 Emery Road to Hicks Gate: Segregated bi-directional cycle lane provided on southern side, continuous bus lanes both directions from P&R junction to Hicks Gate.
  - Section 3 Hicks Gate to Broadmead roundabout: Continuous bus lanes both sides along Keynsham Bypass and a reduced speed limit. Segregated bi-directional cycle lane provided along Durley Hill between Hicks Gate and Station Road in Keynsham
  - Keynsham Hub: Transport Hub with on carriageway bus stops and at grade crossing of A4, bus shelters provided along with walking/cycling connections to Keynsham town centre and train station.
  - Hicks Gate: Bus Stop Enhancement on Corridor and improved access to bus stops.

3.15.3. Whilst the two projects have separate identified funding streams within the West of England Combined Authority CRSTS allocation, they have been considered as a single scheme for the purposes of the economic appraisal. Therefore, the Do Something scenario considers the scope of both Projects 2 and 3. Within the economic appraisal, the Do Something scenario is compared to the Do Minimum. This is the without scheme scenario and the underlying assumptions of this are detailed within the Overview of Transport Modelling section of this Economic Dimension.

3.15.4. The economic assessment identifies and appraises the impacts over an appraisal period to determine the scheme's overall VfM. It takes account of the costs of developing, building and maintaining the scheme over the agreed lifetime of the asset.

3.15.5. The appraisal has been undertaken in alignment with DfT's TAG and Value for Money Framework.

Scheme Costs

3.15.6. The following cost lines have been considered for the OBC appraisal:

- Investment costs
- Maintenance and renewal costs, to estimate the whole life costs for the scheme

3.15.7. As the OBC is centred around the infrastructure requirements on the corridor the costs of this only will be included within the Financial Dimension and the economic appraisal.

Capital Expenditure

3.15.8. At the OBC stage, scheme infrastructure costs were based on the available design information and applying unit rates to the bill of quantities. These costs have then been uplifted for indirect costs (STATS, preliminaries, professional fees, traffic management) using different percentage rates based on standard industry rates and benchmarks from other schemes of a similar nature.

3.15.9. These costs were profiled over the delivery period (2023-2027) and adjusted for inflation. Inflation has been applied in line with the latest Building Cost Information Service (BCIS) Tender Price Index (TPI) forecast at the time of preparing the costs (Q2 2023). Risk has been estimated using 23% optimism bias as this was higher than the QRA adjusted costs.

3.15.10. Within the appraisal, costs have been adjusted to 2010 PV, in-line with guidance, resulting in a cost of £21.63m.

Maintenance and renewal costs

3.15.11. In addition to the costs of delivering the scheme, there will also be costs associated with maintaining and renewing the infrastructure. These have been calculated over a 40 or 60 year appraisal period and are £3.37m. In addition, there are potential operating cost savings to bus operators as a result of more efficient running. This has been estimated within WERTM and TUBA and is estimated to be £0.23m (2010 PV), this cost saving is attributed to the private sector.

3.15.12. The AMAT estimates the impact on infrastructure maintenance costs associated with modal shift to active modes from private car. This cost saving has been included within the PVC calculation. The scale of infrastructure cost saving estimated within the AMAT is suitably small such that it doesn't bias the appraisal by not including the maintenance and renewal costs of the new infrastructure.

3.15.13. The overall PVC is estimated to be £25.00m (2010 PV).

Scheme Impacts

3.15.14. The main sources of benefits contributing to the PVB include health benefits associated with increased physical activity, noise and carbon impacts, transport user benefits to bus and rail users and journey quality impacts to active mode and public transport users. There are also negative impacts to highway users as a result of the scheme.

3.15.15. Overall, the monetised impacts of the scheme gives a PVB of £36.98m.

3.15.16. There are also impacts which have not been monetised which could impact on the value for money. From an environmental perspective there are potentially substantial adverse impacts on landscape, biodiversity and heritage as a result of the infrastructure proposed within the vicinity of the Keynsham Consvervation Area and the BBRP. This risk requires careful consideration at more detailed design stages. There are also beneficial social impacts in terms of severance, security and accessibility.

Initial BCR

3.15.17. The Initial BCR for the scheme is 1.5, suggesting it delivers Medium VfM. The BCR calculation is based on the monetised impacts alone.

Adjusted BCR

3.15.18. An Adjusted BCR has been calculated which includes the quantified reliability impacts of this scheme. Inclusion of these impacts increases the BCR to 1.6.

Uncertainty Analysis

3.15.19. A range of sensitivity tests have been undertaken to understand the sensitivity of changes to input assumptions on the resultant value for money. These tests identified that the scheme is most sensitive to the assumptions of active mode demand uplift as a result of the scheme. The value for money is less sensitive to changes in cost and high and low growth scenarios. An upside sensitivity test has shown the potential for the BCR to increase to 1.8.

3.15.20. Switching value analysis has shown that the monetised benefits could reduce by up to 32% before the value for money category reduces to Low, or the costs could increase by 48%. Conversely, in order to reach an initial BCR of 2, the benefits would need to increase by 35%, or the costs reduce by 26%.

3.15.21. Initial spending objective analysis, noting this is guidance released recently from DfT, suggests the scheme appraisal shows impact which support delivery of the objectives.

4 Financial Dimension

4.1 Introduction

4.1.1. The Financial Dimension outlines the proposed funding and financing of the scheme in terms of the affordability of the proposal, the sources of funding, and the annual breakdown of costs.

4.1.2. As the scheme is focussed on providing infrastructure to improve walking, wheeling, cycling and public transport facilities, the costs focus on capital and whole-life costs of this infrastructure. There is no change in the service frequency or routes of bus services on the corridor as a direct part of the scheme, therefore there is not anticipated to be any additional public transport operating costs. The change in public transport revenue as a result of the increase in demand (due to the improved infrastructure as opposed to frequency changes) has been included within the Financial Dimension.

4.1.3. The costs are shown separately for Projects 2 and 3 as these were separate funding line items within the CRSTS submission. Project 2 refers to the corridor between Keynsham and Bath, and Project 3 refers to the corridor between Emery Road and Keynsham, as well as Keynsham Transport Hub.

4.2 Capital Expenditure

4.2.1. The capital expenditure of the scheme has been estimated using the available design information at the OBC stage and have been developed in line with TAG A1.2. The costs have been estimated separately for the different sections and elements of the scheme. These costs have then been combined to provide an overall scheme cost.

4.2.2. The construction cost estimate has been developed using the Bill of Quantities based on the latest design drawings. Unit cost rates (in Q2 2023) have then been applied to the Bill of Quantities. The unit cost rates are sourced from SPONS. Allowances have also been made for the main contractor's preliminaries and overhead and profit, based on live schemes that WSP are supporting on, that are of a similar nature. A cost allowance has also been included for temporary works and traffic management. These costs will be refined through dialogue with the contractor as the scheme design progresses.

4.2.3. The construction costs have been uplifted to account for the wider costs of the scheme, these uplifts are based on industry knowledge derived from other schemes and include:

- Professional fees: 20% of base cost including all design, survey and professional fees pre/post contract and during construction
- STATS diversions: 20% of base cost

4.2.4. Land costs have been included. These are based on a high-level view of land and property acquisition costs in respect of the realignment of the Bath to Bristol Strategic Corridor. The plots of land identified have been reviewed and valued to market value within its existing use, with the exception of where it is clearly identifiable that re-development value is present.

4.2.5. In addition, as a high-level desk top exercise, a 20% contingency allowance has been included to reflect uncertainty, along with an allowance for incentive to encourage landowners to sell the land. The costs also include an estimate for legal and surveyors' fees, and Stamp Duty Land Tax where applicable.

4.2.6. The total cost of acquiring the land, including contingency and incentives, is £1,413,804. The Property Cost Estimate will be reviewed again once more detailed scheme design is established at the next stage.

Biodiversity Net Gain (BNG)

4.2.7. At this stage it is very challenging to provide costs for BNG delivery. This is due to the many varying factors which will impact the BNG requirements, further exacerbated by the wealth of options available for BNG delivery, which will affect the cost.

4.2.8. As an overview, some of the factors at play which will influence the BNG assessments, outcomes and subsequent delivery strategy have been summarised.

4.2.9. The baseline conditions (the ecology field work for either section of the scheme has not yet been completed), areas of priority and irreplaceable habitats (of most relevance for the BBRP), areas of confirmed loss, landscape specification, areas of temporary loss and other ecological mitigation requirements) will all impact the outcomes of the BNG assessment, i.e. how many units will be required, across what habitat types to meet a set goal. At this stage, it is not known what the BNG outcome for the Project is.

4.2.10. The consenting route taken forward will impact how many separate BNG assessments need to be presented; i.e. will all separate planning applications need to demonstrate 10% in their own right. If so, all will need separate assessments and reporting, and additional mitigation to get each component to the desired BNG goal may be needed. Alternatively, the separate applications could be submitted in a phased approach - this would still require separate applications, although mitigation can be pooled and the 'programme' as a whole will need to demonstrate 10% across all components. The Combined Authority has set a 10% outcome for all transport projects, so even sections of the scheme which are permitted development, will need to demonstrate 10% outcome. Therefore, it is not known how many BNG assessments will be required for the Project at this stage.

4.2.11. The areas of impact (vegetation clearance, temporary loss and permanent lost and creation) are not confirmed for the Scheme. Therefore, the current BNG assessments cannot quantify the loss of biodiversity accurately.

4.2.12. Once a BNG assessment has been undertaken, design improvements will be considered, based on the outcomes of the work, to improve the BNG outcome. Following the mitigation hierarchy, it is recommended that firstly opportunities to improve outcomes on site are considered, before looking at offsetting. Therefore, changes to the Scheme design may be required and additional BNG assessments required to quantify those changes. Compensation scenarios (run in the BNG metric) would support those decisions.

4.2.13. After the design improvements, should there still be a requirement for offsetting, this could take a number of forms. The offsetting could be delivered on third party land or via authority led conservation schemes, a third-party provider may be used to provide the required units, or, as a last resort, statutory credits may be purchased. It is not only the required units and type of units required that will influence delivery cost, but also the offsetting strategy taken forward. There is also a risk that offsetting credit may not be available or suitable for the Scheme.

4.2.14. The BBRP contains irreplaceable habitats in the form of ancient woodland, veteran trees and parkland habitats. If these habitats are being impacted, and under the current assumed design, they are, then BNG cannot be achieved for the Project. The metric cannot fully assess impacts on these irreplaceable habitats and a bespoke mitigation strategy would be required. The approach and requirements of this are not known and will need to be determined via assessments, research and consultation. Offsetting may be a requirement for the bespoke mitigation strategy, in addition to that which may be required for the Scheme as a whole.

Risk

4.2.15. The final cost of delivering the scheme will not be known until completion of the detailed design and land purchase, and completion of the statutory process. For this reason, the scheme cost estimate includes an allowance to account for this uncertainty, or risk.

4.2.16. To reflect the uncertainty associated with known risks, a Quantified Risk Assessment (QRA) has been undertaken. The QRA has been carried out considering each specific risk identified during the development of the OBC, the probable effects of that risk, the likelihood of occurrence and cost. The cost is based on a detailed understanding of the project costs driven from the cost plan/forecast.

4.2.17. The output of the QRA includes a range of risk probabilities and values. For the purposes of the Financial Dimension, the P75 value has been used which has a quantified risk of £9.14m (Q2 2023) and represents 28% of the scheme costs. The outputs of the QRA are included in **Appendix K.**

4.2.18. The Management Dimension includes further information on the approach to risk and issue management. The Combined Authority will be both Accountable and Responsible for the project and will continue to Project Manage it.

Inflation

4.2.19. The cost estimates have been developed in Q2 2023 prices. An allowance has therefore been made for the expected inflation between the cost price base and the date when the expenditure is expected to be incurred. Subject to funding, it is currently programmed that construction works will start in Spring 2025 and will be completed, and the scheme open, by the end of March 2027. The costs associated with scheme development will be incurred prior to Spring 2025.

4.2.20. Inflation has been applied based on forecasts from the Building Cost Information Service (BCIS) Tender Price Index (TPI) from May 2023. **Table 4-1** shows the inflation forecast used.

Table 4-1 - BCIS inflation forecast

BCIS TPI inflation	2023/24	2024/25	2025/26	2026/27
BCIS TPI inflation	2.62%	3.06%	2.72%	3.61%

4.2.21. The estimated cost of the scheme, disaggregated into the two projects, is shown in **Table 4-2**.

4.2.22. The capital expenditure of Project 2 is £19.53m inclusive of risk and inflation, and the cost of Project 3 is £25.70m. **Appendix L** shows the detailed breakdown of the cost estimate.

Table 4-2 – Capital Expenditure Breakdown (£m)

Scheme Element	Project 2	Project 3	Total
Construction costs including prelims, traffic management, land and overheads and profit (£Q2, 2023)	9.89	13.40	23.29
Professional fees (£Q2, 2023)	1.98	2.40	4.38
STATS (£Q2, 2023)	1.98	2.40	4.38
Risk (£Q2, 2023)	3.95	5.19	9.14
Inflation	1.74	2.30	4.04
Total (nominal)	**19.53**	**25.70**	**45.23**

Exclusions

4.2.23. The following cost line items have been excluded from the costs estimates at this stage.

- Legal issues
- VAT
- Planning and approval changes
- Taxes and levies

- Licenses and all associated costs and fees
- Changes in legislation and any form of applicable standards
- Costs associated with invasive and/or protected species
- BNG Costs

Spend Profile

4.2.24. Costs have been profiled over the design and construction period based on the project programme included in Section 6.6 of the Management Dimension. **Table 4-3** shows the cost in each year for Project 2, including the breakdown across the cost line items. **Table 4-4** shows the cost profile for Project 3.

Table 4-3 - Project 2 Capital Expenditure Cost Profile (£m)

Scheme Element	2023/24	2024/25	2025/26	2026/27	Total
Construction costs including prelims, traffic management, Land and overheads and profit (£Q2, 2023) (£Q2, 2023)	0	0	0	9.89	**9.89**
Professional fees (£Q2, 2023)	0.04	0.79	0.55	0.59	**1.98**
STATS (£Q2, 2023)	0	0.10	0.91	0.97	**1.98**
Risk (£Q2, 2023)	0.01	0.25	0.42	3.27	**3.95**
Inflation	0	0.04	0.14	1.56	**1.74**
Total (nominal)	**0.05**	**1.19**	**2.02**	**16.28**	**19.53**

Table 4-4 – Project 3 Capital Expenditure Cost Profile (£m)

Scheme Element	2023/24	2024/25	2025/26	2026/27	Total
Construction costs including prelims, traffic management, Land and overheads and profit (£Q2, 2023) (£Q2, 2023)	0	0	0.76	12.64	**13.40**
Professional fees (£Q2, 2023)	0.03	0.73	0.72	0.91	**2.40**
STATS (£Q2, 2023)	0	0.12	0.87	1.41	**2.40**
Risk (£Q2, 2023)	0.01	0.24	0.67	4.27	**5.19**

Scheme Element	2023/24	2024/25	2025/26	2026/27	Total
Inflation	0.00	0.04	0.22	2.04	**2.30**
Total (nominal)	**0.04**	**1.13**	**3.25**	**21.27**	**25.70**

4.3 Whole Life Costs

4.3.1. There will be additional maintenance and renewal costs associated with the new infrastructure delivered as part of the scheme. Whilst much of the scheme will be delivered within the existing highway boundary the additional costs will include:

- Carriageway plane and resurface – assumed every 20-years
- Drainage gully inspection and cleaning – assumed every year
- Footpath maintenance and renewal – assumed every 20-years
- Landscaping maintenance and renewal – assumed every 3-years
- Changes in existing maintenance and renewal due to road space reallocation

4.3.2. The costs are assumed to grow in line with general inflation over the lifetime of the project.

4.3.3. Over the course of the 40 or 60-year appraisal period, the additional maintenance and renewal costs are estimated to be £2.95m (2023 prices) or £6.43m including inflation for Project 2 and £13.22m (2023 prices) or £29.37 including inflation for Project 3.

4.3.4. The additional maintenance and renewal costs would be included as part of B&NES' annual maintenance programme. There are currently discussions between B&NES and the Combined Authority to request appropriate maintenance funding equal to the additional infrastructure being installed. This will be further developed as the detailed design is produced.

4.3.5. As there is no change in service frequency of bus services on the corridor as a direct part of the scheme, there is not anticipated to be any additional public transport operating costs.

4.4 Farebox Revenue

4.4.1. The scheme will improve the journey times and reliability of the existing services on the corridor. As a result of this there is forecast to be modal shift to bus from other modes, which will result in additional farebox revenue on bus services. The revenue impact has been forecast using the West of England Regional Transport Model (WERTM), the details of which are described in Economic Dimension. It should be noted that WERTM is not designed to be a revenue forecasting tool and does not provide investment grade revenue forecasts. The revenue forecasts are used to show the potential financial impacts of the scheme.

4.4.2. The fare structure within WERTM is based on the fares at the time of the development of the 2019 base year model. The bus fare system assumed mirrors that of First Bristol, Bath and the West fare zones and ticket prices as they were in 2019. In the forecasting, the fare zone structures don't change, with bus stops remaining in the same fare zone. Growth is applied to fares within the model based on analysis of historic fare indices from DfT's Statistics Table BUS0405a. The forecast increases in fares are 19% between 2019 and 2029, and 50% between 2019 and 2042. Over the 60-year period, the scheme is anticipated to generate an additional bus farebox revenue of £56.04m (nominal).

4.4.3. The mode choice modelling has identified there is modal shift from rail to bus as a result of the scheme. Therefore, there will be a reduction in rail farebox revenue. Within WERTM rail fares are modelled on a stop-to-stop basis based on averaging the fare values available from Network Rail fare information in 2019. As they are modelled station to station, there is no differential for different operators. Within the model rail fares are assumed to grow in line with RPI+1% to 2024, and then RPI to 2025. This results in an increase in rail fares of 12% between 2019 and 2029, and 21% between 2019 and 2042. Over the 60-year period, the impact of the scheme on rail farebox revenue is estimated to be -£50.26m (nominal).

4.5 Budgets and Funding Cover

Funding Strategy

4.5.1. It is anticipated that both projects will be funded entirely from public finances. This BBSC Programme is one of the flagship schemes within the Combined Authority CRSTS Programme. Therefore, funding has been earmarked for delivery of the scheme; and in line with the requirements of the grant funding, this must be spent by March 2027. As discussed previously, the Programme is disaggregated into a number of projects, where these each formed individual funding line items within the CRSTS bid.

4.5.2. The Combined Authority had a confirmed settlement figure of £540m, this is supported by a local contribution from the unitary authorities of 19% (exceeding the 15% minimum required by the CRSTS guidance for Mayoral Combined Authorities). Of this overall settlement, the budget allocated from CRSTS towards the Projects 2 and 3 of the BBSC Programme is £61.26m, and £13.46m allocated from local contribution. This gives a total budget allocation for Projects 2 and 3 of the Programme of £74.72m. Of this £35.87 is allocated to Project 2 with £38.85 allocated to project 3. These are the values after programme level costs have been removed.

4.5.3. The total scheme cost at the OBC stage is £45.23m, with Project 2 accounting for £19.53m and Project 3 accounting for £25.70m. Of the £45.23m, £37.08m will be funded through CRSTS and £8.14m will be funded through a local contribution from B&NES. Project 2 will be funded through £16.01m from the CRSTS allocation, and £3.52m from local contribution. Project 3 will be funded through £21.07m from the CRSTS allocation, and £4.63m from local contribution. Across the two projects, the local contribution from B&NES will account for 18% of the scheme costs. B&NES have identified the following potential funding avenues to source the local authority contribution:

- Clean Air Zone Levy
- CIL

- S106
- Capital Finance Reserve Contributions
- Council Approved Borrowing
- Development Receipts

4.5.4. **Table 4-5** shows the funding by source in each year compared to the cost profile. This will be refined further through the FBC stage once more information around construction phasing costs becomes available which is commensurate with the level of detail at that subsequent stage.

4.5.5. It should be noted that the spend profile has been set so that all costs are incurred by March 2027. However should the programme overrun past this date local authority contribution will cover any expenditure beyond March 2027.

Table 4-5 – Cost profile by funding sources (£m, nominal)

Funding Source	2023/24	2024/25	2025/26	2026/27	Total
Project 2 CRSTS Funding	0.04	0.97	1.65	13.35	**16.01**
Project 2 Local Contribution	0.01	0.21	0.36	2.93	**3.52**
Project 2 Total	**0.05**	**1.19**	**2.02**	**16.28**	**19.53**
Project 3 CRSTS Funding	0.03	0.93	2.66	17.45	**21.07**
Project 3 Local Contribution	0.01	0.20	0.58	3.83	**4.63**
Project 3 Total	**0.04**	**1.13**	**3.25**	**21.27**	**25.70**

4.6 Summary of the Financial Dimension

4.6.1. The Financial Dimension outlines the proposed funding and financing of the scheme in terms of the affordability of the proposal, the source of funding, and the annual breakdown of costs. The costs are shown separately for Projects 2 and 3 as these were separate funding line items within the CRSTS submission.

4.6.2. The capital costs of the scheme have been estimated using the available design information at the OBC stage and have been developed in line with TAG A1.2. The construction cost estimate has been developed using the Bills of Quantities based on the latest design drawings. Allowances have also been made for the main contractor's preliminaries and overhead and profit, based on live schemes that WSP are supporting on, that are of a similar nature. A cost allowance has also been included for temporary works and traffic management.

4.6.3. To reflect the uncertainty associated with known risks, a Quantified Risk Assessment (QRA) has been undertaken. The QRA has been carried out considering each specific risk, the probable effects of that risk, the likelihood of occurrence and cost. For the purposes of the Financial Dimension, the P75 value has been used which has a quantified risk of £9.14m (Q2 2023).

4.6.4. Inflation has been applied to the capital expenditure based on forecasts from the BCIS TPI from May 2023.

4.6.5. The capital expenditure of Project 2 is £19.53m inclusive of risk and inflation, and the cost of Project 3 is £25.70m. These costs have been profiled over the design and construction period.

4.6.6. Over the course of the 40 and 60-year period, the additional maintenance and renewal costs are estimated to be £6.41 for Project 2 and £29.37 for Project 3. The additional maintenance and renewal costs would be included as part of B&NES' annual maintenance programme.

4.6.7. The scheme will improve the journey times and reliability of the existing services on the corridor. As a result of this there is forecast to be modal shift to bus from other modes, which will result in additional farebox revenue on bus services. Over the 60-year period, the impact of the scheme on bus farebox revenue is estimated to be £56.04m (nominal). Over the 60-year period, the impact of the scheme on rail farebox revenue is estimated to be -£50.26m (nominal), due to abstraction of demand from rail to bus.

4.6.8. Project 2 will be funded through £16.01m from the CRSTS allocation, and £3.52m from local contribution. Project 3 will be funded through £21.07m from the CRSTS allocation, and £4.63m from local contribution. Overall, these two projects are estimated to cost £45.23m, of which £37.08m will be funded through CRSTS, and the remaining £8.14m through local contribution provided by B&NES.

5 Commercial Dimension

5.1 Introduction

5.1.1. This chapter outlines the approach taken to assess the feasibility and practicability of delivering the Emery Road to Bath sections (hereafter known as the B&NES section) of the Bath to Bristol Strategic Corridor (BBSC) programme. The Bristol to Emery Road section of the programme is not as developed as the B&NES section and is unlikely to be fully complete and delivered at the same time. However, short term elements could be delivered by March 2027. If elements of the Bristol section of the BBSC are to be delivered before March 2027, the Combined Authority will ensure that delivery will not cause conflicts between the two neighbouring sections.

5.1.2. The Commercial Dimension provides evidence of the commercial viability of the proposed scheme and describes the procurement strategy that will be used to engage the market. It provides evidence on the appropriateness of the selected delivery model and the approach to risk allocation and transfer, contract and implementation timescales and the approach to managing the contract.

5.1.3. Risk allocation is based on guidance contained within the Outsourcing Playbook[22], with a clear delineation between the contractor's and client's risk ownership. Additional detail on the Combined Authority's approach to risk management can be found in section 6.9 of the Management Dimension.

5.1.4. The Commercial Dimension is structured in line with 'the Transport Business Case: assessment and process procedures' guidance from the DfT, and outlines the current understanding of the proposed commercial requirements including:

- Output-Based Specification
- Procurement Strategy
- Sourcing Options
- Payment Mechanisms
- Pricing Framework and Charging Mechanisms
- Potential for Risk Transfer
- Contract Length
- Contract Management
- Resourcing Issues

[22] The Outsourcing Playbook, Central Government Guidance on Service Delivery, including Outsourcing, Insourcing, Mixed Economy Sourcing and Contracting, version 2.0, June 2020

5.2 Output-Based Specification

5.2.1. This section summarises the schemes functional requirements in terms of outcomes and outputs. These outcomes and outputs have been split by the design and planning, and construction phases of the B&NES section of the BBSC programme.

5.2.2. The BBSC programme objectives were initially developed by WSP, the Combined Authority, and the associated Unitary Authorities as part of the OAR development in 2020 in alignment with regional priority outcomes and policy aims. These were reviewed and updated in early 2023 by the Combined Authority, B&NES and BCC.

5.2.3. The objectives for the BBSC programme can be found in the Strategic Dimension. The outputs outlined in **Table 5-1** will drive decision making throughout delivery of the B&NES section of the BBSC programme. The themes between the objectives and the outputs are aligned in terms of what the BBSC programme is seeking to achieve.

Table 5-1 – Output-based specification

Phase	Outputs
Design and Planning	▪ Preliminary design for the B&NES section of the BBSC programme ▪ Detailed design for the B&NES section of the BBSC programme ▪ Development of the scheme design and preparatory works design ▪ Surveys and ground investigations ▪ Advance works - including utility diversions and other enabling works ▪ Planning application and determination ▪ Land purchases ▪ Development of the scheme business cases ▪ Programme management

Phase	Outputs
Construction	Construction of system wide infrastructure improvements and enhancements to facilitate the provision of the BBSC programme. Outputs may include: ▪ Provision of bus priority at key locations along the corridor including six miles of new bus lanes across the entire BBSC scheme ▪ Provision of a Transport Hub at Keynsham to include: two new bus stops, two new bus shelters and waiting areas with seating and live digital bus information screens. In addition, a new crossing across the bypass will create a new alternative level cycling and walking link between north and south Keynsham, and a connection to the town centre through Memorial Park on new paths for walking and cycling connecting with existing routes. ▪ A continuous segregated strategic cycling corridor between Bristol and Bath providing safe and well-lit cycling including nine miles of new or improved cycle lanes across the entire BBSC scheme ▪ Cycling and walking connections between local communities and the A4 Corridor

5.3 Procurement Strategy

5.3.1. B&NES has extensive experience of procuring complex highway engineering projects. Additional detail can be found in section 6.2 of the Management Dimension.

5.3.2. The Combined Authority has developed an overarching procurement strategy for the Sustainable Transport Corridors programme, the BBSC scheme sits within this programme.

Procurement Objectives

5.3.3. **Table 5-2** provides a list of suggested procurement objectives relevant to the Combined Authority and the BBSC programme. These objectives will support the selection and definition of an optimal procurement strategy, route to market and contracting strategy. As the scheme design and planning develops over the programme lifecycle, these procurement objectives will be reviewed at each stage with consideration given to their continued relevance.

Table 5-2 – BBSC procurement objectives

Objective	Consideration
Cost Certainty	Ensure cost certainty around the delivery of the scheme within the agreed funding constraints and achieve the most economically advantageous delivery.
Programme/Pace of Delivery	Time for overall delivery, time for procurement, consideration of key milestones ultimately ensuring delivery within the available funding window.
Value for Money / Innovation / Whole-life costs	Ensure appropriate Value for Money while allowing innovation and consideration of whole-life costs.
Risk	Ensure risk is allocated fairly based on who is best able to manage risk, appetite to retain risk or incentivise a contractor to manage project risk.
Sustainability / Environment	Ensure the scheme is developed in a sustainable way that minimises the impact on the environment i.e., carbon reduction, social value, local supply chain involvement etc.

5.4 Procurement Approach

Procurement Model Options

5.4.1. **Table 5-3** outlines each of the public procurement model options that have been explored for BBSC and the advantages and disadvantages of each type available.

5.4.2. Considering that an incremental, phased, and programmatic approach will benefit the delivery of the BBSC and maximise the value of each investment, several public procurement models will be available to the Combined Authority.

Table 5-3 – Public procurement model options

Procurement Strategy *Public Ownership (Separate Operations & Maintenance)*	**Advantages** *Public Ownership (Separate Operations & Maintenance)*	**Disadvantages** *Public Ownership (Separate Operations & Maintenance)*
Traditional Single Stage Consultant develops design in partnership with client before competitive tenders are invited and before the main works contract is let. The contractor appointed to deliver works (possibly including some level of contractor design post-award) under a lump sum or a re-measurable contract	▪ Established procurement route ▪ The client develops the specification, manages risk and retains control and flexibility to change the specification ▪ Award of contract on the lowest price basis /best value demonstrating Value for Money (potentially using quantities which may vary at completion) ▪ Construction costs can be accurately determined in advance ▪ The contractor assumes responsibility and financial risk for the delivery of the design	▪ No incentive for a contractor to innovate ▪ No link between design and construction or contractor input to design ▪ The nature of risks is not fully realised at the point of award resulting in the potential for an increase in outturn cost and delays with completion ▪ A detailed design is required in advance of procurement ▪ The sequential nature of design/construction extends the delivery duration ▪ Can create an adversarial relationship between the contract parties ▪ Further detailed design post contract award may result in programme delays
Design and Build The main contractor is appointed to design and construct the works. They act as a single point of responsibility for delivering the project. Either a single-stage or two-stage tender process can be used to procure and appoint	▪ Integration of design and construction leads to efficiencies in cost and time ▪ Single point of responsibility for the client resulting in a potentially reduced client risk profile ▪ Stimulates innovation, reducing cost ▪ Price certainty can be obtained before commencement ▪ Risks are identified and allocated during the procurement phase	▪ Detailed design, specification or requirements are required ▪ There is reduced competition with fewer companies interested ▪ The contractor takes on greater risk and price risk into the estimate (increasing scheme costs) ▪ Lack of flexibility to change the specification ▪ In-contract scope change can be expensive ▪ Delay to the delivery programme to allow for contractor design development ▪ Quality may be overridden by cost-efficiency ▪ Limited design liability
Management Contracting The works are constructed by several different contractors who are contracted to a management contractor. The management contractor is generally appointed by the client early in the design process	▪ Overlap of design and construction leads to time efficiencies ▪ Management contractor and works contractors can contribute to design development ▪ Works packages can be let competitively within shorter procurement windows and market reflective pricing at different stages ▪ Allows for scope changes later in delivery with lower impact due to phased delivery approach of trade packages of work	▪ A high-quality design brief is required as design completion will overlap construction ▪ Lack of price certainty before letting construction contract ▪ Experienced management contractor required to secure successful delivery ▪ Delays to design completion can impact the schedule and be costly ▪ Procurement of works contractors can impact on schedule

Procurement Strategy *Public Ownership (Separate Operations & Maintenance)*	**Advantages** *Public Ownership (Separate Operations & Maintenance)*	**Disadvantages** *Public Ownership (Separate Operations & Maintenance)*
Construction Management The client appoints a design team and Construction Manager to oversee the delivery of the works. The works are then constructed by several different trade contractors. The Construction Manager role is to manage, programme and coordinate the design and construction	▪ Time-saving due to overlap between design and construction ▪ Contractors and trades can contribute to the design phase ▪ Clear roles and responsibilities ▪ The direct contractual relationship between client and trade contractors results in increased price/cashflow certainty ▪ Allows for scope changes later in delivery within lower impact due to phased delivery approach of trade packages of work	▪ Price and time certainty is not available until all work packages have been let ▪ A detailed and clear brief is required to ensure quality delivery ▪ An experienced delivery team is required ▪ High levels of informed and pro-active communication management are required for successful delivery
Partnering / Alliancing Development of cooperative and collaborative relationships to improve project delivery performance. Usually combined with a traditional construction procurement strategy to align clients and contractors	▪ Reduction in the number of contractual disputes once collaborative relationships established ▪ Allows for early supply chain involvement in the project ▪ Based on an open book style and a win/win approach ▪ Greater levels of design integration within the construction process	▪ Success depends on all partners acting in a similar spirit and abiding by the rules ▪ Requires additional client inputs and resources compared to more traditional projects ▪ There is a potential learning curve for inexperienced parties

5.4.3. At this OBC stage, the preferred procurement option for the B&NES section of the BBSC programme identified by the Combined Authority is Design and Build (D&B). As part of the Sustainable Transport Corridors procurement strategy a delivery model evaluation was undertaken comparing the shortlisted options which included Early Contractor Involvement (ECI) had the highest score across the shortlisted options. This is using the D&B process but introduces the contractor at an earlier stage to utilise the skills of the contractor and its supply chain.

5.5 Route To Market Options

5.5.1. The size and complexity of the BBSC programme gives the Combined Authority several different routes to market for the procurement of the programme whilst achieving the procurement objectives set out earlier in the chapter. These options include:

- A new procurement exercise under the Public Contract Regulations (PCR) 2020 using an open procedure, restricted procedure, competitive dialogue procedure or competitive procedure with negotiation.
- A new procurement exercise to create a new framework to deliver the outputs of the relevant projects under the Combined Authority programme. Once suppliers have qualified for a place on the framework, the Combined Authority can direct award or hold mini competition packages of works to select the deliverer of choice.
- Using existing frameworks to access pre-qualified contractors to deliver the scheme.

5.5.2. The advantages and disadvantages of each of these routes has been covered in **Table 5-4**

Table 5-4 – Advantages and disadvantages of the routes to market available for the BBSC

Route to Market	Advantages	Disadvantages
PCR 2020 procurement exercise Multiple legally compliant procurement exercises for packages of work	▪ Alignment of the qualification criteria to the procurement objectives set out by the Combined Authority ▪ Specific packages of works can be procured with a clear scope	▪ Several procurements would result in a significant time and resource commitment from the Combined Authority

Route to Market	Advantages	Disadvantages
A Combined Authority framework Creation of a framework with multiple contractors pre-qualified	▪ Alignment of the qualification criteria to the procurement objectives set out by the Combined Authority ▪ With reduced certainty on the requirements for the programme, the client and market can work together to define the scope	▪ The Combined Authority will need to develop the scope and pipeline of works early in the programme to allow a contractor to tender competitively
Existing framework The Combined Authority to use an existing framework to procure the relevant packages of works	▪ A legally compliant process will have been followed to shortlist available contractors ▪ The Combined Authority can get to market quicker	▪ Frameworks are available for periods of time which could elapse during the programme resulting in a further procurement. ▪ Potentially reduced competition on elements pre-qualified during the tendering process for the framework

5.5.3. For the B&NES section of the BBSC the route to market identified is through an existing framework. As part of the Sustainable Transport Corridors procurement strategy a number of routes to market were considered included those listed in **Table 5-4**. The combined authority will use an existing framework that was procured in line with the PCR 2020, (previously PCR 2015). The advantage of this is that it reduces the burden on tenderers and reduces the time to get to market for the Combined authority.

5.6 Commercial Strategy

Contracting Model

5.6.1. The contracting model outlines how the client intends to contract with the supply chain. It summarises the role the supply chain will play, how it will be paid and the proposed risk allocation between the contract parties.

5.6.2. The selection of a preferred contracting model should be informed by the client's appetite towards risk, the clarity and detail of its requirements, the capability and capacity of the market and the overall scheme contract packaging.

5.6.3. A list of the available contracting models is seen in **Table 5-5.** This table considers current best practice outlined by the Infrastructure and Projects Authority (IPA) Project Routemap. When selecting a preferred contracting model, the Combined Authority will consider the advantages and disadvantages of each model against the project.

Table 5-5 – Contracting Model Options

Model and features	Advantage	Disadvantages	Considerations
Direct Delivery The works are constructed by directly employed in-house management and labour using owned or hired plant and materials purchased on a supply only basis ▪ Expertise in-house ▪ Clear requirements ▪ Limited complexity and innovation ▪ Majority of risk held internally ▪ Confidence in budget	▪ Having access to internal subject matter expertise ▪ Prior experience of the organisation and likely the works ▪ Likely to have access to prior cost, quality and schedule indicators and learning	▪ Relies on having sufficient internal resource (labour, plant, materials) for delivery ▪ Risks associated with business continuity and internal delivery arise with this approach ▪ Reputational considerations of direct delivery	▪ Capacity of the organisation to deliver ▪ Learning and lessons from prior projects is available and utilised by those undertaking the works
Management A management contractor is engaged by the client to manage the construction process. The management contractor has direct contractual links with all the works contractors and is responsible for all the construction works. The management contractor is paid a fee on top of the construction costs for the services provided ▪ Need specialist expertise ▪ Need support defining requirements ▪ Project lends itself to clear packages ▪ Risk split across trades but ultimate integration and management with client ▪ Budget may be released in gateways	▪ Schedule advantage associated with bringing a Management Contractor onboard ▪ Good market availability ▪ Enables performance of the supply chain to play to its core strengths by bringing in Management Contractors in to reduce “learning curve” risks	▪ Relationship between Management Contractor/ Consultant can lack definition, so risk transfer does not occur as intended ▪ Trade contracts exploit interfaces/ dependencies ▪ Budgets and programme/s are not fixed	▪ Scope any management appointments clearly and define responsibilities of Construction Manager if external appointment ▪ Plan interfaces and dependencies ▪ Share internal data clearly with Construction Manager
Cost-Based The works are designed and/or constructed by a main contractor that is reimbursed for all of its allowed costs plus additional payment to allow for a profit. The arrangement can be incentivised via a target price ▪ Performance on quality and schedule to be enhanced through commercial incentives ▪ Reliant on market knowledge for complex elements ▪ Shared risk profile	▪ Can support collaborative initiatives if correctly implemented ▪ Clear visibility of actual costs to support benchmarking and efficiency challenges’ ▪ Proactive management of risk if correctly managed	▪ Inadequate client understanding of risk transfer erodes incentive scheme ▪ Incorrect or inflexible performance or commercial measures ▪ Can be collaborative in letter not in spirit if both parties don’t set out correct behaviours from the outset ▪ Reactive management of risk	▪ Does the client have cost data to make informed decisions, if not then seek this out or seek advice ▪ KPIs/ commercial incentive needs validation against balanced scorecard ▪ Informed understanding of optimal level of risk transfer ▪ Requires engagement of client
Price Based The works are designed and/or constructed by a main contractor that is paid based on tendered prices ▪ Price key driver ▪ Commodity or prior category delivery ▪ Limited complexity ▪ Risk allocated and included in price	▪ Contracting Authority generally has familiarity with subject matter ▪ Simple procurement process ▪ Speed to market with a reduced negotiation time ▪ Price certainty if scope is locked down	▪ Least likely to consider balanced scorecard although not irrelevant ▪ Quality considerations not captured in tender ▪ Price risk entirely with contractor (subject of course to client change)	▪ If used for complex/ innovative projects, then change erodes price risk transfer ▪ No regard to benchmarks ▪ Has to be clear scope and known or limited variations

Model and features	Advantage	Disadvantages	Considerations
Outsourced The client transfers ownership of an asset for an extended period of time, such as under a PFI arrangement. An organisation with design, construction, maintenance and operational expertise and financing capability is appointed under a single contract to design, build, operate and maintain the asset ▪ Complexity or frontier in scale and in scope ▪ Client unable to manage and/or carry delivery risk	▪ Full transfer of delivery and operational risks ▪ Life of project considered in detail at outset as contract needs to cover extended period ▪ Temporary transfer of financial risk to private sector	▪ Deal complexity can drive up time to market and costs of preparation/ negotiation ▪ Challenge obtaining operating expenditure (opex) value for money ▪ Sustainability of contractor delivery entity	▪ Whole-life considerations to be consistent in both design & operations phase to get an availability regime and opex costs that deliver ▪ Client to consider where it can support process and generate value e.g., planning and regulatory ▪ Risk transfer should not engender "sit on hands" approach ▪ Client carries reputational risk ▪ Client underestimates resource to manage contract

Reproduced and adapted from the IPA Project Routemap – Procurement Module

Form of Contract

5.6.4. For civil engineering works in the UK, there are two main forms of contract: the New Engineering and Construction (NEC) Contract suite of contracts; or the Infrastructure Conditions of Contract (ICC), a successor to the Institution of Civil Engineers (ICE) Conditions of Contract since 2011. There are limitations on what these contracts can cover, especially where public-private partnerships are involved. Therefore, consideration of bespoke forms of contract is needed. The following sections provide more detail on each of the contract options.

New Engineering and Construction (NEC) Contract

5.6.5. The NEC Contract is a modern-day suite of contracts that facilitates the implementation of sound project management principles and practices as defining legal relationships.

5.6.6. Key to the successful use of NEC is users adopting the desired behaviours from each party. The main aspect of this is moving away from a reactive and hindsight-based decision-making arrangement to one that is foresight based encouraging a creative environment with pro-active and collaborative relationships.

5.6.7. The contract has been developed to make improvements to more traditional forms of contract under three fundamental headings:

- Flexibility – can be used in a wide variety of commercial situations for procuring a diverse range of works, services, and supply in any location.
- Clarity and simplicity – NEC contracts are written in ordinary language using words, which are in common use to promote understanding.
- Stimulus to good management – designed so that its implementation contributes to rather than detract from the effectiveness of the management of the work.

5.6.8. The NEC suite of contracts is broken down into three areas Works, Service and Supply. **Table 5-6** outlines the suite of NEC Works Contracts (with their associated abbreviation) and guidance on when to use each.

Table 5-6 – Types of NEC Works Contracts[23]

NEC Works Contract	Abbreviation of the NEC Works Contract	When to use it
NEC Engineering and Construction Contract	ECC	For the appointment of a contractor for engineering and construction work, including any level of design responsibility.
NEC Engineering and Construction Subcontract	ECS	As a subcontract to the ECC, for the appointment of a subcontractor for engineering and construction work.
NEC Engineering and Construction Short Contract	ECSC	As an alternative to the ECC, for the appointment of a contractor for straightforward engineering and construction work which does not require sophisticated management techniques and imposes only low risk on both the client and contractor.
NEC Engineering and Construction Short Subcontract	ECSS	As a subcontract to the ECC or ECSC, for the appointment of a subcontractor for straightforward engineering and construction work which does not require sophisticated management techniques and imposes only low risk on both the contractor and subcontractor.
NEC Design Build and Operate Contract	DBO	For the appointment of a contractor to design, build and operate or maintain as asset over a defined period of time.

[23] Adapted from NEC4 Establishing a procurement and Contract Strategy – Volume 1

5.6.9. For single one-off complex engineering and construction projects, the NEC ECC is usually selected as it offers a contract which provides a variety of options with different approaches to pricing, risk management, payment, and delivery. The NEC ECC has six main options which are outlined in **Table 5-7**.

Table 5-7 – NEC ECC Main Options[24]

Main Option	**When to use it**
Option A – Priced contract with activity schedule	This option is suited to projects where the scope is well defined, and a contractor can price detailed activities. The contractor bears the financial and delivery risk of Providing the Works in accordance with the Scope.
Option B – Priced contract with bill of quantities	This option is also suited to projects where the scope is well defined, and a contractor can price detailed activities. However, it includes a remeasurement payment mechanism to assess the Price of work completed where the Scope included the scope of work but does not include detailed quantities. The contractor bears the financial and delivery risk of Providing the Works in accordance with the Works Information and the agreed rates, and the client bears the financial risk of fluctuations in quantities of work completed.
Option C – Target contract with activity schedule	This option is used where the extent of the work to be done is not completely defined and uncertainty and high levels of delivery risk are present. Both client and contractor share the financial risk. Payment is based on the completion of activities on an activity schedule.
Option D – Target contract with bill of quantities	This option is also used where the extent of the work to be done is not completely defined and uncertainty and high levels of delivery risk are present. Both client and contractor share the financial risk. Payment is based on a re-measurable bill of quantities.

[24] *Adapted from NEC4 Establishing a procurement and Contract Strategy – Volume 1*

Main Option	When to use it
Option E – Cost reimbursable	This option is used when the works required cannot be defined sufficiently to inform even a target price. The client bears the financial risk as the scope is not clearly defined prior to commencing the contract. The contractor is paid their 'Defined Cost' plus fee.
Option F – Management contract	This option is used when a management contracting approach is required. The contractor is paid a fee based on the work completed by Subcontractors and bears the risk of subcontractor's delivery in line with the Scope.

Infrastructure Conditions of Contract (ICC)

5.6.10. The ICE Conditions of Contract were republished by Thomas Telford in 2011 as the Infrastructure Conditions of Contract (ICC). The standard suite of ICC contracts is outlined in **Table 5-8.**

Table 5-8 – Types of ICC Works Contracts

ICC Contract	When to use it
ICC Design and Construction Version	In this version, the contractor is responsible for the design and construction of the works. Contracts are lump sum with no remeasurement.
ICC Target Cost Version	This version encourages the contractor to be more involved in early design and planning. It provides incentivisation for both the employer and contract to share profits or loss compared to the agreed Target cost.
ICC Term Version	This version uses work orders to accommodate rolling renewal and replacement works and is based on re-measurement or lump-sum payment.
ICC With Quantities Version	This version is shorter than the measurement version and is intended for Engineer/Consultant designed works whilst acknowledging and providing for an element of Contractor design.

ICC Contract	When to use it
ICC Measurement Version	This version is based on traditional engineer designed, contractor-built works. Payment is on a remeasurement basis.
ICC Minor Works Version	Shortened version to cover minor works.

5.6.11. The NEC and ICC contract suites both provide a robust contracting framework through which the scheme could be delivered. They have proven track records for the delivery of infrastructure schemes and are widely accepted within the UK civil engineering industry. The NEC is considered a less adversarial form of contract although the most recent revisions of the ICC have also attempted to promote collaboration.

5.6.12. Both the NEC and ICC offer a range of conditions of contract which would enable the Combined Authority to select conditions that best align to the scheme procurement objectives.

5.6.13. The Combined Authority contract procurement rules allow for either the NEC or ICC standard form to be adopted for the delivery of major projects. The Combined Authority has adopted the NEC for engineering, maintenance and professional services contracts and has found from its experience in procuring construction works that this is generally the preferred form within the sector. Not only is this the standard form of contract for infrastructure works in the UK, but the additional flexibility and existing in-house familiarity with the NEC suite make it the preferred option for the delivery of the BBSC.

5.7 Procurement Strategy Summary

5.7.1. The contract will be a two-stage NEC4 ECC. Stage one will be an Option E (cost reimbursable) and stage two will be delivered using the (target price) (Option C) main option. Option C provides incentivisation for the contractor to seek cost savings and means that risk of increase in the outturn cost is shared between The Combined Authority and the contractor.

5.7.2. ECI is an alternative procurement strategy that introduces the contractor at an earlier stage to utilise the skills of contractor and its supply chain and help drive greater efficiencies. ECI has long been recognised as a method for reducing risk and increasing buildability through collaborative working, pre-construction planning, design scrutiny, and true value engineering to deliver optimal value for money.

5.7.3. ECI is a secondary option (X22) available for use with the NEC4 Contract (Options C or E). The parties enter into a single two-stage cost reimbursable contract to collaborate in developing the project, including design and planning for construction (Stage One), before progressing to the main construction phase (Stage Two). The NEC Practice Note assumes the Contractor being responsible for the design and the use of an ECC Option C Contract.

5.8 Payment Mechanisms

5.8.1. The BBSC will employ the fourth New Engineering Contract (NEC4) suite of contracts. The following figure illustrates the aims of NEC4 contracts.

Figure 5-1 – Aims of NEC Contracts

5.8.2. The suite of contracts reflects user feedback, industry developments and user best practice. NEC4 Contracts have:

- Improved contract administration and reduced administration costs
- Increased flexibility in each contract and NEC suite
- Improved risk opportunity and management
- Been designed for international use
- Better value, greater certainty and improved delivery

5.9 Risk Allocation and Transfer

5.9.1. Thorough risk assessment processes and mitigation measures have been established and undertaken throughout the development of the scheme to date, including a number of risk workshops with the design team, B&NES and the Combined Authority. Throughout the detailed design stage, the design and construction teams will further develop the project risk register with design risks being managed and mitigated as they are identified and arise.

5.9.2. Following the design stage, the primary risks going forward will be in construction. The ownership of these risks is built into the construction contract to ensure that risks are the responsibility of the party best placed to manage them.

5.9.3. BBSC's Project Management Team are responsible for wider risks, including: managing planning consent and the discharge of planning conditions; road space and rail agreements; land acquisition; funding arrangements; non-construction programme conflicts; and demands from businesses and residents.

Table 5-9 – Risk Allocation Table

Risk Theme	Risk allocated to
Data accuracy – inaccurate / incomplete data may be provided to bidders during the procurement exercise leading to inaccurate pricing or solution	Client
Inflation risk – the cost of supplier's 'inputs' might rise over time due to inflation	Shared and Supply Chain
Performance risk – risks that the services may not be delivered to the requisite performance / availability levels	Supply Chain
Volume/Demand risk – risk that the actual usage of the service varies from the levels forecast	Client
Currency risk – risk that the cost of supplier's inputs would rise due to fluctuations in foreign exchange rates	Supply Chain
Changes in the law – risk that a specific change in the law affects the supplier's ability to deliver any aspect for the contract to required time, budget and performance	Shared
Solution / design - risk that the project has not been designed adequately for the purpose required	Client
Delivery – risk that the design and build phase of the project runs behind the planned timescales	Shared
Scope change – risk of a change in requirements or scope over the course of the project	Shared and Supply Chain
Supplier default – risk that the programme would terminate (or partially terminate) the contract early i.e., before the end of the initial contract term	Shared
Termination risk – risk that the programme would terminate (or partially terminate) the contract early (i.e., before the end of the initial contract term)	Shared

Risk Theme	Risk allocated to
Subcontractor insolvency – risk that a subcontractor within the supplier's supply chain becomes insolvent during the contract term	Supply Chain
Industrial action – risk of industrial action by any of the supplier's staff	Supply Chain
Unforeseen events (force majeure) – risk of unforeseen events affecting the supplier's ability to deliver any aspect of the contract to required time, budget and performance	Shared

5.10 Contract Lengths

5.10.1. The contract is a two-stage Design & Build contract: Stage 1 for the contractor to deliver the detailed design; and Stage 2 for the construction following completion of the design and agreement of a target price.

5.10.2. From contract signature, it is envisaged that the support to the planning process, the development of the detailed design, appointment of any sub-contractors not forming part of the original consortium, enabling works and mobilisation will together take up to 18 months.

5.10.3. Construction is expected to commence in winter 2025 and is expected to be complete by spring 2027. The conditions of the CRSTS grant from central government advises that any spend must be complete by March 2027, therefore any spend incurred after this will be covered by the local authority contribution.

5.10.4. It is envisaged that the contractor will be contracted to do the landscape maintenance for a period of 2-5 years after the scheme is open. This will be set out in the contract documentation.

5.11 Contract Management

5.11.1. The main tool that will be employed for contract management is the NEC4 contract itself. It provides details of the roles and responsibilities of each party to the Contract (Client and Contractor), and how time, quality management, payments, compensation events, title, liabilities and insurances, and termination are to be managed throughout the duration of the contract.

5.11.2. NEC4 supports the on-going drive towards further collaboration and integration of teams, use of modern work methods, avoidance of disputes, and identification and management of both risk and opportunity for a successful outcome.

5.11.3. It is critical to the success of the organisation that contracts are managed in a structured and planned way. A Contract Management Plan (CMP) will be developed prior to the award of contracts by the Combined Authority.

5.11.4. This plan will be developed through close liaison between the Combined Authority senior owners, The Commercial Team, and key stakeholders and will be tailored so that it is specific to the contract.

5.11.5. The contract will be manged in accordance with the NEC4 contract management guidance which includes the content of the contract and its options (x clauses) and how to operate them to achieve a successful outcome.

5.12 Human Resource Issues

5.12.1. No significant human resources issues have been identified that could affect the deliverability of the scheme. No TUPE issues are expected.

5.12.2. The loss of key personnel with the project management team could have a significant impact on the scheme programme and its delivery. A successor will be identified for each key person to ensure knowledge transfer and continuous delivery.

5.12.3. More information on the governance and management of the project, including details of the people involved, is set out in the Management Dimension.

5.13 Summary of the Commercial Dimension

5.13.1. The Commercial Dimension provides evidence of the commercial viability of the proposed scheme and describes the procurement strategy that will be used to engage the market. It provides evidence on the appropriateness of the selected delivery model and the approach to risk allocation and transfer, contract and implementation timescales and the approach to managing the contract.

5.13.2. Risk allocation is based on guidance contained within the Outsourcing Playbook, with a clear delineation between the contractor's and client's risk ownership.

Output Based Specification

5.13.3. The Output-Based Specification section summarises the schemes functional requirements in terms of outcomes and outputs. These outcomes and outputs have been split by the design and planning, and construction phases of the scheme.

Procurement Strategy

5.13.4. The Combined Authority has developed an overarching procurement strategy for the Sustainable Transport Corridors programme, the BBSC scheme sits within this programme. The procurement strategy for the scheme is based on the overarching Sustainable Transport Corridor Strategy.

5.13.5. The contract will be a two-stage NEC4 ECC. Stage one will be an Option E (cost reimbursable) and stage two will be delivered using the (target price) (Option C) main option. Option C provides incentivisation for the contractor to seek cost savings and means that risk of increase in the outturn cost is shared between The Combined Authority and the contractor.

5.13.6. ECI is an alternative procurement strategy that introduces the contractor at an earlier stage to utilise the skills of contractor and its supply chain and help drive greater efficiencies. ECI has long been recognised as a method for reducing risk and increasing buildability through collaborative working, pre-construction planning, design scrutiny, and true value engineering to deliver optimal value for money.

5.13.7. ECI is a secondary option (X22) available for use with the NEC4 Contract (Options C or E). The parties enter into a single two-stage cost reimbursable contract to collaborate in developing the project, including design and planning for construction (Stage One), before progressing to the main construction phase (Stage Two). The NEC Practice Note assumes the Contractor being responsible for the design and the use of an ECC Option C Contract.

Route to Market

5.13.8. The Combined Authority will use an existing framework that was procured in line with the PCR 2020, (previously PCR 2015). The advantage of this is that it reduces the burden on tenderers and reduces the time to get to market for the Combined Authority.

Risk Allocation and Transfer

5.13.9. Thorough risk assessment processes and mitigation measures have been established and undertaken throughout the development of the scheme to date, including a number of risk workshops with the design team, B&NES and the Combined Authority. Throughout the detailed design stage, the design and construction teams will further develop the project risk register with design risks being managed and mitigated as they are identified and arise.

5.13.10. Following the design stage, the primary risks going forward will be in construction. The ownership of these risks is built into the construction contract to ensure that risks are the responsibility of the party best placed to manage them.

Contract Management

5.13.11. The main tool that will be employed for contract management is the NEC4 contract itself. It provides details of the roles and responsibilities of each party to the Contract (Client and Contractor), and how time, quality management, payments, compensation events, title, liabilities and insurances, and termination are to be managed throughout the duration of the contract.

5.13.12. NEC4 supports the on-going drive towards further collaboration and integration of teams, use of modern work methods, avoidance of disputes, and identification and management of both risk and opportunity for a successful outcome.

Human Resource Issues

5.13.13. No significant human resources issues have been identified that could affect the deliverability of the scheme. No TUPE issues are expected.

5.13.14. The loss of key personnel with the project management team could have a significant impact on the scheme programme and its delivery. A successor will be identified for each key person to ensure knowledge transfer and continuous delivery.

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6 Management Dimension

6.1 Introduction

6.1.1. The Management Dimension examines whether the scheme is considered deliverable from a management perspective. It sets out the processes and controls in place to manage the implementation of the scheme, and track and realise future benefits.

6.1.2. This dimension considers the following structure in line with 'the Transport Business Case: assessment and process procedures' guidance from the DfT and sets out:

- Evidence of similar, large-scale projects that have been successfully delivered by the Combined Authority and Unitary Authorities (UAs)
- Governance arrangements that have been put in place to oversee delivery
- The assurance regime for the project
- The project reporting arrangements
- Programme scope dependencies and constraints
- The key work packages and the programme plan for delivery
- The stakeholder management process
- The strategy for identifying and managing programme risks
- How lessons learned will be fed back through the project
- How the intended benefits of the scheme will be realised
- How critical systems and data will be maintained safely and securely
- How the performance of the scheme will be monitored
- How the Combined Authority will close out the programme once all deliverables have been met

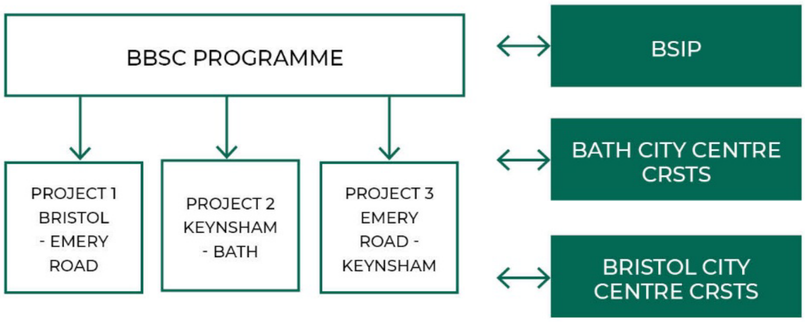
6.2 Scheme context

6.2.1. As set out in **section 1.3.1** of the Introduction, the BBSC Programme is split into three projects:

- Bristol to Emery Road
- Keynsham to Bath
- Emery Road to Keynsham and Keynsham Transport Hub

6.2.2. These three schemes exist within the wider context of a number of emerging schemes along the A4 corridor, as shown in **Figure 6-1** and detailed in **section 1.3.5**.

Figure 6-1 - BBSC Programme Structure



6.2.3. This Management Dimension looks at the Keynsham to Bath scheme, as well as the Emery Road to Keynsham and Keynsham Transport Hub components. The business case for the Bristol to Emery Road scheme is being developed separately to this OBC, with integration and coordination at a Programme level by the Combined Authority.

6.2.4. The BBSC programme is being led by the Combined Authority as the responsible organisation. As part of that, the Combined Authority will be responsible for instructing design and any changes, with any designs subject to review and approval by the B&NES Highways and Design and Projects team, in their capacity as the Local Highway Authority. The B&NES technical assurance process will be followed to obtain agreement. Detail around the role of the Combined Authority and B&NES in the planning process can be found in **section 6.9.6**.

6.2.5. The Management Dimension demonstrates the way in which the scheme will be delivered in accordance with best practice in planning, governance, risk and issue management, lessons learned, communications and stakeholder management, benefits realisation, and assurance.

6.3 Evidence of Similar Projects

6.3.1. The delivery of the scheme is expected to build upon experience gained on major schemes delivered by the Combined Authority and UAs. A selection thereof is listed in **Table 6-1**, summarising the scheme, timescales, and project value. The identified evidence demonstrates the Combined Authority's ability to deliver schemes of a similar nature. Where possible, the lessons learned from these projects and programmes will be applied to the delivery of the scheme.

6.3.2. The proposed BBSC Programme will be a significant undertaking in terms of strategic planning, preparation, resource requirements, design, procurement, construction delivery and operations. As such, it is expected that the programme will be delivered with a phased approach to mitigate some of the complexities of delivering such a large programme of works. Additional detail can be found as part of the Construction Phasing Strategy (70093741-WSP-PJM-0002, **Appendix Y**).

Table 6-1 - Evidence of similar projects

Contract	Scheme Description	Works Date	Approximate Value	Project Delivered Successfully
Metrobus - North Fringe (Cribbs Causeway to Hengrove Package (NFHP))	New bus lanes and priority measures, new or improved stops and interchanges, served by m1 and m3/m3x commercial metrobus services (linking north / east Bristol with the city centre and south Bristol). The scheme included: ▪ Stoke Gifford Transport Link (a new 1.6km highway / rapid transit link) ▪ A reconfigured city centre interchange and public realm upgrade ▪ A new bus-only junction on the M32 for metrobus vehicles only ▪ Parallel walking and cycling routes Relevance to the scheme: The scheme includes new bus lanes and priority measures, the Hicks Gate and Keynsham transport hubs and the parallel walking and cycling routes along the corridor itself.	2015 – 2017	£119m	Complete
Metrobus – Ashton Vale to Temple Meads (Bristol City Centre) Rapid Transit (AVTM)	An 8km public transport link running from Long Ashton Park and Ride to Bristol Temple Meads station and the city centre, served by the m2 commercial metrobus service. This includes a 2.5km guided busway, new bus lanes and priority measures, new or improved stops and interchanges and parallel walking and cycling routes. Relevance to the scheme: The scheme includes new bus lanes and priority measures, the Hicks Gate and Keynsham transport hubs and the parallel walking and cycling routes along the corridor itself.	2014 - 2017	£63m	Complete
Metrobus - South Bristol Link Road (SBL)	A 4.5km transport link between Long Ashton Park and Ride and Hengrove Park in South Bristol. The new link includes rapid transit, highway and segregated cycle and pedestrian facilities. Relevance to the scheme: The scheme includes new bus lanes and priority measures and the parallel walking and cycling routes along the corridor itself which are segregated from the highway traffic.	2015 - 2016	£48m	Complete

6.4 Governance, Organisational Structure and Roles

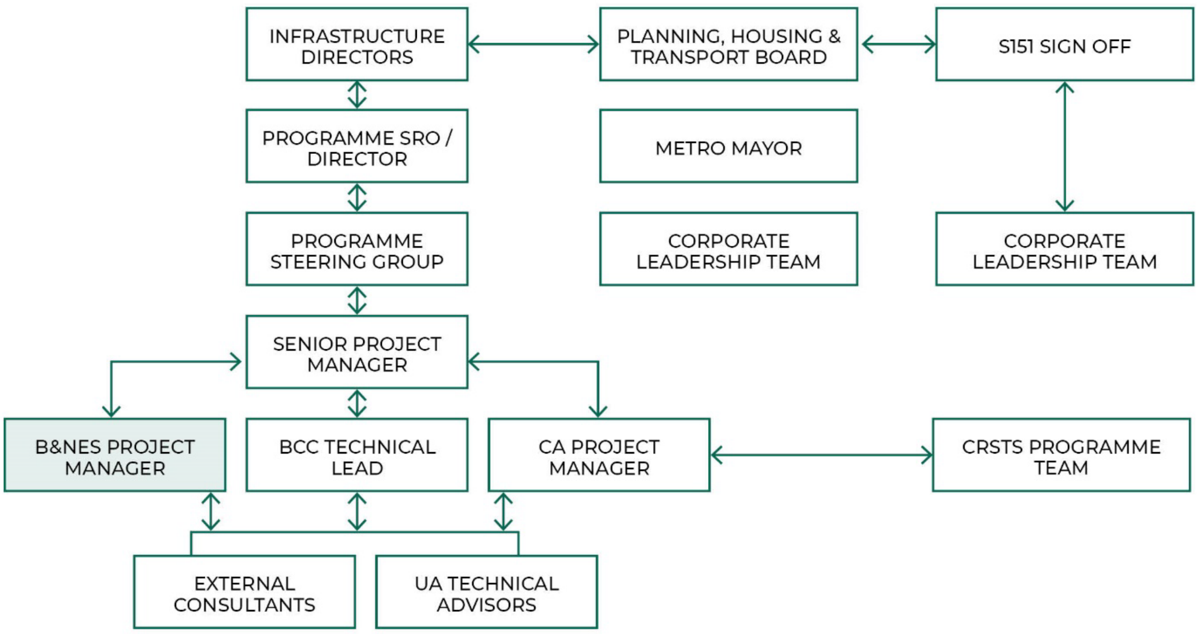
6.4.1. Appropriate levels of governance are critical to the successful delivery of the scheme. Defining a clear governance structure with evident lines of communication will ensure decisions are made proactively for the benefit of the project.

6.4.2. As detailed in the Construction Phasing Strategy (**Appendix Y**), the overall BBSC programme will be delivered as a series of individual work packages. The Governance Structure outlined below is designed to accommodate the required flexibility of different work packages progressing at differing rates (in line with their respective complexity and needs), while maintaining a consistent foundation.

Governance Structure

6.4.3. The organisational and governance structure in **Figure 6-2** shows the lines of accountability and responsibility for the scheme. This reflects the Combined Authority's constitution, which is attached as **Appendix N** and aligns to the organisation's approach to governance on major projects and programmes. **Table 6-2** outlines the responsibilities of each party within this governance structure.

Figure 6-2 - Governance Structure



6.4.4. Each member of the project's organisational structure has responsibilities that contribute to the overall successful delivery of the proposed scheme. The structure has been developed in close cooperation with B&NES, who in turn has its own organisational structure that is mapped to that of the Combined Authority. This is shown below in **Figure 6-3,** with roles and responsibilities set out in **Table 6-3**.

Figure 6-3 - B&NES Organisational Structure

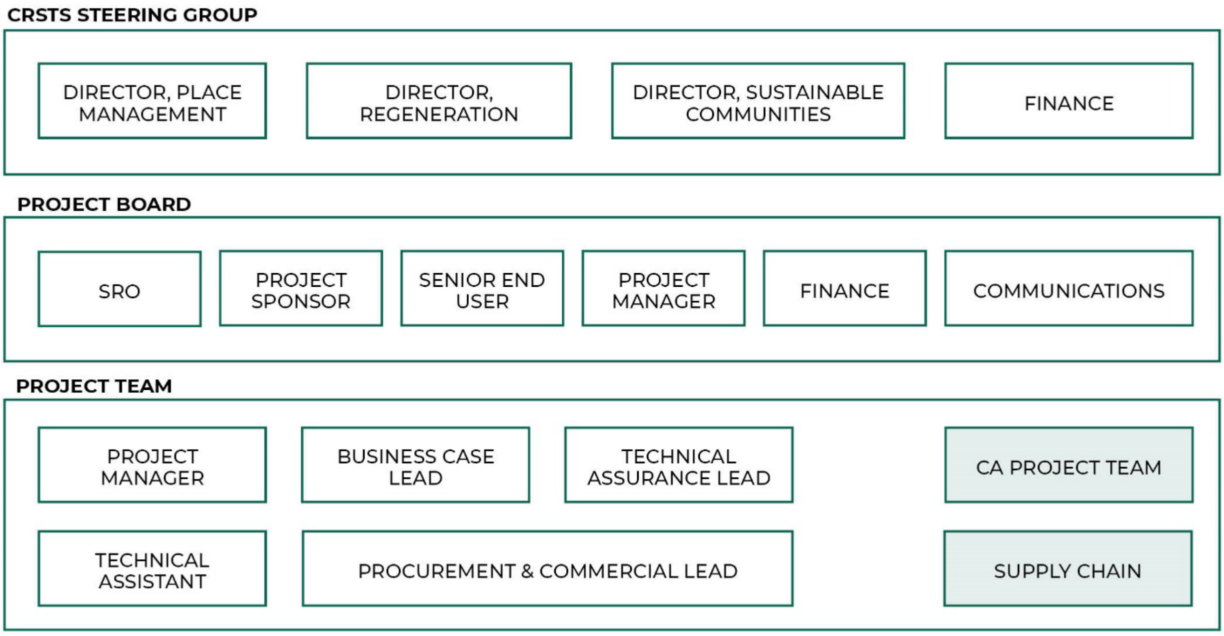


Table 6-2 - Roles and responsibilities within the BBSC governance structure

Role	Responsibilities
CA Committee	The Combined Authority Committee is comprised of the Mayor of the Combined Authority and other leaders from the Unitary Authorities (B&NES, BCC and SGC). The Combined Authority Committee is accountable for overall programme oversight, assurance, risk, approval of funding, and benefits realisation.

Role	Responsibilities
Senior Responsible Owner	A Senior Responsible Officer (Head of Capital Delivery, Malcolm Parsons [SRO]) has been appointed who is responsible for the work of the Programme Steering Committee. The SRO will be primarily accountable for the delivery of the scheme, ensuring that it meets its objectives and delivers its intended benefits. Their roles and responsibilities will include: ▪ Risk identification ▪ Defining and communicating the vision and objectives in line with policy or strategic intent ▪ Ensuring a real policy or business need is being addressed ▪ Assuring ongoing viability ▪ Engaging with key stakeholders ▪ Ensuring the delivered solution meets the needs of the business and stakeholders ▪ Providing the Scheme project team with leadership, decisions, and direction

Role	Responsibilities
Programme Steering Group	The Regeneration, Development and Transport (RDT) Programme Steering Group is comprised of the SRO and the Senior Project Manager from the Combined Authority, along with directors from the Combined Authority and the Unitary Authorities. At the time of submission, members are Malcolm Parsons (Combined Authority), Louise McBridge (Combined Authority), Emma Blackham (SGC) and Pam Turton (B&NES). The Programme Steering Group's primary function is decision-making and review. It provides strategic governance, as opposed the technical input of the project 'Delivery Teams'. The Steering Group will be responsible for: ▪ Authorisation of expenditure in line with the programme schedule ▪ Managing the Scheme and ensuring its successful delivery ▪ Providing guidance and support to the Programme Manager ▪ Authorising necessary funds and spending ▪ Stakeholder management ▪ Communication of information about the project to other parts of the Combined Authority / facilitating communication to aid the decision-making process ▪ Signing off any changes to the programme schedule or budget in line with set delegations of approval ▪ Managing key strategic risks highlighted in the programme risk register ▪ Signing off key stages of the programme and approval to proceed to the next phase ▪ Monitoring the programme as it develops to ensure that it meets the Scheme objectives

Role	Responsibilities
S151 Officer	The role and functions of the S151 Officer are directly informed by a comprehensive framework of statutory duties and responsibilities. In summary, the S151 Officer: ▪ Is a role prescribed by law with all local authorities assigning S151 duties to one officer who must be a qualified member of a recognised accountancy body. ▪ Must ensure compliance with all statutory requirements for accounting and internal audit (including supporting records and all systems of internal checks and control). ▪ Manage the financial affairs of the authority in all its dealings and transactions and in so doing secure the proper stewardship of Council (and Members) responsibilities. ▪ Must report under S114 powers to the Executive, the District Auditor and all Members of an authority if there is, or is likely to be, any item of unlawful expenditure or an unbalanced budget. ▪ Owes a personal duty of care to local taxpayers in managing Council resources on their behalf. In discharging this responsibility, the S151 Officer must balance the needs and interests of both current and future taxpayers.

Role	Responsibilities
Project Manager	Each scheme that is part of the BBSC programme has its own project manager, all of which report into a single Senior Project Manager responsible for the day-to-day running of the programme. At the time of writing, the Senior Project Manager for the Combined Authority is Stephen Hathaway. The Senior Project Manager is responsible for tracking and resolving interlinkages between the different schemes, as well as reporting upwards to the Programme Steering Group. The individual Project Managers are responsible for the day-to-day oversight of their respective schemes. The main responsibilities or the Project Manager are: ▪ Representing the Combined Authority at main stakeholder events to provide updates on the project ▪ Delivering their respective projects to a required specification and quality within budget and according to plan ▪ Project managing and planning all stages of the project ▪ Monitoring progress, expenditure and resources across the individual workstreams, initiating corrective action as required ▪ Managing project risks ▪ Coordinating workstream groups and reporting key progress / issues into the Operational Project Board ▪ Identifying, commissioning and overseeing external resources necessary for the assessment, evaluation, design, management and planning of the project

Table 6-3 – B&NES Roles and Responsibilities

Role	Responsible Officer
Director, Place Management	Chris Major
Director, Regeneration	Simon Martin

Role	Responsible Officer
Director, Sustainable Communities	Sophie Broadfield
Steering Group, Finance	Giles Oliver
SRO	Tom Foster
Project Sponsor	Pam Turton
Senior End User	Gary Peacock
Programme / Project Manager	Nik Bowyer
Project Board, Finance	Kate Clements
Communications	Jacob Newbury
Business Case Lead	Nik Bowyer
Technical Assurance Lead	Steve Froggat
Procurement and Commercial Lead	Andrew Brentley
Technical Assistant	Krzysztof Fedorczuk

6.4.6. In addition to this set structure, there are targeted workstream groups responsible for individual components of the project, such as procurement, legal issues, communications, finance and design issues. The workstream groups meet as needed.

6.5 Assurance and Approvals

6.5.1. It is essential that large, complex, and long-running projects are monitored effectively. All major transport schemes must demonstrate that a system for monitoring progress is part of the management structure and plan.

6.5.2. The Scheme programme will follow the Combined Authority's Assurance Framework. The framework[25] sets out arrangements adopted by the Combined Authority in relation to:

- Governance and key decision-making arrangements (Section 2)
- The Project Lifecycle, including scheme identification and prioritisation, business case development and appraisal, and the approvals process (Section 3)
- Approach to monitoring and evaluation (Section 4)

[25] West of England Investment Fund Assurance Framework, West of England Combined Authority, June 2018

6.5.3. The Seven Principles of Public Life (the Nolan principles) underpin the Assurance Framework. In addition, the Scheme programme will follow applicable assurance and approval processes at both a national and local level.

6.5.4. In line with the Assurance Framework, the Combined Authority will monitor the Scheme and the overarching BBSC programme through the Programme Steering Group. The Programme Steering Group will determine whether the review gateways (shown in **Figure 6-4)** have been successfully completed while also releasing funding, where appropriate, based upon the completion of milestones to desired quality and cost.

Combined Authority Assurance Framework

6.5.5. The Assurance Framework is in place to show that suitable arrangements are followed to effectively manage Combined Authority investments, and that robust systems are in place to ensure resources are spent with regularity, propriety, and value for money, whilst at the same time achieving projected outcomes.

6.5.6. It outlines clear and transparent procedures for all stakeholders in the Combined Authority area regarding the delivery and spending associated with Combined Authority investments. The Assurance Framework and the Scheme investment will be managed in accordance with the usual authority checks and balances, including the financial duties and rules that require local authorities to act prudently in spending.

Unitary Authority Assurance

6.5.7. As the Local Highway Authority responsible for the highway network affected by the proposals, the project will also need to pass through the B&NES pre-construction gateway review process and technical assurance processes. This will review and approve the following aspects of the scheme before proceeding to construction:

- Programme management
- Engagement and consultation
- Design
- Records and plans
- Highway Asset Improvement Plans
- Construction Design and Management Regulations
- Street Works Permit Scheme
- Procurement
- Road Safety Audit
- Traffic Regulation Orders
- 3rd Party Approvals

6.5.8. A Scheme Assessment Meeting will be held to approve the preliminary design freeze and progression to detailed design. Detailed designs would be approved via the Technical Approval Authority process. The Outline Business Case stage will be approved via B&NES internal governance arrangements (including the Transport Steering Group, Transport

Members Board and Cabinet Member approval), which will be completed in parallel with the Combined Authority Grant Assurance Review process.

Gateway Reviews

6.5.9. Gateway Reviews will be undertaken in line with the principles set out in the Project Control Handbook. A Gateway review is a 'peer review' in which independent project managers from outside the project use their experience and expertise to examine the progress and likelihood of successful delivery of the project. In the case of the Scheme, these peer reviews have been undertaken by the Grant Assurance team within the Combined Authority.

6.5.10. A Gateway Review provides assurance and support to the SRO that:

- Suitable skills and experience are deployed on the project
- All stakeholders understand the project status and issues
- There is assurance that the project can progress to the next phase
- Time and cost targets have a realistic basis
- Lessons are learned
- The project team are gaining input from appropriate stakeholders.

6.5.11. Gateway Reviews are a mandated assurance process for all publicly funded major projects, although not all reviews will apply to all projects. The SRO and the Combined Authority's Project Manager will engage early with the relevant parties to agree which gateways are required and when. Throughout the process, guidance and advice will be sought from relevant centres of expertise (e.g., finance, procurement, economists).

6.5.12. The gateway review process will assess the programme's viability and the proposed approach for achieving delivery of the objectives. This approach will assure the SRO, and ultimately the Programme Steering Group, that the selected delivery approach is appropriate.

6.5.13. **Figure 6-4** lists the normal stages for gateway reviews, as part of the process of managing programme stage gates.

Figure 6-4 – Gateway Review Stages

Gateway Review 1	▪ Business justification ▪ Entry to the options phase (undertaken on behalf of DfT) (option identification stage)
Gateway Review 2	▪ Delivery Strategy ▪ Entry to the development phase (preliminary design stage)
Gateway Review 3a	▪ Investment decision ▪ Entry to the statutory procedures and powers stage
Gateway Review 3b	▪ Investment decision ▪ End of the construction preparation stage
Gateway Review 4	▪ Readiness for service ▪ Prior to open for traffic or consent to operate
Gateway Review 5a	▪ Operational review and benefits realisation ▪ Following handover into operations and before the end of the defects period
Gateway Review 5b	▪ Operational review and benefits realisation ▪ A further operational benefits review may need to be undertaken. The timing is at the discretion of the SRO

6.5.14. The Programme Steering Group will determine whether the review gateways have been successfully completed. It will also release funding, where appropriate, based on the completion of milestones to the desired quality and cost.

6.5.15. A project plan has been developed that covers each key stage of the project and the critical path. The detailed project milestones are set out in the project plan in **Table 6-5**. The assurance and approvals milestones are set out in **Table 6-3**.

Table 6-4 – Assurance and Approvals Milestones

Milestone		Current estimate
1	**Submission of Outline Business Case**	December 2023
2	**Combined Authority OBC Approval (anticipated)**	March 2024
3	**Combined Authority approval to appoint Contractor**	July – August 2024
4	**Submission of Planning Application**	September 2024

Milestone		Current estimate
5	**Combined Authority approval to submit Full Business Case**	June 2025

Active Travel England Review

6.5.16. Given the significant sections of walking and cycling improvements that are part of the scheme, it is recognised that the scheme will need to be reviewed by Active Travel England (ATE) as a grant condition under CRSTS.

6.5.17. This will be undertaken as part of early-stage FBC works, in parallel to detailed design and prior to design freeze. At this point in time, the Combined Authority will request that inspectorate resource be allocated via a regional representative. Designs will be provided to ATE, along with any documentation needed around exceptions and signal phasing. Any returns from ATE will be reviewed, particularly should any critical issues be flagged.

6.5.18. To mitigate risk prior to ATE review, designs will be assessed against the ATE Route Check Tools and Junction Assessment tools.

6.6 Programme Reporting

6.6.1. The Scheme will be delivered in line with the Combined Authority's existing effective programme and project management procedures as set out in Part 1 & 2 of the Constitution (**Appendix N**). The Combined Authority project managers will report to the Senior Project Manager, who will be responsible for coordinating the delivery of the scheme elements, identifying key interdependencies, and ensuring that the overall programme is delivered to schedule, quality, and budget. Through reporting to the Programme Steering Group, the SRO will oversee the development and delivery of the project.

6.6.2. Project reporting will be a live process, which will be kept up to date over the lifecycle of the project. This relates to reporting of progress, risks and issues. This will involve the following regular actions, as well as additional reporting as and when required:

6.6.3. Combined Authority Project Managers will meet with workstream leads on a weekly basis to monitor individual project progress, risks, and issues. Where possible, they will seek to resolve issues between the various workstreams and report any key decisions or issues that exceed tolerance to the Senior Project Manager for resolution. Key tasks include:

- Reviewing the project schedule and obtaining updates on outstanding actions
- Reviewing upcoming milestones
- Resolving project-level issues or bottlenecks from workstream groups
- Progressing technical designs in line with the agreed scope
- Communicating with key stakeholders and partners where the scheme impacts upon their assets, including other schemes that are part of the BBSC programme, and complementary schemes

- Managing risks in line with an approved Risk Management Plan, and escalating risks where project tolerances are exceeded
- Monthly progress reporting to the Senior Project Manager

6.6.4. The Combined Authority's Senior Project Manager will report to the Programme Steering Group monthly in line with the Combined Authority's reporting requirements. The Programme Steering Group will report progress to Director's Board, which has executive powers. Reports to Mayors and Leaders will be prepared if the Board considers these necessary to resolve a specific delivery matter.

6.6.5. The SRO will provide regular updates to the responsible Committee Member(s). This ensures appropriate involvement of the elected members in this important project.

6.6.6. It should be noted that representatives from B&NES sit within the Programme Steering Group, as well as the project team. These individuals provide valuable links to the B&NES organisational structure (as listed in **Table 6-3**), which is itself split across three levels. Within B&NES, the Project Team reports into the Project Board via the Project Manager. This, in turn, reports in to the CRSTS Steering Group via the B&NES SRO.

6.6.7. The Senior Project Manager reviews the actual and forecast expenditure against budget profiles and reports by exception to the Programme Steering Group. Where changes are expected or need to occur, this will be communicated with this Steering Group through an agreed change control process. The limits of the delegation of authority will drive the change control process and confirm what the Senior Project Manager will bring to the Programme Steering Group for approval.

6.6.8. Underpinning this reporting is the programme's delegation of authority. The change control process will ensure the Senior Project Manager can efficiently manage changes in scope, plan or budget while ensuring the Steering Group has sufficient oversight.

6.7 Scope, Dependencies and Constraints

Programme Scope

6.7.1. In July 2022, the West of England Combined Authority was awarded £540m under the DfT CRSTS to improve sustainable transport provision in the region. The BBSC Programme was a key flagship project to be developed and delivered within this award.

6.7.2. The vision for the Programme is:

"To connect new and existing communities along the A4 via sustainable modes of transport to places of employment, study and key services to enhance the lives of existing and future residents and those travelling to and along the corridor. This will be achieved by increasing the access to, attractiveness and availability of sustainable and active transport modes for those living, working and travelling through the area."

6.7.3. The Programme focuses on improving access, reducing journey times and improving reliability for bus users, cyclists and pedestrians through the provision of:

- A high-quality, high frequency bus service between Bath and Bristol
- A continuous segregated cycling corridor between Bath and Bristol
- Cycling and walking connections between local communities along the A4 between Bath and Bristol and the new bus service, and strategic cycling corridor

Project Scope

6.7.4. This OBC encompasses Sections 2 to 6, as presented in **Figure 1-1** of the Introduction. Broadly speaking this covers the stretch between Emery Road and Bath, with Section 6 ending just east of Midland Road in Bath, with the section of the corridor between Nile Street and the bus station covered by the Bath City Centre Sustainable Transport Corridor, which also forms part of the wider CRSTS Programme. The approach to considering Projects 2 and 3 within one OBC has been previously agreed with the Combined Authority Grant Assurance team.

6.7.5. **Section 2.10** of the Strategic Dimension provides further detail of the scope of the Scheme.

Dependencies

6.7.6. The A4 corridor contains a number of neighbouring or adjoining schemes, that may interact with the proposed intervention. These are listed in **section 2.14** of the Strategic Dimension.

6.7.7. These interdependencies are monitored and documented in a Dependency Register, which can be found in **Appendix AH**. This register is co-owned by the Senior Project Manager at the Combined Authority and the Project Manager from B&NES and reviewed on a monthly basis.

6.7.8. A small number of schemes on the corridor are being driven by Curo, a residential private developer at Withies Green, reference number 20/02673/OUT. A further residential development is taking place on an old car garage site at Hartwells of Bath, reference number 20/02673/OUT. B&NES have had discussions with the developer and provided information from the BBSC design team on design parameters. This is so that works on the developer schemes will not prejudice the implementation of the remaining elements of the BBSC design; some of the elements within the BBSC design may be delivered by the developer where the designs are concurrent. B&NES will manage the design of the developer scheme and it interface as part of their normal technical approval process with the developer. Likewise, regular integration meetings are being held with BCC to discuss the design of Emery Road Junction, where the different scheme components meet.

Constraints

6.7.9. The scheme constraints were originally set out in the *Option Assessment Report* (BBSC OAR Revision 1 – FINAL DRAFT 2021). The key themes included:

- Environmental
- Land
- Funding and Financing, including consideration of the CRSTS timetable
- Utilities

- Construction constraints – including space and existing asset constraints
- Legislation and legal constraints

6.7.10. Following the development of the scheme to OBC stage the constraints have been further reviewed and are discussed in detail within **Section 2.13** of the Strategic Dimension.

6.7.11. The impact of potential programme delays exceeding the March 2027 cutoff for CRSTS funding is reflected in a number of individual programme risks as part of the Risk Register. Each risk is being carefully monitored and mitigated in order to reduce its overall likely impact. The Combined Authority is also in regular contact with the DfT on the wider CRSTS programme to discuss progress.

6.7.12. The Risk Register will continue to capture and assess the impact of the constraints on the delivery of the scheme. Moving forward, designs and technology options will continue to be assessed against the constraints to ensure their feasibility.

6.8 Programme Implementation

6.8.1. As part of the OBC works, a Construction Phasing Strategy has been drafted and appended (**see Appendix Y**), that considers the feasibility and phasing sequence of the A4 Bath to Bristol Corridor Improvements construction. It looks at the requirements for Temporary Traffic Management and anticipated durations for constructing the scheme.

6.8.2. While this is preliminary in nature based on the design stage available it is noted that concurrent working will need to be undertaken along the corridor to complete construction by March 2027.

6.8.3. At this stage it has therefore been assumed that concurrent works can occur on the network so long as they are a sufficient distance apart from each other to enable suitable traffic management, and that any procurement of the contractor will identify sufficient resource to work on site in more than a single location at any one time.

6.8.4. It is expected that the Construction Phasing Strategy will be reviewed as part of any Early Contractor Involvement, and will be updated in line with detailed design progression as part of FBC.

6.9 Project Schedule

6.9.1. Key delivery milestones are shown in **Table 6-5** below, with a full project schedule detailed in **Appendix P**. The schedule is a live document, with progress against planned task completion monitored against actual progress on a weekly basis by the scheme's Project Manager. The Senior Project Manager holds responsibility for the programme interfaces across the overall BBSC programme, including interlinkages with complementary CRSTS schemes.

6.9.2. Construction is programmed to commence in September 2025 and complete in March 2027. Key milestones, including a scheduled risk allowance, are shown in **Table 6-5** below.

Table 6-5 – Key Delivery Milestones

Milestone	Estimated Date
OBC Approval	March 2024
FBC Start	May 2024
D&B Contractor Appointment	August 2024
Public Consultation	September – November 2024
Planning Submission	September 2024
Planning Determination	May 2025
FBC Completion	June 2025
Construction Start	September 2025
Construction Finish	March 2027

6.9.3. As per the programme, detailed design is currently scheduled to complete in December 2024, which overlaps with planning assumptions around the BBRP and Keynsham Transport Hub, with submission in September 2024 and determination in May 2025.

6.9.4. While a completed detailed design is not needed prior to the submission of planning, the design programme will be far enough progressed to offer a degree of confidence in decisions around what design is being taken to planning; this will help to mitigate programme and cost delays. This is aided by the expected appointment of a contractor in August 2024.

6.9.5. Should design changes be necessitated following the submission of a planning application, this will either need to be manged by amending the submitted application, which could impact the programme, or the change could be resolved by seeking to amend the consent after the application is determined (either through a variation of conditions or material amendment application).

6.9.6. Pre-application with the Local Planning Authority will enable an approach to be agreed within the planning applications, as well as the level of detail and documentation expected. This is currently scheduled for March 2024 based on the Preliminary Designs, noting that there may be scope for change. Any planning permissions will be sought by the Combined Authority, collaborating with B&NES to resolve queries around Permitted Development rights.

6.9.7. Where there is divergence between the planned and action project schedule, action plans will be developed to mitigate the factors generating the divergence. Any divergences will be reported upwards to the Programme Steering Group and the action plans summarised.

While there is float built into the project programme, reporting will include any exceedance of agreed tolerances for delegated work.

6.10 Carbon Management

6.10.1. The carbon management standard PAS2080:2023 defines carbon management as “assessment, removal and reduction of Greenhouse Gas (GHG) emissions during the delivery of new, or the management of existing, infrastructure assets and programmes”.

6.10.2. The purpose of the carbon management process is to manage and reduce the Greenhouse Gas (GHG) (carbon) emissions over the course of the project lifecycle. This can be achieved through taking actions that maximise emission reduction impacts (e.g., modal shift) and minimising impacts that increase emission (e.g., embodied carbon). These actions must be informed by carbon assessments that provide an understanding of the whole-life carbon impact.

6.10.3. As made clear in PAS2080 and acknowledged in the DfT’s Carbon Management Guidance (November 2021) having a good carbon management system in place is essential to managing and reducing carbon emissions over the course of the project lifecycle. This must occur from the earliest stages of the project lifecycle when there is the greatest ability to influence whole-life carbon outcomes. In the context of the UK’s legal decarbonisation commitment, it is critical that transport infrastructure is designed to support decarbonisation pathways and minimise any impacts that act contrary to this.

6.10.4. A *Carbon Management Plan* (**Appendix AB**) has been prepared as part of the OBC. This supports the development and implementation of a carbon management process within the programme which supports low carbon infrastructure planning and delivery.

6.10.5. This plan sets out:

- The Combined Authority’s methodology for applying the carbon management process to the delivery of the proposed scheme
- How the Combined Authority will develop and implement a carbon management process for the project which supports low carbon infrastructure planning and delivery and delivers the agreed outcomes – aligning to relevant guidance
- A high-level corridor carbon impact assessment, which identifies carbon ‘hot spots’ to focus carbon management
- The Combined Authority’s decarbonisation commitments and an approach to setting targets for the Scheme
- The roles and responsibilities for carbon management on the Scheme.

6.10.6. A *Carbon Management Plan* has been developed in alignment with the principles of the following guidance:

- PAS2080:2023
- DfT Carbon Management Guidance – Management Case (November 2021)

- Institute of Environmental Management & Assessment Delivering Quality Development (2016)
- Construction Playbook
- Transport Analysis Guidance: Unit A3 environmental impact appraisal

Carbon Management Strategy and Policy

6.10.7. The Combined Authority's carbon management objectives for the Scheme are as follows:

- To reduce carbon emissions during operation
- To reduce the level of embodied carbon in the construction of the Scheme
- To reduce the level of carbon emission during construction
- To minimise the impacts of the Scheme on people and the built and natural environment

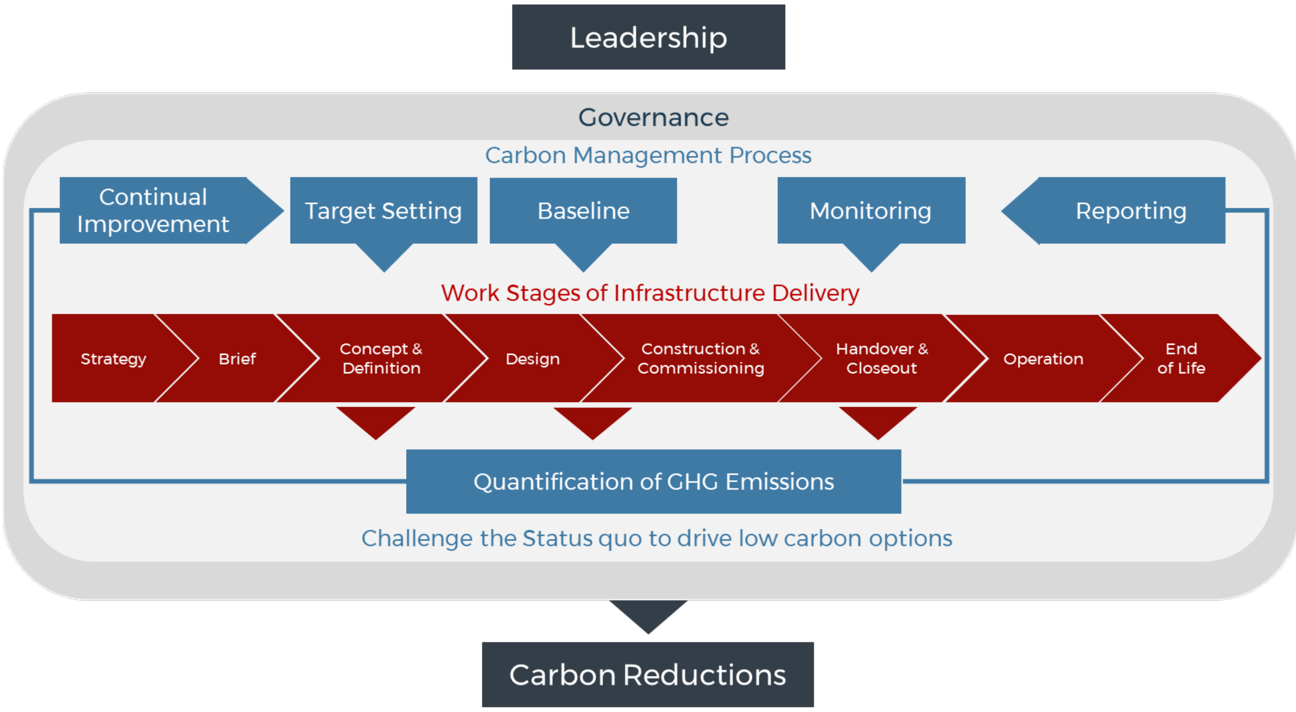
6.10.8. In addition, the Strategic Dimension highlights specific carbon related measures of success for the Scheme. The particular focus is to reduce overall carbon emissions in the region. The measures of success for this are captured in **Table 2-13** of the Strategic Dimension.

Carbon Management Process

6.10.9. The Combined Authority will implement a PAS2080:2023 carbon management process for the Scheme, which will drive the entire supply/value chain to collaborate in reducing carbon and cost throughout infrastructure delivery. Targets will be set relative to agreed baseline values and outlining the frequency, methodology and process for measuring, quantifying, and reporting on the management of carbon throughout infrastructure planning and delivery.

6.10.10. PAS2080 notes that 'a carbon management process that is integrated into Infrastructure delivery processes will drive the value chain to collaborate and create a culture of innovation. This supports reductions in carbon and cost during Infrastructure delivery by driving the use of low carbon solutions.'

Figure 6-5 - PAS2080 Carbon Management Process



6.10.11. **Table 6-7** outlines the various activities within the carbon management process that will be applied on the Scheme. The carbon management process is iterative, and the plan will be updated regularly throughout the project lifecycle.

Table 6-6 - Carbon Management Process (Developed from PAS 2080:2023 guidance)

Activity	Description
Baseline and target setting	Setting carbon reduction targets provides clear direction and communicates intent for carbon reduction. Targets will be set against clear baselines so that performance against them can be determined.
Monitoring	Robust monitoring will be completed at frequent intervals during infrastructure delivery to highlight progress of carbon reductions against set targets.

Activity	Description
Quantification	Establish the frequency of carbon emissions quantifications during delivery to ensure that quantification sufficiently informs decision-making in reducing whole-life carbon impacts.
Reporting	Reports will make carbon reduction performance visible at different infrastructure work stages and inform decision-making in managing whole-life carbon. This will be done with sufficient frequency to enable progress monitoring against targets and continuous improvement over the duration of the project or programme.
Continuous improvement	Continual improvement is a core part of the carbon management process and allows lessons learned from applying the carbon management process components to improve the delivery of future assets and programmes of work. Continual improvement also allows organisations to embark on the low carbon journey without having comprehensive carbon data or low carbon solutions at the outset and allows them to gradually improve their carbon management maturity.

Carbon Communications

6.10.12. The Combined Authority will communicate consistently with 'the value chain' (DfT, other Arm's Length Bodies (ALBs), designers, constructors, and the supply chain) to share current best practice and develop collaborative relationships with the goal of reducing carbon emissions. The method for doing this will be agreed pre-OBC.

Training Requirements

6.10.13. The whole value chain and specific roles within the project will require upskilling around carbon management and the implementation of a carbon management process within the project/ programme to support low carbon infrastructure planning and delivery.

6.10.14. The entire value chain for the Scheme will be required to complete carbon management training as outlined in **Table 6-8**.

Table 6-7 - Carbon Management training requirements

Training	Attendees	Contents
Carbon Literacy training	All value chain members	This training will provide a level of awareness of the cost and impact of carbon dioxide from everyday activities.
Carbon Management in Infrastructure	All value chain members	Training on the application of PAS 2080 to infrastructure projects, with the combined aims of reducing carbon, reducing cost, and adding value.
Carbon Management in Design	All value chain members	General training in the application of carbon management to the design of infrastructure assets.

Whole-Life Carbon and Cost Reduction Incentivisation

6.10.15. The Combined Authority will consider the adoption of an outcome-based approach to incentivisation in relation to whole life carbon and cost reduction as part of the commercial strategy development.

6.10.16. NEC have recently released a new secondary option, ‘Option X29 Climate Change’, that enables clients to engage their suppliers in the global drive towards net-zero greenhouse gas emissions and sustainability. The Combined Authority will develop a contract strategy, which adopts this new secondary option to bring carbon reduction to the fore in terms of incentivisation and reward throughout design and delivery.

6.11 Carbon Management Governance

Roles, Responsibilities and Accountabilities

6.11.1. The *Carbon Management Strategy* acknowledges that all members of the programme have a responsibility to support its delivery. In line with best practice, the UA and the Combined Authority will appoint a Carbon Coordinator.

6.11.2. In addition to the Carbon Coordinators and in line with PAS2080, the programme will identify the stakeholders who cover the following areas:

- Leadership and governance – key stakeholder responsible for embedding carbon management into the programme
- Scheme design – design experts who can lead the carbon reduction workshop and feasibility assessment to ensure carbon reduction opportunities are exploited
- Procurement – personnel who ensure the carbon reduction targets are cascaded across the value chain, and suitable suppliers are selected who can support the Scheme carbon requirements.

6.11.3. The complete value chain will be required to undergo a PAS2080 verification of supply chain exercise and the supply chain will be required to demonstrate PAS2080 verification to ensure all those involved in the planning and delivery of the Scheme are compliant with the standard and that carbon management underpins the delivery of the asset or programme of work.

6.11.4. PAS 2080 defines the roles and responsibilities of the various parties involved in the carbon management process as outlined in **Table 6-9**.

Table 6-8 - Carbon Management Process roles and responsibilities (Developed from PAS 2080:2023 guidance)

Party	Roles and responsibilities
Value chain members	During the delivery of assets and programmes of work, all value chain members shall: ▪ Take early action to reduce carbon emissions, where the reduction opportunity is greatest ▪ Demonstrate they have investigated alternative solutions for carbon reduction at relevant work stages ▪ Follow the carbon reduction hierarchy and select the best collective approach for meeting or exceeding the targets by engaging with other members of the value chain ▪ Communicate and share the proposed carbon reduction actions they have identified with other value chain members ▪ Encourage other value chain members to choose products/materials and adopt approaches which provide the lowest whole-life carbon solution ▪ Adopt an approach to carbon management that defines and implements measures that achieve whole-life carbon reductions against a baseline
Scheme asset owner	In addition to roles and responsibilities outlined for all value chain members, the ultimate Scheme asset owner shall: ▪ Develop a carbon management process that incorporates the following components ▪ Quantification of carbon emissions ▪ Target setting, baselines, and monitoring ▪ Reporting ▪ Continual improvement ▪ Unambiguously identify the assets or programmes of work to which the carbon management process is to be applied ▪ Allocate and communicate unambiguous responsibilities for each aspect of the carbon management process to value chain members involved in the delivery of identified assets or programmes of work ▪ Develop a collaborative environment for all value chain members involved in the implementation of the carbon management process during the delivery of assets and programmes of work.
Designers	In addition to roles and responsibilities outlined for all value chain members, designers shall: ▪ identify the part of their organisation, as demonstrated through work on selected assets and/or programmes of work, to define the scope of activity to which the carbon management process is to be applied ▪ Share details of their own carbon management process ▪ Propose improvements to the asset owners/manager and encourage their use in the delivery of assets and programme of work ▪ Document the anticipated benefits of any proposed improvements
Constructors	In addition to roles and responsibilities outlined for all value chain members, constructors shall: ▪ Unambiguously identify the part of their organisation, as demonstrated through work on selected assets and/or programmes of work, to demonstrate the scope of activity to which the carbon management process is to be applied ▪ Share details of their own carbon management process with the asset owner/ manager and other relevant value chain members ▪ Where the constructor believes that improvements can be made to the asset owners/managers approach to carbon management, constructors shall propose such improvements to the asset owners/manager and encourage their use in the delivery of assets and programme of work ▪ Where carbon management improvement proposals are made by constructors, they shall be documented in evidence of their submission to the asset owner/manager, supported by the anticipated benefits to the carbon management process and record of the outcome

Party	Roles and responsibilities
Product/material suppliers	In addition to roles and responsibilities outlined for all value chain members, product/material suppliers shall: ▪ Unambiguously identify the part of their organisation, as demonstrated through work on selected assets and/or programmes of work, to demonstrate the scope of activity to which the carbon management process is to be applied ▪ Share details of their own carbon management process with the asset owner/ manager and other relevant value chain members ▪ Where the product/material supplier believes that improvements can be made to the asset owners/managers approach to carbon management, product/material suppliers shall propose such improvements to the asset owners/manager and encourage their use in the delivery of assets and programme of work ▪ Where carbon management improvement proposals are made by product/material suppliers, they shall be documented in evidence of their submission to the asset owner/manager, supported by the anticipated benefits to the carbon management process and record of the outcome

6.11.5. The SRO will be accountable to the Combined Authority for the programme meeting its carbon management objectives, delivering the projected target carbon reduction outcomes, and realising the required benefits.

6.11.6. The Programme Manager will be responsible for the project meeting its carbon management objectives, delivering the projected target carbon reduction outcomes.

6.11.7. The full value chain will be responsible for delivery of the required carbon emission reductions throughout the planning and delivery of the Scheme. The value chain will also be required to provide evidence of how the implementation of low carbon solutions in their operations are fully supported and how this will support the delivery of low carbon solutions on the Scheme.

6.11.8. The Combined Authority will embed the carbon management process within the programme through the Carbon Coordinator and Programme Steering Group.

Document management

6.11.9. A Carbon Management Plan has been developed as part of the OBC. Going forwards this document will be updated and maintained as circumstances of the Scheme and its carbon management evolve.

6.11.10. A carbon management actions/opportunities log has been established and will be reviewed and updated as the Scheme design develops. This log will continually evolve along with the carbon management process and as such, where management actions have been undertaken or complete, they will be recorded as ‘carbon influence to date’.

6.11.11. Carbon has been considered in the optioneering process that has occurred since the SOC and the design process undertaken as part of the OBC. The Carbon Management Plan currently sets out those activities that have already occurred and the opportunities for further carbon management reductions as the Scheme progresses.

6.12 Stakeholder and Communications

6.12.1. To date, engagement has taken place with the aim of introducing the scheme with key stakeholder groups throughout the region. Before any proposals were developed, between July and September 2021, residents and businesses along the A4 took part in a transport survey to find out their opinion on local transport issues and what improvements can be made.

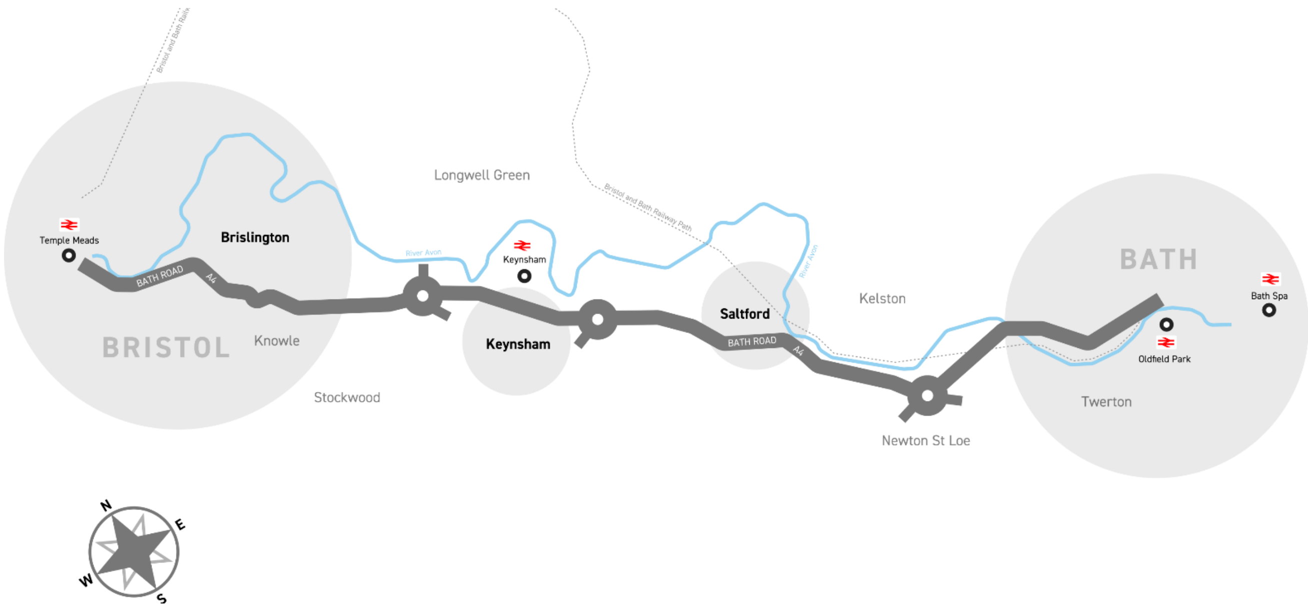
6.12.2. Over 1700 people responded, with the key issues raised being:

- Most journeys are made by car.
- Traffic flow, air quality, noise, cycle paths and safety all rated currently as poor.
- 70% would cycle more often if there were separate cycle lanes.
- 60% would use buses more often if they were more reliable.
- 50% would walk along the A4 if the air was cleaner and less polluted.

6.12.3. This feedback was then used to identify the potential improvements, and more than 100 different options were considered, leading up to the current proposals.

6.12.4. In 2023, further engagement was undertaken, which is documented in the Bath to Bristol Strategic Corridor Consultation Analysis Report (November 2023, currently in Draft). Proposals across four key areas were covered, as shown in **Figure 6-6.**

Figure 6-6 - A4 Bath to Bristol Proposals



6.12.5. A six-week public engagement exercise was held between 21 August 2023, and 01 October 2023. Eight consultation events were hosted, both in-person and online, allowing people to engage using methods that suited them. The consultation received 4,703 responses. The outcomes of the public engagement are outlined in **section 2.8**.

6.12.6. There was a combination of engagement events hosted in-person and online, meaning there were opportunities to engage with people using methods that suited them. All in-person venues were selected to ensure that they were accessible to all and had accessible facilities to ensure the widest possible attendance. Events were advertised by the Combined Authority on their channels, in local print media, and were also included on the engagement webpage.

6.12.7. Due to the congestion that currently exists on the A4, the proposals engaged on in 2023 are focused on investing in better infrastructure (a requirement of CRSTS) to create an improved network to deliver more frequent and reliable bus services, and increase attractiveness for walking, wheeling, and cycling along the corridor. The proposals could deliver more than nine miles of new cycle lanes, six miles of new bus lanes, and increase greenery and community space across the proposed area.

6.12.1. A draft *Engagement Strategy* that identifies stakeholders, describes the communication objectives and activities required to achieve them has been developed for the CRSTS programme. Due to the sensitive nature of the scheme, and the public response to date, consideration is being given as to how the programme of engagement can best be expanded; this will be developed further as part of early-stage FBC works, and the Engagement Strategy updated to reflect this.

6.12.2. As part of the FBC process, an additional round of consultation is expected to be held to show progress against feedback from stakeholders. This is currently programmed in from September to November 2024, in advance of a potential pre-election period, should a November General Election materialise.

6.13 Risk and Issue Management

6.13.1. Risk management is a continual process involving the identification and assessment of risks (including threats and opportunities) and the implementation of actions to mitigate the likelihood of them occurring and the impact if they did. The Programme Steering Group's approach to risk management will be proportionate to the decision being made or the impact of the risk, to enable the programme to manage risks in a consistent manner, at all levels.

6.13.2. The approach to risk management taken on the programme, which is compliant with the approach outlined within the *HM Treasury Green Book*, is a methodical approach, which involves identifying, quantifying and managing risks. It proceeds through a broadly cyclical process (plan-do-review) requiring on-going review and update of risks to ensure that effective controls are implemented during scheme development and delivery.

6.13.3. Issue management relates to the exceedance of agreed tolerances for delegated work and requires regular and ongoing support from the SRO to resolve identified issues. Issues can relate to scope, quality, time, cost, or benefits and usually result in an actual or expected impact on the programme.

6.13.4. Risk and issue management processes happen in conjunction to support the Programme Steering Groups and respective Project Management teams identify potential issues to the project while managing those issues that transpire.

Risk management process

6.13.5. Risk management is seen as a key process underpinning good programme governance and the achievement of scheme objectives in a cost-effective manner. Programme risk assessments have been undertaken using the three-stage process, enabling the population of a risk register. This three-stage process includes:

- Risk identification
- Risk quantification
- Risk management through response planning and risk mitigation

Risk identification

6.13.6. The programme risks can largely be grouped into two themes – strategic and programme risks. Strategic risks are those which could impact the programme delivering its objectives while the programme risks are those associated with delivering the programme. Broadly, these risks fall into the following categories:

- Risks to the programme plan
- Political risks
- Risks to scheme cost
- Risks to scheme funding
- Risks to the operation of the transport network
- Design and information risks
- Health and safety risks
- Reputational risk
- The risk to impact on existing highway network

Risk Quantification

6.13.7. During the qualitative assessment of the risks at the SOC stage, the identified risks were quantified by considering the likelihood (or probability) of them occurring and the severity of impact on the programme. These scores are multiplied together to determine a qualitative risk assessment. This has allowed the ranking and prioritisation of the captured risks.

6.13.8. As the programme developed, this qualitative assessment has been translated into a detailed quantitative assessment. *TAG Unit A1.2* requires all project related risks, which may impact on the Scheme costs, to be identified and quantified in a Quantified Risk Assessment (QRA) to produce a risk-adjusted cost estimate. The QRA will be used as the master risk and opportunity register on the Scheme so that threats and opportunities can continue to be captured and managed; and the effect of the overall scheme cost estimate can also be managed.

6.13.9. A Quantified Risk Assessment has been undertaken, resulting in the post mitigation risk exposure figure to be £9,143,751, an estimated 20% of the project budget at a P75 value. This is in line with the level of risk associated with a programme of the complexity of the A4 BBSC.

6.13.10. The biggest risks to successful delivery are managing the requirements of multiple stakeholders with conflicting priorities, which could divert or delay the programme. There are a number of other, related projects are happening at the same time in the region which may cause confusion amongst stakeholders, hold up decisions and influence designs There is also the risk of potential conflicting objectives or priorities across authorities that may delay progress. There is the potential for further future inflationary measures that could add pressure to affordability to undertake all of the desired interventions, this has been mitigated by the work carried out to date that informs the decision-making to support value for money-based decisions and value engineering initiatives.

Response Plans and Mitigation

6.13.11. Following the initial assessment of the programme risks, a systematic approach was adopted to respond to risks (threats and opportunities) and allocate responsibility to the most appropriate party in line with the governance arrangements.

6.13.12. For the threats, one of the following four strategies was, and will continue to be, adopted when developing a suitable response plan:

- Accept or tolerate consequences if the risk occurs, where a) the cost of taking any action exceeds the potential benefit gained; or b) there are no alternative courses of action available
- Treating the risk: continuing with the activity that caused the risk by employing four different types of control – preventative, corrective, directive, and detective controls
- Transferring the risk: risks transferred to a third party e.g., insurer or contractor
- Terminating the activity that gives rise to the risk

6.13.13. For the opportunities, one of the following four strategies was, and will continue to be, adopted when developing a suitable response plan:

- Exploiting the opportunity to maximise the benefits it can bring
- Sharing the opportunity with third parties best able to manage them
- Enhancing the probability and / or impact of the opportunity
- Ignoring the residual minor opportunities

6.13.14. Both risks and opportunities are captured as part of monthly Highlight Reporting to the Programme Steering Group.

6.13.15. Following the implementation of these strategies, if a threat can be treated and its effects mitigated, the risks are 're-scored', and this new score is added to the risk register. Risk management is a continual process involving the identification and assessment of risks and the implementation of actions to mitigate the likelihood of them occurring and impact if they did. The Project Steering Group's approach to risk management will be proportionate to the decision being made or the impact of the risk, to enable the Combined Authority to manage risks in a consistent manner, at all levels.

6.13.16. The relevant and necessary mitigation measures to reduce all risk scores based on a qualitative assessment have been considered in the Risk Register. **Table 6-10** is an extract of the current risk register for the risks that were classified as high prior to mitigation with the full Risk Register provided in **Appendix Q.**

Table 6-9 - Risk Register

Category	Risk Description	Initial Rating	Response	Residual Rating
Stakeholders	Dealing with multiple non-political stakeholders including CA and UA with conflicting priorities could inadvertently divert the course of the programme	Very High	Agreement of requirements and objectives at Directors level took place prior to finalisation of design. Ongoing engagement and sign off at key milestones. Bi-weekly meetings between CA and BCC/B&NES to flag any emerging risks and changes in direction.	High
General	Programme alignment / interdependencies - numerous related projects are happening at the same time which could confuse stakeholders, hold up decisions and influence designs etc. The Scheme may require a high degree of certainty from other schemes. There are potentially a number of interdependent schemes. Potential conflicting objectives / priorities across authorities (objectives / deliverables not clearly defined) may also delay progress.	High	Project Interdependencies Register will help identify which schemes need to be taken into consideration by the OBC, which will inform subsequent actions and mitigation measures.	Medium
Design	Design constraints - heritage assets - potential impacts on archaeologies - delays due to programme due to SI requirements. Design constraints due to Bath's designation as a World Heritage Site and Spa Town as well as potential impacts on designated and non-designated heritage assets.	High	Refer to the scheme objectives about delivering overall journey time savings for the entire route and focusing on delivering best value for money options possible.	High
Commercial & Contracts	Cost inflation higher than anticipated which increases outturn programme cost and may exceed the cost profiling undertaken at SOBC stage.	High	Inflation is being managed at the CRSTS Programme Level	Medium
Commercial & Contracts	Lack of cost certainty given current level of designs within the programme.	High	Development of requirements and reviewing of objectives to inform option shortlisting, ensuring shortlisted options contribute towards the requirements and objectives.	Medium
Environment	Full extent of ecological surveys not yet carried out due to number of surveys required across at least 2 years to gather baseline data There is a risk that surveys not being undertaken at the correct time of year will miss key data	Medium	The Ecology team has details of which species' survey windows are within the calendar year and plans surveys accordingly. Some key surveys were carried out in October 2023, obtaining 1 season of data.	Low
General	Third Party Approvals - the extent of approvals is not currently understood e.g., Planning, EIA, Wessex Water and the Environment Agency, Historic England etc. Uncertainty around how long it might take to get approvals.	High	Have engaged with utilities and planning teams within consultant team to support in these areas.	Medium

Category	Risk Description	Initial Rating	Response	Residual Rating
Commercial & Contracts	CPO Requirements - there are potentially CPO requirements that may have budget implications if land cannot be secured through negotiation.	High	Use only the required amount of land needed for the scheme design. Planning & land referencing teams to identify land parcels that may be affected, informing potential CPO costs.	Medium
Commercial & Contracts	Funding does not cover the do minimum option.	High	Identification of how much design interventions, cost through QS team & calculation of BCR through business case process will keep costs within funding limits.	Medium
Approval	Relationship to Bristol OBC - there is a risk that if we can't progress the Bristol section then the project cannot proceed.	High	The CA has taken on the delivery of this scheme.	Medium
Technical	Not including Bristol section interventions in the modelling, may lead to the modelling needing to be rerun prior to FBC, will lead to assessment being redone and changes to VfM	High	The CA PM is in contact with team leading Bristol works, will advise us once confirmed what is being delivered there in CRSTS period	Medium

6.14 Issue Management Process

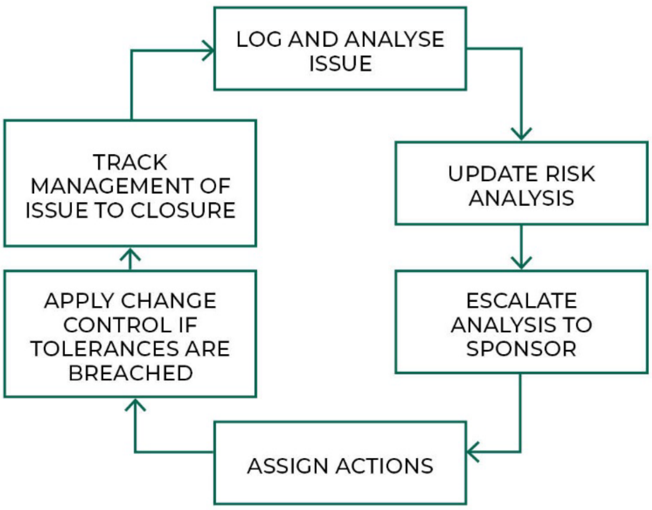
6.14.1. Issue management relates to the exceedance of agree tolerances for delegated work and requires regular and ongoing support from an SRO to resolve identified issues. Issues can relate to scope, quality, time, cost, or benefits and usually result in an actual or expected impact on the programme.

6.14.2. The issue management process that is being employed by the Combined Authority includes the following steps:

- Log issue in issues register when identified. This will include a quick assessment of the nature of the issue, causation, and impact. The issues register will present a prioritised view of the live issues on the programme and will be reviewed on a regular basis
- Following an initial assessment, issues are escalated to the Programme Board as required under the delegation of authority
- The Programme Manager, SRO and Programme Board will identify actions and ownership to ensure a timely resolution of each issue
- Where an issue impacts on the programme's scope, the proposed mitigation action will be progressed through the change control process to ensure the impact of the change on the programme is fully assessed, agreed, and recorded

6.14.3. **Figure 6-7** outlines the key aspects of issue resolution as defined by the Association of Project Management. This process will be adopted by the Scheme as best practice in issue management and resolution.

Figure 6-7 - Issue Management Process



6.14.4. The Project Steering Group will regularly meet and discuss issues recorded on the register to review and track issues and progress towards their resolution. These discussions will be held as part of regular monthly reporting and will feed into the SRO.

6.15 Lessons Management

6.15.1. Lessons management is a key element of a project or programme approach to continuous improvement and commitment to delivery excellence. Learning from experience and harnessing lessons learned makes a significant contribution to successful programme delivery. Ensuring lessons learned from historic or current project successes or failures is therefore paramount to successful programme delivery.

6.15.2. Lessons should be captured, understood, and communicated to the wider project and programme teams to inform delivery. This means:

- Capturing lessons learned throughout delivery of the scheme
- Assessing whether lessons are individual to the project (or programme component), or whether they are likely to be beneficial to other parts of the programme and future projects
- Sharing lessons learned with the wider project and programme teams, including delivery partners and major stakeholders
- Adoption of lessons learned which are deemed applicable and beneficial across the BBSC and CRSTS programmes.

6.15.3. The Combined Authority will establish a Lessons Management Register and communication plan. The register will be initially populated with historic lessons learned from previous Combined Authority, B&NES, and stakeholder experience in addition to other available lessons learned from major project delivery across the UK such as the IPA's Project Initiation: Lessons Learned Report and Project Routemap.

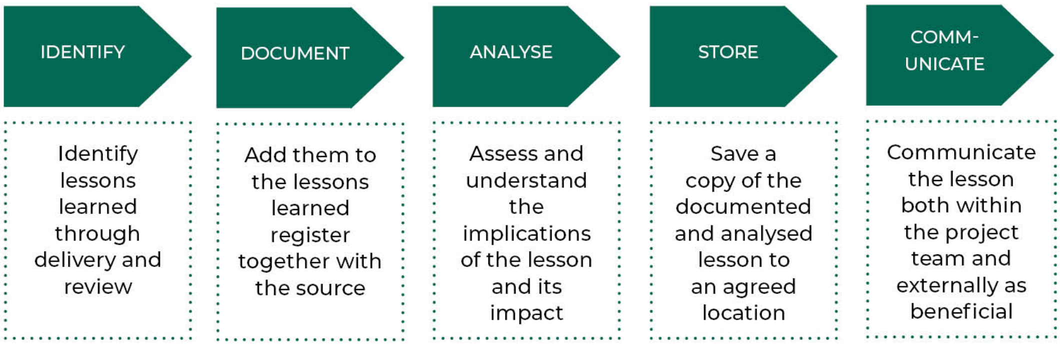
6.15.4. The Senior Project Manager will be responsible for managing the register, with input from individual project managers. Lessons learned will be captured at the following points:

- Ongoing throughout the project to capture day to day innovation and best practice and share with the wider delivery team. Also, consideration of any particular issues which have led to a lesson learned – this will be captured in lessons learned reports and circulated to the project team
- At each point in the stage gate review process
- At the end of the project so that lessons can be fed back into future projects/programmes

6.15.5. The lesson management process will include several steps outlined in **Figure 6-8**.

![WSP logo]

Figure 6-8 – Lessons Management Process



6.16 Data And Information Security

UK General Data Protection Regulation (UK GDPR)

6.16.1. Regulation (EU) 2016/279 of the European Parliament and the Council of 27 April 2016 on the protection of natural persons regarding the processing of personal data and on the free movement of such data (General Data Protection Regulation), known as the GDPR, came into force on 25 May 2018 alongside the Data Protection Act 2018 (DPA 2018). The DPA 2018 tailored the GDPR in the UK, defining UK specific exemptions and interpretation.

6.16.2. The GDPR continues to apply in the UK post Brexit; it is retained in English law under the (amended) DPA 2018 as the UK GDPR.

6.16.3. The UK GDPR sets out seven key principles, which will guide the Programmes approach to processing personal data. These are outlined in the context of actions the Scheme will undertake:

- Lawfulness, fairness, and transparency - Processing Personal Data will be considered from the perspective of the Data Subject
- Purpose limitation - Processing Personal Data will be permitted for the specified purpose only
- Data minimisation – The Scheme will not ask for, retain, or give out more Personal Data than is required for a specified purpose
- Accuracy – The Scheme will ensure Personal Data is up to date and accurate
- Storage limitation – The Scheme will ensure that Personal Data is only kept for as long as the purpose specified to the Data Subject exists
- Integrity and confidentiality (security) – The Scheme will ensure appropriate access controls, confidentiality, and IT security for Personal Data
- Accountability – The Scheme will appoint an individual to take responsibility for UK GDPR compliance

6.16.4. The Scheme will adopt a 'data protection by design and default' approach as recommended by UK Information Commissioner's Office. This will include it approach when adopting a level 2 BIM approach in line with PAS 1192-2 and PAS1192-3 best practice guidance and establishing a Common Data Environment (CDE) in line with PAS 1192 guidance. A robust information management system will support the Combined Authority meet its GDPR and information security obligations.

6.17 Benefits Management and Evaluation

Benefits Management

6.17.1. The Strategic Dimension identifies the measures of success associated with each programme objective. These measures of success are captured in **Table 2-10** of the Strategic Dimension.

6.17.2. A Benefits Realisation Plan will be developed as part of the FBC. The plan is designed to enable benefits, and disbenefits, that are expected to be derived from the programme to be planned for, managed, tracked, and realised. The plan will help demonstrate whether the scheme objectives identified can generate the identified measures for success. This can be assessed by tracking and realising the desired outputs and outcomes of the project.

6.17.3. Desired outputs are those tangible effects that are funded and produced directly as a result of the scheme. Desired outcomes are the final impacts brought about by the scheme in the short, medium and long-term. The scheme objectives, together with the desired outputs and outcomes, are mapped in **Figure 2-38** and shown in **Table 6-11.**

6.17.4. In developing the Benefits Realisation Plan, an early exercise will require identifying the owner of any potential benefits. The owners will be responsible for tracking the identified benefits and for reporting any exceptions to the Senior Project Manager. This will allow early identification of any expected benefits that may become unrealised to be remedied.

Monitoring and Evaluation

6.17.5. Robust monitoring and evaluation are key elements of the overall appraisal process. Projects under the CRSTS banner, including all components of the BBSC programme, will be subject to monitoring and evaluation in line with processes and guidance set out by the DfT.

6.17.6. As of October 2023, Monitoring Data Collection Guidance has been issued by the DfT, setting out the data metrics and sources that can be collected, where relevant, to help monitor CRSTS interventions. This note is intended to act as a guide for Mayoral Combined Authorities in the development of their own M&E plans, helping to ensure consistency – both at a CRSTS level, and with BSIP evaluation, which uses the same data metrics and sources suggested.

6.17.7. At FBC stage, a full M&E plan will be developed for the BBSC scheme, with the intention of tracking:

- Passenger satisfaction
- Transport flows and volumes
- Patronage, journeys and mode shift
- Safety and environment
- Service levels, performance and journey times

6.17.8. Data collection will need to take place prior to the construction of any BBSC interventions. Baseline monitoring is therefore currently programmed for 2025. As referenced in the Guidance, it is expected that different parts of the BBSC programme will come online at different intervals, which may make it difficult to identify the pre and post period. Consideration will be given at the FBC stage as to whether components of the scheme should be monitored separately as they come online, or at a corridor level.

Table 6-10 – Benefits Realisation Plan

Objective	Beneficiary	Outcomes	User benefit	Baseline measure	Timescale
Improved PT Infrastructure	Local and strategic trips	Improved PT journey times	Less time spent travelling (value of time)	Journey time surveys Queue surveys	1 & 5 years post opening
Improved PT Infrastructure	Residents and businesses	Ability to accommodate new homes and employment opportunities	Improved ability to live and work in a well-connected area	Employment, income and economic statistics Numbers of new homes delivered	1 & 5 years post opening
New transport hubs and walking and cycling links	Local and strategic trips and residents	Increased interchange opportunities between bus services and other modes More people travelling by PT	Connectivity Improved ability to live and work in a well-connected area	Employment, income and economic statistics Numbers of new homes delivered Travel Surveys	1 & 5 years post opening
Improve walking, wheeling and cycling infrastructure	Local residents	Improved air quality Reduced traffic noise Reduced severance affects from traffic volumes	Improved health from reduction in polluting effects of high levels of traffic Connectivity	Traffic surveys to include pedestrians and cyclists Air quality and noise surveys	1 & 5 years post opening
Improve walking, wheeling and cycling infrastructure	Active travellers	Reduced congestion Improved quality of journey with fewer vehicles	Improved safety and wellbeing More attractive environment	Number of people using active travel Number and severity of active travellers involved in road traffic incidents	1 & 5 years post opening

6.18 Project Closure

6.18.1. Following completion of the delivery phase activities, the Combined Authority will commence the administrative closure of this element of the Scheme. This will include the following steps for each project under the BBSC programme:

- Formal completion of monitoring and evaluation, documented via a monitoring and evaluation report
- Completion of a delivery closeout report, which includes a summary of the delivery phase and evidence that the project has achieved the required outputs and that these have been accepted and signed off
- The benefits management and evaluation plan will also be finalised and signed off by the SRO confirming that the benefits included in the FBC have or can be realised
- Individual close out reports from all contracts confirming final positions in terms of spend and contract obligations
- Health and Safety File for the completed BBSC Asset
- Register of outstanding or residual risks/issues that will transition into the operational phase of the BBSC system
- Stakeholder feedback and lessons learned will be captured and disseminated in line with the lessons management strategy outlined in **section 6.11**.

6.18.2. A robust document archiving exercise will also be completed to ensure that project documentation is available to the Scheme operations phase as required.

6.19 Summary of the Management Dimension

6.19.1. In close cooperation with B&NES, the Combined Authority has built on the existing working groups to formalise a Programme Steering Group which is accountable to Committee. This aligns with best practice programme management guidance and the constitution of the Combined Authority. The primary function of the governance framework will continue to support the Scheme deliver the programme.

6.19.2. The schemes identified as part of this fall under the greater banner of a corridor wide BBSC programme and have interlinkages with a number of complementary schemes along the A4. Given the scheme's complexity and expected interdependencies, a Construction Phasing Strategy has therefore been established to better understand how the scheme components can be brought forward. The Governance Structure outlined is designed to accommodate the required flexibility of different work packages progressing at differing rates (in line with their respective complexity and needs), while maintaining a consistent foundation.

6.19.3. The schedule will remain a live document, with progress being monitored monthly by the Senior Project Manager and the Programme Steering Group.

6.19.4. A Carbon Management Plan has also been prepared to support the development and implementation of a carbon strategy for the scheme. This strategy outlines how the scheme will track and reduce emissions throughout its development, govern the carbon management process, train and upskill personnel on legislation and finally ensure that it complies with standards including PAS:2080.

6.19.5. Key stakeholders have been identified and an engagement plan adopted, following the practice used in previous projects. This engagement plan will be updated further following consultation. The programme constraints and dependencies are discussed in detail in the Strategic Dimension.

6.19.6. Risk and issue management processes will follow best practice guidance throughout the programme lifecycle. A risk register has been developed, which identifies the key challenges and threats to the Scheme programme. These have been logged in the programme risk register for continuous monitoring. The issue management process follows the process for issue resolution as defined by the Association of Project Management. This will support the Senior Project Manager track and monitor the programme cost and schedule against the baseline.

6.19.7. Finally, this dimension discusses the roles and responsibilities in closing out the programme. With the phased approach, it’s likely that each project will follow a close out process. A key element of this will be the approval by the SRO of the Benefits Realisation Plan and implementing the Monitoring and Evaluation Plan.

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix A - Average flow weighted speeds

70093741
January 2024

West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix A - Average flow weighted speeds

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Contents

Tables

1 Introduction

This appendix provides supplementary transport data to support the existing situation for the West of England Combined Authority (Combined Authority) Bristol to Bath Corridor Programme. Data includes:

- Delay and vehicle speeds
- Traffic flow data
- Bus service
- Rail station usage

Delay and vehicle speeds

Average delay and vehicle speed data has been obtained from the DfT website for A-roads within each local authority within the West of England between the years 2017 and 2019. Shown as seconds per vehicle per mile (spvpm).

Table 1-1 - Average delay (flow-weighted) on locally managed 'A' roads in England, by local authority and road name: annual averages 2017-2019 (DfT).

Local authority	Road name	Average delay (spvpm) in 2017	Average delay (spvpm) in 2018	Average delay (spvpm) in 2019[6]
Bath and North East Somerset	A3039	269.9	176.6	246.1
Bath and North East Somerset	A3062	74.6	74.7	69.9
Bath and North East Somerset	A36	82.7	115.3	81.2
Bath and North East Somerset	A362	38.3	37.2	35.5
Bath and North East Somerset	A363	17.5	21.5	16.2
Bath and North East Somerset	A367	34.5	36.5	31.2
Bath and North East Somerset	A368	17.7	19.0	17.2
Bath and North East Somerset	A37	23.9	26.7	21.7

Local authority	Road name	Average delay (spvpm) in 2017	Average delay (spvpm) in 2018	Average delay (spvpm) in 2019[6]
Bath and North East Somerset	A39	28.1	32.7	22.7
Bath and North East Somerset	A4	42.3	47.8	36.7
Bath and North East Somerset	A4175	40.0	33.8	33.2
Bath and North East Somerset	A431	26.0	26.7	24.7
City of Bristol	A3029	58.2	66.3	62.9
City of Bristol	A369	57.9	77.7	57.2
City of Bristol	A37	125.9	138.6	117.4
City of Bristol	A370	117.2	130.2	78.6
City of Bristol	A38	117.7	119.3	105.5
City of Bristol	A4	54.2	56.4	50.9
City of Bristol	A4018	90.1	96.3	87.3
City of Bristol	A403	52.0	53.7	57.1
City of Bristol	A4044	210.5	248.0	223.5
City of Bristol	A4162	49.5	60.1	55.7
City of Bristol	A4174	87.3	89.8	95.8
City of Bristol	A4176	73.5	75.7	69.4
City of Bristol	A420	101.5	112.5	99.5
City of Bristol	A431	50.6	58.1	53.8
City of Bristol	A432	130.6	142.5	137.5
City of Bristol	A4320	84.7	87.8	74.2
Average delay	Average all roads	77	80.8	73.7

Table 1-2 - Average vehicle speeds (flow-weighted) on locally managed 'A' roads in England, by local authority and road name: annual averages 2017-2019 (mph) (DfT)

Local Authority	Road Name	2017	2018	2019
Bath and North East Somerset	A3039	7.5	9.7	7.7
Bath and North East Somerset	A3062	16.9	16.7	17.1
Bath and North East Somerset	A36	15.8	13.9	16.0
Bath and North East Somerset	A362	23.8	23.5	23.6
Bath and North East Somerset	A363	36.2	33.9	36.3
Bath and North East Somerset	A367	26.6	25.7	27.3
Bath and North East Somerset	A368	32.8	31.9	32.3
Bath and North East Somerset	A37	30.1	29.3	30.2
Bath and North East Somerset	A39	27.4	26.7	29.5
Bath and North East Somerset	A4	25.9	24.5	26.5
Bath and North East Somerset	A4175	26.0	27.1	25.9
Bath and North East Somerset	A431	25.7	25.7	26.0
City of Bristol	A3029	21.4	19.7	17.7
City of Bristol	A369	20.8	18.6	20.6
City of Bristol	A37	13.2	12.6	13.4
City of Bristol	A370	13.3	12.7	16.0
City of Bristol	A38	12.9	12.8	13.1

Local Authority	Road Name	2017	2018	2019
City of Bristol	A4	23.0	22.5	22.9
City of Bristol	A4018	15.1	14.6	15.1
City of Bristol	A403	23.6	23.3	22.5
City of Bristol	A4044	10.3	9.1	10.1
City of Bristol	A4162	20.4	19.4	19.8
City of Bristol	A4174	17.1	17.0	15.1
City of Bristol	A4176	16.8	16.6	16.9
City of Bristol	A420	13.9	13.0	13.5
City of Bristol	A431	19.2	18.2	18.6
City of Bristol	A432	12.6	11.9	11.8
City of Bristol	A4320	18.5	18.2	18.5
Average delay	Average all roads	20.2	19.6	20.1

Traffic flows

The following tables show traffic flows for each DfT traffic count from the website for the year 2019 on A4 Bristol to Bath corridor. These are AADT in both direction.

Table 1-3 - AADT on A4 Bristol to Bath corridor

Count Point	Year 2019
16123	23011
99508	25639
74761	17136
74760	15052
18376	26320
77977	35446
36132	35095
73026	35095
6134	27504
76061	16043
7937	16043
56445	21881
27156	14221
46133	27141

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix AA - Natural Capital Assessment Technical Report

70093741
January 2024

West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

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Contents

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1 Introduction

1.1.1. WSP was commissioned by West of England Combined Authority to undertake natural capital assessments utilising the NATURE Tool (WSP et al. 2022) for the A4 Bristol to Bath Strategic Corridor (BBSC) to inform the Outline Business Case (OBC). That West of England Combined Authority considers natural capital should be applauded as it goes beyond the 'business-as-usual' scope of an OBC for this type of project. Considering and assessing natural capital at this early stage should also provide the best opportunities for protecting and enhancing valuable natural capital assets as part of the final design.

1.1.2. Natural capital can be defined as follows (HM Government 2018, page 19):

"Natural capital is the sum of our ecosystems, species, freshwater, land, soils, minerals, our air and our seas. These are all elements of nature that either directly or indirectly bring value to people and the country at large. They do this in many ways but chiefly by providing us with food, clean air and water, wildlife, energy, wood, recreation and protection from hazards."

1.1.3. The Nature Assessment Tool for Urban and Rural Environments (short: NATURE Tool) is an Excel tool to assess the impact of land-use and/or management changes on natural capital performance. Its aim is to encourage better design, mitigating negative outcomes for natural capital and clearly demonstrating change, including the results of positive sustainable action during development or other land-use interventions.

1.1.4. The NATURE Tool allows the assessment of up to 17 ecosystem services and physical and mental health benefits through a scoring system, indicating both the direction and magnitude of project impacts. These scores were aggregated based on policy priorities resulting in an overall Natural Capital Score for the project. Carbon impacts on carbon stored in vegetation and corresponding soils alongside carbon emissions abated through photovoltaic installations were also assessed in tonnes of carbon dioxide equivalent (tCO_2e) and in monetary terms following HM Treasury Green Book (HM Treasury 2022) guidance.

1.1.5. The development of the NATURE Tool was led by WSP and the Ecosystems Knowledge Network, in collaboration with Northumbria University, and was first released in July 2021. The tool has been co-developed together with more than 30 organisations involved in the built environment industry, a tool developed by the industry, for the industry. This strong partnership approach has also been acknowledged at the 2022 CIEEM Awards (CIEEM 2022) where the NATURE Tool was Highly Commended for its stakeholder engagement.

2 Methodology

2.1 Assessment Options

2.1.1. Altogether, four high-level NATURE Tool assessments were conducted. Two assessments cover the proposed BBSC OBC Scheme Extent, one for Option 1 and one for Option 2. In addition, assessments were conducted for Hicks Gate and Keynsham, respectively. These are hereafter collectively referred to as the Assessed Projects.

2.1.2. NATURE Tool version 1.1 BETA has been used for the assessments which was the latest NATURE Tool version available at the time of the analysis. The full NATURE Tool scope has been applied meaning the impact across 17 ecosystem services plus physical and mental health benefits has been assessed.

2.1.3. The NATURE Tool can be used for various purposes including baseline assessments (to understand the baseline natural capital performance), and change assessments (to assess change in natural capital due to interventions). In this case, change assessments were conducted where the initial ‘post-development’ designs have been assessed against the ‘baseline’ condition. This change assessments presented in this report indicate the potential change in natural capital without further mitigation and design changes which are to be expected.

2.1.4. The baseline habitat data informing the assessments were provided by the West of England Combined Authority mass transit project which itself was mainly based on publicly available datasets. Gaps in the mass transit dataset were supplemented by an aerial imagery interpretation conducted by WSP. The post-development habitat data was digitised based on files provided by the design team. The same data that informs the NATURE Tool assessments was also used to inform the Biodiversity metric assessments which are not covered in this report.

2.1.5. The NATURE Tool is flexible in terms of data requirements and can work with basic and advanced data. For these high-level assessments, a basic assessment has been conducted as an initial step to consider potential natural capital impacts. The high-level assessments predict potential changes and opportunities to improve outcomes for natural capital and are based on desk-based data (see Section 2.2). It should therefore be considered as a starting point on which basis further design stages and mitigation measures can be informed and optimised. It is not a prediction of the natural capital impacts of the final design and delivery.

2.1.6. The assessments were projections, meaning that the projects have not been implemented yet. For a projection, the NATURE Tool applies risk factors acknowledging that an intended habitat creation may fail, depending on the difficulty of the habitat creation. This habitat creation risk is acknowledged in the scoring system.

2.1.7. The NATURE Tool also accounts for the fact that habitats usually need to mature until they reach their full natural capital potential. This means that, for the same habitat area and type, a newly created habitat tends to score lower than an existing (retained) habitat as the latter is assumed to have already reached its full natural capital potential.

2.1.8. The NATURE Tool results also outline the Policy Priority (high, medium or low) on which basis the overall Natural Capital Score and category scores (Cultural & Health etc.) are aggregated. The Policy Priority was based on national planning and environmental policy with respect to ecosystem services. The Policy Priority determines how ecosystem services and benefits are weighted when aggregated.

2.1.9. The assumed completion year for the Assessed Projects is 2027, with the exception of Hicks Gate which was assumed to be completed in 2028. A construction time of 2 years has been assumed for the main corridor options, meaning that a time-lag of two years is assumed between habitat removal and creation where habitats are not retained. For Hicks Gate and Keynsham, no significant time-lag was assumed. A habitat lifetime of 30 years post-development has been assumed in line with the minimum requirement for managing habitats post-development for meeting Biodiversity Net Gain requirements.

2.1.10. The monetary value per tCO_2e was calculated based on the HM Treasury Green Book supplementary guidance (BEIS 2021). Carbon value increases over time. Therefore, for monetary valuation (only), a discount rate was applied which means that future benefits and costs were discounted following HM Treasury Green Book guidance. Results are summarised in Chapter 3 with more detailed results tables provided in Appendix A.

2.1.11. Appendix B provides a summary of how the scores and values are calculated for each assessed ecosystem service and benefit. Please refer to the NATURE Tool User Guide (Hölzinger et al. 2022) for more technical detail on how the NATURE Tool model works and how scores and values are calculated.

2.2 Our Approach

2.2.1. Assessment assumptions:

- The high-level assessments were based on habitat data informed by publicly available high-level datasets rather than detailed field surveys. This means that results should be interpreted with some care as the habitat data informing the assessments may not necessarily reflect what can be observed on the ground.
- For the baseline, habitats were assumed to be mature and to have already reached their full ecosystem services potential;
- For the post-development scenario, any newly created habitats were assumed to be newly planted whilst retained habitats were assumed to have reached maturity;
- Single trees were assumed to be created on neutral grassland (this assumption only applies for the route options);

- All hedgerows were assumed to be 3m wide; and
- The proposed Keynsham photovoltaic installation would have a panel area of $63m^2$, have a capacity of 12kw (conservative assumption), is South-West facing and has a slope of 10 degrees.

2.2.2. In addition to the specific assumptions that apply to this assessment, there are also general limitations of the NATURE Tool model that should be acknowledged:

- Whilst most data informing the NATURE Tool model is evidence-informed, the multipliers in particular are mainly based on expert opinion and should be understood as a rating system rather than a direct expression of ecosystem services value;
- The NATURE Tool is a decision support tool. In this context, the NATURE Tool can help to systematically consider natural capital impacts throughout planning and design with the aim to protect and enhance natural capital;
- The NATURE Tool only captures natural capital benefits and impacts. Engineered solutions that serve a similar purpose are not considered. For flood risk regulation, for example, the NATURE Tool indicates the contribution of vegetation and Sustainable Drainage System (SuDS) but would not capture the benefits of a flood defence wall or an underground flood water storage tank;
- Due to the context of the sites, for food and fish production (both, commercial and community), no food function has been assumed for any habitat, either at baseline or post-development. The same applies for wood production where no wood (timer) production function of habitats was assumed;
- Especially for provisioning services, the aggregated provisioning score does not always aggregate the overall provisioning impact accurately for the present assessments. This is due to rounding issues in combination with a very low level of provisioning services. The aggregated Provisioning score should therefore be interpreted with some care. The Change Score for Water Availability is the only relevant Provisioning service for the assessed interventions as no service provision (change) was assumed for food, fish and wood production; and
- The NATURE Tool is designed to be applied alongside the Biodiversity Metric and Biodiversity Metric results can be presented alongside the natural capital results. Due to timing issues, Biodiversity Metric results were not presented in the results tables but WSP intends to present and discuss BNG results alongside NATURE Tool results in future iterations, given the importance of biodiversity for natural capital.

2.3 Land Use Changes

2.3.1. Habitat areas were translated into the NATURE Tool habitat classification system. Tables 2-1 to 2-4 show the baseline and proposed post-development habitat areas translated into the NATURE Tool classification for the scheme extent option 1, scheme extent option 2, Hicks Gate and Keynsham, respectively.

2.3.2. Please note that there may be some differences between the habitat areas stated below and the habitat areas stated within the respective Biodiversity Metric assessments. This is for example because in the Biodiversity Metric, some areas such as for single trees are 'added' to the total area, leading to a degree of area double counting where the habitat areas can exceed the total red line boundary area of a site. In the NATURE Tool, each area is only accounted for once which means that total areas can be slightly smaller matching the red line boundary area. Discrepancies in habitat areas can also occur where proposed single tree areas were removed from the assumed underlying habitat (neutral grassland) and where linear habitats in the Biodiversity Metric such as hedgerows and lines of trees were converted (buffered) to area habitats in the NATURE Tool.

Table 2-1 Baseline and Post-Development Habitat Areas for Scheme Extent Option 1

Habitat Type	Habitat Areas (ha) Baseline	Habitat Areas (ha) Post-Development
Lowland mixed deciduous woodland	0.47	0.33
Line of trees	0.63	0.63
Mixed scrub	3.91	1.81
Other neutral & semi-improved grassland	0.97	2.3
Improved grassland (unspecified)	0.05	0.04
Other rivers & streams	0.01	0.00
Native hedgerow	0.26	0.26
Urban/street tree	0.00	0.55
Developed land; sealed surface	27.51	27.95
…of which is photovoltaic panel area	*0.0000*	*0.0063*
Artificial unvegetated, unsealed surface	0.90	0.83
Total Site Area (Note 1)	**34.70**	**34.70**

Note 1 Habitat areas may not always exactly add up to the total site area due to rounding issues.

Table 2-2 Baseline and Post-Development Habitat Areas for Scheme Extent Option 2

Habitat Type	Habitat Areas (ha) Baseline	Habitat Areas (ha) Post-Development
Lowland mixed deciduous woodland	0.46	0.33
Line of trees	0.27	0.27
Mixed scrub	2.86	1.52
Other neutral & semi-improved grassland	0.85	1.98
Improved grassland (unspecified)	0.06	0.04
Other rivers & streams	0.01	0.00
Native hedgerow	0.20	0.20
Urban/street tree	0.00	0.70
Developed land; sealed surface	26.26	25.97
…of which is photovoltaic panel area	*0.0000*	*0.0063*
Artificial unvegetated, unsealed surface	0.90	0.85
Total Site Area(Note 1)	**31.87**	**31.87**

Note 1 Habitat areas may not always exactly add up to the total site area due to rounding issues.

Table 2-3 Baseline and Post-Development Habitat Areas for Hicks Gate

Habitat Type	Habitat Areas (ha) Baseline	Habitat Areas (ha Post- Development
Lowland mixed deciduous woodland	0.08	0.08
Line of trees	0.01	0.01
Mixed scrub	2.16	1.26
Other neutral & semi-improved grassland	0.16	0.55
Developed land; sealed surface	2.17	2.75
Artificial unvegetated, unsealed surface	0.90	0.83
Total Site Area (Note 1)	**5.48**	**5.48**

Note 1 Habitat areas may not always exactly add up to the total site area due to rounding issues.

Table 2-4 Baseline and Post-Development Habitat Areas for Keynsham

Habitat Type	Habitat Areas (ha) Baseline	Habitat Areas (ha Post- Development
Lowland mixed deciduous woodland	0.07	0.01
Mixed scrub	0.31	0.17
Other neutral & semi-improved grassland	0.00	0.16
Improved grassland (unspecified)	0.05	0.04
Developed land; sealed surface	1.04	1.09
…of which is photovoltaic panel area	*0.0000*	*0.0063*
Total Site Area(Note1)	**1.47**	**1.47**

Note 1 Habitat areas may not always exactly add up to the total site area due to rounding issues.

3 Results

3.1 Introduction

3.1.1. The NATURE Tool results are summarised in Figures 3-1 to 3-4, respectively. Please refer to Appendix B for more detailed results. The left-hand columns show all assessed ecosystem services and benefits, categorised into Cultural & Health, Regulating & Supporting and Provisioning.

3.1.2. The main NATURE Tool indicator in the context of this assessment is the Change Score which indicates the change in natural capital performance and benefits of the projects against the baseline. Results are expressed as a percentage change against the baseline.

3.2 NATURE Tool results: Scheme Extent (Both Options)

3.2.1. The NATURE Tool results for both scheme extent options indicate that natural capital losses through all services and benefit categories should be expected without further design optimisation, with the exceptions of Sense of Place and Water Availability in Option 2 where small gains are indicated. The proposed photovoltaic installation at Keynsham indicated a positive photovoltaic carbon impact. Most Provisioning services were assumed to have a zero-baseline with no change. Having this indication of possible natural capital impacts at this stage is valuable because it provides a baseline on which basis impacts can be improved as part of ongoing planning and design.

3.2.2. The carbon stock in vegetation and soils was predicted to decline by 466tCO_2e for Option 1 and by 205tCO_2e for Option 2, respectively. This decline was only marginally compensated for by the expected carbon impact of the photovoltaic installation at Keynsham, resulting in an overall decline by 455tCO_2e for Option 1 and by 193tCO_2e for Option 2, respectively, if the current design was implemented (see detailed results in Appendix A).

3.2.3. The main driver for the potential natural capital losses across both options is the loss of scrub and deciduous woodland; although the latter to a lesser extent due to the smaller area of habitat loss. Both habitats score comparatively high across most services and benefit categories.

3.2.4. The creation of neutral grassland and tree planting provides a level of mitigation for the losses but not to the extent to mitigate the losses of other habitats as a possible result of the scheme. This is partially due to the time newly planted trees take to mature and develop their full ecosystem services potential.

3.2.5. Please also note that the creation of safe modal shift in travel is not a natural capital benefit which is why this is not reflected in the physical health scores of the NATURE Tool. Hence, negative health scores in the NATURE Tool do not mean that the scheme as a whole would have a negative impact on health.

3.2.6. When comparing the results of the two options, the results indicate that, from a natural capital perspective, Option 2 would be preferrable as less-negative impacts are indicated at this early stage. This is reflected in the aggregated Natural Capital Score which is -23% for Option 1 and -11% for Option 2. Comparable differences can be seen across most relevant ecosystem services.

3.2.7. Whilst it is acknowledged that the assessments for both options are based on imperfect data and initial designs, given the initial results it is still likely that natural capital benefits would be easier to protect and enhance for Option 2.

3.2.8. For context, the Biodiversity Metric results indicate a potential loss of habitat units of -20% for Option 1 and -1% for Option 2, respectively. This also indicates that Option 2 may be preferrable from a Biodiversity Net Gain perspective.

Figure 3-1 NATURE Tool Summary Results for Scheme Extent Option 1

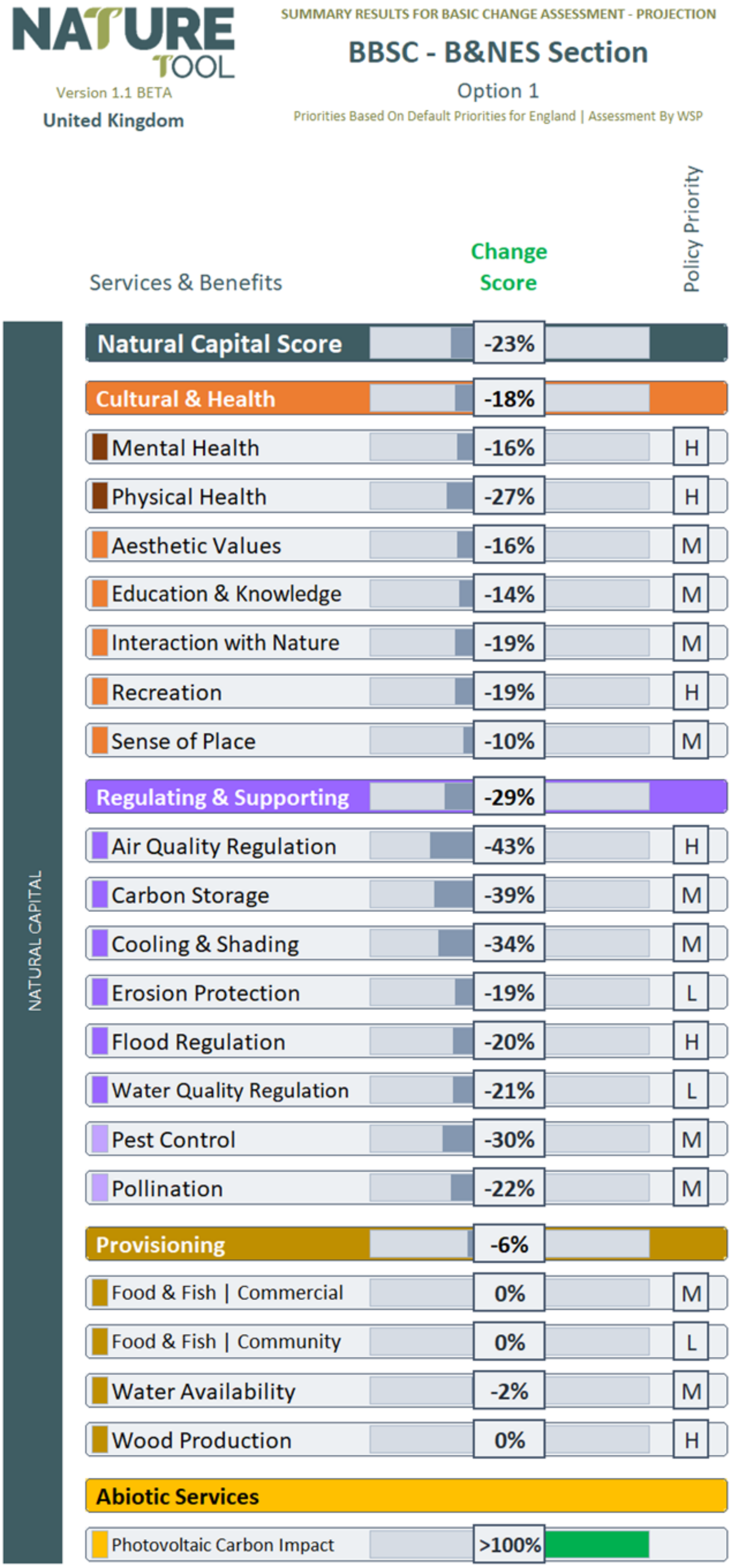
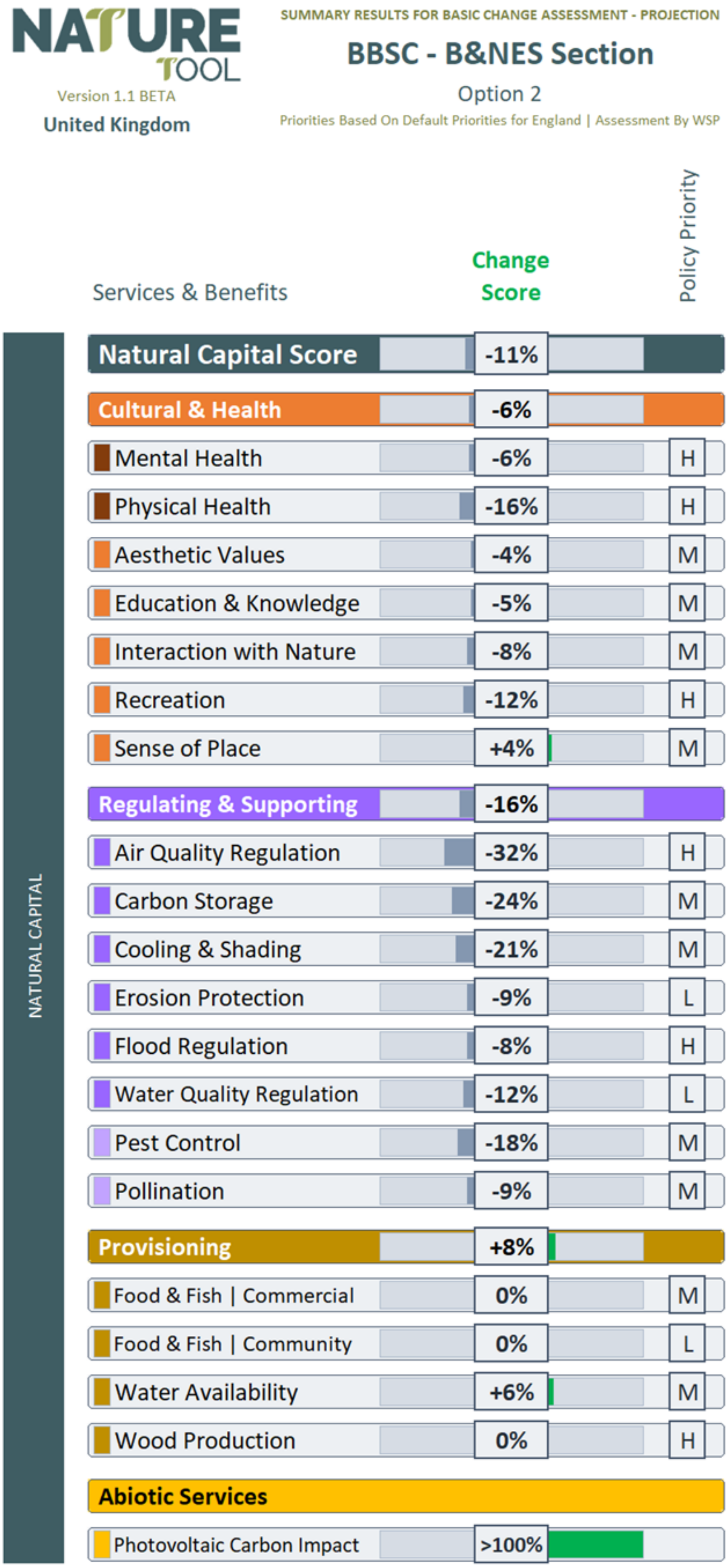


Figure 3-2 NATURE Tool Summary Results for Scheme Extent Option 2



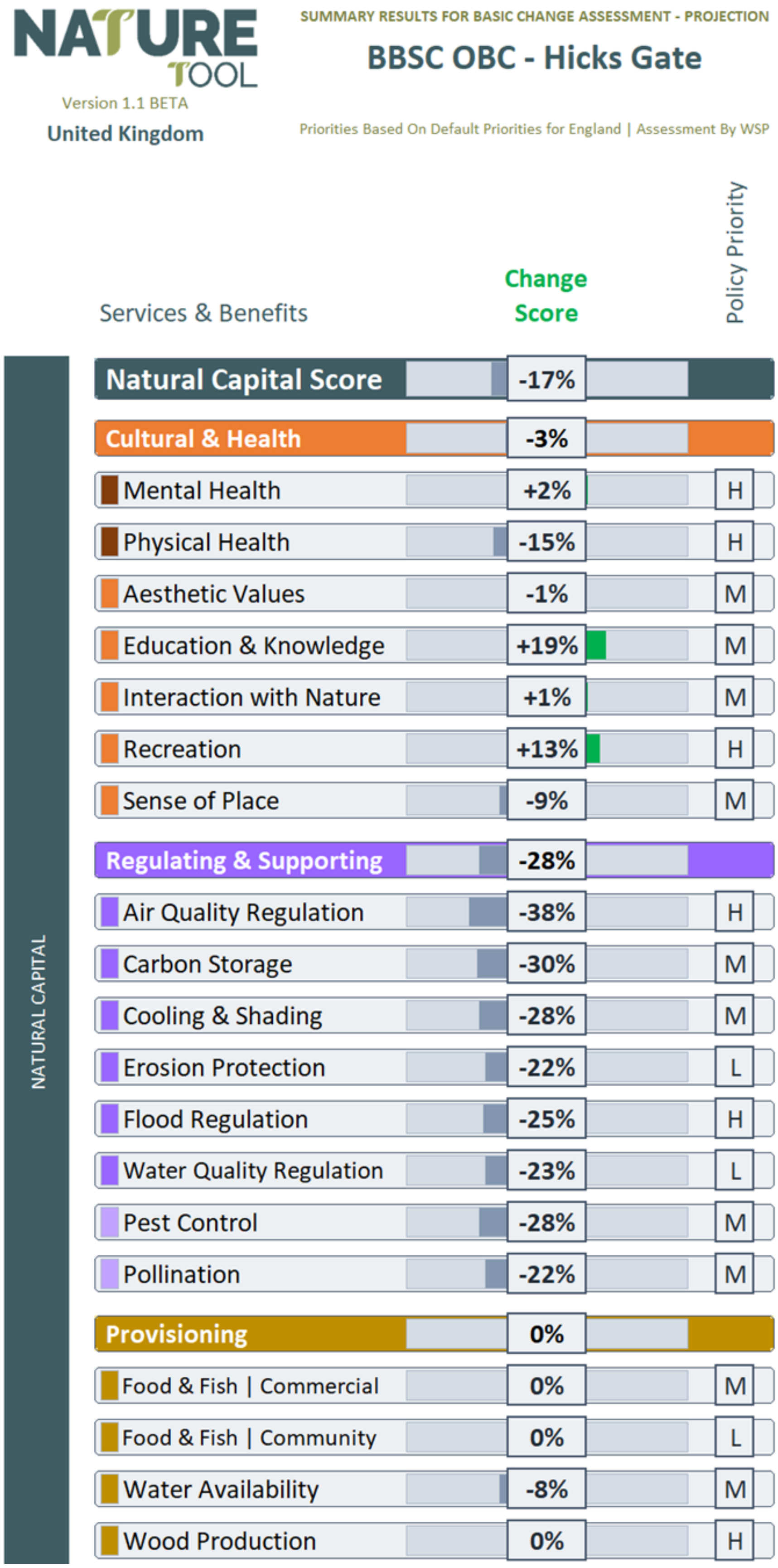
3.3 NATURE Tool results: Hicks Gate

3.3.1. For Hicks Gate, the NATURE Tool results also indicate losses should the current initial design be implemented, with a change in the Natural Capital Score of -17%. The main losses can be seen in the Regulating & Supporting services category where losses range from -22% to -38%. This includes a possible decline in carbon storage in vegetation and soils by 110tCO_2e (see detailed results in Appendix A). Within the Cultural & Health section, scores are mixed. Positive scores can be seen for Education & Knowledge (+19%) and Recreation (+13%). Negative scores were indicated for Physical Health (-15%) and Sense of Place (-9%). Other scores are close to zero. Provisioning services are almost all unchanged from an assumed zero-baseline.

3.3.2. The losses, especially within the Regulating & Supporting section, would be mainly due to the loss of scrub area and the land-take due to the expansion of sealed surface. The comparatively small increase in neutral grassland would not fully mitigate for these losses.

3.3.3. The initial results will help to inform future design stages with the aim to protect and enhance natural capital alongside achieving a net gain in biodiversity. The NATURE Tool assessment provides a valuable evidence base and will help to inform future development and design stages.

Figure 3-3 NATURE Tool Summary Results for Hicks Gate



3.4 NATURE Tool results: Keynsham

3.4.1. With a natural capital change score of -26%, the NATURE Tool assessment for Keynsham also indicates losses for natural capital at this early stage, acknowledging that this is just a starting point rather than the final design.

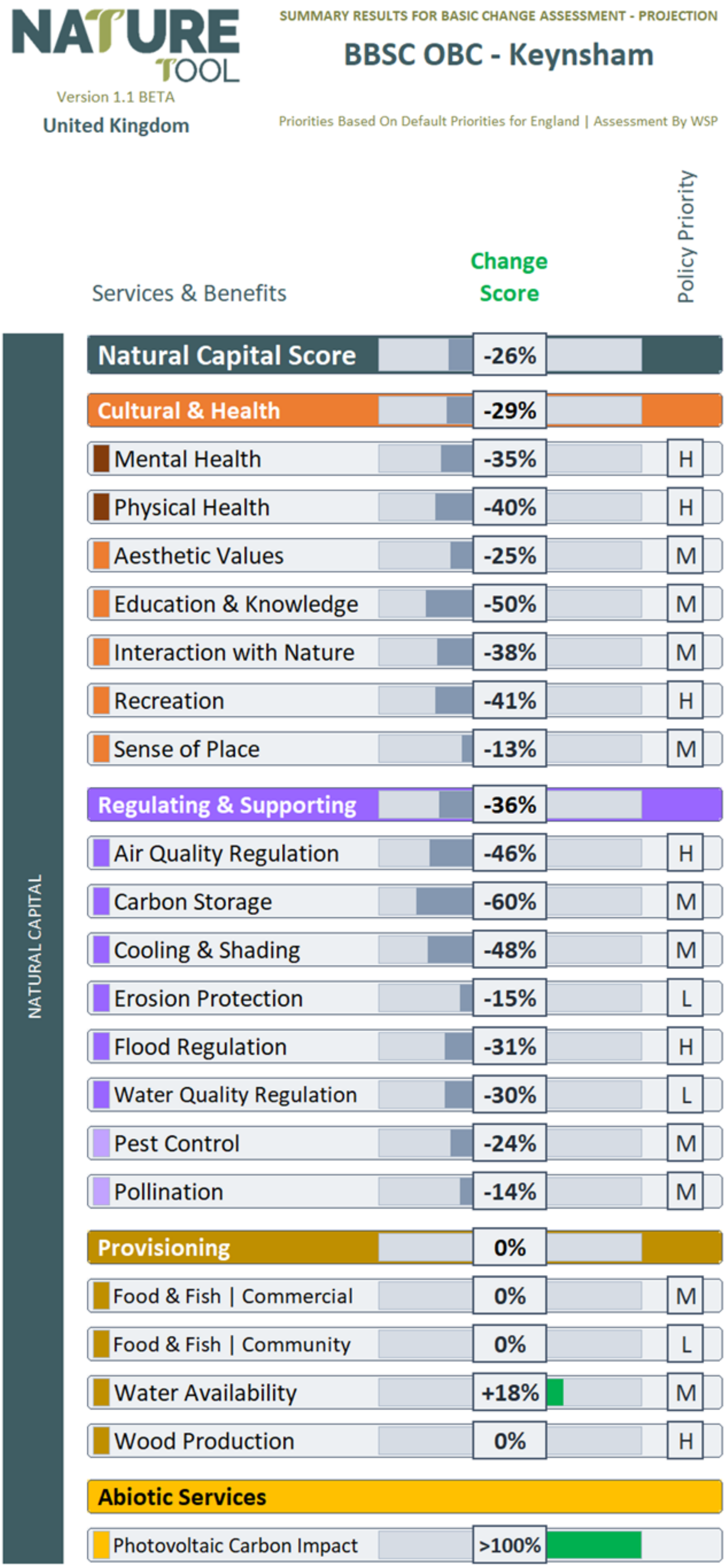
3.4.2. If the initial design was implemented, a decline in carbon storage in vegetation and soils by 44tCO_2e could be expected. This loss was only partially compensated for by the photovoltaic installation, resulting in an overall carbon impact of -32tCO_2e (see detailed results in Appendix A).

3.4.3. The main drivers for the losses are the loss of deciduous woodland and scrub within the Keynsham scheme. These habitats perform particularly well across many ecosystem services categories. Water availability is the exception as deciduous woodland and scrub require comparatively more water than other habitats. This explains the change score of +18% for water availability.

3.4.4. It is beneficial to systematically assess possible natural capital impacts at this stage as it will help to optimise mitigation with the aim to achieve gains for natural capital along the planning and design process.

3.4.5. The NATURE Tool results indicate slightly less possible adverse impacts compared to the Biodiversity Metric Results where a loss of -36% habitat units is indicated.

Figure 3-4 NATURE Tool Summary Results for Keynsham



4 Conclusions and Recommendations

4.1.1. The NATURE Tool assessments have provided a valuable initial indication of possible adverse natural capital impacts of the scheme and identified opportunities for further enhancement. Systematically assessing natural capital at this early stage should be applauded as it offers the best chances of achieving and demonstrating net gains for natural capital towards the final design and goes above and beyond 'business-as usual'.

4.1.2. The outcomes provide a valuable insight into the possible natural capital impact of the proposed interventions, and although they are high-level indicative outcomes, they can support multi-beneficial design through the next phases of the Scheme.

4.1.3. Considering the possible adverse impacts across the proposed interventions, stronger consideration of natural capital impacts and design of appropriate mitigation within the Scheme design should be promoted for the remaining planning and design stages.

4.1.4. Based on the high-level NATURE Tool assessment of the proposed BBSC interventions, WSP makes the following recommendations for future planning and design stages:

- From a natural capital perspective, Scheme Extent Option 2 in its current design is predicted to have a smaller adverse impact on natural capital which means that this option is likely to provide better opportunities to achieve natural capital enhancements through optimised design.
- Whilst, unlike for Biodiversity Net Gain, there is no statutory requirement for enhancing natural capital and related wider environmental benefits to the local community and society, there are now strong policy hooks in relation to natural capital and ecosystem services. The National Planning Policy Framework (NPPF; MHCLG 2021), for example, states in par 174b that *"Planning policies and decisions should contribute to and enhance the natural and local environment by: […] recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services*". It continues in par 175 that *"Plans should: […] allocate land with the least environmental or amenity value […] and plan for the enhancement of natural capital at a catchment or landscape scale…"* This policy clearly indicates an expectation to aim for an enhancement of natural capital benefits rather than a mitigated decline. WSP therefore recommends developing realistic natural capital targets for each of the project areas against which success can be measured. Natural capital targets could be defined based on a local policy review, stakeholder engagement, or a combination of both.
- WSP also recommends that natural capital is considered in the design principles, with input from natural capital specialists. Natural capital specialists should also input to a design workshop so that natural capital is systematically considered early on in the design. These measures will help to highlight potential natural capital enhancement opportunities from the outset and make it more likely to achieve net gains for natural capital.

- WSP furthermore recommends to systematically assess and manage natural capital impacts throughout design. To implement this cost-efficiently, WSP recommends running advanced NATURE Tool assessments at the most relevant design stages. The results would be used to engage with the planning and landscape teams to advise on opportunities for mitigation and enhancement. A design workshop would also be beneficial to effectively integrate natural capital considerations. These engagements would closely align with engagements by the biodiversity team with the aim to achieve the Biodiversity Net Gain requirement.
- As the scheme extents (red line boundaries) do not provide much space for habitat creations and enhancements, it is likely that not all adverse natural capital impacts can be avoided or mitigated on-site. The same is likely for biodiversity. It is therefore recommended to consider offsetting opportunities as soon as possible. NATURE Tool assessments can inform the likely offsetting requirements to achieve the project's natural capital goals. Offsetting scenarios could be developed with the aim to achieve and demonstrate natural capital enhancements alongside Biodiversity Net Gain.

4.1.5. This systematic approach to assessing, managing, and achieving natural capital benefits with the final design would not only add value to the local community and society as a whole, but would also demonstrate West of England Combined Authority's commitment to sustainable development and forward-looking approach to policy development in England.

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Appendix A Detailed Results

Figure A-1 - NATURE Tool Detailed Results Capture - BBSC Option 1

NATURE TOOL
Version 1.1 BETA
United Kingdom

SUMMARY RESULTS FOR BASIC CHANGE ASSESSMENT – PROJECTION

BBSC - B&NES Section

Option 1

Priorities Based On Default Priorities for England | Assessment By WSP

NATURAL CAPITAL

Services & Benefits	Baseline Units/ Score	Project Units/ Score	Unit/ Score Change	Change Score	Potential Score	Completeness Score (Max=10)	Policy Priority	Objectives Met?	Achievements	Baseline Carbon Impact ($t\ CO_2e$)	Project Carbon Impact ($t\ CO_2e$)	Carbon Impact Change ($t\ CO_2e$)	Baseline Monetary Value (NPV; £2020)	Project Monetary Value (NPV; £2020)	Monetary Value Change (NPV; £2020)
Natural Capital Score	28	22	-6	-23%	7%	8		N/A		1,208	753	-455	£199,392	£121,096	-£78,295
Cultural & Health	11	9	-2	-18%	7%	7		N/A							
Mental Health	24	20	-4	-16%	6%	7	H	N/A							
Physical Health	27	20	-7	-27%	7%	7	H	N/A							
Aesthetic Values	40	34	-6	-16%	10%	7	M	N/A							
Education & Knowledge	20	17	-3	-14%	5%	7	M	N/A							
Interaction with Nature	31	25	-6	-19%	8%	8	M	N/A							
Recreation	20	16	-4	-19%	5%	6	H	N/A							
Sense of Place	38	34	-4	-10%	10%	8	M	N/A							
Regulating & Supporting	16	11	-5	-29%	11%	8		N/A							
Air Quality Regulation	37	21	-16	-43%	8%	5	H	N/A							
Carbon Storage	14	9	-6	-39%	10%	10	M	N/A		1,208	741	-466	£199,392	£118,851	-£80,540
Cooling & Shading	30	20	-10	-34%	8%	4	M	N/A							
Erosion Protection	52	43	-10	-19%	14%	10	L	N/A							
Flood Regulation	39	31	-8	-20%	11%	9	H	N/A							
Water Quality Regulation	37	29	-8	-21%	9%	9	L	N/A							
Pest Control	58	41	-17	-30%	12%	10	M	N/A							
Pollination	45	35	-10	-22%	13%	10	M	N/A							
Provisioning	2	2	-0	-6%	2%	10		N/A							
Food & Fish | Commercial	0	0	0	0%	0%	10	M	N/A							
Food & Fish | Community	0	0	0	0%	0%	10	L	N/A							
Water Availability	30	29	-1	-2%	8%	10	M	N/A							
Wood Production	0	0	0	0%	0%	10	H	N/A							
Abiotic Services															
Photovoltaic Carbon Impact	0	1	+1	>100%				N/A		0	12	+12	£0	£2,245	+£2,245

Figure A-2 - NATURE Tool Detailed Results Capture - BBSC Option 2

NATURE TOOL
Version 1.1 BETA
United Kingdom

SUMMARY RESULTS FOR BASIC CHANGE ASSESSMENT – PROJECTION

BBSC - B&NES Section

Option 2

Priorities Based On Default Priorities for England | Assessment By WSP

NATURAL CAPITAL

Services & Benefits	Baseline Units/ Score	Project Units/ Score	Unit/ Score Change	Change Score	Potential Score	Completeness Score (Max=10)	Policy Priority	Objectives Met?	Achievements	Baseline Carbon Impact ($t\ CO_2e$)	Project Carbon Impact ($t\ CO_2e$)	Carbon Impact Change ($t\ CO_2e$)	Baseline Monetary Value (NPV; £2020)	Project Monetary Value (NPV; £2020)	Monetary Value Change (NPV; £2020)
Natural Capital Score	21	19	-2	-11%	7%	8		N/A		858	665	-193	£141,605	£107,988	-£33,617
Cultural & Health	8	7	-1	-6%	6%	7		N/A							
Mental Health	18	17	-1	-6%	5%	7	H	N/A							
Physical Health	20	17	-3	-16%	6%	7	H	N/A							
Aesthetic Values	30	29	-1	-4%	9%	7	M	N/A							
Education & Knowledge	15	14	-1	-5%	5%	7	M	N/A							
Interaction with Nature	23	21	-2	-8%	7%	8	M	N/A							
Recreation	15	13	-2	-12%	4%	6	H	N/A							
Sense of Place	29	30	+1	+4%	9%	8	M	N/A	G						
Regulating & Supporting	12	10	-2	-16%	10%	7		N/A							
Air Quality Regulation	27	18	-9	-32%	8%	4	H	N/A							
Carbon Storage	10	8	-2	-24%	9%	10	M	N/A		858	653	-205	£141,605	£105,743	-£35,862
Cooling & Shading	22	17	-5	-21%	8%	4	M	N/A							
Erosion Protection	39	35	-3	-9%	12%	10	L	N/A							
Flood Regulation	29	27	-2	-8%	10%	9	H	N/A							
Water Quality Regulation	27	24	-3	-12%	8%	9	L	N/A							
Pest Control	43	36	-8	-18%	12%	10	M	N/A							
Pollination	34	30	-3	-9%	12%	10	M	N/A							
Provisioning	1	1	+0	+8%	2%	10		N/A	G						
Food & Fish | Commercial	0	0	0	0%	0%	10	M	N/A							
Food & Fish | Community	0	0	0	0%	0%	10	L	N/A							
Water Availability	24	26	+1	+6%	8%	10	M	N/A	G						
Wood Production	0	0	0	0%	0%	10	H	N/A							
Abiotic Services															
Photovoltaic Carbon Impact	0	1	+1	>100%				N/A		0	12	+12	£0	£2,245	+£2,245

Figure A-3 - NATURE Tool Detailed Results Capture - BBSC Hicks Gate

NATURE TOOL
Version 1.1BETA
United Kingdom

SUMMARY RESULTS FOR BASIC CHANGE ASSESSMENT - PROJECTION

BBSC OBC - Hicks Gate

Priorities Based On Default Priorities for England | Assessment By WSP

NATURAL CAPITAL

Services & Benefits	Baseline Units/ Score	Project Units/ Score	Unit/ Score Change	Change Score	Potential Score	Completeness Score (Max=10)	Policy Priority	Objectives Met?	Achievements	Baseline Carbon Impact ($t\ CO_2e$)	Project Carbon Impact ($t\ CO_2e$)	Carbon Impact Change ($t\ CO_2e$)	Baseline Monetary Value (NPV; £2020)	Project Monetary Value (NPV; £2020)	Monetary Value Change (NPV; £2020)
Natural Capital Score	11	9	-2	-17%	19%	8		N/A		365	255	-110	£57,919	£40,496	-£17,422
Cultural & Health	4	4	-0	-3%	19%	8		N/A							
Mental Health	9	9	+0	+2%	17%	8	H	N/A	G						
Physical Health	11	9	-2	-15%	19%	8	H	N/A							
Aesthetic Values	15	15	-0	-1%	28%	8	M	N/A							
Education & Knowledge	7	9	+1	+19%	16%	6	M	N/A							
Interaction with Nature	12	12	+0	+1%	22%	8	M	N/A							
Recreation	8	9	+1	+13%	16%	7	H	N/A	G						
Sense of Place	13	12	-1	-9%	21%	8	M	N/A							
Regulating & Supporting	6	4	-2	-28%	25%	9		N/A							
Air Quality Regulation	16	10	-6	-38%	26%	7	H	N/A							
Carbon Storage	4	3	-1	-30%	11%	10	M	N/A		365	255	-110	£57,919	£40,496	-£17,422
Cooling & Shading	12	8	-3	-28%	23%	6	M	N/A							
Erosion Protection	20	15	-4	-22%	33%	10	L	N/A							
Flood Regulation	15	11	-4	-25%	27%	8	H	N/A							
Water Quality Regulation	13	10	-3	-23%	21%	9	L	N/A							
Pest Control	24	17	-7	-28%	31%	10	M	N/A							
Pollination	17	13	-4	-22%	24%	10	M	N/A							
Provisioning	1	1	0	0%	6%	10		N/A							
Food & Fish | Commercial	0	0	0	0%	0%	10	M	N/A							
Food & Fish | Community	0	0	0	0%	0%	10	L	N/A							
Water Availability	14	13	-1	-8%	23%	10	M	N/A							
Wood Production	0	0	0	0%	0%	10	H	N/A							

Figure A-4 - NATURE Tool Detailed Results Capture - BBSC Keynsham

NATURE TOOL
Version 1.1 BETA
United Kingdom

SUMMARY RESULTS FOR BASIC CHANGE ASSESSMENT – PROJECTION

BBSC OBC - Keynsham

Priorities Based On Default Priorities for England | Assessment By WSP

NATURAL CAPITAL

Services & Benefits	Baseline Units/ Score	Project Units/ Score	Unit/ Score Change	Change Score	Potential Score	Completeness Score (Max=10)	Policy Priority	Objectives Met?	Achievements	Baseline Carbon Impact (t CO_2e)	Project Carbon Impact (t CO_2e)	Carbon Impact Change (t CO_2e)	Baseline Monetary Value (NPV; £2020)	Project Monetary Value (NPV; £2020)	Monetary Value Change (NPV; £2020)
Natural Capital Score	2	1	-1	-26%	11%	8		N/A		83	50	-32	£13,350	£8,412	-£4,938
Cultural & Health	1	1	-0	-29%	9%	7		N/A							
Mental Health	2	1	-1	-35%	8%	8	H	N/A							
Physical Health	2	1	-1	-40%	9%	7	H	N/A							
Aesthetic Values	2	2	-1	-25%	12%	7	M	N/A							
Education & Knowledge	1	1	-1	-50%	5%	7	M	N/A							
Interaction with Nature	2	1	-1	-38%	9%	8	M	N/A							
Recreation	2	1	-1	-41%	7%	7	H	N/A							
Sense of Place	2	2	-0	-13%	14%	8	M	N/A							
Regulating & Supporting	1	1	-0	-36%	15%	8		N/A							
Air Quality Regulation	3	1	-1	-46%	14%	6	H	N/A							
Carbon Storage	1	0	-1	-60%	6%	10	M	N/A		83	38	-44	£13,350	£6,167	-£7,183
Cooling & Shading	2	1	-1	-48%	12%	6	M	N/A							
Erosion Protection	3	3	-1	-15%	23%	10	L	N/A							
Flood Regulation	3	2	-1	-31%	16%	9	H	N/A							
Water Quality Regulation	2	2	-1	-30%	12%	9	L	N/A							
Pest Control	4	3	-1	-24%	20%	10	M	N/A							
Pollination	3	2	-0	-14%	16%	10	M	N/A							
Provisioning	0	0	0	0%	3%	9		N/A							
Food & Fish | Commercial	0	0	0	0%	0%	9	M	N/A							
Food & Fish | Community	0	0	0	0%	0%	10	L	N/A							
Water Availability	2	2	+0	+18%	14%	10	M	N/A							
Wood Production	0	0	0	0%	0%	10	H	N/A							
Abiotic Services															
Photovoltaic Carbon Impact	0	1	+1	>100%				N/A		0	12	+12	£0	£2,245	+£2,245

Appendix B Nature Tools Indicators Benefits & Services Key

The below keys are written so that each item can be read independently. Please acknowledge that this leads to a degree of repetition.

Indicator Key (Columns)

- **Baseline Units/Scores**: This indicator provides an indication of the natural capital (biodiversity) performance of the site in its baseline state over the assessment period. This is effectively the business-as-usual scenario assuming the site remains unchanged.

  The scores for natural capital are commonly based on base scores for each habitat type present. The base scores also depend on habitat maturity which is factored in. The base scores indicate the general level of ecosystem service provision by that habitat. The base scores are then adjusted based on multipliers in relation to indicators for ecosystem location and condition. A habitat receives for example a higher Recreation score if the habitat has good access. Please refer to the Detailed Results sheet for more information on how scores are calculated.

  For biodiversity, units are commonly calculated with the Biodiversity Metric with results being imported into the NATURE Tool so that results can be displayed alongside natural capital.

  In a change assessment, the baseline scores (units) are used as baseline against which project impacts are assessed and directly inform the Change Score.

- **Project Units/Score**: This indicator provides an indication of the natural capital (biodiversity) performance of the site in its proposed future state. It is based on the scores (units) indicated for the post-development state of the site but also takes the natural capital performance during the construction phase into account (where applicable).

  The scores for natural capital are commonly based on base scores for each habitat type present. The base scores also depend on habitat maturity. The base scores indicate the general level of ecosystem service provision by that habitat. The base scores are then adjusted based on multipliers in relation to indicators for ecosystem location and condition. A habitat receives for example a higher Recreation score if the habitat has good access. For the project scores, habitat delivery risks are also accounted for which may reduce the score for certain habitats compared to already established habitats of the same type.

  The project scores (units) are compared against the baseline to inform the Unit/Score Change and subsequently the Change Score.

- **Unit/Score Change**: The score (unit) change indicates the impact of the project on the score (units) for each service/benefit.

  The score (unit) change is calculated by subtracting the 'Baseline Units/Score' from the 'Project Units/Score'.

- **Change Score:** This is the main indicator for measuring project success in terms of natural capital (biodiversity) impact. For each assessed ecosystem service and benefit, the Change Score indicates the percentage change against the baseline. A Change Score of +30%, for example, indicates that the service provision would be 30% higher than it would have been if the baseline state of the site remained in place. If the Change Score is greater than +100%, it will simply be displayed as >100%. A positive Change Score generally indicates a positive impact on natural capital (biodiversity). The higher the Change Score, the greater the indicative ecosystem service/benefit.

  The Change Score is calculated by dividing the 'Unit/Score Change' by the 'Baseline Units/Score'.

- **Potential Score**: This indicates how much of the maximum ecosystem services/benefit potential for the site has been/would be achieved. A score of 40%, for example, indicates that the site achieves 40% of its maximum potential. The Potential Score is a main indicator of the NATURE Tool.

  For a change assessment, the Potential Score relates to the Project Score (post-development, incl. construction time if applicable). In this case Change Score and Potential Score should be interpreted together. If for example the Change Score is high but the Potential Score is low then this indicates there are significant improvements compared to the baseline but that the baseline performance was also low to start with which makes it easier to achieve a high Change Score. An extreme example would be a zero baseline where any improvement, no matter how small, would result in Change Score of >100%. Where there is a zero/low baseline it is especially important to take the Potential Score into consideration when comparing the natural capital performance of different design options/scenarios..

  The Potential Score is calculated by comparing the proposed (change assessment) score against the maximum possible site potential score (100%). The latter is calculated by assuming for each habitat/land-use, that it is either retained or replaced by the best-scoring alternative, whichever achieves a higher score (taking into account delivery risks and habitat maturity for newly created habitats). The exceptions are open water and coastal habitats as it is assumed that these cannot easily be replaced with other habitats.

  It should be noted that the Potential Score is a theoretical score and 100% may not often be achievable in practice. 100% is for example not achievable if there are any buildings/sealed surfaces on site which score zero in terms of natural capital. Hence, a goal of 100% is often not realistic. It should also be noted that 100% can never be achieved across all ecosystem service categories, even for a project where the sole objective is to maximise natural capital. This is because of trade-offs between services. It would for example be impossible to maximise the commercial food provision score (all agricultural land) at the same time as the wood production score (all woodland).

- **Completeness Score**: This indicates how complete the assessment is and is mainly displayed for transparency. It indicates how accurate the assessment is as far as user entries allow. Not considered are general uncertainties and caveats related to the scientific evidence informing the NATURE Tool. It is therefore NOT a general confidence score in the reliability of the results. It only indicates to what extent optional elements of the NATURE Tool have been completed by the tool user. Scores are rounded to full decimals and the maximum score is 10.

  The Completeness Score calculation is based on both how detailed habitat data has been entered and how many optional advanced indicators have been used. Habitat areas can be entered at different detail levels. If all habitats are entered at the most detailed level then this will maximise this part of the completeness score. If habitats are entered at a less detailed level then the completeness score is reduced. If for example 'Woodland (unspecified)' is entered, then this could be any of the woodland habitats which may have different scores. This variation from the average score for 'Woodland (unspecified)' is accounted for by reducing the Completeness Score.

  The second element considered in the Completeness Score is how many of the advanced indicators have been used. All advanced indicators have a default value which applies if no data is entered by the tool user. If default values apply, that also means that circumstances are not clear as far as advanced indicators are concerned. A habitat could for example be located within or outside a flood risk regulation opportunity area which impacts the flood risk regulation multiplier. This possible variation from the default multiplier is accounted for by a reduced Completeness Score.

- **Confidence Rating**: The Confidence Rating indicates the general confidence in the scores and units calculated. It is mainly provided for transparency and considers general model uncertainties and caveats such as how well the model reflects the complexity of the ecosystem service/benefit and the evidence base informing scores and multipliers.

  The Confidence Rating is fixed and does not change with how many advanced indicators were utilised or how detailed habitat data has been entered - this is reflected in the Completeness Score. The fixed Confidence Rating is based on utilising the highest habitat detail level and the application of all relevant advanced indicators. It therefore applies for a Completeness Score of 10. The Confidence Rating can be High (Green), Medium (Yellow), Low (Orange) or Experimental (Red):

  - High (Green): Very confident – There is a strong evidence base upon which to base scores across the range of habitats and multipliers used for the respective ecosystem service. Please note that this category is not currently applicable.

• Medium (Orange): Reasonably confident – There is some suitable evidence to calibrate the range of scores across habitats and multipliers and/or scoring applied to a limited range of habitats/multipliers for which there is a sound and simple rationale.

• Low (Orange): Low confidence – The relationship between the provision of the ecosystem service and habitats is complex. Evidence for scoring/multipliers is partial, although may be stronger for some habitats than others. Evidence gaps have been filled by consulting experts and with a degree of subjectivity, particularly for cultural services.

• Experimental (Red): An experimental approach which applies for aggregated benefit categories such as health benefits and the natural capital score. This category reflects the additional uncertainty and caveats attached to aggregated scores.

- **Policy Priority**: This indicator informs how scores are aggregated for the Natural Capital Score, Cultural & Health score, Regulating & Supporting score and Provisioning score, respectively. They are mainly displayed for reference and transparency. By default, policy priorities are based on a literature review where relevant national environmental and planning policies were reviewed for each UK jurisdiction. The policy priority for each service and benefit can either be high, medium or low. This classification should be based on both the frequency of policies related to a service/benefit as well as how strong the wording is formulated.

  Policy Priorities translate into aggregation weights as follows:

  • High (H) = 3

  • Medium (M) = 2

  • Low (L) = 1

  As a result, an ecosystem services/benefit score with a high policy priority is weighted 3 times as much in the aggregated Natural Capital Score than the same score for a service/benefit with a policy priority weight of 1 (low).

  Please note that physical and mental health scores are aggregated scores based on a literature review (see below). That means that certain ecosystem services scores feed into the health scores which feed into the aggregated Natural Capital Score which would result in double-counting. To avoid the double-counting issue, any contribution of ecosystem services scores to the health scores is deducted from the ecosystem services scores when feeding into aggregated scores such as the Natural Capital Score. For more detail refer to the relevant section within the Detailed Results sheet.

- **Objectives**: For adapted (local/corporate/project) NATURE Tool versions, the objective setter can define quantitative natural capital objectives. If all objectives are met, a ✓ will be shown in the respective row. If any objectives were not met, a ✕ will be displayed. If no objectives were defined, ‘N/A’ will be shown. By default, no objectives are defined for the standard UK version of the NATURE Tool.

- **Achievements**: The NATURE Tool also indicates Achievements which highlight particularly positive impacts on natural capital (biodiversity) above and beyond what would usually be expected. The main intention of Achievements is to provide a simple means for communicating and reporting net gains for the environment and anything above and beyond.

  Achievements are automatically allocated based on thresholds for the Change Score, Potential Score and Completeness Score as follows:

  - Gain (G): +1% Completeness Score AND 1% Potential Score and 6.5 Completeness Score.
  - Bronze Excellence Standard: +20% Completeness Score and 10% Potential Score AND 7.5 Completeness Score.
  - Silver Excellence Standard: +40% Completeness Score and 20% Potential Score AND 8.5 Completeness Score.
  - Gold Excellence Standard: +60% Completeness Score and 30% Potential Score AND 9.5 Completeness Score.
- **Baseline Carbon Impact**: This indicator represents the average carbon stock (tonnes of carbon dioxide equivalent; tCO_2e) of baseline habitats over the assessment period plus carbon abated through existing photovoltaic installations, if applicable.

  Average carbon stocks are based on estimated stocks in vegetation and corresponding soils. For woodland, carbon stock (changes) are based on the **Woodland Carbon Code (WCC)** calculation tool (version 2.1). For other habitats, estimates are based on Natural England's publication **Carbon Storage and Sequestration by Habitat 2021**. Please note that there is still significant uncertainty particularly around soil carbon stock changes.
- **Project Carbon Impact**: This indicator represents the average carbon stock (tonnes of carbon dioxide equivalent; tCO_2e) of project habitats over the assessment period (both, during construction and post-development) plus carbon abated through new photovoltaic installations, if applicable.
- **Carbon Impact Change**: The Carbon Impact Change (in terms of gains/losses to tonnes of carbon dioxide equivalent; tCO_2e) indicates the impact of the project on carbon storage in vegetation and soils (and carbon abated due to photovoltaic installations, if applicable).

  The tCO_2e are calculated by subtracting the 'Baseline Carbon Impact' from the 'Project Carbon Impact'.
- **Baseline Monetary Value**: The Baseline Monetary Value (Net Present Value; NPV) has been calculated for carbon impacts. The value represents the average carbon stock value of baseline habitats over the assessment timescale (plus the average value of carbon abated due to existing photovoltaic installations, if applicable). It is NOT the annual sequestration.

The monetary valuation approach follows the Green Book (HM Treasury 2022) in combination with Supplementary Guidance on the Valuation of Energy Use and Greenhouse Gas Emissions for Appraisal (BEIS 2021). Both discounting future benefits and the increasing value per t CO_2e over time have been considered.

- **Project Monetary Value**: The Project Monetary Value (Net Present Value; NPV) has been calculated for carbon impacts. The value represents the average carbon stock value of proposed post-development habitats (and habitats during construction, if applicable) over the assessment timescale (plus the average value of carbon abated due to new photovoltaic installations, if applicable). It is NOT the annual sequestration.
- **Monetary Value Change**: The Monetary Value Change (for gains/losses to tonnes of carbon dioxide equivalent) indicates the impact of the project on carbon storage in vegetation and soils (and carbon abated due to photovoltaic installations, if applicable), expressed in monetary terms.

  The values are calculated by subtracting the 'Baseline Monetary Value' from the 'Project Monetary Value'.

Benefit and Services (Category) Key (Rows)

- **Natural Capital Score**: This is an aggregated headline indicator. It indicates the overall natural capital performance of the project and is based on scores for all ecosystem services/benefits as well as the Policy Priorities. This is effectively based on a Multi Criteria Decision Analysis (MCDA) framework and does NOT represent the overall value change in natural capital performance. Hence, the indicative Natural Capital Score should be read and interpreted alongside the individual ecosystem services/benefit results (and objectives where applicable).

  The aggregated Natural Capital Score is calculated as the average of each ecosystem services/benefits score below, each multiplied by the aggregation weight attached to the respective Policy Priority (see Policy Priority for further detail). The abiotic Photovoltaic Carbon Impact is also considered when applying the Carbon Storage policy priority.
- **Cultural & Health (Category):** The Cultural & Health score is an aggregated headline indicator. It indicates the overall Culture & Health performance of the project and is based on scores for all ecosystem services/benefits as well as the Policy Priorities within this category. This is effectively based on a Multi Criteria Decision Analysis (MCDA) framework and does NOT represent the overall value change in Culture & Health performance. Hence, the indicative Culture & Health score should be read and interpreted alongside the individual ecosystem services/benefit results within the category (and objectives where applicable).

  The aggregated Culture & Health score is calculated as the average of each ecosystem services/benefits score below, each multiplied by the aggregation weight attached to the respective Policy Priority (see Policy Priority for further detail).

- **Mental Health**: The Mental Health score is an indicative aggregated indicator. It effectively aggregates ecosystem services scores based on their indicative contribution to Mental Health. This only indicates the contribution by natural capital and not any other engineered assets such as the presence of a hospital.

  The Mental Health score is effectively based on a Multi Criteria Decision Analysis (MCDA). A percentage-contribution to Mental Health is allocated to each ecosystem service which adds up to 100% (the Mental Health score). The percentage allocation is based on a literature review exploring the links between ecosystem services and Mental Health. To avoid double-counting when aggregating (the already aggregated) Mental Health score to for example the Natural Capital Score, the percentage allocation is deducted from the ecosystem services again when aggregated to the Natural Capital Score.

- **Physical Health**: The Physical Health score is an indicative aggregated indicator. It effectively aggregates ecosystem services scores based on their indicative contribution to Physical Health. This only indicates the contribution by natural capital and not any other engineered assets such as the presence of a hospital.

  The Physical Health score is effectively based on a Multi Criteria Decision Analysis (MCDA). A percentage-contribution to Physical Health is allocated to each ecosystem service which adds up to 100% (the Mental Health score). The percentage allocation is based on a literature review exploring the links between ecosystem services and Physical Health. To avoid double-counting when aggregating (the already aggregated) Physical Health score to for example the Natural Capital Score, the percentage allocation is deducted from the ecosystem services again when aggregated to the Natural Capital Score.

- **Aesthetic Values**: The aesthetic value of nature is highly subjective and therefore difficult to reflect in a habitat-based scoring system which should be acknowledged when interpreting results. Different groups of society have different levels of appreciation for different natural settings and places. However, not valuing aesthetic and other cultural ecosystem services also means that they can be undermined in decision-making. It is important to stress, however, that this is only a broad indication of aesthetic value.

  The Aesthetic Values Score only considers nature/habitats and not the aesthetics of constructed features such as buildings or monuments. The score is purely habitat-based and does not consider wider landscape impacts such as the appropriateness of habitats within the landscape setting. Nor does the automatically calculated score consider the preferences of the local community.

  The Aesthetic Values Score is based on a habitat base score, as well as the following multipliers:

  - Level of accessibility: The multiplier is higher for sites that have better public access as people are more likely to benefit if they can be physically present.

- Nature designations: The multiplier is higher dependent on whether the site has local, national or international nature designations.
- Population density/external visitor numbers: The multiplier is higher in areas with higher population density and/or which are frequently visited which indicates a higher demand/likelihood of exposure.
- Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
- Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

▪ **Education & Knowledge**: Alongside more theoretical environmental education in the classroom, frequent interaction with the natural environment can form a key element of acquiring ecological knowledge.

The Education & Knowledge Score only considers informal interaction with/formal educational visits to nature/habitats. It does not consider for example classroom-based ecological education which means that the presence of a school building or education centre would not enhance the score.

The Education & Knowledge Score is based on a habitat base score, as well as the following multipliers:

- Educational use: The multiplier is higher for areas that are specifically designed for educational purposes, areas that are located on primary school grounds and areas regularly visited for organised educational visits.
- Level of accessibility: The multiplier is higher for sites that have better public access as people are more likely to benefit if they can be physically present.
- Nature designations: The multiplier is higher based on whether the site has local, national or international nature designations.
- Population density/external visitor numbers: The multiplier is higher in areas with higher population density and/or frequently visited which indicates a higher demand/likelihood of exposure.
- Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
- Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

▪ **Interaction with Nature**: Interaction with nature refers to observing nature such as bird watching; either formally or informally. It also includes random encounters with wildlife and more generally feeling ‘connected to nature’. To distinguish interaction with nature from recreation, for example, amenity grassland or a natural sports pitch may provide great recreational opportunities but it is unlikely to provide many opportunities to interact with nature.

The Interaction with Nature Score is purely habitat-based and does not directly consider the presence of species. Nor does it consider species/habitat diversity across a site.

The Interaction with Nature Score is based on a habitat base score, as well as the following multipliers:

- Level of accessibility: The multiplier is higher for sites that have better public access as people are more likely to benefit if they can be physically present.
- Nature designations: The multiplier is higher based on whether the site has local, national or international nature designations.
- Population density/external visitor numbers: The multiplier is higher in areas with higher population density and/or which are frequently visited which indicates a higher demand/likelihood of exposure.
- Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
- Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

▪ **Recreation**: The cultural ecosystem service recreation refers to greenspace that enables enjoyment, recovery from stress and the promotion of health. Accessible greenspace provides opportunities for a range of human activities such as walking, cycling, horse riding, climbing and informal relaxation. Recreational activities are known to increase individual wellbeing.

The Recreation Score is based on a habitat base score, as well as the following multipliers:

- Level of accessibility: The multiplier is higher for sites that have better public access as people are more likely to benefit if they can be physically present. The Recreation Score is highly dependent on the level of accessibility and sites without any level of access receive a score of zero.
- Population density/external visitor numbers: The multiplier is higher in areas with higher population density and/or which are frequently visited which indicates a higher demand/likelihood of exposure.
- Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
- Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

▪ **Sense of Place**: Sense of place refers to the aspects of a place that make it special and distinctive. This includes historic features, personal reasons, but also natural features such as habitats. The NATURE Tool provides indicative scores for different habitat types.

The Sense of Place Score is purely indicative and only captures a proportion of what gives a space sense of place. Not considered, for example, is how habitats fit into the local setting or interact with other features such as buildings, monuments or the landscape. It also doesn't consider any spiritual or religious meanings of a space to communities.

The Sense of Place Score is based on a habitat base score, as well as the following multipliers:

- Level of accessibility: The multiplier is higher for sites that have better public access as people are more likely to benefit if they can be physically present.
- Nature designations: The multiplier is higher based on whether the site has local, national or international nature designations.
- Population density/external visitor numbers: The multiplier is higher in areas with higher population density and/or which are frequently visited which indicates a higher demand/likelihood of exposure.
- Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
- Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

- **Regulating & Supporting (Category)**: The Regulating & Supporting score is an aggregated headline indicator. It indicates the overall Regulating & Supporting performance of the project and is based on scores for all ecosystem services/benefits as well as the Policy Priorities within this category. This is effectively based on a Multi Criteria Decision Analysis (MCDA) framework and does NOT represent the overall value change in Regulating & Supporting performance. Hence, the indicative Regulating & Supporting score should be read and interpreted alongside the individual ecosystem services results within the category (and objectives where applicable).

  The aggregated Regulating & Supporting score is calculated as the average of each ecosystem services/benefits score below, each multiplied by the aggregation weight attached to the respective Policy Priority (see Policy Priority for further detail).

- **Air Quality Regulation**: Complex vegetation and especially trees usually have a positive effect on the regulation of air quality. This applies particularly to areas where pollution emissions are comparatively high. Trees and other vegetation absorb, through physical deposition as well as chemical reactions, deleterious pollution such as nitrogen dioxide; but also carbon monoxide, sulphur dioxide, ozone and fine particulates which are responsible for major illnesses such as respiratory ailments, heart disease and cancer.

  Please note that good project design is assumed such as not creating a canopy 'roof' over busy roads which could potentially worsen localised air quality.

  The Air Quality Regulation Score is based on a habitat base score, as well as the following multipliers:

  - Population density/external visitor numbers: The multiplier is higher in areas with higher population density and/or which are frequently visited which indicates a higher demand/likelihood of exposure.

- Air Quality Management Area (AQMA): The multiplier is higher if a site is located in an area with an AQMA which indicates a higher demand for air quality regulation services.
- Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
- Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

- **Carbon Storage**: Carbon Storage in this context refers to natural carbon storage in vegetation and corresponding soils which makes an important contribution to mitigating climate change and reaching climate/net-zero targets. The photosynthetic activities of trees and other vegetation sequester carbon dioxide from the atmosphere and therefore act as a net carbon sink, especially when carbon is stored in corresponding soils. This score indicates (the project's impact on) average carbon stocks in vegetation and corresponding soils. It is NOT the carbon sequestration as this would not appropriately account for the carbon loss of deforestation, for example.

  In addition to the scores, Carbon Storage is also assessed in biophysical terms (tonnes of carbon dioxide equivalent; t CO_2e) and in monetary values. Please click on the info notes for respective headers for more information.

  For woodland, carbon stock (changes) are based on the Woodland Carbon Code (WCC) calculation tool (version 2.1). For other habitats, estimates are based on Natural England's publication Carbon Storage and Sequestration by Habitat 2021. Please note that there is still significant uncertainty particularly around soil carbon stock changes. Please also note that the impact of peatland management/degradation is not implemented yet. However, the development team is intending to implement that in subsequent versions. Not considered in this assessment are for example non-natural carbon impacts such as from building energy use or traffic (except the impacts of photovoltaic installations - see further below).

  The Carbon Storage Score is based on a habitat base score, as well as the following multipliers:

  - Grazing & Mowing: The multiplier is slightly higher for non-degraded grassland habitats.
  - Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
  - Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

- **Cooling & Shading**: Green vegetation has an influence on the local climate, and particularly so in more urbanised areas. Urban areas are usually warmer than their surroundings. This Urban Heat Island Effect (UHIE) is caused by the built environment retaining heat, which is released during the night, as well as the concentration of waste heat from warming and cooling. The UHIE will increasingly combine with global warming caused by climate change. Green vegetation and in particular trees have a significant cooling effect on the local climate in cities and towns. The temperature around vegetation is reduced by evapotranspiration. Trees and scrub also provide shading and protection from heat and UV radiation. Therefore, natural capital has the potential to play a vital role in helping urban areas to adapt to climate change.

Cooling & Shading only indicates the contribution of natural vegetation. Not considered are for example sunshade sails which also provide shading but are not natural. Also not considered are engineered solutions to reduce waste-heat from buildings, for example.

The Cooling & Shading Score is based on a habitat base score, as well as the following multipliers:

- Level of accessibility: The multiplier is slightly higher for sites that have better public access as people are more likely to benefit from shading.
- Population density/external visitor numbers: The multiplier is higher in areas with higher population density and/or which are frequently visited which indicates a higher demand/likelihood of exposure. For Cooling & Shading, the population density is more significant because it also indicates the level of urbanisation/UHIE.
- Habitat maturity: The score is usually higher for mature habitats that already have reached their full ecosystem services potential.
- Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

- **Erosion Protection**: Soil erosion happens when wind and water results in the loss of nutrients, minerals and organic compounds. Such loss reduces the fertility of soils and is therefore undesirable. Soil erosion also puts pressure on water bodies through increased sediment runoff. Vegetation cover can protect soils from eroding – especially complex vegetation such as woodlands and vegetation that provides good soil coverage such as grassland habitats. Arable fields where soils are often exposed to water and wind provide lower erosion protection services.

The Erosion Protection Score is based on a habitat base score, as well as the following multipliers:

- Slope steepness: The multiplier is higher for sites with steeper slopes because this makes soil erosion more likely which in turn indicates higher demand for Erosion Protection.
- Rainfall: The multiplier is higher in areas that experience more rainfall as heavy rain can contribute to soil erosion.
- Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
- Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

- **Flood Regulation**: Flood Regulation refers to the ability of natural habitats to slow down and store water in case of a flooding event. Woodlands, for example, do this by canopy interception, infiltration and water storage in soils.

  Please note that the Flood Regulation Score only provides a rough indication of flood regulation. Modelling floods is complex, and this high-level assessment cannot capture the full complexity of flooding events. Not considered, for example, is the reduced level of damage/disruption mitigated flooding events would otherwise cause. Hence, scores are essentially indicative.

  The Flood Risk Regulation Score is based on a habitat base score, as well as the following multipliers:

  - Flood regulation location: The multiplier is higher in locations that are more likely to be flooded as long as water could run off (flow routes).
  - Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
  - Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

- **Water Quality Regulation**: Vegetation can, retain, remove and transform for example nitrate pollution from agricultural habitats or other pollution sources such as from sewage overflows during periods of heavy rainfall. The complexity of vegetation is important because complex vegetation can trap more pollutants when water flows through.

  Not considered in the score are engineered water quality improvement measures such as chemical water treatment facilities.

  The Water Quality Regulation Score is based on a habitat base score, as well as the following multipliers:

  - Water status: The multiplier is higher for sites located in areas with generally poorer water quality, indicating a higher demand for the service.
  - Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
  - Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

- **Pest Control**: Pest Control describes nature's ability to self-regulate pests which are species that compete with humans for provisioning services such as food. Birds and spiders, for example, prey on pests and therefore naturally control pest populations. Chemical pesticides are a threat to natural pest control because natural enemies of pests are often more susceptible than the pests themselves. This is because pests build up resistance to chemical pesticides whilst their predators are more vulnerable and also generally smaller in population. Semi-natural habitats tend to have higher Pest Control Scores than improved grassland or arable fields, for example.

Not considered in this score are for example chemical pest treatment or other non-natural measures. Also not considered is the local demand for Pest Control as this would require further context analysis. Arguably, Pest Control is more important in areas with higher volumes of agricultural production, for example.

The Pest Control Score is based on a habitat base score, as well as the following multipliers:

- Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
- Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

- **Pollination**: Most wild plants and crop species depend on insect pollination. Hence, pollination represents a vital ecosystem service supporting food supply and other ecosystem services such as aesthetic values. Many pollinators in the UK, especially those associated with semi-natural habitats, have become less widespread which may have implications for pollination services. Semi-natural habitats tend to have higher Pollination scores than for example improved grassland.

  Not considered in this score is the local demand for Pollination as this would require further context analysis. Arguably, Pollination is more important in areas with higher volumes of agricultural production, for example. Also not considered are for example the presence/establishment of bee hives on a site.

  The Pollination Score is based on a habitat base score, as well as the following multipliers:

  - Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
  - Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

- **Provisioning (Category)**: The Provisioning score is an aggregated headline indicator. It indicates the overall Provisioning performance of the project and is based on scores for all ecosystem services/benefits as well as the Policy Priorities within this category. This is effectively based on a Multi Criteria Decision Analysis (MCDA) framework and does NOT represent the overall value change in Provisioning performance. Hence, the indicative Provisioning score should be read and interpreted alongside the individual ecosystem services/benefit results within the category (and objectives where applicable).

  The aggregated Provisioning score is calculated as the average of each ecosystem services/benefits score below, each multiplied by the aggregation weight attached to the respective Policy Priority (see Policy Priority for further detail).

- **Food & Fish | Commercial**: Commercial food and fish production includes all production/catch that has a commercial purpose – essentially food/fish that is produced/caught to be sold. This is in contrast to community food and fish which is assessed below.

The score only captures grown food but does not include for example pig or poultry farms. This is because arguably such food production is not based on an ecosystem service (apart from the food grown to feed animals which is included in the score). It could also lead to double-counting with grown food that is then fed to livestock.

The Food & Fish - Commercial Score is based on a habitat base score, as well as the following multipliers:

- Commercial food/fishing function: Scores are zero if a habitat is not used for commercial fishing/food production.
- Agricultural Land Classification (ALC) grade: The multiplier for food production is higher for sites with a better ALC grade. The ALC grade indicates the quality of land for agricultural production. Please note that the ALC grade multiplier only applies to habitat types which typically rely on it. Habitat types that are not connected to ALC classification include woodland which may be used to collect mushrooms.
- Water status: The multiplier for fish production is higher for water that has a good status.
- Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
- Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

▪ **Food & Fish | Community**: Community food and fish production refers to non-commercial food production such as gathering berries and mushrooms or managing an allotment for private consumption. This service also includes non-commercial angling where the fish caught can be kept.

Not captured within the score is the recreational aspect of, for example, recreational fishing or enjoying gardening in an allotment. The score only indicates the produce, rather than the experience of the process.

The Food & Fish - Community Score is based on a habitat base score, as well as the following multipliers:

- Community food/fishing function: Scores are zero if a habitat is not used for community fishing/food production.
- Water status: The multiplier for fish production is higher for water that has a good status.
- Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
- Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

- **Water Availability**: The availability of water is, for example, crucial for ensuring affordable and safe drinking water and sanitation. Habitats such as running and standing water contribute directly to water abstraction whilst other habitats such as wetlands and woodlands allow the recharge of groundwater as surface water can impede through soil. This water availability function can be interrupted when surfaces are sealed or compacted, for example.

  Water Availability needs to be distinguished from water supply where water is actually abstracted. This has not been included because information is usually difficult to obtain. Also not considered within the score is the local demand for water availability, for example whether water is/will be in shortage in an area.

  The Water Availability Score is based on a habitat base score, as well as the following multipliers:

  - Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
  - Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

- **Wood Production**: Wood Production includes harvesting of timber and other woodland products such as wood-based biofuels or firewood. Woodland habitats usually receive the highest scores, but orchards, scattered trees and scrub can also provide some level of woodland products.

  The Wood Production Score is based on a habitat base score, as well as the following multipliers:

  - Woodland management: The multiplier is higher if a woodland is primarily managed for wood/timber production. The score is zero for woodlands that are not managed for wood production.
  - Habitat maturity: The score is usually higher for mature habitats that have reached their full ecosystem services potential.
  - Delivery risk: For newly created habitats, a delivery risk penalty may apply where failure of creating the intended habitat is likely to reduce ecosystem services.

- **Abiotic Services (Category)**: Abiotic Services differ from ecosystem services (above) by not arising from processes or ecosystems. The only abiotic service assessed by the NATURE Tool is Photovoltaic Carbon Impact.

- **Photovoltaic Carbon Impact**: Photovoltaic Carbon Impact refers to the abated carbon emissions through the installation of photovoltaic (PV) systems for solar electricity production. This is based on the substitution of electricity from the general electricity generation mix (including coal and gas) by clean PV electricity. Also considered are potential savings to electricity transmission and operation losses which can be avoided if PV electricity is used on-site. Please note that the NATURE Tool also calculates the estimated electricity production in kilowatt hours (kwh) - see Photovoltaic sheet.

Please note that the carbon impact only considers carbon abated from electricity generation but not carbon emissions as part of the construction of PV panels, for example.

Photovoltaic Carbon Impact is calculated based on the location of the PV installation, informed by the **PV GIS Tool**, as well as standard specifications for PV installations, but with the option to amend. Carbon impact is calculated as a score which represents the abated carbon should new PV be installed. Impacts are also calculated in tonnes of carbon dioxide equivalent (t CO_2e) and in monetary terms. The monetary valuation approach follows the **Green Book (HM Treasury 2022)** in combination with **Supplementary Guidance on the Valuation of Energy Use and Greenhouse Gas Emissions for Appraisal (BEIS 2021)**. Both discounting future benefits and the increasing value per t CO2e over time have been considered.

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix AB - Carbon Management Plan

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January 2024

West of England Combined Authority

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Contents

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Executive summary

WSP have been commissioned by the West of England Combined Authority (Combined Authority) to prepare a Carbon Management Plan (CMP) to support the Outline Business Case (OBC) submission for the proposed A4 Bath to Bristol Strategic Corridor (BBSC) scheme. The scheme, as described in Chapter 2, proposes improvements for pedestrians, cyclists and bus users on the A4 corridor between Bath and Bristol and for settlements in between (Saltford, Keynsham and Brislington).

This CMP establishes in Chapter 3 a carbon management process in line with PAS 2080 – the global carbon management standard – for the scheme. By influencing the scheme development process, the intended outcome of this process is to maximise reductions in carbon emissions achieved by this intervention.

The **infrastructure carbon associated with construction, maintenance and end-of-life** of the current design of the Proposed Scheme has been estimated as **12,023 tonnes of carbon dioxide equivalent (tCO2e) over 60 years**. The implementation of the Proposed Scheme is expected to result in **changes in general traffic patterns and modal shift that produce a 58,971 tCO2e reduction in user emissions**. This reduction in user emissions, over the 60-year appraisal period, considerably exceeds the infrastructure carbon impact of constructing (and maintaining) the Proposed Scheme. As such, the delivery of the Proposed Scheme is expected to result in **a net-reduction of 46,948 tCO2e.**

A full report of the whole-life carbon assessment and its methodology is available as Appendix A and B.

The quantified assessment of infrastructure carbon associated with the Proposed Scheme provides a baseline against which a carbon reduction target of 25-30% has been set. The scope and role of this baseline and target is set out in Chapters 4 and 5 respectively. Governance and actions have been defined in Chapter 6.to ensure this carbon reduction target is achieved.

A carbon workshop attended by key members of the project team has been held to identify opportunities to help realise this target. Design improvements and value engineering decisions have so far resulted in a 17% reduction from the original bill of quantities developed to the Proposed Scheme baseline presented in this CMP.

1 Introduction

1.1 Background

1.1.1. WSP has been commissioned by the Combined Authority to prepare a Carbon Management Plan (CMP) to support the development of the Outline Business Case (OBC) for the A4 Bath to Bristol Strategic Corridor (BBSC, hereafter referred to as the 'Proposed Scheme').

1.1.2. The BBSC seeks to improve travel between Bath and Bristol and settlements in between through improvements to bus infrastructure, and to develop facilities to enable more cycling and walking services and along the A4, as well as to the A4 from neighbouring communities. The regional Bus Service Improvement Plan (BSIP) is considering the opportunity to deliver additional services along the corridor. Whilst complementary to BBSC, this is being developed separately.

1.2 Purpose of this document

1.2.1. This CMP has been prepared to detail the carbon management process recommended for the Proposed Scheme. In presenting the results of the carbon assessment and related actions to manage carbon outcomes, this document adheres to the principles in PAS 2080:2023 Carbon Management in Buildings and Infrastructure (herein referred to as PAS2080).

1.2.2. The carbon management standard PAS2080:2023[1] defines carbon management as the "assessment, reduction and removal of greenhouse gas emissions during the planning, optioneering, design, delivery, operation, use, end of life (and beyond) of new, or the management of existing, assets, networks and/or systems".

1.2.3. This document has been prepared to guide the project team's planning and delivery of the Proposed Scheme, and their ability to manage carbon emissions throughout.

1.2.4. It is recommended that a carbon management process is adopted which aligns with the principles of PAS 2080:2023. It is recommended that this CMP is maintained and updated by the appointed carbon lead as the scheme and its carbon management evolve and should be updated iteratively at key stages of the project lifecycle. Ideally this process will be mandated at each stage of the project. Each iteration will provide the latest description of the status of carbon management measures (Table 1-1).

1.2.5. As per guidance[2] at Strategic Outline Case (SOC) for BBSC outlined the project's whole life carbon management approach, which included the completion of a CMP to be submitted at OBC stage. The baseline assessment presented in this document is the first whole life carbon assessment of the Proposed Scheme.

[1] The British Standards Institution (BSI) (2023) PAS 2080:2023 Carbon Management in Buildings and Infrastructure
[2] Transport business case guidance - GOV.UK (www.gov.uk)

1.3 Document management

1.3.1. This is the first iteration of the CMP (document version 1.0) for the Proposed Scheme, and is expected to evolve as the Combined Authority, the Unitary Authority of Bath & North-East Somerset (B&NES), and Bristol City Council (BCC), engage further on the strategic approach to carbon management, embedding operational processes into scheme development and delivery, and further develop the evidence base to support effective decision making.

1.3.2. Where carbon management actions and commitments have been actioned or completed, this will be recorded in future iterations of this report. The carbon emissions of the scheme will be reassessed following the implementation of any actions and this will be compared to the baseline assessment reported in V1.0 to assess any carbon reductions achieved.

1.3.3. Table 1-1 documents the versions of the CMP to date.

Table 1-1 - Version control

Version Number	Date updated	Brief description of updates
1.0	14/11/2023	A Carbon Management Plan has been developed as part of the OBC for the Proposed Scheme in November 2023.

2 The proposed scheme

2.1 Introduction

2.1.1. This chapter provides a summary description of the proposed scheme. This reflects the current iteration of the scheme as considered in the most recent whole-life carbon assessment (see Chapter 4). Further details are available in the Outline Business Case document, to which this CMP is appended.

2.2 Description of the proposed scheme

2.2.1. BBSC is being developed jointly by the Combined Authority, Bristol City Council (BCC), and Bath & North East Somerset Council (B&NES) to provide a step-change in public transport and active travel provision along the Bath to Bristol corridor. The primary aim of the BBSC Programme is to connect new and existing communities along the A4 via sustainable modes of transport to places of employment, study, and key services to enhance the lives of existing and future residents and those travelling to, and along, the corridor.

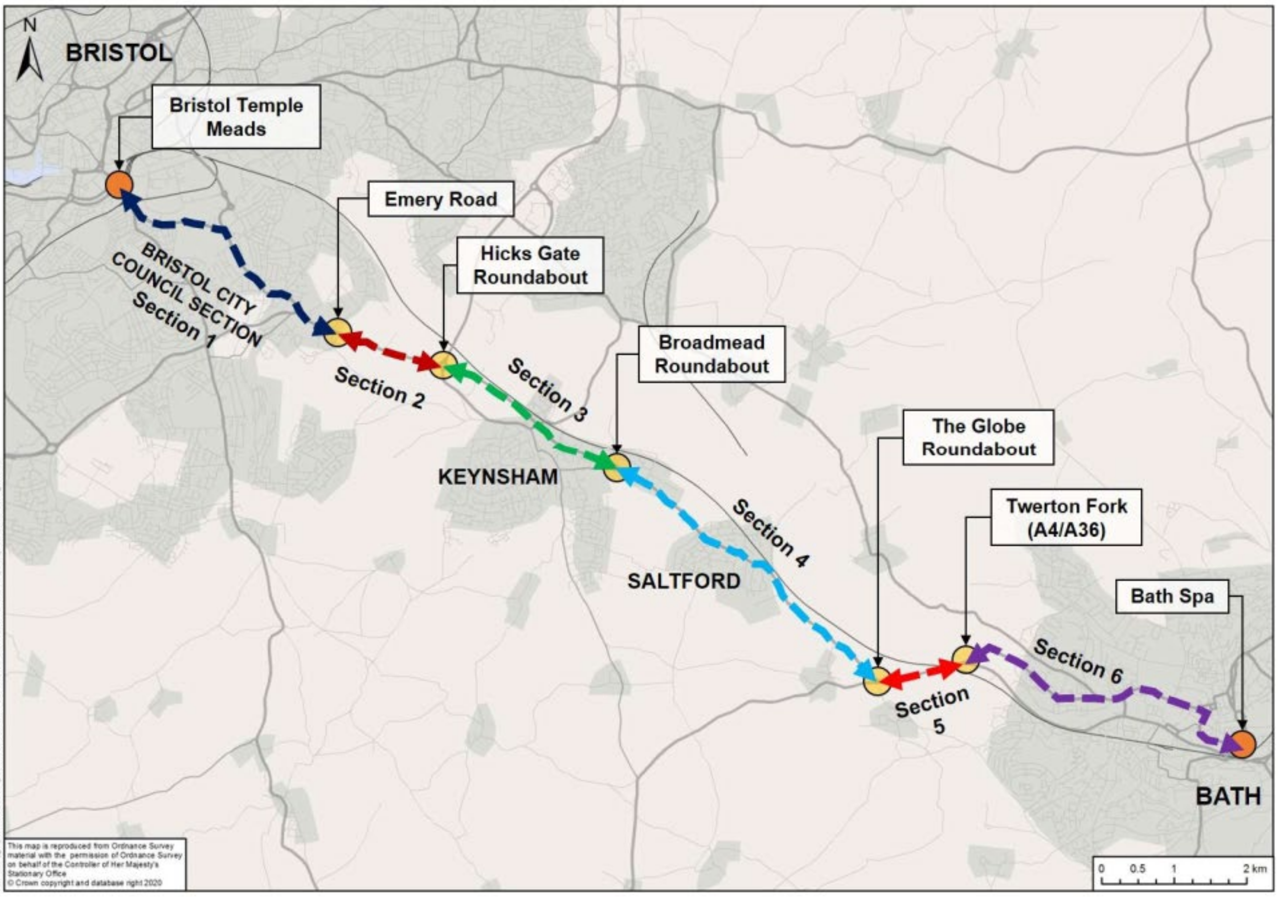
2.2.2. Improvements to the A4 strategic corridor focus on improving access and reducing journey times for pedestrians, cyclists and bus users through the provision of:

- Improved infrastructure for bus services on the corridor, providing additional priority, reducing journey times and improving reliability.
- Provision of a transport hub on the Keynsham Bypass section of the A4.A continuous segregated strategic cycling corridor between Bath and Bristol.
- Cycling and walking connections between local communities along the A4 between Bristol and Bath and the new bus service and strategic cycling corridors.

2.2.3. The Proposed Scheme is composed of 6 sections, 5 of which (Sections 2 to 6) form part of the Proposed Scheme. Section 1, west of Emery Road junction in Bristol, is the subject of a separate project team but will draw funding from the same City Region Sustainable Transport Settlements (CRSTS) programme.

2.2.4. Figure 2 1 shows all six sections comprising the Bath to Bristol route.

Figure 2-1 – Sections comprising the Bath to Bristol route



2.2.5. This CMP relates to Sections 2-6 and associated Community Connections (Areas 1-8) and Transport Hubs (Keynsham Mobility Hub & Hicks Gate). When data becomes available, Section 1 can be integrated into the analysis.

2.2.6. Keynsham Mobility Hub is proposed as a transport hub with on carriageway bus stops and at grade crossing of A4, bus shelters provided along with walking/cycling connections to Keynsham town centre and train station.

2.2.7. Hicks Gate includes Bus Stop Enhancement on Corridor and improved access to bus stops and has been modelled as such in the CMP.

2.2.8. Table 2-1 below provides a description of the Community Connections areas.

Table 2-1 – Description of the community connection areas

Community connection area (no.)	Description
1	Keynsham Centre and connection to train station: Junction upgrades, connections to proposed Keynsham Transport Hub
2	Culvers Road and St Francis Road, Keynsham: Junction upgrades and walking, cycling provision
3	Bath Road, Keynsham: Broadmead roundabout access to Wellsway sports centre and onward to the west
4	Bristol to Bath Railway Path (BBRP) Saltford Section: Upgrade of existing connections (Norman Road & High Street), potential walking/cycling crossing upgrades
5	Saltford, Manor Road: walking/cycling provision and crossing upgrades
6	Globe Roundabout to Bath Spa Campus: Upgrade existing shared use facility along A39 Wells Road from Globe Roundabout to Corston Drive, facility is currently substandard
7	Osborne Road, Bath: Connecting A4 to BBRP, possible Modal Filter at this location
8	Grange Road Saltford: Junction improvements and cycleway

2.2.9. Design options were considered throughout the design process for each Section. Through a refinement process, The 'Core Scenario' was developed which delivered on the Proposed Scheme objectives and was analysed in this CMP. The final options selected includes the following:

- Section 2 – Option 1
- Section 3 – Option 2
- Section 4 – Option 2
- Section 5 – Option 1
- Section 6 – Option 2
- Community Connections (CC) (Areas 1-8)
- Keynsham Mobility Hub
- Hicks Gate

2.2.10. Note: this assessment was completed based on the status of the Scheme and associated Bill of Quantities (BoQ's) before engagement was finalised. At the time of writing (December 2023) it is understood that only community connections areas 1 and 4 are being taken forward as part of the preferred scheme. However, the analysis in the CMP presents all 8 Community Connections areas. The impact on the results are likely to be minimal and will be updated alongside other design updates at FBC.

2.2.11. Table 2-2 shows the design drawings which informed the BoQ's considered as part of this CMP and the whole life carbon assessment in Chapter 4.

Table 2-2 – Proposed scheme drawings

Scheme drawing ref.	Description
70093741-WSP-S2-XX-DR-LP-201-01	Section 2 Emery Road To Hicks Gate Roundabout (Option 1)
70093741-WSP-S3-XX-DR-LP-302-01	Section 3 Concept Design Drawing Option-2 Sheet 01 of 03
70093741-WSP-S3-XX-DR-LP-302-02	Section 3 Concept Design Drawing Option-2 Sheet 02 of 03
70093741-WSP-S3-XX-DR-LP-302-03	Section 3 Concept Design Drawing Option-2 Sheet 03 of 03
70093741-WSP-S4-XX-DR-LP-402-01	Section 4 – Part 01 Broadmead Roundabout to Saltford Option 2
70093741-WSP-S4-XX-DR-LP-402-02	Section 4 – Part 02 & Part 03 Broadmead Roundabout to Saltford Option 2
70081974-WSP-2-001	Section 5 (Option 1) The Globe Roundabout to Twerton Fork
70093741-WSP-S6-XX-DR-LP-602-01	Section 6 Option-2 Sheet 01 of 02
70093741-WSP-S6-XX-DR-LP-602-02	Section 6 Option-2 Sheet 02 of 02
70093741-WSP-CC-DR-C-061	Community Connections Area 1-Option 1 (Station Road, High Street)
70093741-WSP-CC-DR-C-062	Community Connections Area 2 (Culvers Road, St Francis Road)
70093741-WSP-CC-DR-C-063	Community Connections Area 03 (Bath Road)
70093741-WSP-CC-DR-C-064	Community Connections Area 4 (High Street, Norman Road)

Scheme drawing ref.	Description
70093741-WSP-CC-DR-C-065	Community Connections Area 5 (Manor Road, Saltford)
70093741-WSP-CC-DR-C-066	Community Connections Area 6 (Globe Roundabout to Bath Spa Campus)
70093741-WSP-CC-DR-C-067	Community Connections Area 7 (Osborne Road/Avondale Road, Bath)
70093741-WSP-CC-DR-C-068	Community Connections Area 8 (Grange Road, Saltford)
70093741-WSP-S2-XX-DR-LP-202-MH2	Hicks Gate Transport Interchange with Priority Junction
70093741-KE-2500-001	Keynsham Mobility Hub

2.3 Scheme objectives

2.3.1. The Proposed Scheme has various objectives around the promotion and improvement of sustainable travel on the A4 between Bristol and Bath and its surroundings. These are outlined below:

- To facilitate economic growth along the corridor by improving the public and active travel opportunities. This includes delivering infrastructure which improves access for existing communities and also infrastructure that unlocks new opportunities for sustainable growth:
  - Support the delivery of new housing and job creation through the provision of high-quality public transport that serves existing and future housing. This should include safeguarding the potential for a mass transit solution along the corridor.
  - Unlocking housing growth and enhancing sustainable transport connectivity though the re-provision and enhancement of the Brislington Park and Ride to Hicks Gate.
- Improve public transport infrastructure in the study area to increase the number of people who have access to and use buses to contribute to growing patronage of the X39 (or increase in equivalent new service/bus rapid transit service along the corridor) by at least 24% by 2030:
  - To provide the infrastructure required to enable operators to deliver a fast, reliable, high-frequency bus service between Three Lamps Junction and Bath City Centre.
  - To deliver high-quality, safe and recognisable bus stops (comparable to the existing MetroBus service standards stops)
  - To provide the high-quality bus infrastructure necessary to sustain economic growth and improve the lives of residents of B&NES and BCC.

- Improve walking, wheeling and cycling infrastructure in the study area to contribute to increasing the number of people using the corridor for active travel modes including to increase the number of people commuting by walking, cycling and wheeling modes to 25% of total modal share by 2036:
  - To enable continuous, safe and legible active travel journeys end-to-end and to the corridor for those living and working along the corridor.
  - To improve access by active travel modes to public transport along the corridor
  - To reduce severance for cyclist, walkers, wheelers and other active travel modes.

2.4 Carbon influence to-date

2.4.1. The carbon impact of the scheme is assessed in the current baseline stage of the scheme. A lifecycle assessment of materials (including embodied carbon) has been undertaken in detail and the results of which are presented in Section 4.3.12.

2.4.2. The Proposed Scheme has evolved since the Strategic Outline Case (SOC) stage. Focus has been given to the provision of active mode infrastructure to increase sustainable travel options and encourage uptake of walking, wheeling and cycling. These measures aim to reduce car use, thereby resulting in fewer carbon emissions. Table 2-3 shows a list of carbon commitment decisions taken to date.

Table 2-3 - Carbon focused committed design decisions

Category	Carbon influence decision
Avoid – the need for carbon emitting interventions (e.g., by maximising the use of existing assets)	No amendments to or additional structures – Due to cost changes to existing structures (bridges) or the addition of structures will not be undertaken. This often removes the risk of significant additional carbon emissions. Speed limit – Implementing speed limits throughout the corridor to avoid traffic congestion and reducing carbon through reduced energy use.
Switch – to lower carbon alternatives (e.g., recovering materials to be re-used onsite)	**Toucan and Parallel Crossing - Radar detectors** – The traditional way is to dig trenches 600mm deep and put plastic ducts and cables in them. However, there are now above ground solutions (like radar type detectors that are used on some sites). The radar approach will result in a decrease in construction emissions and possibly a reduction in embodied carbon. The baseline has been modelled assuming use of radar detectors at Toucan and Parallel Crossings.

Category	Carbon influence decision
Improve – resource use (e.g., opting for low carbon materials, reducing maintenance requirement, and maximising energy sources)	Value engineering – Two rounds of value engineering were completed for Sections 2-6 on the original Bill of Quantities (BoQ) before the carbon baseline was set. This has resulted in the capital carbon baseline being ~2,000 tCO_2e lower. **Re-use of onsite fill (rather than import)** – as agreed with the Principal designer, the current carbon modelling assumes that 50% of fill is imported and 50% is from reuse on site.

3 Carbon management process

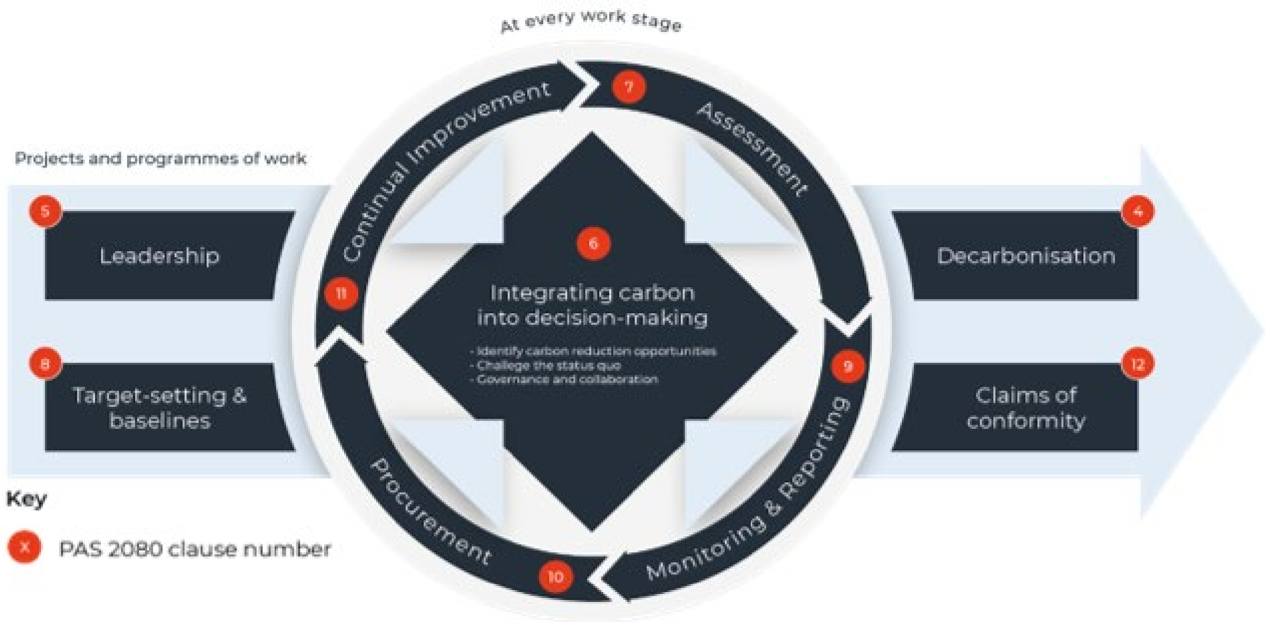
3.1 Introduction

3.1.1. This chapter sets out the process through which scheme-level carbon monitoring, reduction and mitigation will be managed. It addresses the aspects of carbon management detailed in relevant guidance documents, to guide the management processes and carbon calculations.

3.2 The process

3.2.1. The carbon management process to be adopted will be aligned to the principles of PAS 2080. An illustration of this conceptual carbon management process is presented in Figure 3 1. Targets are recommended to be set relative to baseline values and outlining the frequency, methodology and process for measuring, quantifying, and reporting on the management of carbon throughout infrastructure planning and delivery.

Figure 3-1 - PAS2080 Carbon management process



3.2.2. Table 3 1 provides descriptions of the key stages and recommendations for how they can be applied in the carbon management process for the Proposed Scheme. It is recommended to maintain and update this Carbon Management Plan as the Proposed Scheme and its carbon management evolve.

Table 3-1 - Carbon management phases and activities

Clause	Description	Activities
Leadership	Asset owners/managers set objectives, targets and outcomes for the project/programme of works aligned with the decarbonisation principles (Clause 4 of PAS 2080:2023). Map key collaborators/stakeholders for enabling whole-life carbon management. Set governance structure and principles.	It is recommended that the Carbon Management Process is integrated into Project Management and Delivery activities, and the roles and responsibilities for this are assigned. Overall responsibilities should sit with the Project Manager, although specific tasks should be delegated. Scheme objectives and Carbon influence to date (*Chapter 2*) Net Zero targets & Commitments (*Chapter 5*) Training & Upskilling (*Chapter 6)*
Integrate carbon management into decision-making	Asset owners/managers make alignment with net zero transition central to the scope and requirements of work. Identify activities and associated emissions/removals within control and influence across all work stages (as per Clause 4), and the necessary collaborations with value chain members and stakeholders that will enable whole life carbon reductions, and the network(s) and system(s) with which the project or programme of works interfaces. Integrate carbon management into the delivery processes to support system-level low-carbon outcomes. Prioritise implementation of carbon reduction opportunities within control and influence. Integrate the carbon implications of climate resilience (or lack of) in the carbon management at all levels. Prioritise nature-based solutions for reduced carbon and increased sequestration. Follow the carbon reduction hierarchy (Clause 4) across all work stages to identify potential opportunities to reduce whole life carbon emissions: Avoid – Switch – Improve.	Carbon management should be considered a part of normal project delivery and decision-making, at each stage of the project lifecycle and each major design iteration, including construction. The carbon reduction hierarchy shows that the highest carbon reduction potential is at the earliest stages of the project lifecycle. As this scheme is at OBC, there is further scope to influence design through detailed design development and Full Business Case (FBC). Opportunities identified at OBC have been captured in the Scheme carbon risks and opportunities register. Carbon workshops have been held at OBC stage. It is recommended that a low carbon design review or a workshop at each stage of the project is recommended as a minimum requirement. Carbon is embedded through scheme level decision-making by iterative CMP and carbon assessment update at each business case or design stage, and by all stakeholders actively following the actions identified in Chapter 5.
Whole-life carbon assessment principles	Quantification of whole-life carbon emissions with sufficient frequency to inform decision-making throughout the project lifecycle. Principles in PAS 2080 should be followed, such as defining the scope for quantification and use of a chosen study period (i.e., appraisal period)	The carbon baseline for this OBC is presented in *Chapter 4 Quantified Carbon Baseline and Assessment* and Appendix A.
Target setting and baselines	Targets can be set for specific elements such as capital, operational (capital and/or user emissions) and/or whole-life carbon. Targets should relate to a desired outcome and use a fixed timescale by which that outcome is achieved. Where appropriate, targets should align with sector-level or wider national/international carbon reduction targets.	The baseline assessment for this OBC is presented in Chapter 4. Setting a carbon reduction target of 25-30% for infrastructure carbon has been recommended for the proposed scheme and is set out in *in Chapter 5* and *Appendix C* of this report. Recommendations are also set in line with PAS 2080:2023. Limitations and Uncertainties including assumptions used are documented in *Section 4.7.*

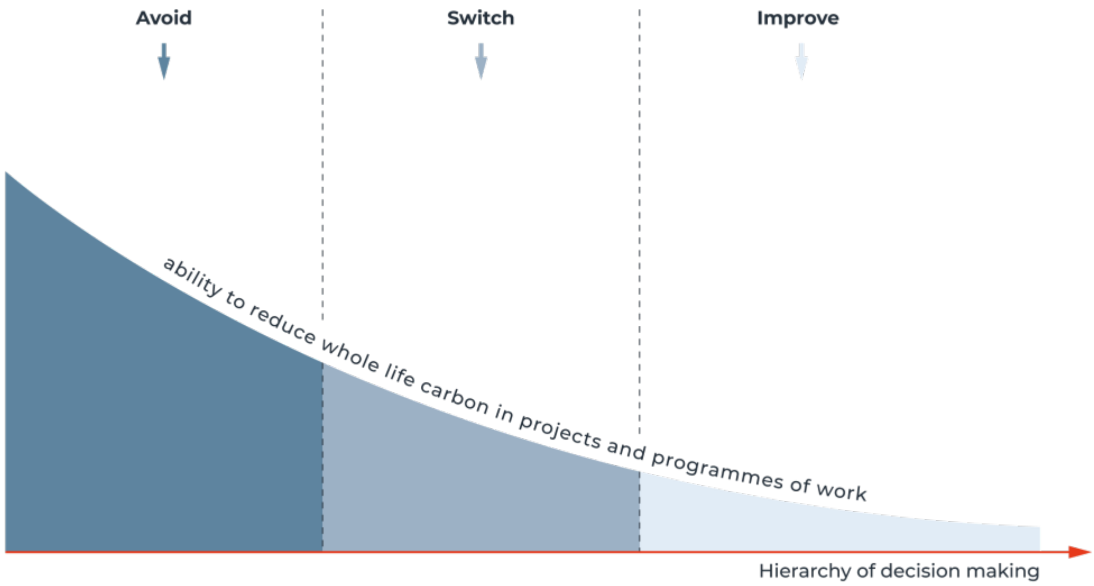
Clause	Description	Activities
Monitoring & Reporting	KPIs to monitor carbon emissions. PAS2080 recommends these are at a minimum monitored during all infrastructure work stages or at key points where decisions are made that influence whole-life carbon reduction.	It is recommended that the carbon assessment be updated at regular stages of the project lifecycle. This should be used to determine whether the project is on track to meet any reduction target set and identify any carbon hotspots in the design and delivery of the project.
Procurement	Include carbon management process requirements (including objectives, targets and project outcomes) in contracts required for the construction of the Proposed Scheme.	It is recommended that the project teamwork with suppliers and contractors to reduce carbon and where possible these requirements are included in contracts required for construction of the Proposed Scheme. See *Chapter 6 – Carbon Management Actions*.
Continual improvement	This should allow lessons to be learned from applying this carbon management process to improve the delivery of future programmes of work. Acknowledging that comprehensive carbon data or low carbon solutions will not be available at the outset, adopting continuous improvement allows promoters to commence carbon management while gradually improving.	Mitigation measures should be identified, implemented, and reviewed across the project lifecycle. This should be informed by the carbon assessments. Any carbon reductions achieved should be recorded at the end of each project stage as well as any mitigation measures which are unable to be implemented and why. This could be used to identify lessons learned at the end of the project. WSP has been accredited a certificate of implementation which assures the capacity of WSP to apply the requirements of PAS2080 as Designer to the provision of consultancy services on infrastructure projects that require carbon management. This accreditation is used to apply the PAS2080 principles to the carbon assessment and management of the scheme and will be updated in line with future PAS2080 updates. Additionally, WSP undertake continual improvement in technical tools, capabilities, and skills. *Training & Upskilling – Chapter 6.*

3.2.3. To optimise design and maximise carbon reduction benefits, PAS2080 guidance clearly defines a carbon reduction hierarchy (detailed below in Figure 3 2) and found in paragraph 4.3 of PAS:2080:2023).

The hierarchy emphasises that all value chain members shall:

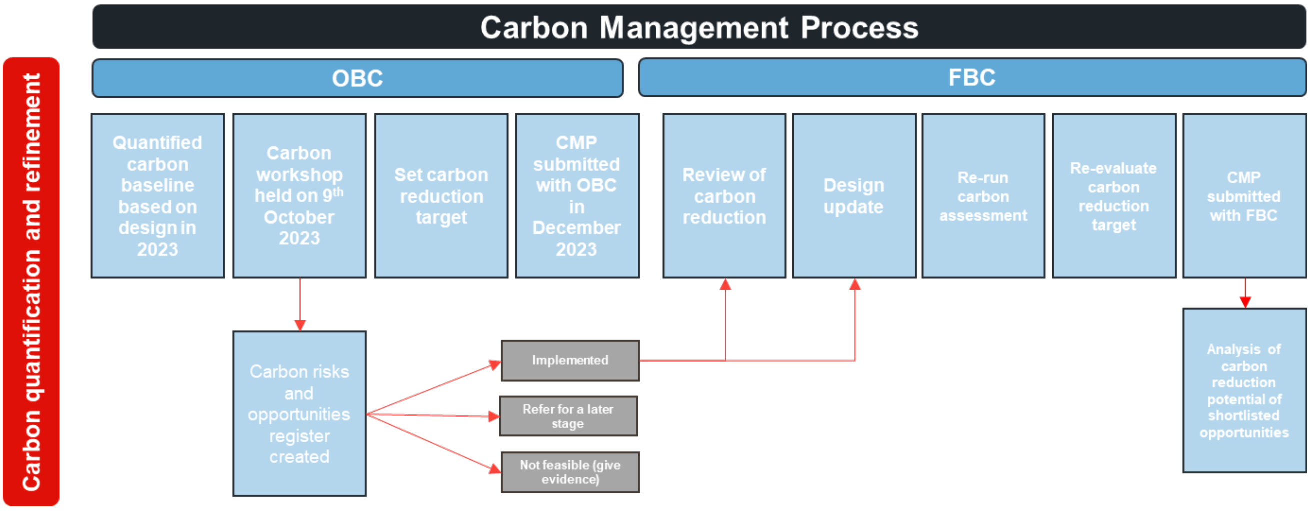
- Follow the carbon reduction hierarchy when identifying potential opportunities to reduce whole life carbon emissions.
- Demonstrate they have taken into account the following:
  - **Avoid:** align the outcomes of the project with the net zero transition at the system level and evaluate the basic need at the asset and/or network level;
  - **Switch:** assess alternative solutions and then adopt one that reduces whole life emissions through alternative scope, design approach, materials, technologies for operational carbon reduction, among others, while satisfying the whole life performance requirements;
  - **Improve:** identify and adopt solutions and techniques that improve the use of resources and design life of an asset/network, including applying circular economy principles to assess materials/products in terms of their potential for reuse or recycling after end of life.

Figure 3-2 - Carbon reduction hierarchy



3.2.4. The carbon management process for the Proposed Scheme is detailed in the flowchart, in Figure 3 3.

Figure 3-3 - Carbon management



4 Quantified carbon assessments and baseline

4.1 Introduction

4.1.1. Quantification of whole-life carbon emissions with sufficient frequency is needed to inform decision-making throughout the project lifecycle. When used as a baseline, this provides a reference against which future performance can be compared with respect to the desired outcome, as specified by PAS2080 (see above).

4.1.2. This Chapter summarises the quantified carbon assessment is established as a baseline. It should be noted that all negative (-) figures represent a reduction in carbon emissions, and are therefore beneficial, while all positive (+) figures represent additional carbon and therefore represent an adverse impact.

4.1.3. It is recognised that the proposed scheme is part of a wider network and system; one that together must transition to a net zero carbon economy by 2050 and meet interim carbon budgets on-route. This scheme and its carbon management process should contribute to this system level change. For this reason, the emission context at a UK, regional and local economy and surface transport level is first established. The scheme's carbon impact is contextualised against this data in the next section alongside the UK carbon budgets.

4.2 Emissions context

4.2.1. At a national level, transport is the largest contributor to the UK's domestic GHG emissions, responsible for 25.6% of emissions in 2021[3]. Where emissions from other sectors have fallen in the last 30 years, domestic transport GHG emissions have remained relatively static (see Figure 4 1), with improvements in efficiency of new cars largely offset by their increased use.

4.2.2. The UK's domestic carbon dioxide (CO_2) emissions from the transport sector for 2021 have risen 10% (9.8 Mt), to 107.5 million tonnes in 2021, when compared to the year 2020. However, 2021 CO_2 emissions from transport remain 11.2% lower than 2019 (the most recent pre-pandemic year), and total UK greenhouse gas emissions are 5.2% lower[4].

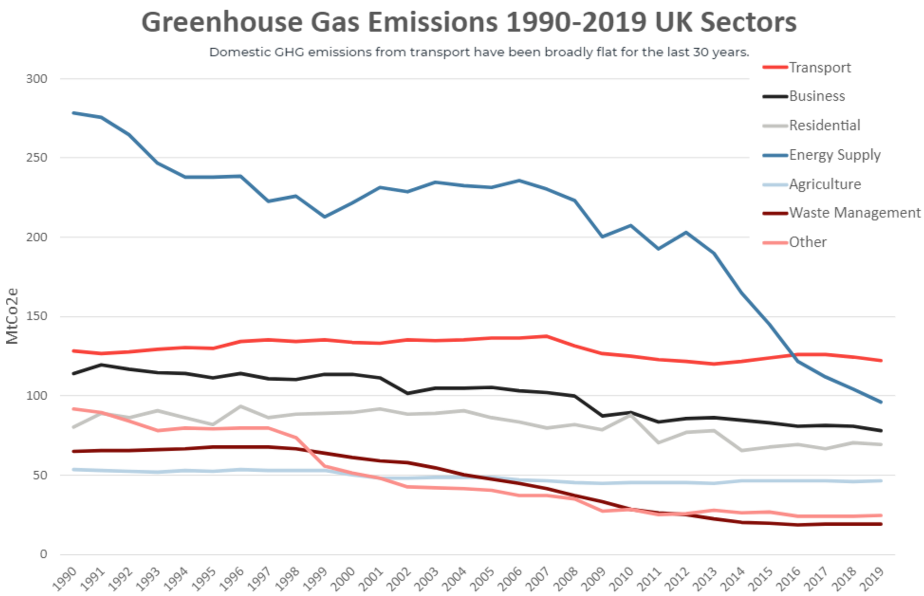
4.2.3. For the year 2021, 31% of GHG emissions in B&NES were from transport, significantly higher than the total UK emissions from transport (25.6%)[3]. In BCC, GHG emissions from transport accounted for 30% of the total emissions in the city council in 2021[3]. Both the B&NES and BCC declared a Climate Emergency in 2019 and pledged to make the areas governed by them carbon neutral by the year 2030. This has led to the development of Bath

[3] UK Government. (2023). 2005 to 2021 UK local and regional greenhouse gas emissions – data tables. Available at: UK local authority and regional greenhouse gas emissions national statistics, 2005 to 2021 - GOV.UK (www.gov.uk) [Accessed: 14/08/2023]

[4] UK Government Department for Transport. (2022). Official Statistics: Transport and environment statistics. Available online: https://www.gov.uk/government/statistics/transport-and-environment-statistics-2022/transport-and-environment-statistics-2022#:~:text=These%20estimates%20suggest%20that%20domestic,gas%20emissions%20are%205.2%25%20lower. [Accessed: 16/08/2023]

& North East Somerset Climate Emergency Strategy[5] and Bristol City Council Mayor's Climate Emergency Action Plan[6]. The plans lay emphasis on strategies and actions to encourage the use of sustainable modes of transport. These include a shift to mass transport, walking, wheeling, and cycling, use of electric cars and electrification of passenger rail. Such measures to decarbonise the transport system have been stated in the 'West of England Climate and Ecological Strategy and Action Plan 2023[7] ' as well.

Figure 4-1 - UK Emissions by sector over time. Provisional figures for 2022 show a ~4% increase in CO_2e emissions from surface transport as they continue to rebound following COVID-19[2]



4.2.4 The UK carbon budgets (Table 4-1) have been set by the UK Government covering 2018 to 2037. The budgets are expressed in millions of tonnes of carbon dioxide equivalents ($MtCO_2e$). The budgets can be used to contextualise the Proposed Scheme emissions.

[5] Bath and North East Somerset Council. (2023). Bath & North East Somerset Climate Emergency Strategy 2019-2030. Available at: https://beta.bathnes.gov.uk/sites/default/files/2023-03/BANES%20Climate%20Emergency%20Strategy%20Document%20AW1.pdf [Accessed: 16/08/2023]
[6] Bristol City Council. (2019). Bristol City Council Mayor's Climate Emergency Action Plan. Available at: https://www.bristol.gov.uk/files/documents/766-mayors-climate-emergency-action-plan-2019-final/file#:~:text=Bristol%20City%20Council%20Climate%20Emergency%20Action%20Plan,-7&text=In%20July%202019%2C%20the%20Mayor,motion%20on%20supporting%20the%20SDGs. [Accessed: 16/08/2023]
[7] West of England Combined Authority (the Combined Authority) (2023).Climate and Ecological Strategy and Action Plan. . Available at: https://www.westofengland-ca.gov.uk/what-we-do/environment/climate-ecological-strategy/ [Accessed: 16/08/2023]

Table 4-1 - UK carbon budget

Carbon Budget Period	UK Carbon Budget
Third: 2018-2022	2,544 $MtCO_2e$
Fourth: 2023-2027	1,950 $MtCO_2e$
Fifth: 2028-2032	1,725 $MtCO_2e$
Sixth: 2033-2037	965 $MtCO_2e$

4.2.4. In addition, the national and local transport emissions for 2021 are presented in Table 4-2 for context.

Table 4-2 - Transport Emissions for Bristol, Bath & North-East Somerset, South West England, and National, in 2021 (ktCO2e)[8]

Category	Bristol	Bath & North-East Somerset	South West England	National
I. Road Transport (A roads)	138	115	4,495	48,450
J. Road Transport (Motorways)	76	0	2,032	25,398
K. Road Transport (Minor roads)	255	109	4,018	36,254
L. Diesel Railways	8	8	172	1,680
M. Transport Other (Note 2)	4	2	129	1,943
Transport Total	481	233	10,846	113,725

Note 1 - Total values may vary slightly from the sum of values due to rounding errors.

Note 2 - Includes: Road Transport – LPG, Road Transport – Lubricants, Road Transport – Urea, Railways – Coal, Inland Waterways / Domestic Navigation and Aircraft support vehicles[9]

[8] Department for Energy Security and Net Zero (2023) UK local authority and regional greenhouse gas emissions national statistics, 2005 to 2021. Available at: UK local authority and regional greenhouse gas emissions national statistics, 2005 to 2021 - GOV.UK (www.gov.uk)
[9] Department for Energy Security and Net Zero (2023) UK local authority and regional greenhouse gas emissions estimates for 2005 to 2021: Technical Report. Available at: UK local and regional greenhouse gas emissions estimates for 2005-2021: Technical Report (publishing.service.gov.uk)

4.3 Methodology

4.3.1. A full methodology statement for the capital and operational carbon assessment is included in Appendix B. A summary is provided here.

4.3.2. Carbon emissions have been assessed in line with the modules defined in BS EN 17472:2922, shown in Table 4-3.

Table 4-3 – BS EN 17472:2022 Infrastructure Lifecycle Stage Modules

Stage	Module	Description of Module	Key
Preconstruction Stage	A0	Land and associated fees/advice Design emissions	Capital Carbon
Product Stage	A1	Raw Material Supply	Capital Carbon
Product Stage	A2	Transport to Factory	Capital Carbon
Product Stage	A3	Manufacturing	Capital Carbon
Construction Stage	A4	Transport to Site	Capital Carbon
Construction Stage	A5	Construction Emissions	Capital Carbon
Use Stage	B1	In Use	Capital Carbon
Use Stage	B2	Maintenance	Capital Carbon
Use Stage	B3	Repair	Capital Carbon
Use Stage	B4	Replacement	Capital Carbon
Use Stage	B5	Refurbishment	Capital Carbon
Use Stage	B6	Energy Use	Operational Carbon
Use Stage	B7	Water Use	Operational Carbon
Use Stage	B8	User's Utilisation	User Carbon
End of Life Stage	C1	De-construction	Capital Carbon
End of Life Stage	C2	Waste Transport	Capital Carbon
End of Life Stage	C3	Waste Processing	Capital Carbon
End of Life Stage	C4	Waste Disposal	Capital Carbon

Capital carbon (product, construction, use, and end-of-life stages)

4.3.3. The capital carbon assessment includes modules A0 to A5, B1 to B5, and C1 to C4 (see Table 4-3).

4.3.4. Emissions calculations for the materials required for the construction phase of the Proposed Scheme have been completed by multiplying quantities of material (sourced from the BoQ's for each section and area of the Proposed Scheme) by the relevant emissions factors to give the estimated greenhouse gas emissions (tCO_2e). In this assessment the emission factors were selected from the Inventory of Carbon and Energy (ICE) V3.0 database[10]. The

[10] Jones and Hammond (2019) ICE (Inventory of Carbon & Energy) V3.0. Available at: Embodied Carbon Footprint Database - Circular Ecology

ICE database is an industry recognised and best practice database for calculating the embodied/ product carbon of materials and therefore deemed to be an appropriate approach for this assessment.

4.3.5. The emissions from the transport of materials and waste were calculated using assumed local (50km) and national (300km) transport distances. The tonnage of the materials and waste transported was multiplied by the distance travelled and by an appropriate emissions factor, selected from the UK Government emissions factors[11].

4.3.6. In the absence of information on the types of fuels used to operate the construction plant, the emissions from plant and equipment use during construction (A5) have been estimated based on the total construction cost, using best practice methods from the Royal Institution of Chartered Surveyors (RICS). The RICS metric is based on 2015 data, therefore in line with the guidance the direct construction cost has been adjusted for inflation to 2015 levels using the Bank of England inflation calculator. For this approach, the project cost of each section of the Proposed Scheme has been used.

4.3.7. In addition to construction (A1-A5), emissions calculations for the use of materials required for the resurfacing of the Proposed Scheme have been calculated using industry standard replacement intervals. End of life (EOL) impacts have also been considered in the assessment.

Operational carbon

4.3.8. B6 (energy use) and B7 (water use) carbon has not been quantified as part of this assessment, as data was not yet available at this stage. The carbon impacts from these modules are expected to be minor relative to other carbon modules. This will be reviewed again at FBC and quantified if considered proportionate.

User carbon

4.3.9. The user carbon assessment comprises the impacts to general traffic changes and modal shift as a result of the Proposed Scheme's implementation. These impacts are classified into BS EN 17472:2022 module B8.

4.3.10. The carbon impacts of general traffic changes and modal shift to bus have been assessed using Annual average daily traffic (AADT) link-by-link data extracted from the West of England Regional Transport Model (WERTM).

4.3.11. The carbon impacts of modal shift to active travel have been assessed using Active Mode Appraisal Toolkit (AMAT) results for the Proposed Scheme.

4.3.12. End-user vehicle emissions were calculated in accordance with Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 14 Climate; LA114. Emissions were quantified using TAG data (v1.21 - May 23[12]) from the Department of Transport. This took

[11] Department for Energy Security and Net Zero (2023) Greenhouse gas reporting: conversion factors 2023. Available at: Greenhouse gas reporting: conversion factors 2023 - GOV.UK (www.gov.uk)

[12] DfT (2023) TAG data book. Available at: TAG data book - GOV.UK (www.gov.uk)

into account the vehicle type, fuel type, forecast fuel consumption parameters and the appropriate emission factors. The whole project lifespan is assumed to be 60 years, in line with DMRB LA114 guidance. From this, emissions were quantified for each year over the lifetime of the Proposed Scheme (up to 2042).

4.4 Results

4.4.1. The analysis shows that over the Proposed Scheme's lifetime (60 years) it will result in a whole life carbon **reduction of 46,948 tCO_2e.** A breakdown of the key impacts that make up this whole-life impact (referenced against BS EN 17472 modules) is provided in Table 4-4. Note that negative values represent a reduction in carbon.

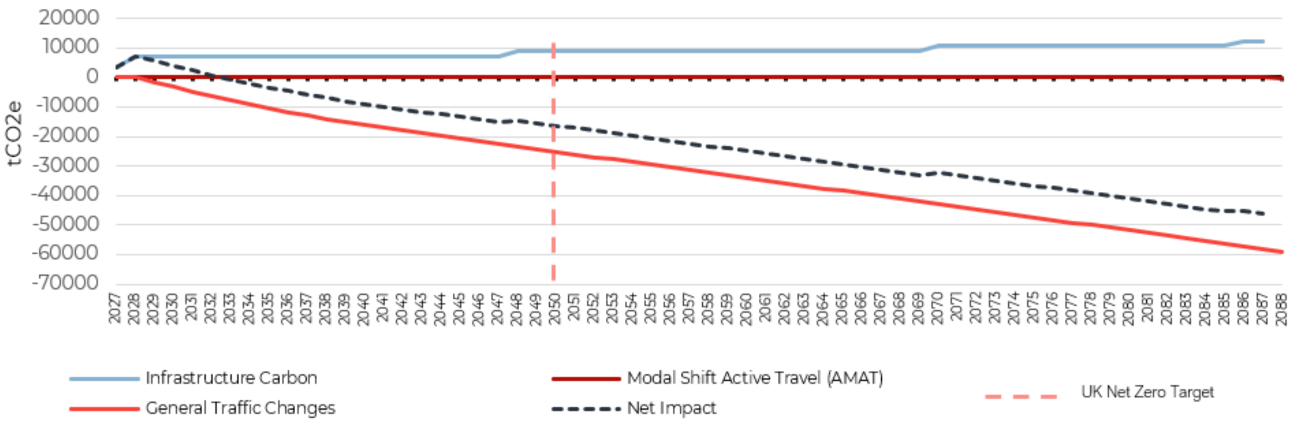
Table 4-4 – Baseline carbon breakdown

Key modules/Impacts	tCO_2e
A1-A3 (Product)	5,581
A4 (Product transport to site)	897
A5 (waste)	417
A5 (construction)	303
B3 & B4 (Repair & replacement)	3,679
B1 (Traffic + modal shift)	- 58,971
C1 (End of Life (EOL) waste)	227
C2 (Transport of EOL waste)	768
C3 & C4 (Recovery & Disposal)	152
Total	- 46,948

Total values may vary slightly from the sum of values due to rounding errors.

4.4.2. Figure 4 2 shows that the initial infrastructure carbon impact of construction is quickly offset by the reduction in user emissions that the Proposed Scheme facilitates. Later increases in infrastructure carbon are due to repair and replacement following typical maintenance schedules as advised by the design team. Modal shift to active travel contributes relatively little to the net impact of the scheme. General traffic changes (which include changes in average vehicle speeds, changes in traffic flow, and modal shift to bus) produce a relatively large reduction in emissions, sufficient to produce significant net-reduction in emissions over the 60-year appraisal period.

Figure 4-2 Whole life carbon impact

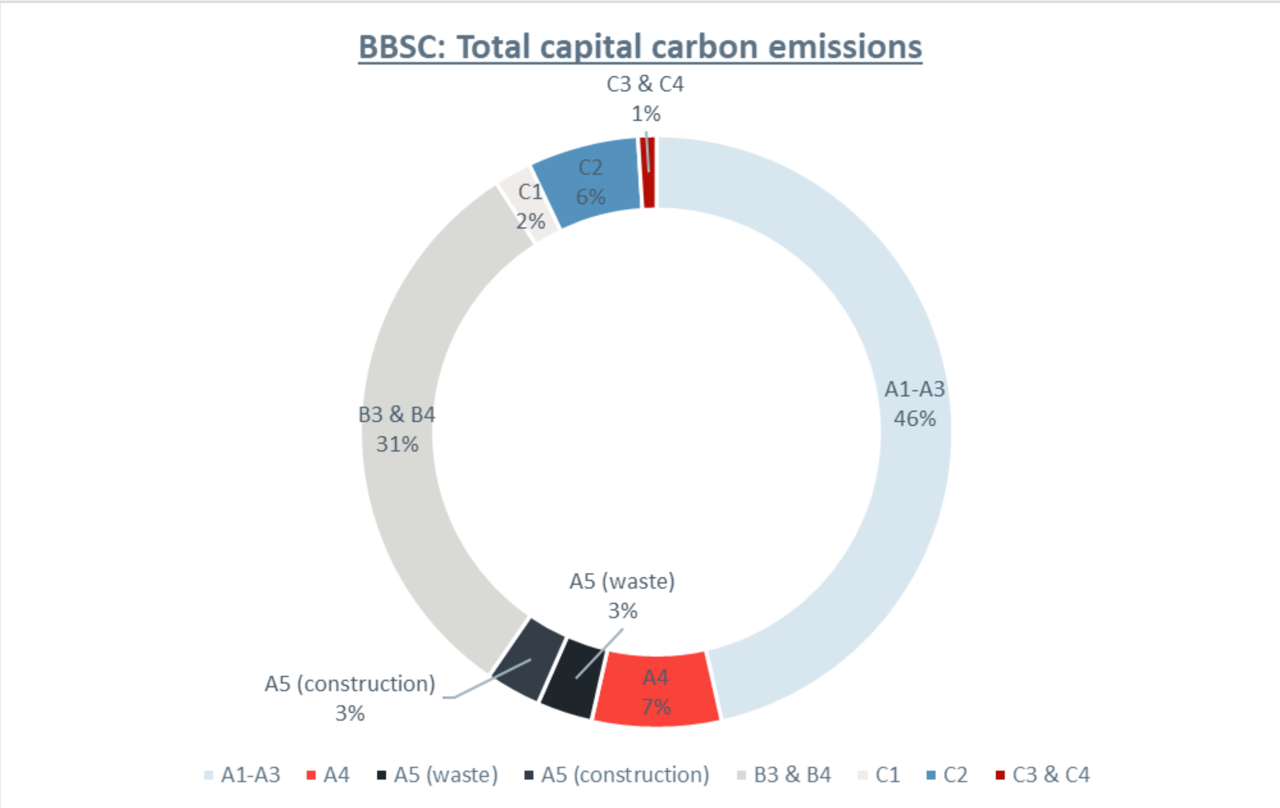


4.4.3. Further details of the whole-life carbon assessment are reported in Appendices A and B.

Capital carbon breakdown

4.4.4. Figure 4-2 demonstrates the breakdown of the infrastructure carbon associated with the Proposed Scheme (all modules except B8). The most significant carbon impacts are from product stage (modules A1-A3; 46%) and repair and replacement (modules B3-B4; 31%).

Figure 4-3 – Total capital carbon emissions (tCO_2e)



4.4.5. Table 4-5 shows the total emission contribution from the whole project with highest emissions being contributed by Sections 2-6, contributing 88% to the total emissions.

Table 4-5 - Scheme emission contribution

Scheme	Total emissions (tCO_2e)	Percentage
Section 2-6	10,532	88%
Community Connection Areas 1-8	935	8%
Keynsham Mobility Hub & Hicks Gate	556	5%

4.4.6. To note, the scope of the assessment does not include Section 1 of the Proposed Scheme. It is likely that capital carbon emissions would increase with the inclusion of Section 1.

4.4.7. Table 4-6 shows the A1-A3 emissions by scheme section. Section 3 contributes the highest impact of any section.

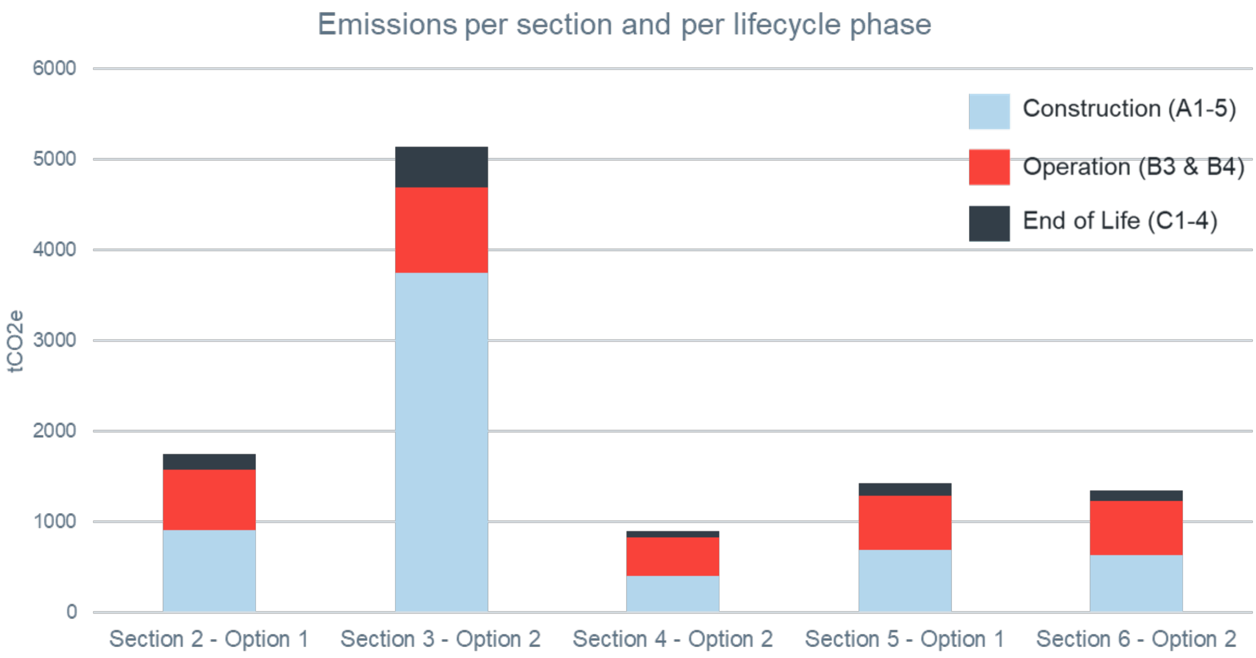
Table 4-6 - Product (A1-3) carbon emissions by scheme section

Section / Area	Product (A1-3) emissions (tCO_2e)	Percentage of Product (A1-3) emissions
Section 3	3,012	54%
Section 2	648	12%
Section 6	490	9%
Section 5	479	9%
Section 4	308	6%
Keynsham	259	5%
CC Area - 3	169	3%
CC Area - 2	47	1%
CC Area - 1	43	1%
CC Area - 4	28	1%
CC Area - 5	39	1%
Hicks Gate	32	1%
CC Area - 8	20	<1%

Section / Area	Product (A1-3) emissions (tCO_2e)	Percentage of Product (A1-3) emissions
CC Area - 6	6	<1%
Total	5,581	

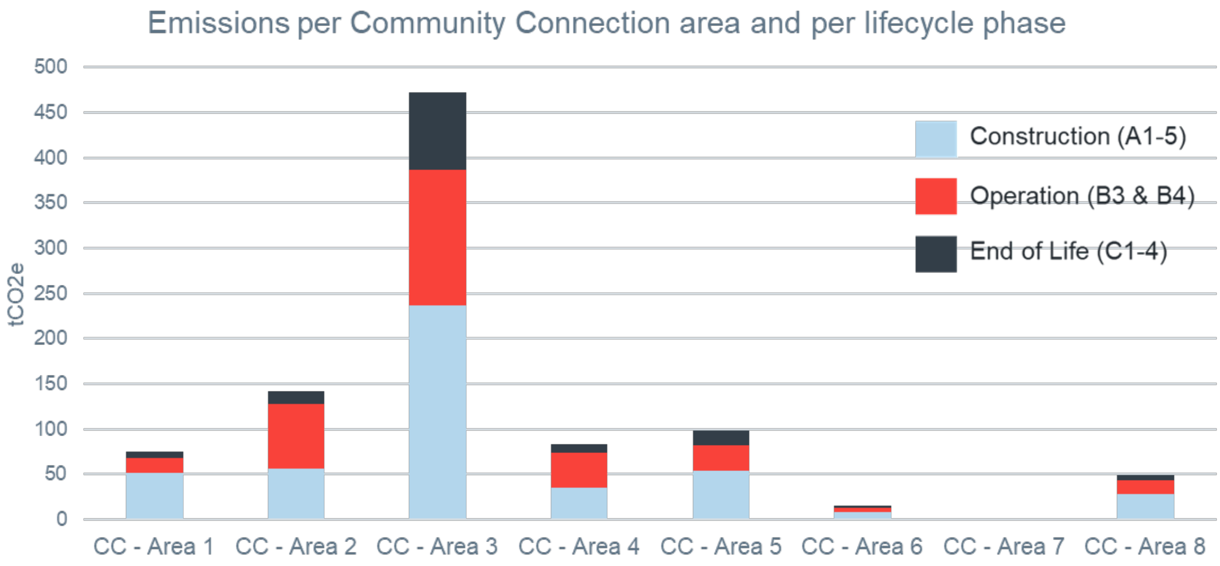
4.4.8. Figure 4-4 shows the capital carbon impact for the5 main sections of the Proposed Scheme, further aggregated by carbon module. As above, Section 3 has the highest impact.

Figure 4-4 - Emissions per section (2-6)



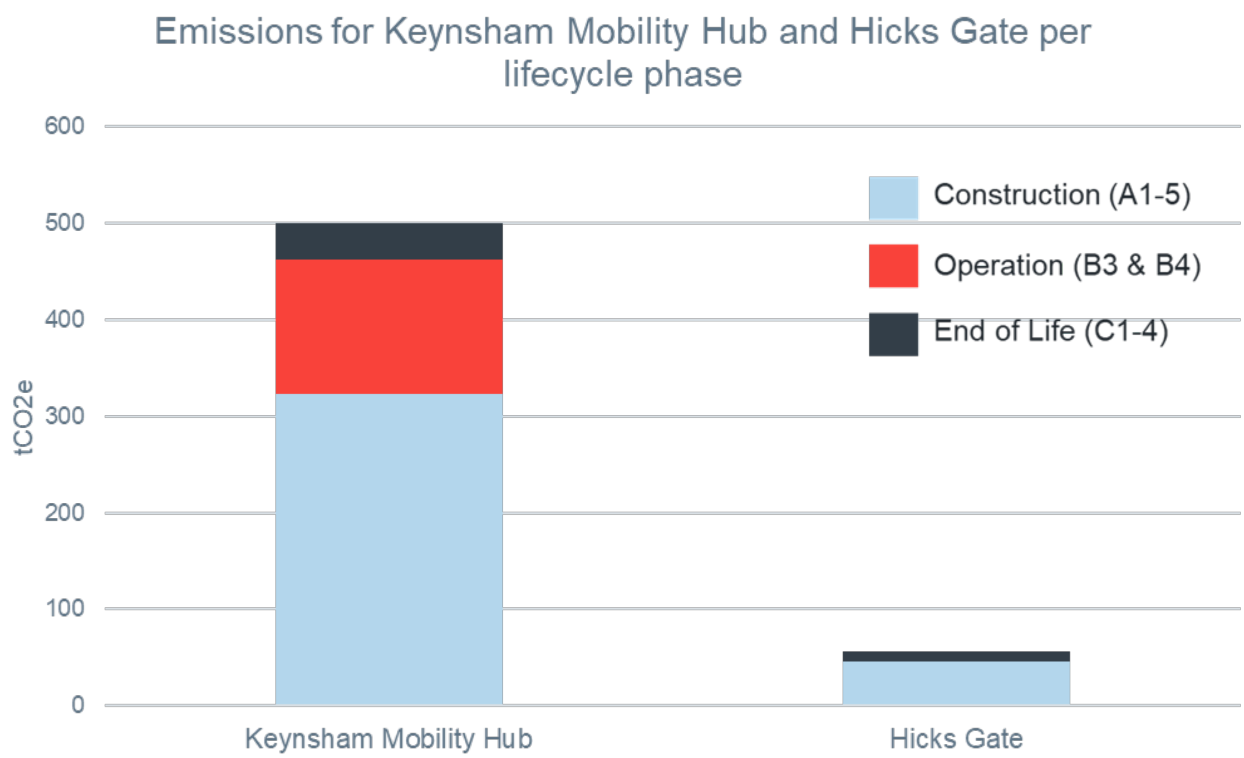
4.4.9. Figure 4-5 shows the capital carbon impact for the community connection (CC) areas of the Proposed Scheme, further aggregated by carbon module. Of these, area 3 has the highest carbon impact, however relative to the main Sections 2-6, impact is low.

Figure 4-5 - Emissions per community connection (CC) (Areas 1-8)



4.4.10. Figure 4-6 shows the capital carbon impact for Keynsham Mobility Hub and Hicks Gate, further aggregated by carbon module.

Figure 4-6 - Emissions from Kensham hub & Hicks Gate



4.5 Emission hotspots

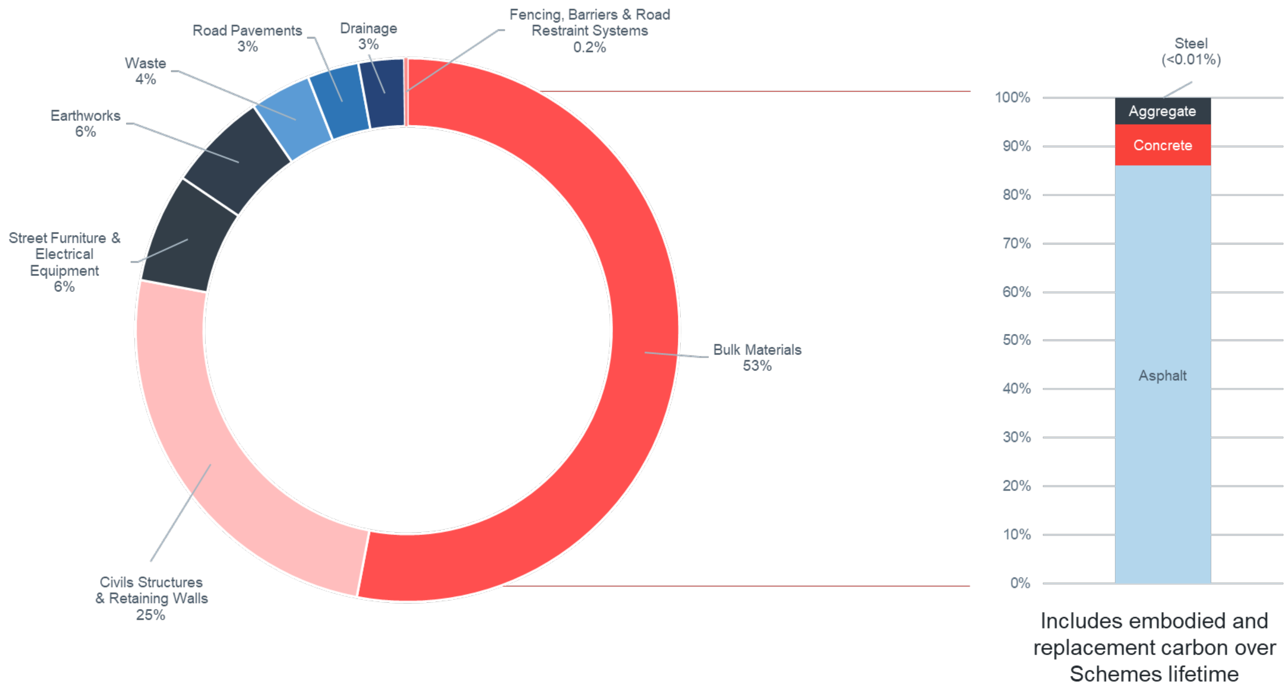
4.5.1. Figure 4-7 shows a breakdown of materials contributing to capital carbon impacts. This can be used to identify hotspots (priority areas for carbon reduction).

4.5.2. Bulk materials constitute the majority (53%) of total capital carbon emissions. This primarily represents asphalt, but also includes concrete, aggregate, and a very small amount of steel.

4.5.3. Civil structures and retaining walls contribute 25% of the total capital carbon.

4.5.4. All other materials are responsible for approximately 22% of capital carbon.

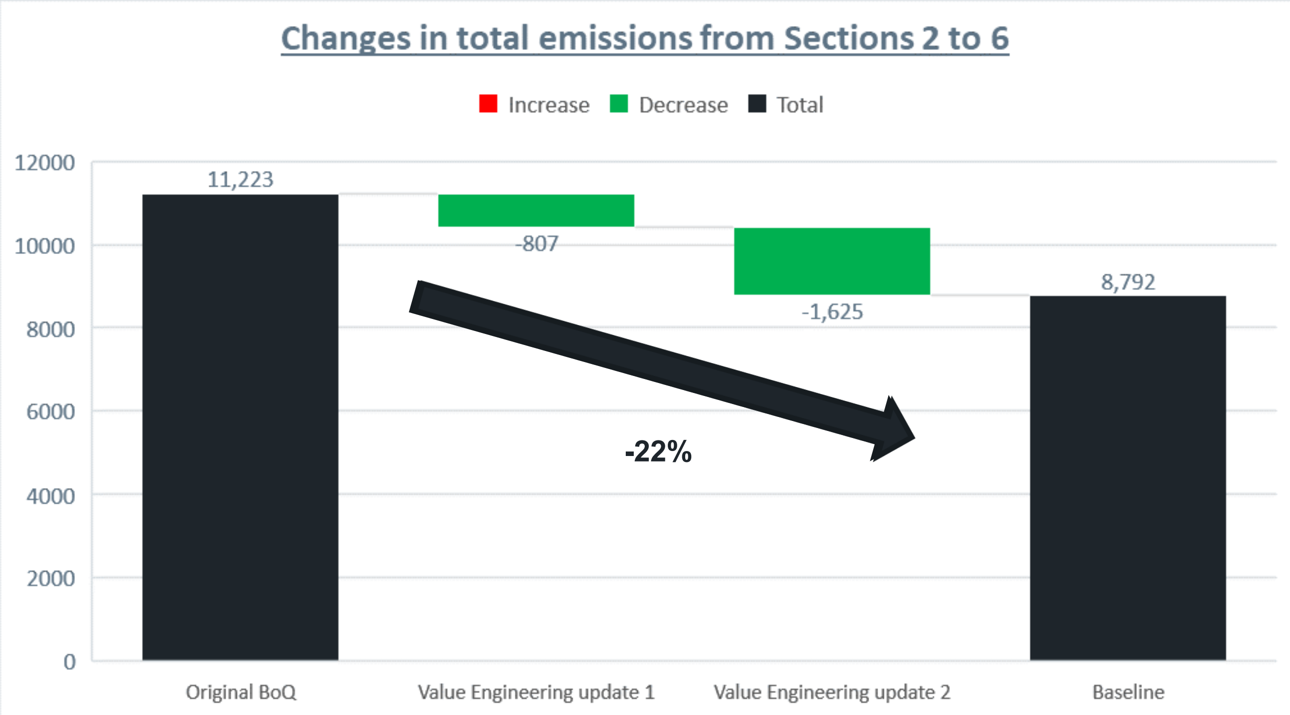
Figure 4-7 - Capital carbon hotspots



4.6 Value engineering

4.6.1. Revised costings were obtained after a first round of assessment where some quantities of materials were changed only for Section 3 to 6. This resulted in a combined reduction of 22% (-2,431 tCO_2e) in emissions from Sections 2 to 6 and an overall reduction of 17% in total emissions as seen in Figure 4-8. The results in sections 4.4. and 4.5 are based on the carbon results after the value engineering exercises were conducted and are considered as the baseline for the Proposed Scheme.

Figure 4-8 - Changes in the emissions due to revised costings: Sections 2 – 6



4.7 Limitations and assumptions

4.7.1. To ensure transparency within the CMP, the following limitations and assumptions have been identified:

- This assessment has been completed based on current available information regarding the scale and nature of the Proposed Scheme. The type and quantities of materials and waste, and traffic data provided at this stage are indicative due to data constraints of working with specimen design.
- Replacement intervals for road and pavements have been assumed in line with industry standards and applied to asphalt and street furniture.
- Ready-mix concrete C25/30 was selected for gullies throughout the project.
- Kerbs were assumed to be pre-cast concrete ones with dimensions 125mmx255mm.
- 150mm diameter PVC plastic pipes were assumed to be used for drainage.
- The transport distances for waste were assumed to be 50kms from site to the landfill.
- Due to insignificant quantities and lack of clarity on the material used, lettering was scoped out of the assessment.
- For toucan and parallel crossings, 3 radar detectors were assumed to be installed per parallel crossing and 5 radar detectors per toucan crossing.
- Bus and bike shelter were assumed to be made of aluminium whereas benches and cycle stands were assumed as steel.

- Tactile pavements, corduroy pavements and kerbs are assumed to be made of precast concrete.
- For the solar panels for Keynsham Mobility Hub, the Natural Capital report is taken as a reference for assessment.
- Awning structure as part of the Keynsham Mobility Hub is assumed to be made of 50% steel and 50% wood (Glulam).
- Landscaping was assumed to be made of 50% imported soil and 50% soil is reused on site.
- Belisha beacons were assumed to be made of LEDs lights along with being solar powered. Environmental Product Declarations (EPD) from Modupost was used as a reference.
- 25 lighting columns were assumed to be installed with a height of 8m and the operational energy for them was calculated separately using industry standard emission factors.
- Retaining walls is assumed to be made of rock gabions and the dimensions of the wall is assumed to be 1x1x3 (m).
- Hicks Gate is assumed to have Vix display (EPD) units installed with LED display which are also assumed to be solar powered. The bus shelter is assumed to be similar to the Keynsham Mobility Hub.
- The design life of signals and equipment is assumed to be 25 years as per industry standards.
- The design life of road pavements for surface course is assumed to be 15 years and that for binder course to be 30 years.
- Design aspects such as lettering, solar panels, operational energy, radar detectors and beacons have been scoped out of the assessment. Their impact could not be estimated due to the lack of information required for the carbon assessment.
- The impact on habitat carbon storage has not been assessed as a result of land use change at this stage. It is anticipated that this will be assessed at FBC.

5 Carbon reduction targets

5.1 Introduction

5.1.1. The PAS 2080 guidance document recommends setting a target which covers an overall carbon budget for the Proposed Scheme.

5.1.2. The carbon budget should reflect both the Before Use and Use stages as considered in PAS 2080:2023, covering the construction and operational phases of the project lifecycle.

5.1.3. It is recommended that project carbon budgets/targets align with sectoral and national decarbonisation trajectories, and local policies.

5.2 Target setting process

The national planning policy framework (nppf)13

5.2.1. Sets out the core planning principle of supporting "*the transition to a low carbon future in a changing climate*…":

- **Chapter 9: Promoting Sustainable Transport**[14] - considers how people should be offered a choice of transportation modes, encouraging a movement away from the use of single private vehicles, the latter being understood to contribute to a significant proportion of total UK carbon emissions. For example, in 2021 transport comprised 26% of UK emissions.

5.2.2. This chapter has been prepared in accordance with the Government's National Planning Practice Guidance[15].

The climate change act 2008 (2050 target amendment)16

5.2.3. The 2019 amendment to the Climate Change Act 2008 established a legal requirement for reaching net zero GHG emissions in the UK economy by 2050. The 2008 Act also created the Committee on Climate Change[17], with a responsibility for:

- Setting five-year carbon budgets;
- Advising and scrutinising the UK Government's associated climate change adaptation programmes; and
- Producing a national adaptation plan for the UK Government to implement.

[13] Department for Levelling Up, Housing and Communities (2012) National Planning Policy Framework. Available at: National Planning Policy Framework - Guidance - GOV.UK (www.gov.uk)
[14] Department of Business, Energy & Industrial Strategy (2023). Available at: UK Greenhouse Gas Emissions 2021: summary (publishing.service.gov.uk)
[15] Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government (2021) Planning practice guidance. Available at: Planning practice guidance - GOV.UK (www.gov.uk)
[16] HM Government (2019) The Climate Change Act 2008 (2050 Target Amendment) Order 2019. Available at: https://www.legislation.gov.uk/ukdsi/2019/9780111187654
[17] Committee on Climate Change. Available at: https://www.theccc.org.uk/

The Paris agreement (2015)18

5.2.4. The Paris Agreement is a legally binding international treaty on Climate Change, which was adopted at COP 21. The Paris Agreement committed countries to maintain global temperatures to below 2°C and pursue efforts to limit the increase to 1.5°C.

Powering up Britain (2023)19

5.2.5. In 2021, the UK Government published the Build Back Greener Net Zero Strategy which set out the UK's plans for meeting net zero emissions by 2050, and the carbon budgets. The strategy was ruled unlawful by the High Court in July 2021, because it was deemed not to meet the legal obligations under the Climate Change Act, as there was not enough detail in the strategy on how the target would be met.

5.2.6. In 2023, The UK published 'Powering up Britain' which is a more detailed document detailing how carbon budgets will be achieved on a policy-by-policy basis and sets out how the Government will enhance the country's energy security and deliver the UK's net zero commitments.

5.2.7. Powering Up Britain includes:

- Net Zero Growth Plan.
- Energy Security Plan.
- Government's response to the Independent Review of Net Zero (the Skidmore Review).
- Government's response to the Climate Change Committee's 2022 progress report.
- Carbon Budget Delivery Plan.

Carbon budget delivery plan and carbon budget 6

5.2.8. The Carbon Budget Delivery Plan details how the UK Government intend to meet Carbon Budgets 4 to 6 (to 2037), though proposals and policies, and their anticipated emissions reductions (where quantified) to 2037.

5.2.9. The Plan also details the expected performance against the Carbon Budgets and shows that for CB6 (965 $MtCO_2e$) there is expected to be an overshoot of 32 $MtCO_2e$ currently.

5.2.10. The Plan also summarises the sector residual emissions for each carbon budget, shown for domestic transport in Table 5-1.

[18] United Nations (2015) Paris Agreement. Available at: ADOPTION OF THE PARIS AGREEMENT - Paris Agreement text English (unfccc.int)
[19] HM Government (2023) Powering Up Britain. Available at: Powering up Britain - GOV.UK (www.gov.uk)

Table 5-1 - Summary of sectoral residual emissions across carbon budgets for Domestic Transport ($MtCO_2e$)

Sector	CB4 5-yr (average pa)	CB5 5-yr (average pa)	CB6 5-yr (average pa)
Domestic transport	546 (109)	422 (84)	254 (51)

West of England climate and ecological strategy and action plan20

5.2.11. In order to meet the Combined Authority's target of net zero by 2030, the Combined Authority (and its partners) have identified six core areas where action is needed to deliver tangible progress to tackle to climate and ecological emergency. With transport representing 42% of emissions in 2020 for the West of England, the strategy for transport outlines the short, medium and long term actions to deliver the objective of achieving a significant modal shift and lifestyle change away from private cars. The plan estimates that a 40% reduction in car mileage is required to meet the Combined Authority's 2030 objectives.

West of England Combined Authority, Joint local transort Plan 4 (JLTP4)21

5.2.12. The Combined Authority works with Bath & North East Somerset, Bristol, North Somerset and South Gloucestershire councils to set out the vision for transport for 2036. The plan, published in March 2020, aims to create a well-connected and sustainable transport network.

Bristol city council climate emergency action plan22

5.2.13. Sets out the carbon reduction and climate resilience actions the Council has committed to take. The strategy allows clarity on:

- The action Bristol City Council is taking to tackle the climate emergency.
- Level of the Council's commitment.
- The Council's integrated approach to tackling the climate and ecological emergency alongside other city priorities which maximises co-benefits.
- The progress at Bristol City Council.

[20] West of England Combined Authority (2023) West of England Climate and Ecological Strategy and Action Plan 2023. Available at: https://www.westofengland-ca.gov.uk/wp-content/uploads/2023/04/West-of-England-Climate-and-Ecological-Strategy-and-Action-Plan-2023.pdf
[21] West Of England Combined Authority, Joint Local Transport Plan. Available at: https://www.westofengland-ca.gov.uk/what-we-do/transport/joint-local-transport-plan/
[22] Bristol City Council Climate Emergency Action Plan. Available at: https://www.bristol.gov.uk/files/documents/5241-climate-emergency-action-plan/file

Bristol city council environmental policy23

5.2.14. The Policy sets out key points to improve Bristol's environment. On the policy they commit to:

- Climate neutrality, climate resilience and ecology.
- Improving their performance, meet compliance obligations, prevent pollution, and protect the environment.
- Manage risks and reduce direct environmental impacts in energy, travel, waste, water, products sourced from sensitive habitats, food, biodiversity, and land use.
- Use resources efficiently.
- Influence policies to manage and reduce citywide environmental impacts.
- Providing training, publicly report on performance and maintain a comprehensive and effective Environmental Management System.

Bath & North East Somerset climate emergency strategy24

5.2.15. Sets out the council's priorities and approach to deliver on the commitments made in the March 2019 Climate Emergency Declaration. The plan also sets out strategic priorities for action that will inform policies and delivery plans across the council, and influence partners who work alongside to deliver services.

Transport delivery action plan for bath25

5.2.16. This plan follows the 2015 "Getting Around Bath Transport Strategy[26]" that was adopted by the council and sets out the plan for the period from 2015 to 2029. The transport delivery action plan identifies and quantifies benefits of the various schemes and sets out different policies that should be implemented for efficient delivery. The "Journey to Net Zero[27]" plan builds further on these plans and provides an overarching, holistic plan, setting out BNES's portfolio of existing transport projects identified to deliver on BNES's climate emergency declaration, as well as providing the foundation to begin developing future initiatives in more detail.

5.3 Methodology

5.3.1. Setting an early project carbon budget or carbon reduction target will help to inform decision-making in the early stages of the project. It will also guide carbon management decisions and improve carbon reduction opportunities across the project lifecycle.

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23 Bristol City Council Environmental Policy. Available at: https://www.bristol.gov.uk/files/documents/770-environmental-policy/file
[24] Bath & Northeast Somerset Climate Emergency Strategy. Available at: https://beta.bathnes.gov.uk/sites/default/files/2023-03/BANES%20Climate%20Emergency%20Strategy%20Document%20AW1.pdf
[25] Transport Delivery Action Plan For Bath. Available at: https://beta.bathnes.gov.uk/sites/default/files/Bath%20Report%20Aug%202020%20-%20Final%20edited.pdf
[26] Getting Around Bath Transport Strategy. Available at: https://beta.bathnes.gov.uk/sites/default/files/2018-10/getting_around_bath_transport_strategy_-_final_issue_web_version.pdf
[27] Bath & Northeast Somerset. Journey to Net Zero (2022). Available at: Journey to Net Zero (bathnes.gov.uk)

5.3.2. Identifying carbon reduction opportunities for the scheme is a vital step to developing a suitable carbon reduction target.

5.3.3. The following steps detail the opportunities identification process as also outlined in Table 6-1:

- Step 1 – Carbon reduction workshop with key stakeholders to discuss the carbon hotspots in the baseline and discuss opportunities (including feasibility). A description of the workshops held to date is provided in paragraph 5.3.5 below.
- Step 2 – Record the opportunities in the 'Recommended Mitigation Measures', see Chapter 6. Opportunities should be recorded as 'Committed to and required', 'To be encouraged', 'To be investigated further', and 'Not to be taken forward'.
- Step 3 – For any 'Committed to and required' opportunities, assess the carbon reductions which will be achieved through implementation. The estimated carbon saving in terms of percentage saving from the baseline will be recorded.
- Step 4 – Agree the scheme carbon reduction target if setting one, using the estimated potential carbon saving as a guide for an appropriate carbon reduction target. The target can be recorded in Table 5-2.

5.3.4. A record of any opportunities identified, should be created to transparently record the process. This can be recorded in Section 6.

5.3.5. A carbon reduction workshop was held on 09th October 2023. It was attended by the Scheme designers and Project Management team. As per the process set out in Section 6 and described above, carbon reduction opportunities identified in that workshop have been categorised and recorded in the 'Recommended Mitigation Measures' table (Table 6-1) in Section 6.

5.4 Scheme reduction targets

Capital carbon

5.4.1. Any carbon reduction target should be measured against the baseline established in Section 4.4 of this Carbon Management Plan. Reductions in GHG emissions are expected to be achieved using available mitigation measures outlined in Table 6-1.

5.4.2. Using an appropriate target range (e.g. 25-30% reduction) at this stage is the best approach as the current baseline is subject to change and will have some inherent inaccuracy due to the availability of data at this stage. The carbon reduction target should not be fixed to this calculation as it is an indicative estimate only.

Operational emissions

5.4.3. Repair and replacement emissions account for 31% of the total scheme emissions over its entire lifespan of 60 years. Choosing a material with greater longevity which would reduce the frequency of replacement of that material and choosing a lower embodied carbon material would reduce these emissions. If the scheme sets a carbon reduction target, it is recommended that replacement is covered by the target due to its substantial share of emissions.

Scheme carbon reduction target

5.4.4. Table 5-2 should be used to record any carbon reduction target for the Proposed Scheme.

Table 5-2 – Carbon reduction target

Proposed Carbon Reduction Target	Date set
25-30% reduction in infrastructure carbon*	TBC

*As discussed with the design team in the workshop

5.4.5. Further breakdown of how this target can be achieved is in Appendix C.

5.4.6. However, during the following scheme development stage, this carbon reduction target should be reviewed. A final target should be proposed based on the baseline, which could be updated to include more accurate data or incorporated construction and installation processes. It is recommended that any carbon reduction targets set for the scheme align with the UK 2050 Net Zero target[28], Powering Up Britain[29], the Paris Agreement[30] and the Combined Authority's net zero target[31].

5.4.7. Consideration of an appropriate carbon reduction target will continue to be monitored with each iteration of this Carbon Management Plan and the key design stages of the Scheme.

[28] Climate Change Act 2008 (legislation.gov.uk)
[29] Powering up Britain - GOV.UK (www.gov.uk)
[30] parisagreement_publication.pdf (unfccc.int)
[31] Climate and ecological action plan - West of England Combined Authority (westofengland-ca.gov.uk)

6 Carbon management actions

6.1 Introduction

6.1.1. As a general recommendation, carbon emissions can be reduced by following the carbon reduction hierarchy detailed in PAS 2080. The new PAS 2080:2023 introduces an updated carbon hierarchy to reduce carbon emissions (shown in Figure 3 2 and found in clause 4 of PAS 2080: 2023).

6.1.2. Throughout the project design and delivery these opportunities should be considered, their status updated, and any additional carbon reduction opportunities should be added.

6.1.3. Each opportunity should be assigned a status:

- Committed to and required.
- To be encouraged.
- To be investigated further.
- Not to be taken forward.

6.2 Roles and responsibilities

6.2.1. It is the responsibility of all within the project team to deliver this Carbon Management Plan and any carbon reduction target set. As best practice, the appointment of an assigned Carbon Co-ordinator should be explored to take ownership of the coordination and delivery of this plan in line with PAS 2080: 2023.

6.2.2. In addition to the carbon co-ordinator, it is recommended that key stakeholders are identified to cover the following areas (these are PAS 2080 aligned):

- **Leadership and governance –** working with the Carbon Co-ordinator to embed carbon management into the Scheme processes, whilst liaising with key project leaders and external stakeholders where necessary. The Carbon Co-ordinator should report the carbon baseline and savings updates to these key stakeholders for wider dissemination if necessary.
- **Scheme design (detailed design) –** Design experts will be required for feasibility assessments to ensure suitable opportunities are considered. Additionally, they should ensure that the opportunities committed to are included in the scheme design.
- **Procurement team –** To ensure the carbon reduction targets are cascaded across the value chain, and suitable suppliers are selected who can support the scheme carbon requirements.
- **Carbon management** action owners are referenced above as a guide to those who should have responsibility for reviewing and implementing (where feasible) the opportunities for carbon reduction.

6.3 Value chain engagement

6.3.1. The procurement process is critical to accelerate whole-life carbon reductions in the value chain when delivering projects or programmes of work. Procurement is not solely the development of a contract, but rather a mechanism that will incentivise the right behaviours (PAS 2080: 2023) and foster 'buy-in' from relevant stakeholders to maximise carbon reductions.

6.3.2. All stakeholders should be briefed on these benefits and responsibilities, as identified in Clause 10 of PAS 2080:2023.

6.3.3. Early value chain engagement is recommended, including early contractor involvement in the detailed design to discuss low carbon solutions to reduce embodied carbon in a cost-effective manner, and to explore the feasibility of carbon actions referenced inTable 6-1.. This should be ongoing to ensure collaboration and sharing of best practice for the successful delivery of this Carbon Management Plan.

6.4 Skills

6.4.1. It is recognised that a degree of upskilling may be required across the parties involved in delivery of the detailed design and construction of the Proposed Scheme. Required skill levels will vary subject to roles and responsibilities.

6.4.2. Gaps in skills or capabilities should be identified based on the actions in Table 6-1. If appointed, the identification of these gaps would be owned by the Carbon Co-ordinator, who works with the stakeholders in each area.

6.4.3. Mitigation actions and carbon reduction measures have been summarised based on the outcomes of the workshop in Table 6-1.

6.4.4. As a general recommendation, carbon emissions can be reduced by following the carbon reduction hierarchy detailed in PAS 2080. The new PAS 2080:2023 introduces an updated carbon hierarchy to reduce carbon emissions (shown in Figure 2 and found in clause 4 of PAS 2080: 2023).

6.4.5. Throughout the project design and delivery these opportunities should be considered, their status updated, and any additional carbon reduction opportunities should be added.

6.4.6. Each opportunity should be assigned a status:

- Committed to and required.
- To be encouraged.
- To be investigated further.
- Not to be taken forward.

Table 6-1 - Carbon management opportunities and recommended mitigation actions

Area	Opportunity detail	Rank	Recommended timescale for completion	Responsibility	Status
Materials	Use of low temperature asphalt for reducing the carbon emissions associated with construction	Best bets – High impact and feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Principal Designer / Principal Contractor	To be investigated further
Materials	Consider using a lower carbon concrete mix during construction of the scheme	Best bets – High impact and feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Principal Designer / Principal Contractor	To be investigated further
Materials	Investigate the potential to use low carbon materials in kerbs	Best bets – High impact and feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Principal Designer / Principal Contractor	To be investigated further
Materials	Look into the feasibility of using recycled, sustainable material for canopy.	Best bets – High impact and feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Principal Designer / Principal Contractor	To be investigated further
Materials	Explore low carbon options for the material and design of retaining walls	Best bets – High impact and feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Principal Designer / Principal Contractor	To be investigated further
Materials	Consider the use of more sustainable plastic substitute for metal in construction	Low hanging fruit – Lower impact, but feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Principal Designer / Principal Contractor	To be investigated further
Materials	Consider the use of wood in path edges instead of concrete	Low hanging fruit – Lower impact, but feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Principal Designer / Principal Contractor	To be investigated further
Design	Consider the use of soft drainage approaches (SUDS)	Best bets – High impact and feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager / Principal Designer / Principal Contractor	To be investigated further

Area	Opportunity detail	Rank	Recommended timescale for completion	Responsibility	Status
Design	Investing the design potential of having green roofs for bus stops.	Best bets – High impact and feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager / Principal Designer / Principal Contractor	To be investigated further
Design	Look into the possibility of carbon reduction opportunities in Section 3 which accounts for the highest emissions amongst all the sections.	Best bets – High impact and feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Principal Designer	To be investigated further
Design	Investigate the potential of using green energy in the operational phase.	Low priority – Low impact and low feasibility	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager	To be investigated further
Design	Make use of solar powered signalling, wherever possible, to ensure lower carbon emissions.	Low priority – Low impact and low feasibility	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager / Principal Designer / Principal Contractor	To be investigated further
Design	Consider adopting passive heating techniques (such as insulation) in buildings.	Low hanging fruits- Lower impact, but feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager / Principal Designer / Principal Contractor	To be investigated further
Design	Use of regenerative, less water-intensive plants in landscaping.	Low hanging fruits- Lower impact, but feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager / Principal Designer / Landscaping Designer / Principal Contractor	To be investigated further
Scheme management	On-site recycling of materials for foundations	Moonshots – High impact, but not as feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager / Principal Designer / Principal Contractor	To be investigated further
Scheme management	Consider the use of locally sourced materials during construction	Moonshots – High impact, but not as feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Principal Contractor	To be investigated further

Area	Opportunity detail	Rank	Recommended timescale for completion	Responsibility	Status
Scheme management	Look into the feasibility of maximising reuse of existing surfaces.	Best bets – High impact and feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager / Principal Designer / Principal Contractor	To be investigated further
Scheme management	Look into the feasibility of reusing cut earthworks on another site locally and achieve cut-fill balance efficiency.	Best bets – High impact and feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager / Principal Designer / Geotechnical Engineer / Principal Contractor	To be investigated further
Scheme management	Investigate the potential for optimisation of signals to reduce congestion and ensure smoother traffic flow.	Low priority – Low impact and low feasibility	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager	To be investigated further
Scheme management	Look into the feasibility of using of electric vehicles during construction to reduce emissions.	Low priority – Low impact and low feasibility	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager / Principal Contractor	To be investigated further
Scheme management	Investigate the potential of re-using in-site fill (instead of importing)	Low hanging fruit – Lower impact, but feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager / Principal Designer / Principal Contractor	To be investigated further
Scheme management	Explore options to provide more sustainable routing for buses	Low hanging fruit – Low impact and feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager	To be investigated further
Scheme management	Use radar detectors for crossings	Low hanging fruit – Low impact and feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager / Principal Designer / Principal Contractor	To be investigated further
Scheme management	Consider putting additional speed limits in place, taking into account fuel efficiency	Low hanging fruit – Low impact and feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager	To be investigated further

Area	Opportunity detail	Rank	Recommended timescale for completion	Responsibility	Status
Scheme management	Consider having efficient construction routes to keep transport distances minimum	Low hanging fruit – Low impact and feasible	To be incorporated into the design at the detailed design stage. To also be confirmed prior to construction.	Asset Owner/Manager / Principal Contractor	To be investigated further

6.5 Carbon budget

6.5.1. The PAS 2080 guidance document recommends setting a target which covers an overall carbon budget for the Proposed Scheme. The carbon budget should reflect both the 'Before Use' and 'Use' stages as considered in the PAS2080:2023, covering the construction and operational phases of the project lifecycle. While no carbon budgets/targets for the Proposed Scheme have been formally set yet (only proposed in Table 5-2), it is recommended to align targets with sectoral and national decarbonisation trajectories, and local policies (such as the Combined Authorities net zero by 2030 target).

6.5.2. The periodic carbon budgets for BNES and the Combined Authority are shown in Table 6 2.

Table 6-2 - Periodic carbon budgets for 2018 BNES[32] and the Combined Authority[33]

Carbon budget period	BNES Recommended carbon budget ($MtCO_2$)	Combined authority recommended carbon budget ($MtCO_2$)
2023 - 2027	1.5	10.7
2028 - 2032	0.7	5.2
2033 - 2037	0.4	2.5
2038 - 2042	0.2	1.2
2043 - 2047	0.1	0.6
2048 - 2100	0.1	0.6

[32] Setting Climate Commitments for Bath and North East Somerset (https://carbonbudget.manchester.ac.uk/reports/E06000022/)
[33] Setting Climate Commitments for Bath and North East Somerset, City of Bristol, North Somerset and South Gloucestershire (https://carbonbudget.manchester.ac.uk/reports/)

Appendix A Carbon appraisal workbook summary

Figure A-1 - Carbon Zero Summary Report

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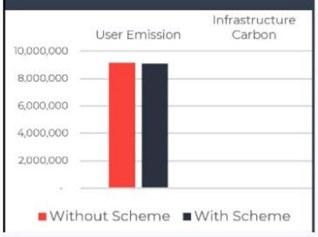
Carbon Zero Summary Report

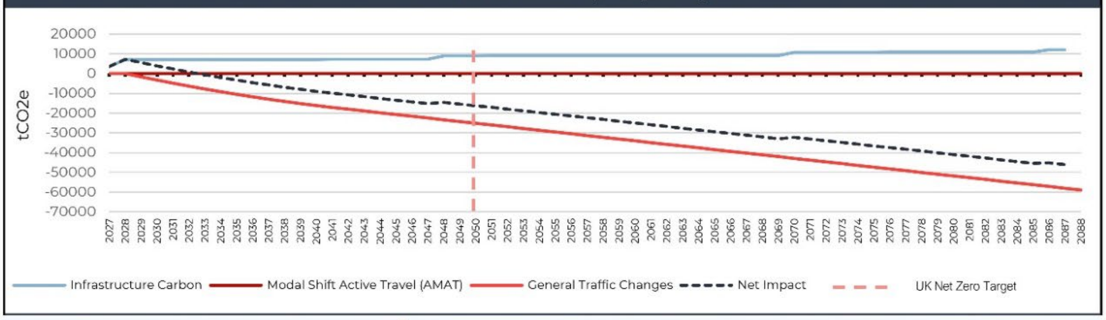
Scheme:	Bristol to Bath Strategic Corridor	WLC Assessment Stage:	Detailed Stage Forecast

Net Impact (tCO2e)			Carbon Value (£) Notes: Includes traded & non-traded carbon; Based on 2010 prices		Carbon Cost Ratio (tCO2e/£100k) Note: Based on direct construction cost
-46,948			Low	-1,636,273	-182.3
User Emissions	Infrastructure Carbon	Removals	Central	-3,272,546	Equivalent Trees
-58,971	12,023	Not Assessed	High	-4,908,820	93,896

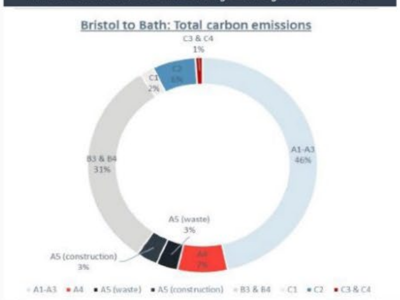


Milestones	4th CB	5th CB	6th CB	Local Commitment	National Net Zero Target	Appraisal Period + Construction
	2024-2027	2028-2032	2033-2037	2023-2038	2023-2050	2023 - 2085
Scheme Impact: Core Scenario (tCO2e)	3,599	-2,794	-6,600	-6,930	-16,317	-45,427
Impact on National Carbon Budget	<0.001%	<0.001%	<0.001%	NA	NA	NA
Carbon Impact on Local Transport Budget (User Emissions) - CCC	0.0%	-1.0%	-1.9%	-0.710%	-1.181%	-2.642%

Whole Life Carbon Impact (tCO2e)



Infrastructure Carbon by Lifecycle Module



Infrastructure Carbon by Material

Explanation

The implementation of the Bristol to Bath Strategic Corridor (the Proposed Scheme) is expected to result in a significant reduction in user emissions. This reduction in user emissions, over the 60-year appraisal period, considerably exceeds the infrastructure carbon impact of constructing (and maintaining) the Proposed Scheme. As such, the delivery of the Proposed Scheme is expected to result in a net-reduction in carbon. Actual user emission reductions may be higher still when the Proposed Scheme is considered in-combination with other schemes and/or interventions that may be delivered in the future, such as improved bus frequency and services, or further onward network enhancements for active travel.

Business Case Stage:	OBC	Design Stage:	Detailed

Appendix B Methodology statement

Carbon Zero Summary Report -Bath to Bristol Strategic Corridor

Table B-1 – Scope of Assessment

Stage	Module	Assessment
Product Stage	A1	Quantified
Product Stage	A2	Quantified
Product Stage	A3	Quantified
Construction Stage	A4	Quantified
Construction Stage	A5	Quantified
Use Stage	B1	Module Not Quantified (But Relevant) – Qualitative Assessment
Use Stage	B2	Module Not Quantified (But Relevant) – Qualitative Assessment
Use Stage	B3	Quantified
Use Stage	B4	Quantified
Use Stage	B5	Module Not Quantified (But Relevant) – Qualitative Assessment
Use Stage	B6	Module Not Quantified (But Relevant) – Qualitative Assessment
Use Stage	B7	Module Not Quantified (But Relevant) – Qualitative Assessment
Use Stage	B8	Quantified
End of Life Stage	C1	Quantified
End of Life Stage	C2	Quantified
End of Life Stage	C3	Quantified
End of Life Stage	C4	Module not relevant
Benefits and Loads beyond the system boundary	D	Module Not Quantified (But Relevant) – Qualitative Assessment

User Emissions

Changes in General Traffic: The Proposed Scheme is expected to result in a **-58,925 tCO_2e** reduction in emissions over the 60-year appraisal period, resulting from changes in general traffic flows. This assessment is based on traffic modelling analysis and includes forecast trips within the designated 'Study Area' affected by the Proposed Scheme. This substantial carbon reduction reflects the Proposed Scheme's impact on average vehicle speeds, and the modelling forecast of a 5-10% reduction in traffic on the A4. Other factors include a modal shift from car to bus, minimal highway disbenefits (i.e. re-routing, congestion), and changing land-use patterns (i.e. unlocking development). In total, the traffic modelling estimates that the Proposed Scheme will prevent over 270 million vehicle kilometres travelled over the 60-year appraisal period.

Modal Shift to Active Travel: The traffic modelling upon which the above carbon assessment of changes in general traffic was based, does not consider modal shift toward active travel (i.e. cycling, walking). As a modal shift is expected from the provision of improved cycling and walking infrastructure, a separate analysis has been conducted using the Active Mode Appraisal Toolkit (AMAT) assessments completed for the Proposed Scheme. The core scenario, which uses standard assumptions of active mode uptake, results in a reduction of **-46 tCO_2e** over the 60-year appraisal period. Under the assumptions of the 25% modal share and ATP Uplift scenarios, a reduction of -227 tCO_2e or -417 tCO_2e is forecasted respectively.

Total User Emissions: Under the core scenario of active travel uptake, total user emissions savings amount to **-58,971 tCO_2e**. The highest estimate of emission savings (under the ATP Uplift scenario) is therefore **-59,342 tCO_2e**. Actual user emission reductions may be higher still when the Proposed Scheme is considered in-combination with other schemes and/or interventions that may be delivered in the future, such as improved bus frequency and services, or further onward network enhancements for active travel.

Changes in Traffic flows during Construction Stage: Any highway disbenefits associated with the traffic management and diversions during the construction stage are likely to be minor relative to the impact of the completed Proposed Scheme. As such, construction stage user carbon has not been quantified. An appropriate traffic management and utilisation of a robust construction management plan would reduce any impact.

Infrastructure Carbon

Construction is scheduled to start in 2027, and the scheme is expected to become operational by 2029. With an assumed lifespan of 60 years, the project focuses on enhancing the bus infrastructure, its amenities, and enabling more cycling and walking services along the A4 corridor. The construction of the project will lead to the generation of carbon emissions associated with various activities, including extraction, and manufacturing of materials, transportation and on-site construction works.

Capital Carbon: The total capital carbon impact amounts to **+12,023 tCO_2e** over the 60-year appraisal period. Bulk materials constitute the majority of the infrastructure's carbon footprint, accounting for 53% of capital carbon emissions (from construction, maintenance and repair and end of life). Among these materials, the most prominent contributors are asphalt (86%), concrete (9%), and aggregate (5%). The next largest contributor is Civils Structures and Retaining Walls (25% of capital carbon), with the stone and wire mesh gabion wall accounting for 91% of this impact.

Operational Carbon: Operational carbon has not been quantified as part of this assessment, as data was not yet available at this stage. Operational carbon impacts are expected to be minor relative to other carbon modules.

Removals

Removals have not been considered as part of the carbon analysis of the Proposed Scheme.

Net-Impact

Over the scheme's lifetime (60 years), a net reduction in emissions of 46,948 tCO_2e is estimated.

The implementation of the Proposed Scheme is expected to result in a significant reduction in user emissions. This reduction in user emissions, over the 60-year appraisal period, considerably exceeds the infrastructure carbon impact of constructing (and maintaining) the Proposed Scheme. As such, the delivery of the Proposed Scheme is expected to result in a net-reduction in carbon. Actual user emission reductions may be higher still when the Proposed Scheme is considered in-combination with other schemes and/or interventions that may be delivered in the future, such as improved bus frequency and services, or further onward network enhancements for active travel.

Carbon Management

A formal Carbon Management Plan, aligned with the principles of PAS2080, has been prepared as part of this OBC.

Several design decisions have been made to-date reflecting commitments to reduce the carbon impact of the Proposed Scheme. These include implementing speed limits to optimise vehicle efficiency, avoidance of additional structures (or amendments to existing structures), and value engineering which has cut approximately 2,000 tCO2e from the baseline. A full list of carbon focused committed design decisions in available in Section 2.4 of the Carbon Management Plan.

At FBC stage, procurement and construction choices and decisions should be focused on as the main carbon management opportunities. The following actions should be considered:

- Actively seek partners for the construction stage with low-carbon construction technical expertise, practice and supply chains.
- Regularly review carbon expertise in the contractor's team to identify those who can support and advise on low carbon solutions, in particular the procurement of services and materials relating to the construction and infrastructure phases of the proposed scheme.

- Through the procurement process, contractors should be incentivised to further reduce the carbon impact, for example through use of NEC Clause X29.
- A final design review should take place to identify any remaining carbon management opportunities.

Methodology Note

WSP’s carbon zero appraisal framework ‑ an overview

The Carbon Zero Appraisal Framework has been developed by WSP to provide a consistent and transparent approach to whole-life carbon assessment. It comprises of a compilation of tools and methods, developed by WSP, for the analysis of carbon impacts both quantitatively and qualitatively. The outputs of this approach comprise a Carbon Zero Summary Report (attached) and the present Methodology Statement.

The methods adopted within the Carbon Zero Appraisal Framework adhere to industry best practices and align with relevant guidelines, as detailed in Table 1. The primary objective of this Methodology Statement is to ensure complete transparency of the methodology and assumptions used during the assessment of carbon impacts, as presented in the Carbon Zero Summary Report, Proforma, Appendix B & Full Business Case.

Relevant Guidance

This whole-life carbon assessment has been prepared in accordance with the requirements of the following guidance.

Table B-2 Relevant Guidance

Guidance	Relevant Requirements	How this has been addressed
TAG Unit A3	4.1.6 – "Appraisal should consider all greenhouse gas emissions." 4.2 – Methodology 4.2.20-25 – Monetisation 4.4.10 – reporting relative to the 'without scheme' case. 4.4.10 – report a breakdown by traded and non-traded. 4.4.10 – reporting by carbon budgets	See Principles of Assessment – whole-life carbon. The quantification of user carbon uses the TAG methodology and datasets referenced in 4.2 TAG carbon values are used as prescribed. See Monetised section below. Impact is reported relative to the 'without scheme' case. See Carbon Zero Summary Report for reporting against carbon budgets
PAS 2080: 2023	7.1.1 Assessing GHG emissions over the whole life to inform decision-making at the asset, network, and system level. 7.1.2 Selecting an appropriate level of accuracy and detail. 7.1.3 Selecting a GHG assessment and methodology. Clause 9 – Monitoring and reporting.	Assessment of whole-life carbon emissions including quantification of capital and operational carbon

Principles of Assessment

The following principles have been adopted in this carbon assessment:

- Whole-life Carbon: all relevant impacts referenced in PAS 2080 and BS EN 17472 have been considered in this assessment.
- Reporting Net-Impact: While the impacts of various components and lifecycle stages of a scheme's influence are documented individually, the comprehensive impact of the scheme on climate change (i.e., the concentration of GHGs in the atmosphere) is determined by the sum of these individual assessments.
- Quantitative analysis whenever possible, to complement qualitative assessment: When data is available and can be proportionally applied, we have conducted quantitative assessments. Aspects that couldn't be quantified have been evaluated qualitatively. Additionally, for quantified impacts, a qualitative narrative has also been provided to describe what the results show, the implications of these results and address any constraints of the quantitative analysis.
- Without Scheme vs With Scheme: The scheme's impact is established by the difference between the "without scheme" and "with scheme" scenarios. Whenever possible, we have assessed the whole life carbon impact in the "without scheme" scenario. It is important to emphasise that carbon emissions do not remain constant in the absence of the scheme.
- Assessment of the scheme in-isolation: As is standard practice for business cases, the assessment focuses solely on the scheme in isolation, without considering combined or synergistic effects with other proposed schemes. Nevertheless, the modelling may consider firm and funded policies or developments, such as the effect of committed housing on traffic growth. It's important to note that the combined impacts are pertinent to the scheme's role in climate change mitigation. Therefore, the potential influence of such combined or system-level impacts is qualitatively examined in the Carbon Zero Summary Report.
- Sensitivity testing: The primary assessment, as outlined in accordance with guidance, is conducted under a core or business-as-usual scenario. However, it's important to note that the assumptions made in this scenario do not consider the potential changes expected under forthcoming policies or the changes required to meet carbon budgets and Net Zero targets. Notably, the TAG Databook (A1.3.9) does not reflect the ban on the sale of new petrol and diesel vehicles (2035) or the Zero Emission Vehicle (ZEV) mandate. Furthermore, the core traffic growth assumptions do not align to decarbonisation pathways. Due to these considerations, a sensitivity test has been prepared to assess the impact under a 'low carbon future'. More details can be found in the section titled 'Low Carbon CERP Sensitivity Test'.

With and Without Scheme Description

The 'without scheme' scenario takes into account the impact of allowing the highway network to operate in its current state.

The ‘with scheme’ considers the impact of the proposed scheme.

Scope and Methodology

In accordance with the latest guidance from DfT in TAG Unit A3, this assessment of Greenhouse Gases (GHGs; hereafter referred to as carbon) has considered carbon emissions over the whole lifecycle of the scheme, including:

- User Emissions (emissions associated with scheme users, such as changes in emissions due to modal-shift);
- Capital Carbon (emissions associated with scheme construction); and
- Operational Carbon (emissions associated with scheme operation and maintenance).

Within these overarching categories of Carbon impact are lifecycle modules as categorised by PAS2080 and BS EN 17472. The scope / assessment boundary of these considered in this assessment is outlined in the Summary Report with the methodology used or rationale for their exclusion presented in Table 2.

Table B-3 Assessment Scope & Methodology

Impact Category	Impact	Assessment Scope	Input Data	Carbon Calculation Methodology or Rationale for Scope
User emissions	Modal shift to active travel (B8)	Quantified	Changes in vehicle kms travelled as calculated in the Active Mode Appraisal Toolkit	Carbon emissions relating to this input data have been calculated using TAG data on fuel consumption and accounts for the proportions of the vehicle type (A1.3.8), fuel type (A1.3.9), forecast fuel consumption parameters (A1.3.11) and emission factors (A3.3).
User emissions	Changes in general traffic flows and modal shift to bus (B8)	Quantified	Changes in vehicle kms travelled as calculated from the traffic modelling for the scheme.	Carbon emissions relating to this input data have been calculated using TAG data on fuel consumption and accounts for the proportions of the vehicle type (A1.3.8), fuel type (A1.3.9), forecast fuel consumption parameters (A1.3.11) and emission factors (A3.3).
Capital carbon	Product manufacture (A1-A3)	Quantified	Material estimates produced as part of the cost estimation process.	In accordance with EN 15978, all items listed in the Bill of Quantities (BoQ) have been quantified. When appropriate, assumptions (agreed with the project team) were used. Materials have been assigned relevant carbon factors from the Inventory of Carbon and Energy (ICE) V3 database and where appropriate, metrics have been adjusted using material densities sourced from relevant EPDs and/or technical documents.
Capital carbon	Transport to site (A4)	Quantified	Default RICS scenarios and carbon conversion factors (UK Government).	In the absence of detailed information on supply locations transport to site has been calculated using RICS default scenarios for transportation distances by material type. These assumptions include an allowance for interim stops at storage depots and/or distribution centres. Carbon conversion factors produced by UK Government (2021) have then be applied based an assumed average rigid HGV with average laden as per BEIS carbon conversion factors. The analysis also captures the departure of HGVs from project site – unladen HGV.
Capital carbon	Construction process (A5)	Quantified	Cost benchmark and material estimates produced as part of the cost estimation process.	A figure of 1.4 tCO_2e/£100k (March 2015) of project value, from RICS Whole life Carbon Assessment for the Built Environment (2017) has been used to calculate emissions associated with the construction and installation process. The direct works cost of the scheme has been adjusted in accordance with the CPI (Bank of England Calculator).
Capital carbon	Repair (B3)	Quantified	A 1% uplift has been applied to emissions associated with modules A1-A4 to account for minimal repair during the 60-year appraisal period considered.	Module B3 is intended to provide a reasonable allowance for repairing unpredictable damage. It considers all activities related to the repair process and any products used.
Capital carbon	Replacement (B4)	Quantified	Reference Service Life information of materials detailed in the Bill of Quantities.	It was assumed that most items would be replaced in a without-scheme case given this is an improvement to existing infrastructure. Where the scheme introduces new items, it was assumed that items were replaced on a like-for-like basis once the reference service life (RSL), or specified lifespan is reached.
Capital carbon	Deconstruction (C1)	Quantified	Construction calculations (A5)	Emissions associated with deconstruction of an asset (C1) are likely to be similar, but less than those associated with the construction (A5) of an asset. For this reason, deconstruction emissions have been assumed to be 75% of construction (A5).

Impact Category	Impact	Assessment Scope	Input Data	Carbon Calculation Methodology or Rationale for Scope
Capital carbon	Transport (C2)	Quantified	None required	In the absence of scheme-specific information, a default distance of 50 km was used for the transportation of waste (C2) to disposal sites, including interim stations. The means of transport is assumed as average rigid HGV with average laden as per BEIS carbon conversion factors.
Capital carbon	Waste Processing for Recovery (C3)	Quantified	Default emission factors as per ICE database.	It was assumed that in 60 years, when the RSP ends, 100% of material will be recycled. For this reason, C3 (waste processing for reuse, recovery, and recycling) has been quantified opposed to C4 (disposal emissions). The assessment includes carbon emissions associated with the treatment and processing of materials and/or components prior to reaching the end-of-waste state. In the absence of specific information default emission factors have been used as per ICE (V3) Database.
Removals	Tree planting	Not quantified	None required	Not assessed.

Key Limitations

The following are considered the key limitations of this assessment:

- This assessment has been completed based on currently available information regarding the scale and nature of the Proposed Scheme. The type and quantities of materials and waste, and traffic data provided at this stage are indicative due to data constraints of working with specimen design.
- Replacement intervals for road and pavements have been assumed in line with industry standards and applied to asphalt and street furniture.
- Ready-mix concrete C25/30 was selected for gullies throughout the project.
- Kerbs were assumed to be pre-cast concrete ones with dimensions 125 mm x 255 mm.
- 150 mm diameter PVC plastic pipes were assumed to be used for drainage.
- The transport distances for waste were assumed to be 50 km from site to the landfill.
- Due to insignificant quantities and lack of clarity on the material used, lettering was scoped out of the assessment.
- For toucan and parallel crossings, 3 radar detectors were assumed to be installed per parallel crossing and 5 radar detectors per toucan crossing.
- Bus and bike shelter were assumed to be made of aluminium whereas benches and cycle stand was assumed as steel.
- Tactile pavements, corduroy pavements and kerbs are assumed to be made of precast concrete.
- For the solar panels for Keynsham Hub, the Natural Capital report is taken as a reference for assessment.
- Awning structure as part of the Keynsham Hub is assumed to be made of 50% steel and 50% wood.
- Landscaping was assumed to be made of 50% imported soil and 50% soil is reused on site.
- Belisha beacons were assumed to be made of LEDs lights along with being solar powered. Environmental Product Declarations (EPD) from Modupost was used as a reference.
- 25 No. lighting columns were assumed to be installed with a height of 8 m and the operational energy for them was calculated separately using industry standard emission factors.
- Retaining walls were assumed to be made of rock gabions and the dimensions of the wall assumed to be
  1 x 1 x 3 (m).
- Hicks Gate is assumed to have Vix display (EPD) units installed with LED display which are also assumed to be solar powered. The bus shelter is assumed to be similar to the Keynsham Hub.
- The design life of signals and equipment is assumed to be 25 years as per industry standards.

- The design life of road pavements for surface course is assumed to be 15 years and that for binder course to be 30 years.
- Design aspects such as lettering, solar panels, operational energy, radar detectors and beacons have been scoped out of the assessment. Their impact could not be estimated due to the lack of information required for the carbon assessment.

Monetisation

The whole-life carbon impacts calculated using the methods described above have been monetised by applying the values in TAG Databook A3.4.

Operational user impacts such as modal-shift and changes in general traffic flows are non-traded (not counted in the UK ETS scheme), as are some aspects of capital carbon impacts (e.g., transportation of materials to site). Other capital carbon impacts such as product manufacture and electricity generation in construction processes, however, will count as traded. As of November 2021, the values in TAG 3.4 refer to both traded and non-traded carbon.

To ensure the full costs of the carbon impacts of the scheme are considered, all impacts have been monetised using the same values in TAG 3.4 and included in the monetised value of carbon. A BEIS policy paper on ‘Valuation of greenhouse gas emissions: for policy appraisal and evaluation’ (September 2021) states that ‘any emission increases or savings resulting from policies (either traded or non-traded) should be considered and valued during appraisal. For emissions in the traded sector, appropriate adjustments should be made to account for any existing carbon pricing in the market prices of goods or services.”. No adjustments have been made to emissions in the traded sector as this is not considered proportionate and the UK ETS is understood to not fully capture the costs of carbon from scheme impacts such as product manufacture.

Context Metrics

The Summary Report presents a series of context metrics intended to aid understanding of what the calculated impact in tCO2e means. These metrics are all derived from the stated total quantified predicted impact over the full scheme lifetime.

Table B-4 Context Metrics

Context Metric	Description	Methodology
Trees	The indicative number of trees you would need to plant to remove this amount of carbon from the atmosphere within the same timeframe.	Woodland Carbon Code (0.5 tCO_2e per tree over 60 years)
Carbon Cost Ratio	The carbon impact per £1 million of scheme cost	Calculated as: ([predicted carbon impact over 60 years]/ [scheme cost] * 1,000,000).
Carbon Value	The monetary value of the predicted carbon impact, based on carbon value scenarios in TAG Unit A3.4	Calculated as: [yearly predicted in emissions] * [yearly TAG A3.4 carbon value]. Undertaken for each scenario (High, Medium, and Low) for carbon value. Non-traded carbon values used. See section above for further information.

Appendix C Carbon reduction target

Introduction

This appendix reports the methodology and results of analysis to inform the carbon reduction target. The purpose of this analysis is to produce a more evidence-led carbon reduction target – providing the Combined Authority with greater confidence that the target is ambitious yet realistic, and supporting the prioritisation of measures based on the scale of carbon reduction they could realise.

Methodological Approach

The process of developing this analysis has been as follows:

A workshop was held to identify carbon reduction opportunities. Of the 25 opportunities identified, 4 were shortlisted on grounds of viability and effectiveness.

- Identified carbon reduction opportunities were 'shortlisted' in accordance with the process identified in Figure 3 3 and Section 3 of the CMP
- Shortlisted carbon reduction opportunities were listed in Table C-1.
- The baseline carbon impact of the aspect of the scheme relevant to this opportunity was extracted from the baseline carbon assessment to identify the relevant reduction.
- A carbon reduction target was identified for shortlisted opportunities, typically through a case study or comparison of carbon factors.
- The carbon reduction targets for each shortlisted opportunity were aggregated and was subtracted from the infrastructure (construction, maintenance and end-of-life) carbon total to provide the total percentage saved to understand the expected total carbon reduction that all these measures would achieve.
- Carbon reduction opportunities not included in the shortlist (and thereby not quantified) were considered as part of making a judgement on what a realistic yet ambitious target could be.

Table C-1 – Shortlisted carbon reduction opportunities

Shortlist opportunity ID	Opportunity	Infrastructure carbon baseline	Reduction target (%)	Source of reduction and absolute reduction (tCO2e)
1	Low temperature asphalt	Asphalt = 5,236 tCO2e	5%	Use of 'warm-mix asphalt from National Highways carbon tool -201 tCO2e

Shortlist opportunity ID	Opportunity	Infrastructure carbon baseline	Reduction target (%)	Source of reduction and absolute reduction (tCO2e)
2	Low carbon concrete	In-situ concrete = 521 tCO2e	60%	*Switch to 25% GGBS content, emissions factors from the ICE v3.0 database* -311 tCO2e
3	100% re-use of onsite fill (rather than import)	50% import and 50% reuse = 683 tCO2e	63%	-427 tCO2e
4	Wooden path edges instead of concrete	Precast Concrete = 279 tCO2e	23%	-64 tCO2e
Total saving (tCO2e) Total percentage reduction on total baseline infrastructure carbon	Total saving (tCO2e) Total percentage reduction on total baseline infrastructure carbon	Total saving (tCO2e) Total percentage reduction on total baseline infrastructure carbon	Total saving (tCO2e) Total percentage reduction on total baseline infrastructure carbon	-1,003 tCO2e -8%

Based on the table above, if all shortlisted measures (deemed likely to be reasonably achievable) were delivered a total carbon reduction of ~10% would be achieved.

The analysis presented in Table C-1 however did not account for a number of other opportunities that are unable to be quantified at this time. This includes:

- A review and analysis of the size, quantities and materials used for the retaining walls.
- Review of sections 3 and 5 for materials and construction required.
- Use of electric vehicles/ plant equipment for construction.
- A soft approach to drainage using SUDs.
- Using more locally sourced materials rather than the distances currently assumed using industry averages.
- Maximising on re-use of existing surfaces rather than the current assumption of excavation and relaying.

Based on this analysis of the unquantified, low certainty or ‘stretch’ measures the total scale of potential carbon reduction could be between 25 and 30%.

This analysis has been discussed with the Principal Designer and informed the chosen carbon reduction target reported in Section 5.4 of the CMP.

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West of England Combined Authority

Bath to Bristol Strategic Corridor – Appendix AE

Appendix AE - Stage 1 Road Safety Audit Report

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January 2024

West of England Combined Authority

Bath to Bristol Strategic Corridor – Appendix AE

Appendix AE - Stage 1 Road Safety Audit Report

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Accepted By: SH, West of England Combined Authority

Accepted By: NB, Bath & North East Somerset Council

Contents

Figures

1 Introduction

1.1 Background

1.1.1. WSP's Road Safety Team has been commissioned by West of England Combined Authority, co-sponsored by Bath & North East Somerset Council (B&NES), to undertake a Stage 1 Road Safety Audit of the proposed bus and active travel improvements between Bath and Bristol on and around the A4 corridor.

1.1.2. The terms of reference of the Road Safety Audit are as described in the Design Manual for Roads and Bridges (DMRB) Requirements and Advice document GG 119.

1.1.3. The Road Safety Audit Team membership was the following:

- KH MCIHT MSoRSA

  WSP (Principal Consultant)
  Road Safety Audit Team Leader

- SB

  WSP (Senior Consultant)
  Road Safety Audit Team Member

1.1.4. Both members of the Road Safety Audit Team have the relevant training, skills and experience recommended for Road Safety Audit Team Leader and Road Safety Audit Team Member in accordance with the guidance stated in GG 119. A Certificate of Competency in Road Safety Auditing is held by KH, the Road Safety Audit Team Leader.

1.1.5. The Road Safety Auditors have examined and reported only on the road safety implications of the proposed highway works, and they have not examined or verified the compliance of the design to any other criteria.

1.1.6. This Road Safety Audit has been undertaken based on the Road Safety Audit Team's previous experience and knowledge in undertaking Road Safety Audits, Highway Design, Collision Investigation and Road Safety Engineering. No member of the Road Safety Audit Team has had any previous input into the design of the scheme.

1.2 Scope

1.2.1. This Stage 1 Road Safety Audit has been undertaken in accordance with the Road Safety Audit Brief which was issued to the Road Safety Audit Team by NR of WSP's Design Team in an email dated 29h August 2023.

1.2.2. This Road Safety Audit comprised of a review of the design drawings and documents supplied to the Road Safety Audit Team, referenced in Appendix A of this report.

1.2.3. The Road Safety Audit Team undertook a site visit together on Monday 8th November 2023 during daylight conditions (between 10:30 and 14:30) when the weather was sunny, and the road surface was damp. Traffic volumes were constant throughout the duration of the site visit, likely due to the nature of the route being a key connection between Bristol and Bath. High volumes of pedestrians were observed in the more urban areas towards Bath and Bristol, particularly in Keynsham, Saltford and the Upper Bristol Road sections of the scheme. A group of 5 cyclists were observed on-road in Keynsham, and otherwise there were few cyclists observed.

1.3 Scheme description

1.3.1. The proposed scheme consists of highway infrastructure alterations on and around the A4 to improve bus journey times, as well as cycle route improvements to facilitate modal shift.

1.3.2. The scheme is approximately 12.5km in length and is located between Keynsham to the east of Bristol and the A3604 / Upper Bristol Road junction at the western side of Bath.

1.3.3. The proposed scheme includes:

- New signal-controlled pedestrian and cycle crossings;
- Conversion of one lane of a dual carriageway to a bus lane;
- Cycle and pedestrian priority treatments at junctions;
- Junction improvement and realignment works;
- Segregated cycle tracks and shared use paths for pedestrians and cyclists; and
- Bus stop relocations and infrastructure improvements.

1.4 Previous road safety audits

The Road Safety Audit Team have not been made aware of any previous Road Safety Audits undertaken for the scheme.

2 Items raised at this stage 1 road safety audit

2.1.1. The following section outlines the problems raised at this Stage 1 Road Safety Audit. The problems are separated into general problems which are applicable throughout the scheme in multiple locations, and then the other problems location specific and are split geographically into sections in line with the scheme proposals.

General problems

2.2 Problem 1

2.2.1. Location: Throughout scheme on A4 Bath Road mainline.

2.2.2. Summary: Side road entry treatments and tactile paving proposals could create confusion over who has priority.

2.2.3. The key to the drawings state side road entry treatments to emphasise pedestrian and cycle priority at minor side road junctions will be provided, but tactile paving and cycle stop lines are proposed. This may result in confusion over who has priority at the various junctions and accesses, resulting in vehicle / pedestrian and cycle collisions.

Recommendation

2.2.4. It is recommended that if cycle and pedestrian priority is intended, then the footway and cycleway surface should continue over the minor junctions and accesses, and tactile paving and cycle stop lines should be omitted. Vehicular give way lines should be provided to encourage drivers to give way to other users.

2.3 Problem 2

2.3.1. Location: Throughout scheme.

2.3.2. Summary: Pedestrian crossings of cycle tracks are proposed without give way lines so priority of pedestrians and cyclists is ambiguous.

2.3.3. The pedestrian crossings across cycle tracks are proposed to include black and white zebra crossing style road markings, but there is no tactile paving proposed for visually impaired pedestrians, and there are no markings indicating that cyclists should give way to pedestrians, creating an ambiguity over who has priority in these locations. This may result in pedestrian and cycle collisions.

Recommendation

2.3.4. In line with TSM Chapter 6 (Figure 15-1) the Give Way lines and studs should be provided along with tactile paving for visually impaired pedestrians, similar to Figure 6.12 in LTN 1/20.

Section 2 – Emery Road to Hicks Gate Roundabout

2.4 Problem 3

2.4.1. Location: Bath Road / Emery Road junction.

2.4.2. Summary: Sight lines to proposed signals potentially obstructed by vegetation.

2.4.3. The central reservation is proposed to be amended on the Bath Road westbound approach to the dedicated right turn lane at the Bath Road / Emery Road junction, however there is existing trees and vegetation located in the central reservation which may obstruct visibility to the signals, resulting in nose-to-tail collisions as vehicles brake suddenly at the signals, or overshoot collisions with users at the cycle crossing.

Recommendation

2.4.4. The trees should be removed or cut back and maintained so that full visibility to the signals is provided at all times.

2.5 Problem 4

2.5.1. Location: Westbound two-lane approach to Bath Road / Emery Road junction.

2.5.2. Summary: No lane destination arrows provided at the junction which could lead to side swipe collisions.

2.5.3. The left-hand lane on the approach to the junction changes from a bus lane only to a general traffic lane on the approach to the Bath Road / Emery Road junction, but there are no arrow road markings near the stop line indicating lane designations to assist users, which could lead to side swipe collisions as drivers make last minute changes, or collisions in the junction as two lanes of traffic continue straight ahead.

Recommendation

2.5.4. Lane destination text road markings and arrows should be provided at the lanes on the approach to the junction.

2.6 Problem 5

2.6.1. Location: Westbound two-lane approach to Bath Road / Emery Road junction.

2.6.2. Summary: No lane destination text road markings provided where the left-hand lane splits in two lane could lead to side swipe collisions.

2.6.3. The left-hand lane general traffic lane on the approach to the Bath Road / Emery Road junction splits into two lanes, a right turn lane and an ahead lane, but there are no lane destination road markings proposed to assist road users. The absence of road markings could increase the potential for driver confusion encouraging late lane changes, resulting in side-swipe collisions.

Recommendation

2.6.4. Lane destination text road markings should be provided in addition to the arrows in both lanes.

2.7 Problem 6

2.7.1. Location: Eastbound Bath Road approach to bus lane.

2.7.2. Summary: A lane drop is proposed as one traffic lane turns into the bus lane on the eastbound carriageway, however the scheme proposals do not include any clear traffic signs and road markings to advise road users of the lane drop, this could result in side swipe collisions.

2.7.3. The two eastbound lanes of traffic on Bath Road will need to merge into one lane where the left-hand lane becomes a bus lane. However, no road marking or traffic signs are provided to provide adequate notice to drivers that they need to merge into one lane. Without appropriate road markings and traffic signs, side swipe collisions may occur due to road users making late lane changing manoeuvres.

Recommendation

2.7.4. Appropriate road markings and traffic signs should be provided on the approach to the lane drop to notify drivers in advance of the lane drop.

2.8 Problem 7

2.8.1. Location: Bus stop opposite The Lodge.

2.8.2. Summary: Bus stop located in dedicated left turn lane may lead to side-swipe collisions.

2.8.3. A bus stop is proposed opposite to The Lodge junction in the dedicated left turn only lane. Drivers are directed by arrows and lane destination markings to align to the left-hand lane for the Park and Ride facility, however the proposal for a bus stop in the carriageway in this location may lead to vehicles pulling back into the right-hand lane to overtake a stopped bus, leading to side swipe / lane change collisions.

Recommendation

2.8.4. The bus stop should be relocated to the bus lane further to the east, or the left turn lane should be amended so that it commences after the bus stop. Alternatively, the bus stop could be located in an bus lay-by adjacent to the carriageway.

2.9 Problem 8

2.9.1. Location: Existing pedestrian crossing between bus stop and The Lodge.

2.9.2. Summary: No crossing is proposed to replace the existing pedestrian crossing across the A4 at The Lodge.

2.9.3. The existing uncontrolled pedestrian crossing across from the proposed bus stop to The Lodge with a pedestrian refuge is proposed to be removed and no crossing facility is proposed to replace this facility. This may result in pedestrians crossing informally across 4 lanes of traffic where they are at risk of being struck by other road user. This is a particular hazard for vulnerable pedestrians due to the removal of the refuge island.

Recommendation

2.9.4. Appropriate crossing facilities should be provided at an appropriate location to accommodate the pedestrian desire line.

2.10 Problem 9

2.10.1. Location: Exit onto the A4 from The Lodge.

2.10.2. Summary: Right turning vehicles emerging from The Lodge may increase the potential for collisions with mainline vehicles.

2.10.3. The existing exit for vehicles from the lodge is restricted to left turn only by means of a traffic island (right turn from The Lodge access is prohibited). The proposed design removes the existing traffic island, so in the future vehicles can turn right when emerging from the access from The Lodge. Right turning vehicles are crossing two lanes of eastbound traffic, and joining two lanes of westbound at a point where the single carriageway and bus lane splits into two lanes - so there are a lot of conflict points and potential for collisions is increased.

Recommendation

2.10.4. The traffic island and left turn only out of The Lodge should be reinstated to prohibit right turns emerging from this access.

2.11 Problem 10

2.11.1. Location: Right turn from A4 westbound into The Lodge access.

2.11.2. Summary: Lack of dedicated right turn lane may result in nose-to-tail collisions involving road users waiting to turn right from the A4 into the access.

2.11.3. There is an existing right turn lane for vehicles wishing to turn into The Lodge access which is proposed to be replaced with smaller a gap in the hatched area which is not wide enough for a vehicle to wait in. Insufficient width of the right turning waiting area may lead to vehicles straddling the white lines resulting in nose-to-tail or head on collisions with oncoming vehicle if waiting vehicles overhang the white centre line.

Recommendation

2.11.4. A dedicated right turn lane should be provided for vehicles turning into The Lodge from the A4 westbound.

2.12 Problem 11

2.12.1. Location: Ironmould Lane / Bath Road

2.12.2. Summary: Restricted sideroad visibility may result in side impact collisions between vehicles pulling out of the junction and those on the mainline carriageway.

2.12.3. The proposed give way line at Ironmould Lane is proposed to be set-back further from the mainline carriageway to allow for the widening of Bath Road. The visibility splay to the west will be notably reduced due to the existing land boundary, vegetation and wall located both sides of the junction. This may result in vehicles pulling out into the path of oncoming traffic due to insufficient visibility.

Recommendation

2.12.4. Appropriate minor road visibility splays should be provided for Ironmould Lane

2.13 Problem 12

2.13.1. Location: Commercial unit exit to the south of the A4.

2.13.2. Summary: Right turning vehicles emerging from the side road access may increase the potential for collisions with mainline vehicles.

2.13.3. There is an existing a left turn arrow opposite the commercial unit access exit, this has not been replicated on the scheme proposals, and there are also no give way lines for vehicles pulling out of the side road. Visibility to the right from the access is likely to be obstructed by buses travelling in the bus lane, as well as the general traffic lane increasing the potential for side impact collisions if vehicles attempt to turn right out of the minor junction.

Recommendation

2.13.4. Visibility splays should be maintained, and if insufficient then the give way line should be moved forward to allow for appropriate visibility. In addition, right turns out of the junction should be prohibited with appropriate signs and road markings.

2.14 Problem 13

2.14.1. Location: Commercial unit entry to the south of A4.

2.14.2. Summary: Potential for collisions between vehicles turning into the commercial unit access and buses in the bus lane.

2.14.3. In the existing situation, a taper diverge lane is provided into the commercial unit entry to facilitate left turning vehicles from the A4 Bath Road. Vehicles turning into the entry with the proposed scheme in place will have to cross the bus lane but it is unclear who has priority as the bus lane does not terminate before the access. This may lead to collisions between buses and vehicles attempting to turn left into the access.

Recommendation

2.14.4. The bus lane should terminate appropriately in advance of the junction and bifurcation arrows should be provided so vehicles are aware of the left turn.

2.15 Problem 14

2.15.1. Location: Private driveway to the north of the A4 Bath Road.

2.15.2. Summary: Restricted visibility for vehicles turning out of the private access road may lead to side impact collisions.

2.15.3. There is a private driveway located to the east of the westbound bus stop. Vehicles turning out of the junction are likely to have their visibility be obscured by a bus stopped at the bus stop which could result in side impact collisions with vehicles on the A4.

Recommendation

2.15.4. The bus stop should be relocated to maintain the visibility out of the access road.

2.16 Problem 15

2.16.1. Location: Private driveway to the north of the A4 Bath Road.

2.16.2. Summary: Lack of dedicated right turn lane may result in nose-to-tail collisions involving vehicles waiting to turn right into the access.

2.16.3. There is a private driveway located to the east of the westbound bus stop which currently has a gap in the central reserve to accommodate right turning vehicles from the westbound mainline into the access. The proposals include a kerbed central traffic island which ends adjacent to the private driveway and a hatched area. It is unclear whether the traffic island is intending to ban right turns from the mainline into the access, as it appears that vehicles would still be able to manoeuvre around it to turn right. The hatched area which is not wide enough to accommodate a waiting vehicle and therefore a vehicle waiting to turn right into the access may be struck by a passing vehicle.

Recommendation

2.16.4. If right turns are proposed to be prohibited from the mainline into the access, the traffic island should be extended further east to prevent vehicles making this turn. If right turns are to be allowed, then an appropriate dedicated right turn lane should be provided so vehicles are not overhanging into the through traffic lanes.

2.17 Problem 16

2.17.1. Location: Bus exit from Bus Hub / P&R

2.17.2. Summary: Wide angle of proposed junction may result in collisions between buses and pedestrians and cyclists.

2.17.3. The proposed Park & Ride Bus hub exit is extremely wide which creates a long crossing for pedestrians and cyclists, and the angle of the junction would make it challenging for buses coming up the exit to see pedestrians or cyclists approaching the crossing, which may result in collisions.

2.17.4. The proposed junction is also unusual layout as it is neither a slip lane or a traditional major / minor junction (approaching at 90 degrees), therefore road users maybe unsure at what speed to approach the mainline carriageway (i.e. approach whilst travelling at a reasonable speed to use the junction as a slip road or approach whilst expecting to stop like a more conventional major / minor junction).

Recommendation

2.17.5. The junction mouth should be “tightened up” to provide a shorter crossing for pedestrians and cyclists, and angle of approach “squared up” to provide a conventional major / minor junction layout and clearer visibility for approaching buses and users on the footway / cycleway.

Section 3 – Hicks Gate roundabout to Broadmead roundabout

2.18 Problem 17

2.18.1. Location: A4175 arm of roundabout.

2.18.2. Summary: Zebra crossings provided across two approach lanes of traffic may result in pedestrian / cycle collisions with other road users.

2.18.3. There are proposed parallel crossings on the A4175 arm of the Hicks Gate roundabout, which appear will operate similar to zebra crossings. Those crossing will cross two lane approaches. Consequently queuing vehicles in one of the approach lanes could mask visibility between people crossing and approaching vehicles in the other lane. Road users may not see pedestrians and cyclists on the crossing which may result in pedestrian / cyclist collisions with other road users.

Recommendation

2.18.4. It is recommended that traffic signal controlled Toucan crossings should be provided across this arm of Hicks Gate roundabout.

2.19 Problem 18

2.19.1. Location: Two-way cycle route to the east of Hicks Gate Roundabout.

2.19.2. Summary: The width of the proposed two-way cycle route is too narrow for two-way cyclists to pass one another, which may lead to cyclists colliding with each other.

2.19.3. The width of the proposed two-way cycle route appears to be too narrow for two-way cyclists to pass one another, which may lead to cyclists colliding with each other or pedestrians on the adjacent pedestrian footway.

Recommendation

2.19.4. Width of 2-way cycleway should be at least 3m wide (1.5m in each direction). If this width is not achievable then a shared use path may have to be provided instead.

2.20 Problem 19

2.20.1. Location: Hicks Gate Roundabout to Broadmead Roundabout

2.20.2. Summary: Reduction of the dual carriageway to a single lane in each direction may result in tailgating and the inappropriate use of bus lane for undertaking, resulting in collisions.

2.20.3. It is possible that the reduction of the dual carriageway to a single lane in each direction may result in the road not having sufficient capacity which may in turn result in driver frustration and people tailgating other drivers or undertaking inappropriate undertakes using the bus lane, which may result in collisions with other vehicles.

Recommendation

2.20.4. The traffic flow forecast should be reviewed to ensure sufficient capacity will be provided. Bus lane enforcement techniques should also be considered.

2.21 Problem 20

2.21.1. Location: Westbound approach to Hicks Gate Roundabout.

2.21.2. Summary: Two lane approach may result in drivers accelerating to overtake queuing vehicles on the approach to Hicks Gate Roundabout, resulting in side-swipe or nose-to-tail collisions

2.21.3. The road increases from a single lane to two lanes on the westbound approach to Hicks Gate Roundabout. Drivers may misinterpret this layout for an overtaking lane, and frustrated drivers may accelerate here to undertake "quick" overtaking manoeuvres before the roundabout, resulting in nose-to-tail collisions with the back of a queue or undertake unsafe lane changing manoeuvres.

Recommendation

2.21.4. Lane destination road markings should be provided to assist with lane choice. In addition, the bus lane should finish closer to the roundabout so there is no temptation for drivers to overtake before the roundabout.

2.22 Problem 21

2.22.1. Location: Keynsham Hub.

2.22.2. Summary: Pedestrian crossings located in the centre of bus stops may result in vehicle and pedestrian collisions.

2.22.3. The proposed signal-controlled pedestrian crossings at Keynsham Hub is located in the centre of the bus stops. If a bus stops across the crossing, then pedestrians will have to navigate around it in the carriageway, which may be a particular issue for mobility or visually impaired pedestrians. In addition, a stopped bus may obscure the signals from pedestrians, resulting in them crossing into live traffic, resulting in collisions.

Recommendation

2.22.4. The pedestrian crossing should be located outside of the bus stops to allow for appropriate visibility to signal heads and for the bus stops to operate independently from the crossings.

2.23 Problem 22

2.23.1. Location: Broadmead Roundabout eastbound approach.

2.23.2. Summary: Short length lane gain immediately upstream of a pedestrian crossing may result in vehicle collisions with pedestrians at the crossing.

2.23.3. The distance between the end of the bus lane and the lane gain to the two lanes at the roundabout is very short, and coincides with the provision of signal-controlled pedestrian crossing, so vehicles will be changing lane in a short distance upstream of the roundabout and pedestrian crossing which may lead to side swipe collisions or drivers not stopping for the pedestrians on the crossing.

Recommendation

2.23.4. The bus lane should further away from the crossing to allow for more time for general traffic to get in the correct lane at the roundabout prior to encountering the crossing facility.

2.24 Problem 23

2.24.1. Location: Broadmead Roundabout.

2.24.2. Summary: Unconventional bus lane layout at roundabout may result in lane change collisions.

2.24.3. The proposed layout of the roundabout includes two lane approaches on each arm, one for left turn only and the other for ahead and right, however buses will be able to continue straight ahead from the left turn lane. This combined with the short sections of bus lane proposed on the roundabout circulatory carriageway results in an unconventional layout that drivers may not be familiar with. This potentially increases the risk of lane changing collisions at the roundabout.

Recommendation

2.24.4. It is recommended that lane destination road markings and appropriate traffic signs are provided on the roundabout approaches, as well as potentially on the circulatory carriageway to minimise the potential for lane changing manoeuvres on the circulatory carriageway.

2.25 Problem 24

2.25.1. Location: Broadmead Lane, northern arm of roundabout.

2.25.2. Summary: Lack of tie in for cyclists to existing infrastructure.

2.25.3. There are new shared use paths and a toucan crossing proposed across Broadmead Lane at the Broadmead roundabout, however it is noted that these are proposed to tie into existing non-motorised user provision. The existing provision on Broadmead Lane is footway only, and there is currently no provision for cyclists. This could lead to cyclist and pedestrian conflict where the footway is too narrow to accommodate both users, or cyclists rejoining the carriageway at an inappropriate location where they may be struck by a passing vehicle.

Recommendation

2.25.4. If cyclists need to rejoin carriageway, then a dropped kerb should be provided at an appropriate location. Similarly, hazard warning paving should be provided at the end of the shared use path to alert users to end of shared facility. Alternatively, the shared use facility should be extended and widened for cyclists use.

2.26 Problem 25

2.26.1. Location: Broadmead Roundabout, Bath Road westbound approach.

2.26.2. Summary: Drivers may utilise the incorrect lane at the roundabout, resulting in side-swipe collisions.

2.26.3. There is a left turn arrow proposed in the left-hand lane at the westbound approach to the roundabout, but also an access road located off the roundabout. Drivers may get confused and use the right-hand lane for the main left turn into Bath Road B3116, resulting in side-swipe collisions.

Recommendation

2.26.4. Lane destination road markings and appropriate traffic signs should be included on the Bath Road approach to the roundabout.

Section 4 – Broadmead roundabout to Saltford

2.27 Problem 26

2.27.1. Location: Bus stop on Bath Road to the west of Fairfield Way.

2.27.2. Summary: Buses stopped at the bus stop will obscure visibility for vehicles turning out of Fairfield Way increasing the potential for collisions.

2.27.3. A bus stop is proposed in close proximity to the west of Fairfield Way. A bus stopped at the bus stop will restrict visibility for vehicles turning out of Fairfield Way, who may be struck by a vehicle on the mainline carriageway.

Recommendation

2.27.4. The bus stop should be relocated further away from Fairfield Way so that appropriate junction visibility is provided.

2.28 Problem 27

2.28.1. Location: Proposed toucan crossing to the west of Pixash Lane.

2.28.2. Summary: Toucan crossing leading into a pedestrian only footway may lead to conflict between users.

2.28.3. There is a toucan crossing proposed across Bath Road to the west of Pixash Lane but there is no existing or proposed shared use path or cycle facility on the northern side of the road. This may lead to cyclists on the footway when the footway is too narrow for pedestrians and cyclists, resulting in conflict, or cyclists attempting to rejoin the carriageway at an inappropriate location, resulting in collisions with vehicles.

Recommendation

2.28.4. Appropriate cycle facilities should be provided on the northern side of Bath Road to accommodate cyclists crossing, or the crossing should be a pedestrian only crossing.

2.29 Problem 28

2.29.1. Location: Proposed bus stop adjacent to Tying Road.

2.29.2. Summary: Proposed bus stop located in the visibility splay of the junction.

2.29.3. The bus stop is proposed to be moved into the carriageway from a bus lay-by at a location where vehicles waiting at the junction are likely to have their visibility obstructed by a bus stopped at the bus stop, resulting in increased potential for collisions with vehicles on the mainline carriageway.

Recommendation

2.29.4. The bus stop should be relocated outside of the visibility splay of the junction.

2.30 Problem 29

2.30.1. Location: Proposed Bus stop adjacent to Corston Lane.

2.30.2. Summary: Proposed bus stop located in the visibility splay of the junction.

2.30.3. The bus stop is proposed to be moved into the carriageway from a bus lay-by at a location where vehicles waiting at the junction are likely to have their visibility obstructed by a bus stopped at the bus stop, resulting in increased potential for collisions with vehicles on the mainline carriageway.

Recommendation

2.30.4. The bus stop should be relocated outside of the visibility splay of the junction.

Section 5 – The Globe roundabout to Tweton Fork

2.31 Problem 30

2.31.1. Location: A39 Wells Road - western arm of The Globe roundabout.

2.31.2. Summary: Toucan crossing leading into a pedestrian only footway may lead to conflict between users.

2.31.3. Toucan crossing across the western arm of the roundabout leads into a pedestrian only footway, and there is no existing or proposed shared use path or cycle facility on the northern side of the road. This may lead to cyclists on the footway when the footway is too narrow for pedestrians and cyclists, resulting in conflict, or cyclists attempting to rejoin the carriageway at an inappropriate location, resulting in collisions with vehicles.

Recommendation

2.31.4. Appropriate cycle facilities should be provided on the northern side of A39 Wells Road to accommodate cyclists crossing, or the crossing should be a pedestrian only crossing.

2.32 Problem 31

2.32.1. Location: A4 Bristol Road, northern arm of The Globe Roundabout.

2.32.2. Summary: Bus lane continuing to the give way at the roundabout may result in side swipe collisions on the circulatory carriageway.

2.32.3. The bus lane on the A4 Bristol Road is proposed to continue up to the give way line at the Globe Roundabout, so all general traffic will be in the right-hand lane for all movements at the roundabout. The A4 Bristol Road eastern arm has two exit lanes, so vehicles coming from the northern arm and continuing along Bristol Road may result in side swipe collisions with buses in the outside lane of the roundabout, or with other vehicles as they attempt to join one of the two lanes at the exit.

Recommendation

2.32.4. The bus lane should be shortened to allow vehicles to use both lanes at the roundabout.

2.33 Problem 32

2.33.1. Location: A4 Bristol Road eastern arm.

2.33.2. Summary: Bus stop proposed at a location with restricted visibility may result in nose-to-tail or side swipe collisions.

2.33.3. There is a bus stop proposed to be relocated into the carriageway on the eastbound A4 Bath Road exit after the roundabout. The bus stop is proposed at a location after a bend where visibility may be obstructed and vehicles will be accelerating away from the roundabout resulting in nose-to-tail collisions with a stopped bus, or side swipe collisions when vehicles change lane at the last minute, after accelerating after the roundabout.

Recommendation

The bus stop should be relocated to a more appropriate location with adequate visibility for approaching users.

Section 6 – Newbridge Park and Ride to Upper Bristol Road / A3604 junction

2.34 Problem 33

2.34.1. Location: Proposed bus stop adjacent to Rudmore Park.

2.34.2. Summary: Proposed bus stop located in the visibility splay of the junction.

2.34.3. The bus stop is proposed to be moved into the carriageway from a bus lay-by at a location where vehicles waiting at the junction are likely to have their visibility obstructed by a bus stopped at the bus stop, resulting in increased potential for collisions with vehicles on the mainline carriageway.

Recommendation

2.34.4. The bus stop should be relocated outside of the visibility splay of the junction.

2.35 Problem 34

2.35.1. Location: Throughout section.

2.35.2. Summary: Buses stopped at bus stops located close to zebra crossings may mask crossing pedestrians.

2.35.3. There are numerous zebra crossings proposed across A4 Newbridge Road, many of which are located adjacent to bus stops. A bus stopped at the bus stop may mask a pedestrian crossing for approaching vehicles, resulting in pedestrian / vehicle collisions.

Recommendation

2.35.4. The separation between the bus stops and zebra crossings should be increased to improve visibility to the crossings. Alternatively, signal-controlled crossings should be provided at these locations.

Community connections area 1 – Station Road, High Street

2.36 Problem 35

2.36.1. Location: Station Road / High Street mini-roundabout.

2.36.2. Summary: The proposed cycle bypass is at a point of conflict with the bus stop.

2.36.3. There is a cycle bypass proposed at the mini-roundabout for cyclists travelling from Station Road and continuing along High Street. However, the cycle bypass ends at a location where buses will be pulling across the carriageway to access the bus stop located on the eastern side of the carriageway, potentially resulting in side swipe collisions between buses and cyclists.

Recommendation

2.36.4. The bus stop should be relocated away from the cycle bypass conflict point.

2.37 Problem 36

2.37.1. Location: Station Road / High Street mini-roundabout.

2.37.2. Summary: Proposed footway is too narrow to facilitate cyclists as well as pedestrians, potentially resulting in conflict.

2.37.3. There are proposed dropped kerbs at the Station Road arm of the roundabout to allow cyclists to join a shared use path on the southern side of the road, however the existing footway is too narrow for a shared use path and there are no proposals to widen this section of footway. This may result in conflict between pedestrians and cyclists.

Recommendation

2.37.4. The footway should be widened to a minimum of 3m allow pedestrians and cyclists to safely utilise the route, or the dropped kerbs should be removed to prevent cyclists from using the footway.

2.38 Problem 37

2.38.1. Location: Station Road / The Park junction

2.38.2. Summary: Zebra crossing located too close to junction may lead to collisions with pedestrians on the crossing.

2.38.3. The proposed Zebra crossing across Station Road is located too close to The Park side road. Vehicles pulling out of the junction and turning left will be looking for oncoming traffic, and will not have enough space to stop for the zebra crossing.

Recommendation

2.38.4. The Zebra crossing should be relocated further west to allow space for vehicles pulling out of The Park to stop for pedestrians utilising the crossing.

Community connections ‐ area 2 Culvers Road, St. Francis Road

2.39 Problem 38

2.39.1. Location: Charlton Road.

2.39.2. Summary: Short section of shared use path may be misleading for cyclists.

2.39.3. A short section of shared use path is proposed to the northern side of Charlton Road which does not connect to existing or proposed shared use facilities. There are also no dropped kerbs for cyclists to join the shared use path at this location, which may lead to cyclists in the carriageway trying to negotiate a full height kerb where they are at risk of being struck by a passing vehicle.

Recommendation

2.39.4. Dropped kerbs should be provided to facilitate cyclists joining the shared use path, and onward connectivity should be provided for cyclists. Alternatively cyclists should be provided with an on-road facility, and the footway maintained as pedestrian only.

Community connections ‑ area 3 Bath Road

2.40 Problem 39

2.40.1. Location: Bath Road.

2.40.2. Summary: Bus stop located too close to zebra crossing will mask crossing pedestrians, potentially resulting in collisions with vehicles.

2.40.3. A bus stop is proposed to the east of the existing mini roundabout, on the zig zag markings for the Zebra crossing. A stopped bus will mask any pedestrians attempting to cross, and vehicles may attempt to overtake the bus, colliding with pedestrians on the crossing.

Recommendation

2.40.4. The bus stop should be relocated away from the crossing to allow for adequate visibility for pedestrians at the crossing.

3 Road safety audit team statement

We certify that this Stage 1 Road Safety Audit has been carried out in accordance with GG 119:

Road safety audit team leader

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Date: 29th November 2023

Appendix A List of documents and drawings considered during this road safety audit

Reports / documents

Document title	Report number	Date
GG 119 RSA 1 Brief – Bristol to Bath Strategic Corridor	N/A	29/08/23
Collision Analysis.xlsx	N/A	16/11/23

Drawings

Drawing title	Drawing number	Revision
Section 2 - Emery Road to Hicks Gate Roundabout (Option 1)	70093741-WSP-S3-XX-DR-LP-201-01	P01
Section 3 (Sheet 1 of 3) Hicks Gate Roundabout to Broadmead Roundabout (Option 2)	70093741-WSP-S3-XX-DR-LP-302-01	P03
Section 3 (Sheet 2 of 3) Hicks Gate Roundabout to Broadmead Roundabout (Option 2)	70093741-WSP-S3-XX-DR-LP-302-02	P03
Section 3 (Sheet 3 of 3) Hicks Gate Roundabout to Broadmead Roundabout (Option 2)	70093741-WSP-S3-XX-DR-LP-302-03	P04
Section 4 (Sheet 1 of 2) Broadmead Roundabout to Saltford (Option 2)	70093741-WSP-S4-XX-DR-LP-402-01	P03
Section 4 (Sheet 2 of 2) Broadmead Roundabout to Saltford (Option 2)	70093741-WSP-S4-XX-DR-LP-402-02	P04
Section 5 The Globe Roundabout to Twerton Fork (Option 1)	70093741-WSP-S5-XX-DR-LP-501-01	P04
Section 6 (Sheet 1 of 2) Newbridge Park & Ride to Upper Bristol Road / A3604 Junction (Option 2)	70093741-WSP-S6-XX-DR-LP-602-01	P03
Section 6 (Sheet 2 of 2) Newbridge Park & Ride to Upper Bristol Road / A3604 Junction (Option 2)	70093741-WSP-S6-XX-DR-LP-602-02	P04
Community Connections Area 1 Option 1(Station Road to High Street)	70093741-WSP-CC-DR-C-061-P01	P01

Drawing title	Drawing number	Revision
Community Connections Area 2 (Culvers Road, St. Francis Road)	70093741-WSP-CC-DR-C-062-P01	P01
Community Connections Area 3 (Bath Road)	70093741-WSP-CC-DR-C-063-P01	P01
Community Connections Area 4 (High Street, Norman Road)	70093741-WSP-CC-DR-C-064-P01	P01
Community Connections Area 5 (Manor Road, Saltford)	70093741-WSP-CC-DR-C-065-P01	P01
Community Connections Area 6 (Globe Roundabout to Bath Spa Campus)	70093741-WSP-CC-DR-C-066-P01	P01
Community Connections Area 7 (Osborne Road / Avondale Road, Bath)	70093741-WSP-CC-DR-C-067-P01	P01
Community Connections Area 8 (Grange Road, Saltford)	70093741-WSP-CC-DR-C-068-P01	P01

Appendix B Road safety audit problem location plan

Figure 1 – Section 2 Road Safety Audit Problem Location Plan

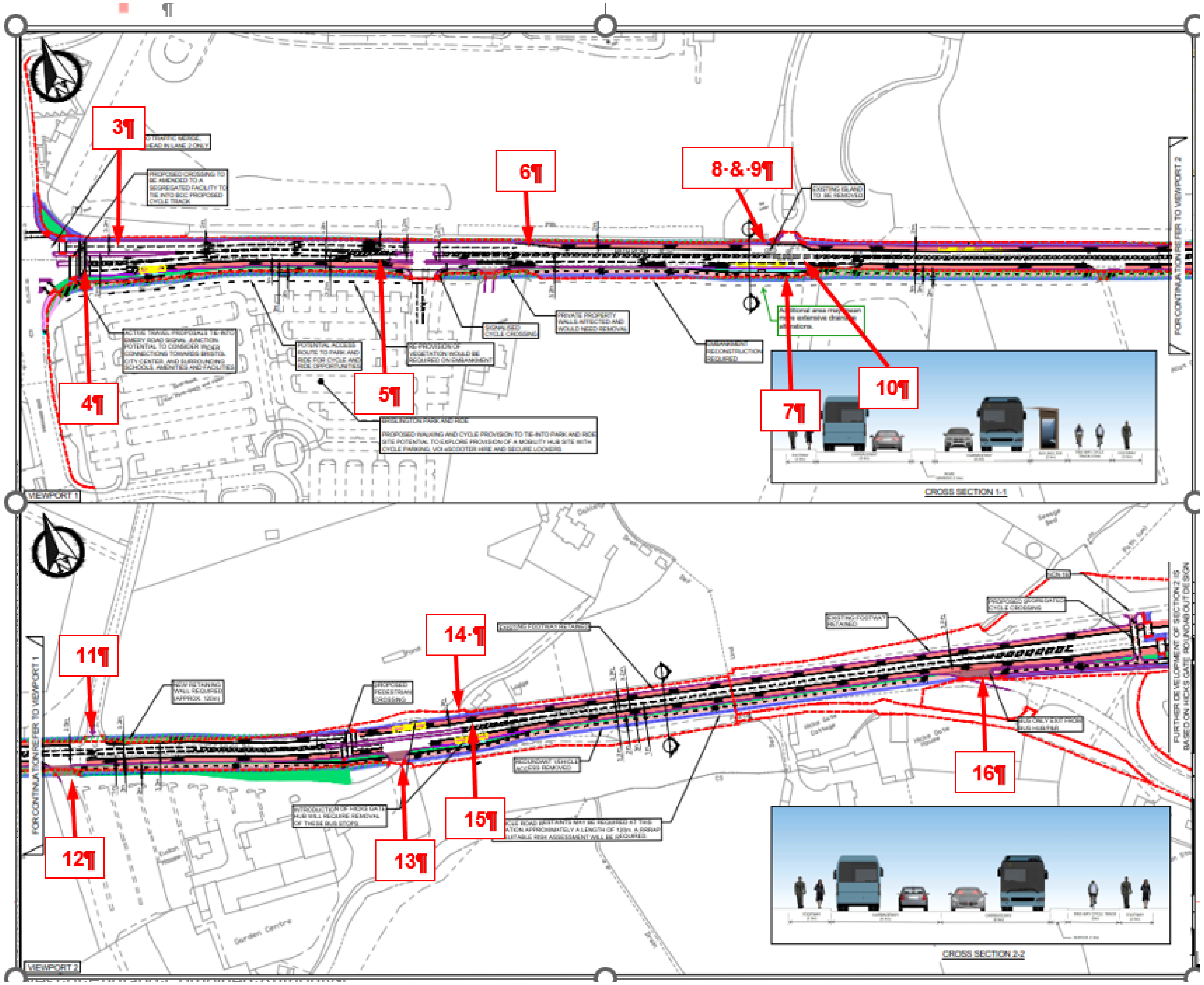
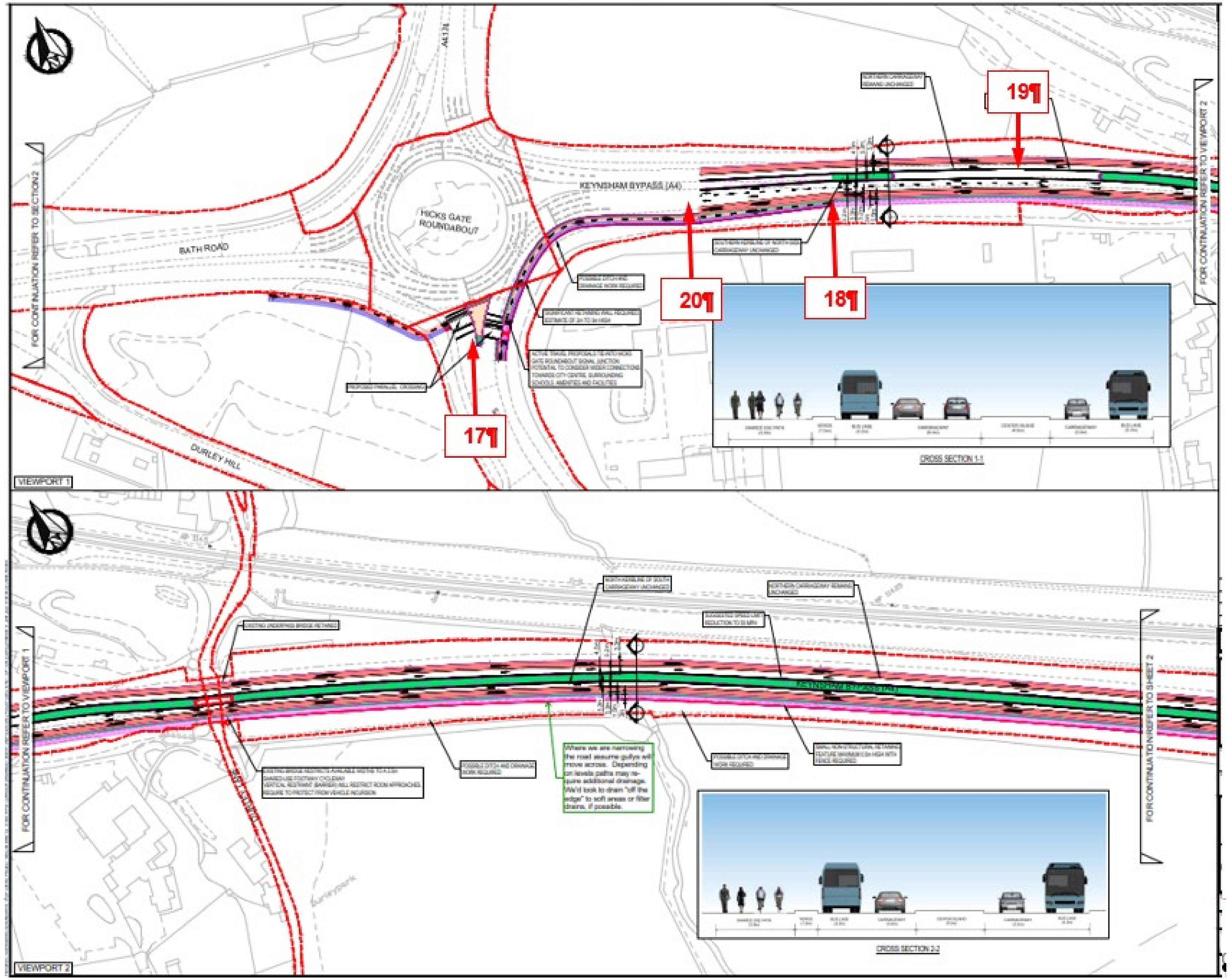


Figure 2 - Section 3 Road Safety Audit Problem Location Plan



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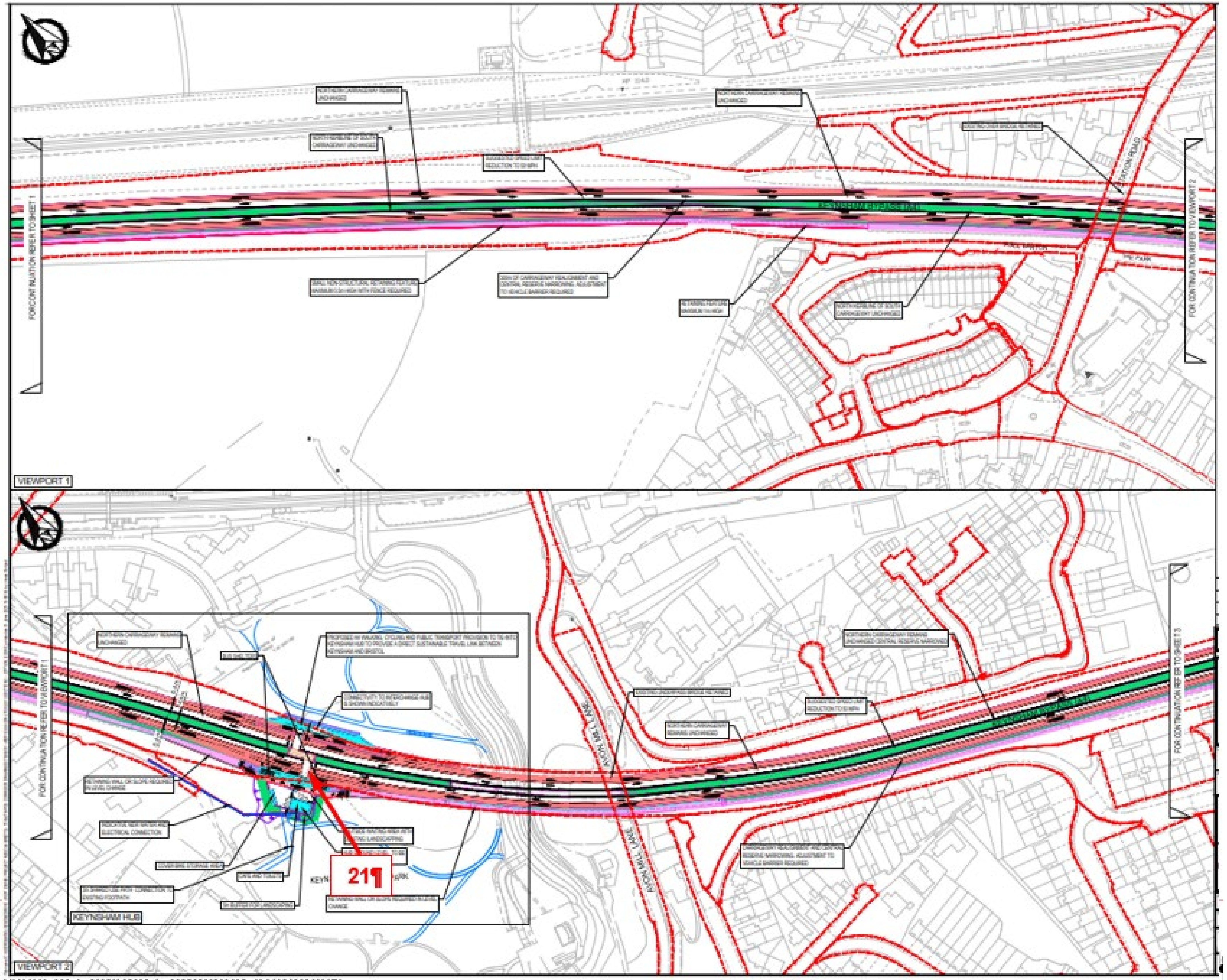

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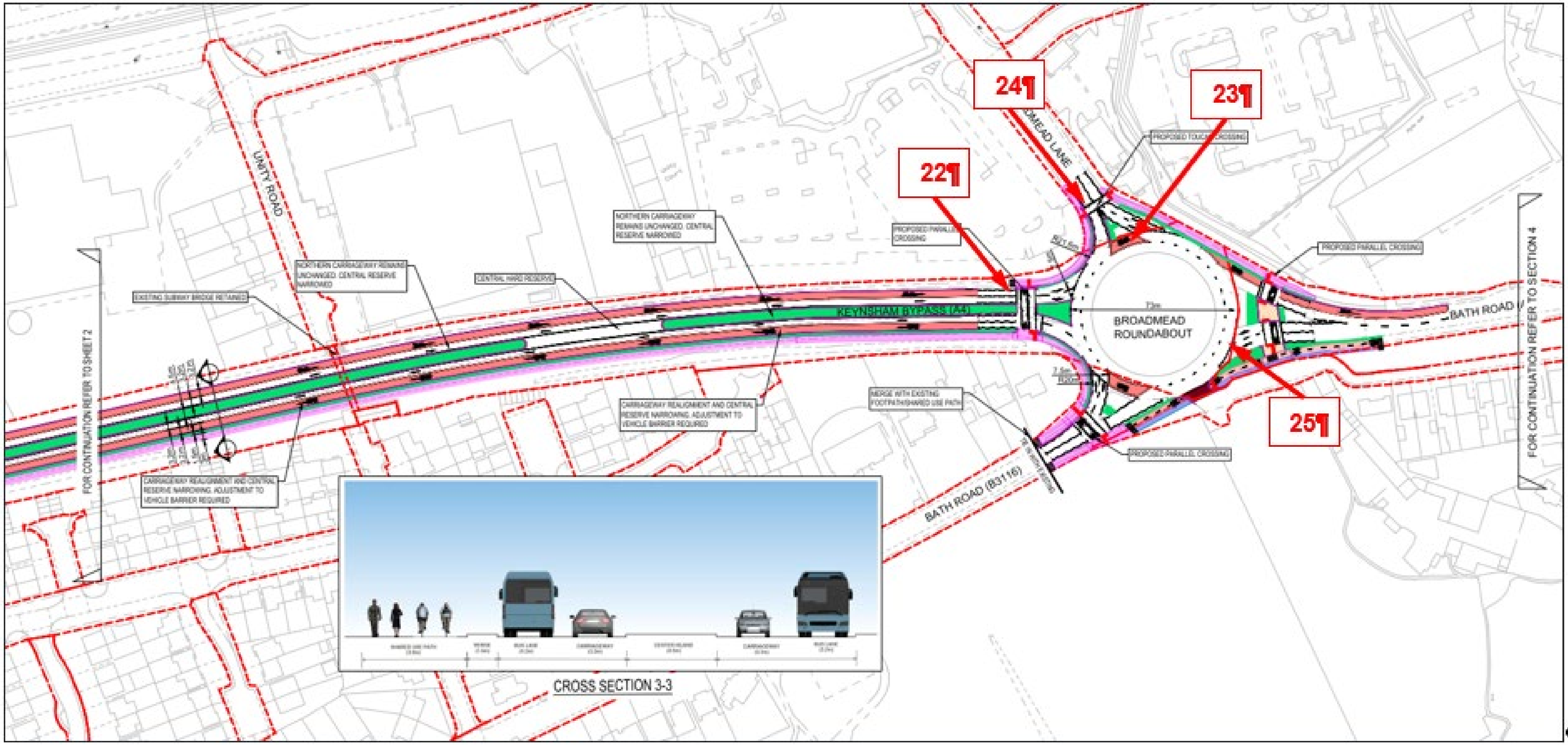

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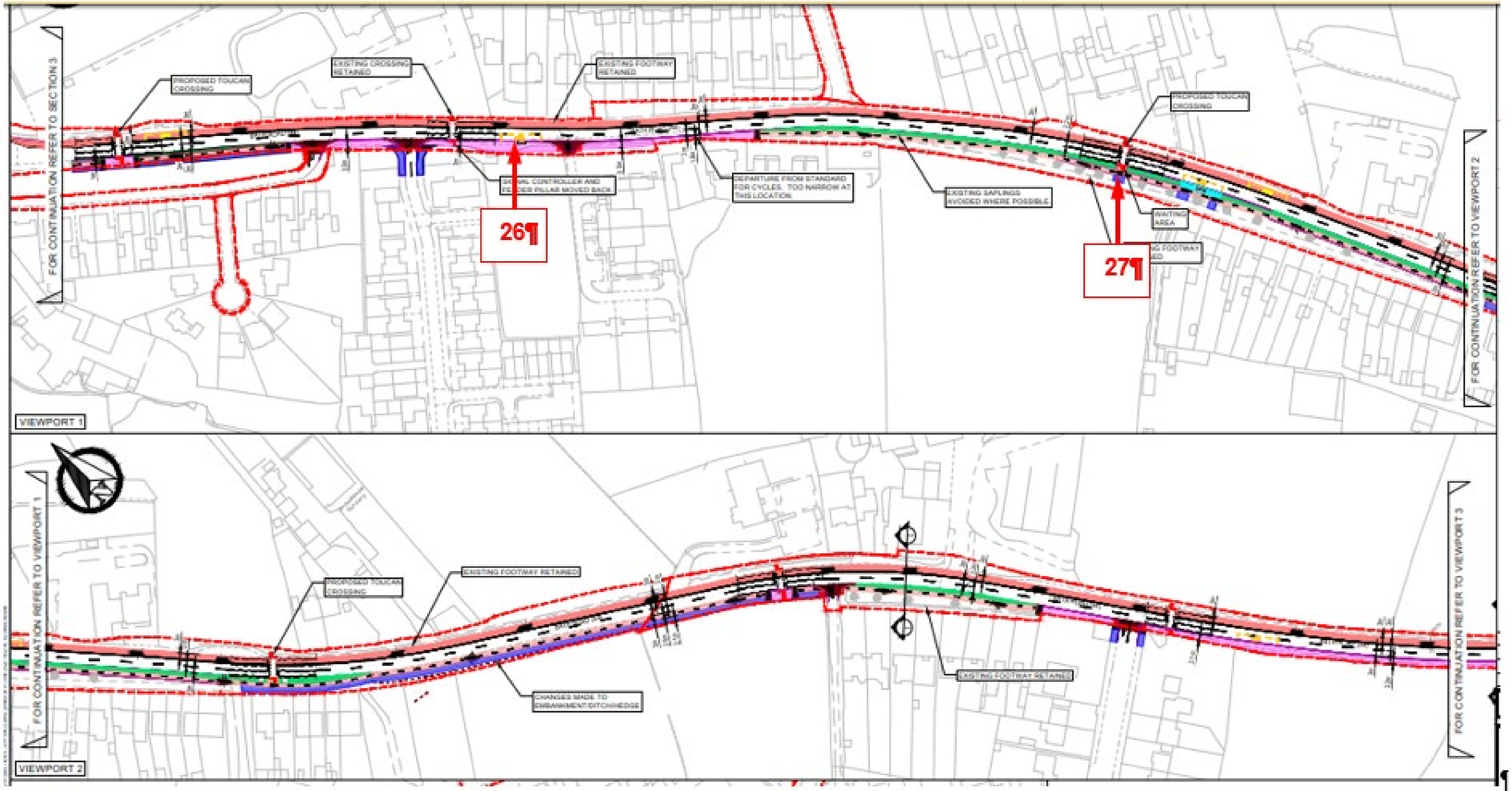

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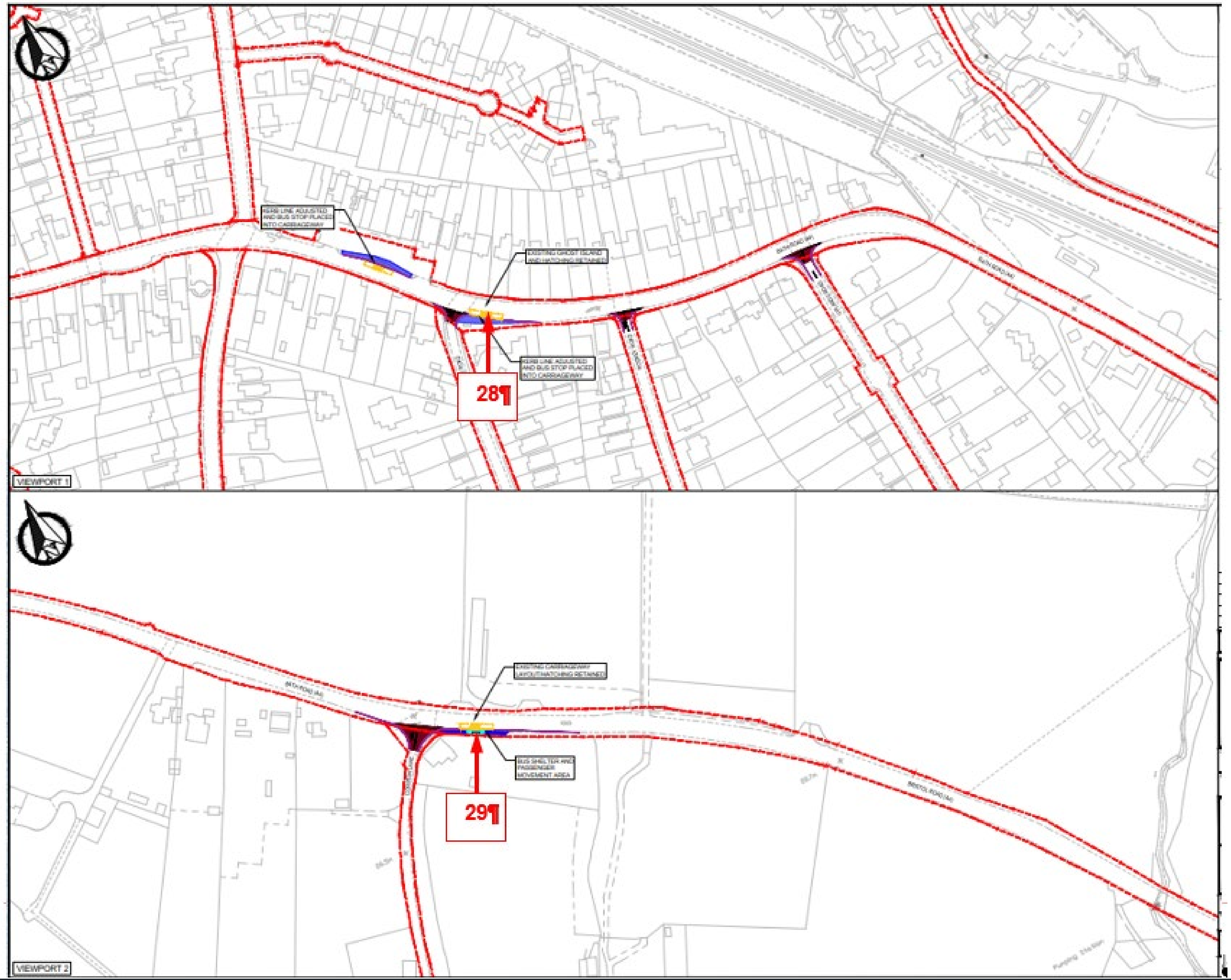

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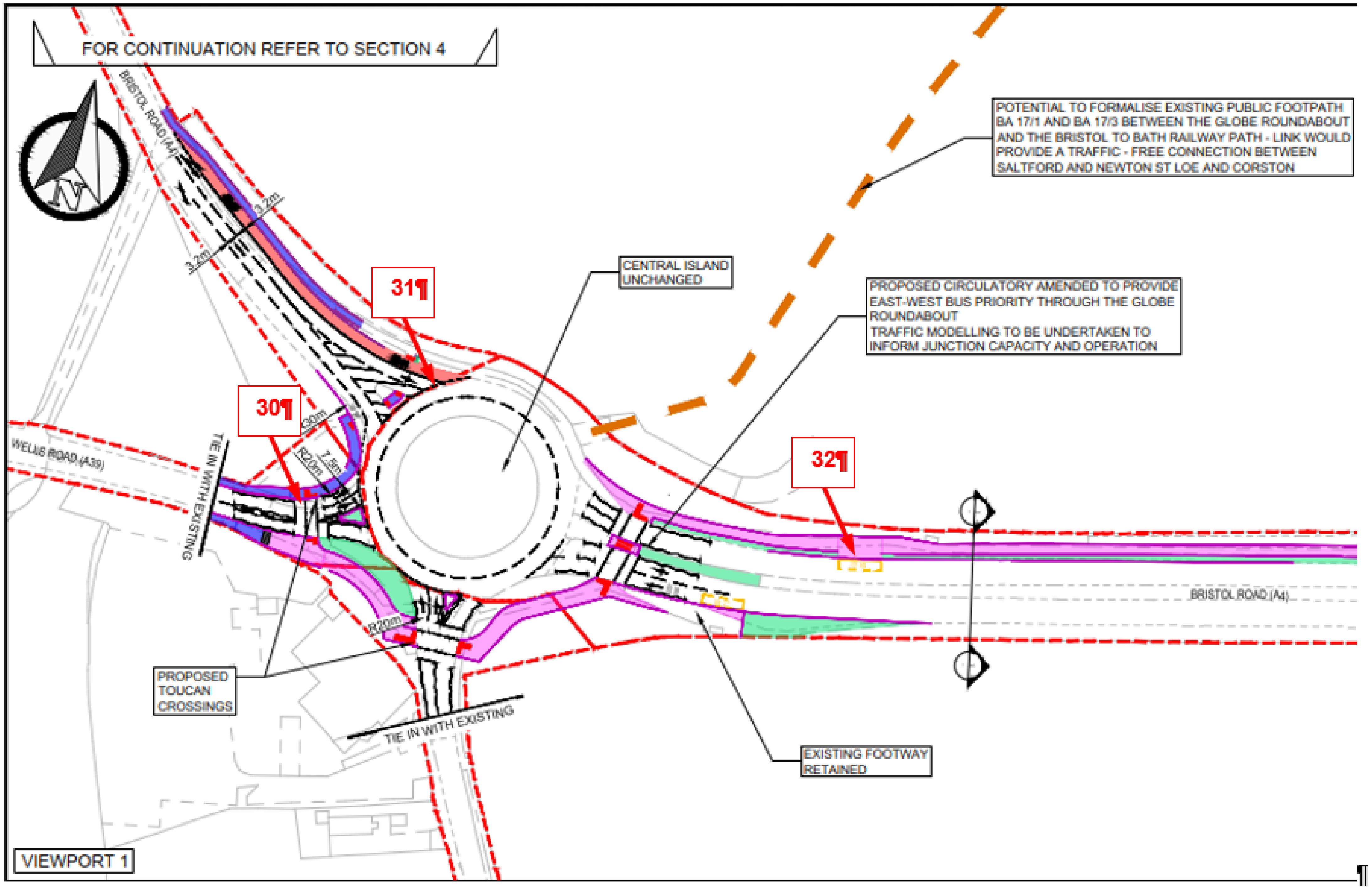

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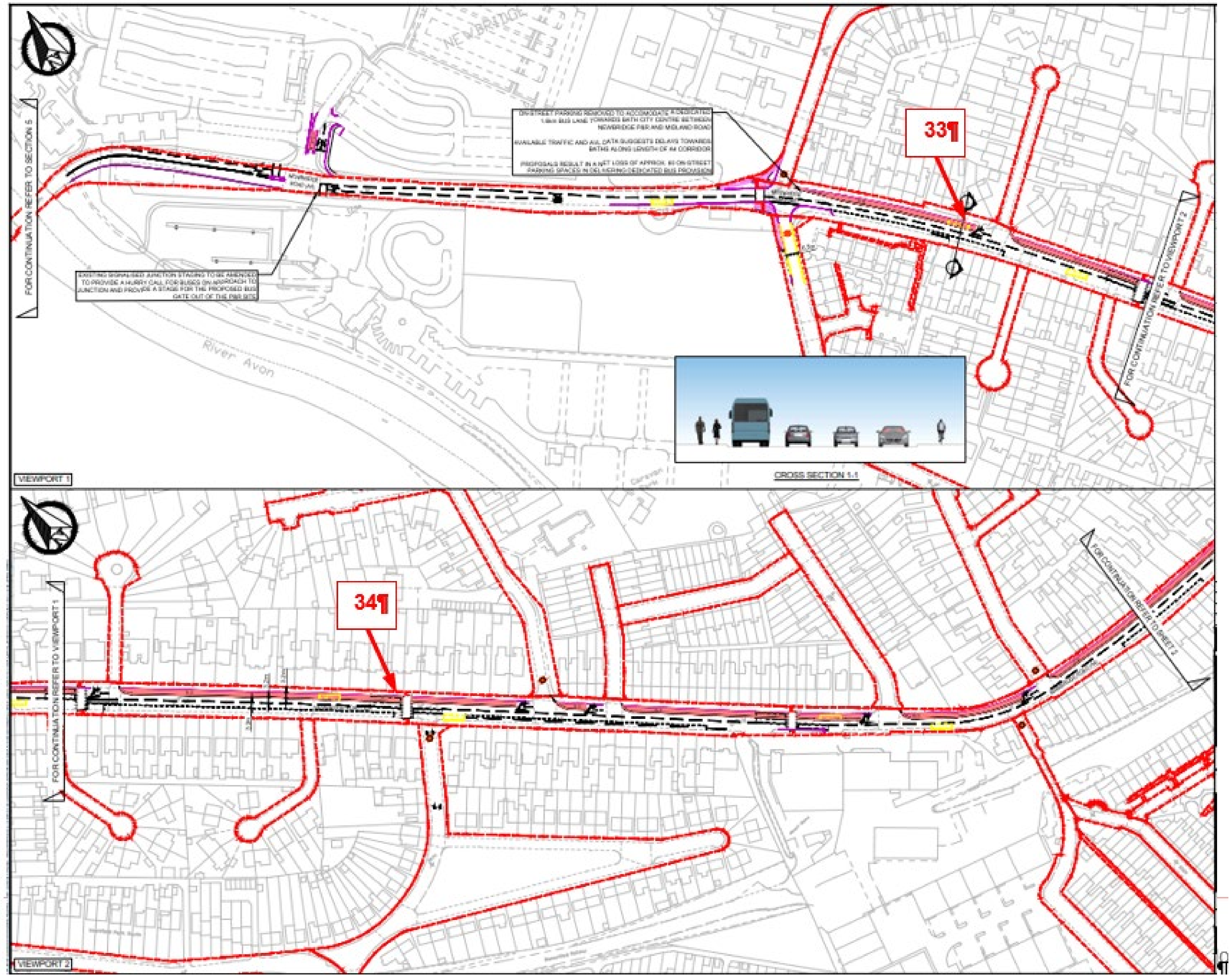

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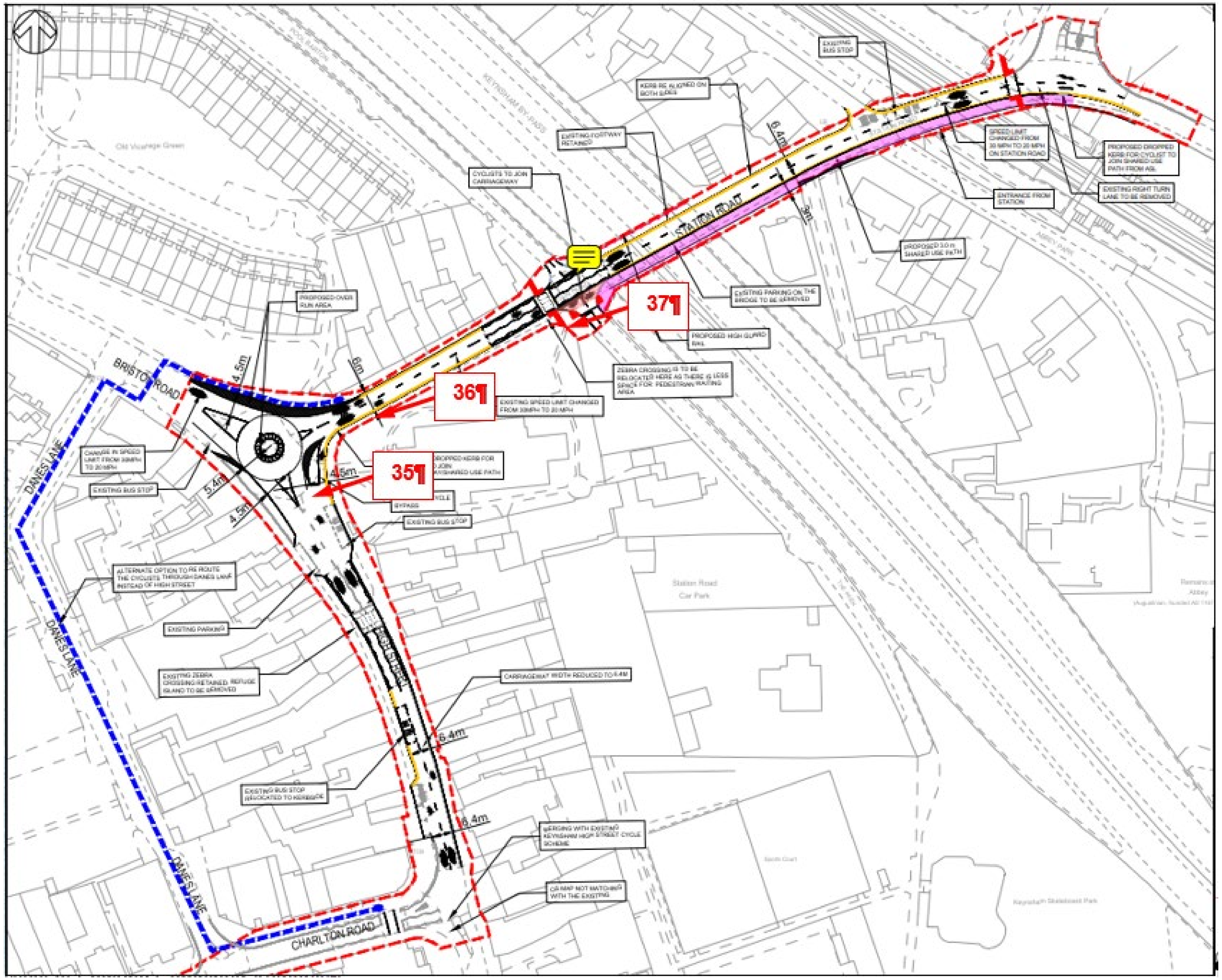

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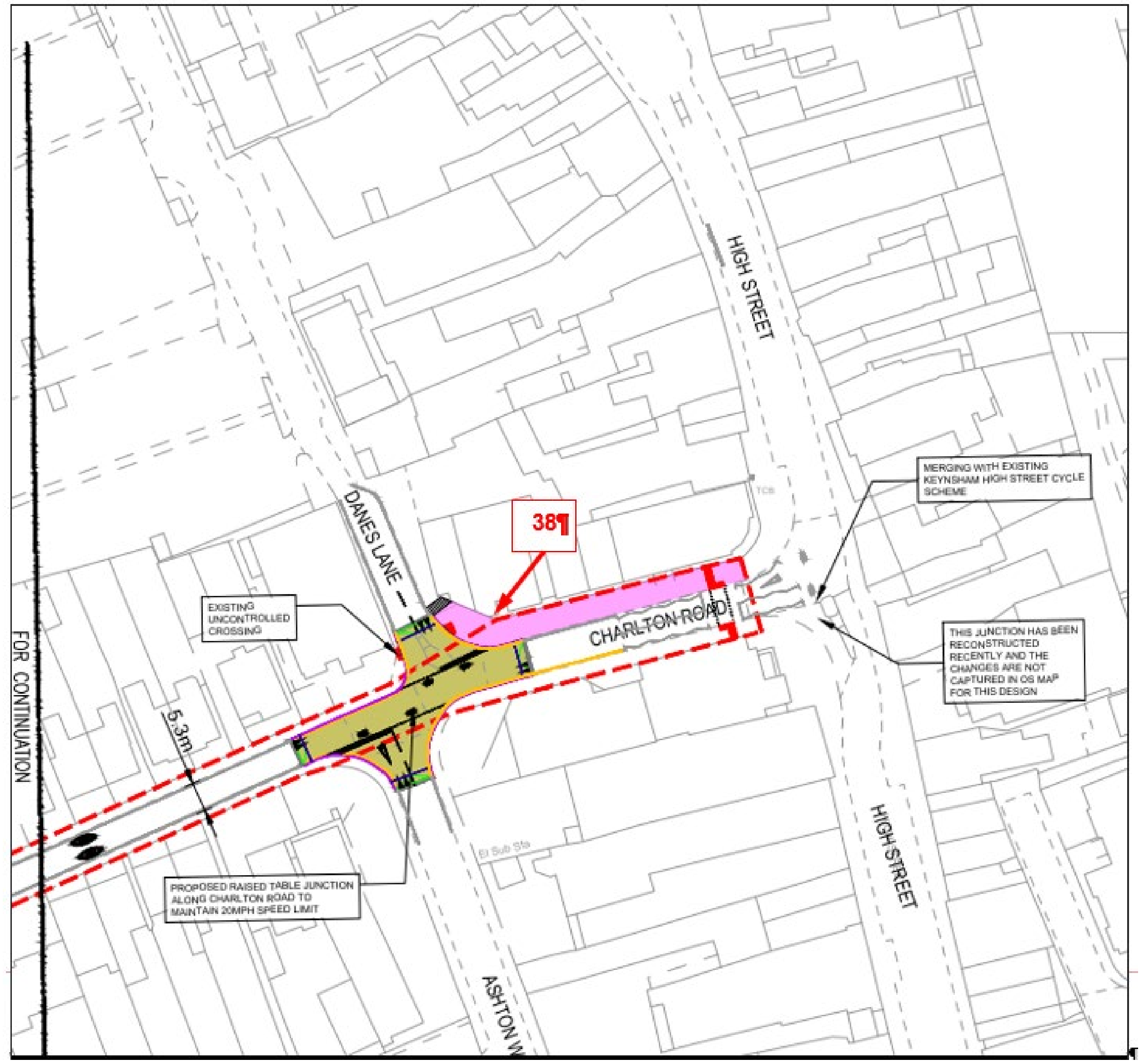

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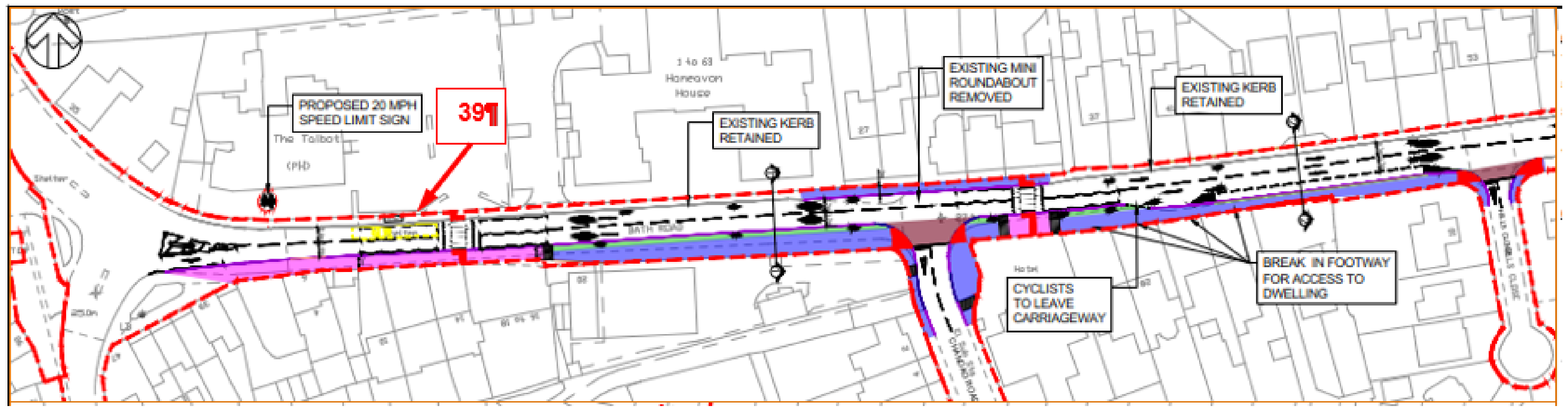

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix AF – Case for Change Note As part of the City Region Sustainable Transport Settlement (CRSTS)

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1 Background and Policy Context

1.1.1 Attracting new passengers and keeping current bus users is critical to the long-term success of a public transport network.

1.1.2 An effective network that is well planned, executed, and further developed, will attract new and retain existing users continuously through a virtuous cycle of growth and improvement:

Figure 1-1 Virtuous cycle of bus network planning and delivery

1.1.3 Supporting this approach, the UK Government set out their plans for significant growth in the local bus service market through the National Bus Strategy: Bus Back Better in 2021.

1.1.4 This strategy challenged local transport authorities to work in partnership with all local bus service providers and focus on five areas for improvement and investment designed to make buses:

- More attractive for passengers
- More affordable
- Easier to understand and use.
- Faster and more reliable
- Greener

1.1.5 The Combined Authority has set out a goal of returning bus patronage to pre-pandemic levels by 2025 across the region and raising it further by a minimum of 24% by 2030. This is especially challenging in the current climate, where the latest Annual Bus Statistics show that for the South West of England, patronage is still at 79% of pre-pandemic levels. One accepted industry approach known to deliver a wide range of benefits that will make substantive in-roads to meeting this goal is to make our bus services more reliable and reduce the amount of time it takes to operate them and in so doing, meeting the main priorities that most people place on public transport when choosing it – frequency, consistency, and reliability.

1.1.6 Providing a network that prioritises buses and makes them the mode of choice when considering a journey is a very important step towards long-term sustainability.

1.1.7 Capital investment targeted to enable a step-change in service quality, appeal, and experience will not only help us to meet our 'net-zero' targets by facilitating a move from private cars to public transport but will also help to make the provision of local bus services more financially viable and commercially sustainable – meaning that investment today can mean decreasing levels of ongoing support from the Combined Authority in future years.

2 Why buses matter

2.1.1 Buses enable access to essential services, education, and employment opportunities, and help reduce congestion as a more efficient mover of people. Together, this supports a more viable and attractive community. They are particularly essential for those without access to a private car, helping to tackle transport poverty and contribute to reduced social inequalities, but provide choice for others.

2.1.2 We understand that the punctuality (buses running on time) and reliability (the bus service running in the first place) are the most important things for our communities. Our BSIP target is 95% of buses running on-time by 2027, a step change in performance that currently stands at 80% - this is important as all local bus operators have a legal obligation to operate services punctually and reliably. Bus priority schemes will support us to do better with incremental changes to our network being the best way for us to deliver improvement.

2.1.3 The other side of the coin is that we need to build patronage – to get more people riding buses more often – people do this when they see buses that run on time, are frequent, clean and high quality, well branded and where buses operate from high quality stops and interchanges across a simple to understand network. The Combined Authority sees the income generated from increased bus use as the other part of the equation - making buses commercially sustainable without scarce revenue top-up funding being needed from the local transport authority year after year.

3 The Bath to Bristol corridor

3.1.1 The Combined Authority has an ambition to enable communities along the A4 corridor between Bristol and Bath to be connected by sustainable modes to travel to key places of employment and study as well as having the opportunity to enhance the social side of their lives positively through increased levels of accessibility over longer periods of the day.

3.1.2 The Combined Authority has a target to significantly increase the use of buses and sees improvements to public transport infrastructure as essential to increase the accessibility to the network and the attractiveness of bus - helping us to meet our goal and making the financial case for more frequent buses that operate for longer hours.

3.1.3 Good levels of bus punctuality and reliability are important for residents along the corridor and bus priority schemes can support in enhancing the network with several small changes creating a cumulative long-term improvement.

3.1.4 Several sections of local bus route between main locations along the A4 between Bristol and Bath have been identified as having potential to accommodate bus priority measures. While much of the corridor is constrained, it is important to deliver infrastructure on the identified sections, as these will achieve time savings and decrease journeys times for buses along the corridor. This is important as consistent time savings will make the bus more attractive and help to reduce costs for operators.

3.1.5 A significant change in the cost of operating buses occurs if we can reach a point where either a bus and driver can be removed from the operational cycle whilst retaining the same number of buses each hour, or more importantly the same number of resources can increase the number of buses each hour.

3.1.6 To achieve either of these changes, we need to build the bus priority infrastructure schemes planned for the corridor as these will generate the journey time savings needed to positively improve local bus services.

3.1.7 We have studied performance data across the A4 between Bristol and Bath and have concluded that small time savings achieved by bus priority features in each critical location where buses experience journey time delays will add up to attractive levels of journey time savings.

3.1.8 The net result of these savings would see reduced journey times and increased punctuality and reliability for all bus services. This will not only meet the Combined Authority's target for on-time performance but will also afford local bus operators the opportunity to reinvest these time savings positively into increased levels of service frequency.

3.1.9 Across the A4 corridor between Bristol and Bath, may services operate on some or most of the corridor. This includes services that operate within Bath or within Bristol, Park & Ride services and Airport services too. This note focuses on the following group of services:

- X39 (39) Bath to Bristol
- 9 Brislington Park and Ride (P&R)
- 349 Bristol to Keynsham
- 552 Bristol to Bath via Radstock

3.1.10 We will now outline the potential for each of these services to benefit from the bus priority measures through an analysis of existing service metrics.

4 The X39 (39) Aquae Service

4.1.1 This local bus service is the primary route operating along the A4 corridor between Bristol and Bath. Operated on a commercial basis by First Bus, this route currently operates every 15 minutes.

4.1.2 The existing service is provided by ten vehicles which all require 150 minutes to make one full round trip (Bristol to Bath and back to Bristol). The operator currently allows for excess recovery time at each end of the route within this round-trip time to account for high levels of congestion (which regularly varies by time and day) across the route. This recovery time can see buses stand at Bristol and Bath for long periods when traffic is lighter to ensure they depart on time – this is time that could be better spent operating services if the trip times could be made more reliable. Current timetabled running between each route end is 58-minutes (Bath-Bristol) and 61-minutes (Bristol-Bath), a total of 119-minutes.

4.1.3 Considering the two outcomes that can result from improvements to journey times brought about by bus priority measures, the following is outlined for the X39 (39) Aquae service:

- To save one bus from the service a fifteen-minute reduction in the scheduled round-trip time (to 135 minutes) would be needed. This bus could then be used to run an additional service.
- To keep the existing fleet of ten buses but use them to provide more journeys per hour, then to increase the service to five buses each hour (one every 12-minutes) would require a 30-minute reduction in round-trip time and to increase the service to six buses each hour (one every ten-minutes) would require a 50-minute round trip time reduction.

4.1.4 The schemes proposed along the A4 corridor are aimed at delivering journey time savings towards the above outcomes.

4.1.5 The Bristol section consists of improvements in the short term followed by a longer-term redesign of the network which will substantially change the way cars and buses interact on this section and will deliver time savings by making temporary peak period bus lanes permanent and ultimately providing continuous priority between the stops of Arnos Vale and Brislington Square.

4.1.6 Beyond Brislington several bus priority measures are being considered using a mixture of bus lanes, junction treatments, priority signals and segregated interchanges.

4.1.7 These would be located along the corridor at over fifteen locations where small/medium scale bus priority measures will collectively create journey time savings up of up to five minutes for each round-trip. The measures would be installed at locations between Brislington House and Windsor Villas.

4.1.8 Between Windsor Villas and the centre of Bath, the Bath City Centre project is looking at developing further improvements to the transport network, both for public transport and for those walking, wheeling and cycling. This is particularly aimed at delivering improvements around the Bus Station, where delays often occur. Improving access to Bath Bus Station and removing the large levels of journey time variability will provide significant levels of confidence in planning consistent and shorter journey times.

4.1.9 Using information supplied by First Bus to understand where delays are currently occurring, and to then simulate new round trip times based on delay being removed in line with current proposals we estimate that each section of the A4 corridor may see round-trip time savings.

4.1.10 These savings will allow bus companies to re-plan timetables using consistent bus operating speeds using the following times:

- Bristol City Centre and Brislington a maximum of eight-minutes.
- Brislington and Bath (Royal Victoria Park) a maximum of four-minutes.

4.1.11 These figures suggest that a total round-trip time saving of at least 12-minutes may be found in each bus's round-trip time per journey, potentially reducing each round trip from 119-minutes (the timetabled running time without recovery) to 107-minutes.

4.1.12 However, added to these journey time savings are additional time savings that can be made by reducing the recovery time given to each bus if bus priority measures can ensure consistent journey times across all periods of the day. Currently recovery time of around 30-minutes is allowed for by the bus operator, around 21% of overall round-trip time.

4.1.13 A standard approach to recovery time when journey times are consistent is to allow 10% of additional time in each direction, so for example a one-hour trip in one direction would need six minutes at each route end for the bus to recover any unplanned late running and allow for the service to turn around and be ready to depart for its next trip.

4.1.14 When this is applied to the earlier results for the lower journey time that may be expected if all the bus priority measures are implemented along the A4 corridor between Bristol and Bath (107-minutes) an additional ten-minutes may be added for recovery, leading to a new round trip time of approximately 117-minutes per bus.

4.1.15 This represents up to 33-minutes of saved time per round-trip and potentially means that using the same number of buses will allow the service provision to improve to at least five buses each hour (one every 12-minutes) and possibly six buses each hour (one every ten-minutes) where further operational savings could be found.

5 Other Corridor Services

5.1.1 The same approach can be taken to assess each of the remaining local bus services that operate across the A4 corridor, though each of these operates either in-part along the corridor or takes a substantively longer route to serve locations outside of the core corridor boundary (for example, Radstock).

5.1.2 Service 9 provides the cross-city Park & Ride service between Portway and Brislington. The route currently operates five buses each hour in the peak and four in the off peak after previously running six buses per hour in 2021.

5.1.3 Analysis of the journey time information available shows that services currently operate with a total round-trip time of 105-minutes using seven buses.

5.1.4 However, with a 15-minute round-trip saving the current route would be able to operate with one less vehicle. Further, if 21-minutes can be saved from the round-trip time, the service could be increased back to a six buses per hour, without adjusting recovery time and using the same number of buses. Reducing recovery time to the minimum feasible may be able to contribute towards some of these results, however, the service 9 has relatively low layover time already for a round trip and if lowered may cause punctuality problems due to traffic congestion and late departures from the termini.

5.1.5 In addition, due to the service 9 being a Park and Ride service, it is optimal for the service to have a bus waiting at the termini on either side of the route, so passengers can board immediately after parking their car and in turn increasing the vehicles in operation higher than current levels.

5.1.6 The journey time savings indicated for the Bristol City Centre to Brislington section of eight-minutes go some way to improving the reliability of service 9 but would need further bus priority measures to be added between Portway and Bristol City Centre to allow a reduction in the number of buses used or an increase in the service frequency.

5.1.7 Service 349 operates between Keynsham and Bristol City Centre with two buses each hour providing a core commercial bus service that is operated by First Bus.

5.1.8 The current round-trip time for the service is 121-minutes, with this including recovery time. The buses on service 349 currently change routes in Bristol to help the operator reduce the number of buses operated each day across the network and this makes understanding the levels of recovery attributed to the service difficult.

5.1.9 However, using the suggested round-trip time and service frequency each hour we can assume that five buses are used to operate the service. Based on this information a reduction in round-trip time of just one-minute would allow one bus to be saved from the route (however, this is likely to be a little higher to allow the bus to operate another bus route from Bristol). Further, using existing bus levels, a round-trip time saving of 21-minutes would be needed to increase the number of buses each hour from two to three (one every 20-minutes).

5.1.10 Collectively, bus priorities being proposed between Bristol and Keynsham would allow one bus to be removed from the route and for reliability to be significantly improved. With changes to the operation of the service (such as disconnecting it from another service in Bristol) it would be possible to isolate the 88-minutes of round-trip time, add a standard

5.1.11 10% recovery time to the service adding nine-minutes and seeing an overall round-trip time of 97-minutes and then reduce this by time saved through the bus priority measures (approximately 10-minutes) to run three buses each hour (one every 20-minutes) with the current allocation of five buses to the route as this would be based on a round trip time of 87-minutes (including recovery).

5.1.12 The final service along the corridor is service 522. This is complicated by two separate routes combining into one with some buses operating only Bristol to Keynsham and others running Bristol to Bath, via Keynsham and Radstock. The result is a combined service with two buses between Bristol and Keynsham but only one bus to and from Bath each hour.

5.1.13 Journey time savings would apply equally as those for service 349, but with only one bus each hour on each service section it is felt that bus priorities would only assist the 522 with punctuality and shorter journey times.

Table 5-1Current service frequency and required improvement for selected services on the corridor

Service	Current Frequency	Time Savings Required to increase frequency
X39	4 per hr	30 minutes to increase to 5 per hr
9	5 per hr	21 minutes to increase to 6 per hr
349	2 per hr	21 minutes to increase to 3 per hr

6 Summary for the Analysis

6.1.1 Without making these changes to our transport network that will influence a change in our travel behaviours, we stand to lose the opportunity to strengthen existing commercial services in partnership with local bus service operators and to see the benefits of increased growth stimulate organic expansion of the local bus network that will meet people's needs for a more accessible and longer running daily bus network.

6.1.2 Further, we need to create an environment for sustainable commercial services that can continue to stand on their own two feet in the face of headwinds that challenge their financial viability, such as congestion, the cost of travel, and the ease of choice. If we do not, then the Combined Authority may be forced to make hard choices about whether it funds the main corridor through commercially operated services, extending their daily appeal and accessibility credentials, at the expense of assisting non-commercial 'supported services'. These are run for social reasons to connect communities living in places where operating buses is not commercially viable to the main corridor network.

6.1.3 Through recent improvements to the commercial and supported services across the region we have seen strong patronage growth, especially on urban corridors. Improvements such as those planned on this corridor play a key part in bridging the gap between the recent growth and the regional BSIP targets.

6.1.4 With the package of bus priority measures proposed across the A4 corridor between Bristol and Bath there is a significant opportunity to build on this strong inter-urban service growth. Analysis of existing service patterns and projected journey-time savings generated by the full package of bus priority measures demonstrates that service trips per hour can be significantly improved at no ongoing cost to the Combined Authority as the improvements are not likely to increase existing bus resources. The increase in mileage generated by additional trips across the day is likely to be more than paid for by the increase in demand which may be in the order of 15% to 25% dependent on which service is considered. These levels of growth also present a commercial argument to extend higher levels of service provision later into the evening and across weekends – both significantly improving people's accessibility to a range of social and employment opportunities outside of the traditional peak hour period.

6.1.5 As patronage is already being boosted by existing approaches of more frequent and reliable services and lower fares, there is an evidence base that suggests people need, and want, to use local bus services in our region. To lock this in we need to complete the journey time and reliability improvements proposed for the A4 between Bristol and Bath, and demonstrate that this is possible within existing service resources.

6.1.6 Even very small reductions in the anticipated benefits along the corridor would compromise the overall package's ability to significantly increase the number of buses per hour in each service and the future levels of service and accessibility that our communities will benefit from.

6.1.7 As well as patronage growth stimulated by the reliability, frequency, and shorter journey times that the proposed bus priority measures will bring, there are other complementary factors that can affect journey times and therefore need equivalent treatment to maximise the benefits brought through substantive capital investment in traditional bus priorities. These include bus stop design (affecting boarding and unloading times and how easy it is for buses to get into/out of bus stops), parking, the capacity of buses and how this relates to demand at different times of the day. The Combined Authority's long-term plan for buses includes action on all these issues though understand that none of them make the same level of difference on patronage growth that reliability, frequency and journey time savings can achieve through the more substantive bus priority measures proposed.

6.1.8 Implementing improvements to local highways and changing behaviour around the way public transport is used are fundamental in maintaining services and ensuring that they remain commercially viable with population and traffic growth. Commercial viability of the services is important to weigh up for the local bus operators involved, with most of the routes already being commercial at existing service levels.

6.1.9 Keeping traffic moving is vital as more bus passengers means fewer cars on the road, which is vital for those that have no other choice for their journey. In the new Local Plan, the council is not planning to deliver lots of major new highway improvements like those seen in the past. The emphasis is on infrastructure that aligns with our commitment to reduce carbon, and this means car use reducing by 40%.

6.1.10 If we fail to achieve mode shift onto bus and other options, the effect will be increasing traffic on a network with fewer options and limited space. The choices we make around investing in bus services will directly affect traffic and congestion on the network in the longer term.

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix AG - 2023 Analysis of Automatic Vehicle Location Data

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Contents

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1 Introduction

1.1 Project background

1.1.1. The A4 Bath to Bristol Strategic Corridor (BBSC) has been developed jointly by the West of England Combined Authority, Bristol City Council (BCC) and Bath & North East Somerset Council (B&NES).

1.1.2. The primary aim of the BBSC is to connect new and existing communities along the A4 via sustainable modes of transport to places of employment, study, and key services to enhance the lives of existing and future residents and those travelling to, and along, the corridor. The objectives are:

- To facilitate economic growth along the corridor by improving the public and active travel opportunities. This includes delivering infrastructure which improves access for existing communities and also infrastructure that unlocks new opportunities for sustainable growth.
- Improve public transport infrastructure in the study area to increase the number of people who have access to and use buses to contribute to growing patronage of the X39 (or increase in equivalent new service/bus rapid transit service along the corridor) by at least 24% by 2030.
- Improve walking, wheeling and cycling infrastructure in the study area to contribute to increasing the number of people using the corridor for active travel modes including to increase the number of people commuting by walking, wheeling and cycling modes to 25% of total modal share by 2036.

1.2 Purpose of the note

1.2.1. This note documents the analysis undertaken to produce evidence for potential journey time savings for buses brought about by the scheme. This predominately involved the analysis of data provided by FirstBus for the X39 service running between Bath and Bristol. The note includes the following sections:

- Automatic Vehicle Location (AVL) Data
- Methodology
- Results, and
- Conclusion and Summary

2 Automatic vehicle location data

2.1 Description of the dataset

2.1.1. The Department for Transport (DfT) require Bus Operators to provide continuous feeds of bus locations as part of the Public Service Vehicle Open Data England Regulations via the Bus Open Data Service (BODS). BODS incorporates (amongst other things) Automatic Vehicle Location (AVL) data, which itself records GPS traces for all active bus vehicles within the Bus Operators fleet:

- information about the location of the vehicle along a route;
- where available, the location of the vehicle in relation to a stopping place;
- the vehicle identifier;
- the name or number of the service;
- the time the vehicle started its journey; and
- the finishing point of the vehicle.

2.2 Data provided

2.2.1. FirstBus have provided a derivative AVL data for the X39 service running between Bath and Bristol Bus stations for the full period between 2nd April 2023 until 30th June 2023. The data covers all days of the week, over the entire day and in total covers over 356,000 individual datapoints, but only contains scheduled arrival, actual arrival and actual departure times for each stop.

3 Methodology

3.1 Filtering

3.1.1. The dataset has been filtered to derive bus journey times for several different time periods, for use in the wider project as follows:

Table 1 - AVL filtering

Filter day	Filter time	Use
Monday - Friday	AM period (07:00 – 10:00)	To inform potential bus journey time savings for inclusion in strategic modelling undertaken in WERTM
Monday - Friday	Interpeak (10:00 – 16:00)	To inform potential bus journey time savings for inclusion in strategic modelling undertaken in WERTM
Monday - Friday	PM period (16:00 – 19:00)	To inform potential bus journey time savings for inclusion in strategic modelling undertaken in WERTM
Monday - Friday	12-hour period (07:00 – 19:00)	Indication of typical potential bus journey time savings

3.1.2. Bank holidays and school holidays have not been removed from the analysis at this stage. The methodology applied has been set up so that it can be easily applied to similar datasets for other bus services in the West of England and to allow maximum flexibility in the bus times being analysed.

3.2 Calculation of potential bus journey times savings

3.2.1. After considering the data which had been provided it was decided that in terms of calculating the potential for bus journey times along the A4 corridor, it would be most informative to analyse ‘stop-to-stop’ times. This is the time taken to travel from the preceding stop to each stop. This enabled the removal of bus wait times at bus stops which the BBSC scheme will do little to address and are assumed to persist into the future.

3.2.2. From preliminary inspection of the AVL data it is apparent that there is large variability in bus journey times along the A4 corridor. Therefore, it is useful to calculate not only average bus journey times, but also journey times split into specific centiles. This is due to the large volume of data and the difficulty in discerning between the large number of similar journey times and the large number of skewed and excessive journey times when the buses are delayed.

3.2.3. The 5th centile stop-to-stop time (i.e., 5% of buses travel in less time) and the 95th centile stop-to-stop time (i.e., 5% of buses travel in more time) have been calculated, though again the methodology applied allows flexibility and alternative centiles could be used in the analysis. Ultimately the 5th and 95th centile was used as they equate to 1 journey in every 20, or the equivalent to once per month for a commuter using the bus every weekday.

3.2.4. The data has been summarised in tabular form and as ‘box and whisker plots’ which graphically show:

- the 5th centile
- the 95th centile
- median, and
- mean

4 Results

4.1 Current conditions

4.1.1. Figure 1 to Figure 8 show the results of the AVL analysis for the two directions and each of the time periods listed in Table 1. The location of the proposed bus lanes is indicated in red. Other stop-to-stop locations in the scheme area are shown, some that have large variability and delay; however, changes aren't proposed at these locations due to the constraints on the network precluding the provision of priority measures. The results are summarised below in Table 2 and Table 3. Overall, the results are summarised as follows:

- average overall stop-to-stop journey times are relatively consistent across the day;
- in the westbound direction stop-to-stop times are slowest in the PM period at 48 minutes and 45 seconds;
- an identical average slowest end-to-end stop-to-stop journey time of 48 minutes and 45 seconds has been calculated in the AM period in the eastbound direction;
- the 5^{th} centile total end-to-end stop-to-stop journey times are around 25 minutes; whereas
- the 95^{th} centile end-to-end stop-to-stop journey times are slower at 1 hour 30 minutes;
- the longest journey times and largest journey time variability is observed between Highs Gate and Ellsbridge House;
- there is greatest variability and highest journey times eastbound in the AM period;
- there is greatest variability and highest journey times westbound in the PM period.

Table 2 - X39 Bus journey times westbound

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Bus Station – Westgate Buildings	03:57	02:18	07:21	04:12	02:30	07:30	04:18	02:30	08:10	04:08	02:27	07:30
Westgate Buildings – Monmouth Place	01:01	00:10	02:53	01:16	00:10	03:40	01:14	00:10	03:42	01:12	00:10	03:30
Monmouth Place – Nile Street	00:30	00:10	01:20	00:31	00:10	01:30	00:33	00:10	01:31	00:31	00:10	01:30
Nile Street – Comfortable Place	00:41	00:20	01:20	00:40	00:20	01:20	00:39	00:20	01:19	00:40	00:20	01:20
Comfortable Place – Park Lane	00:41	00:26	01:15	00:43	00:26	01:20	00:43	00:26	01:21	00:42	00:26	01:20
Park Lane – Windsor Villas	00:31	00:10	01:20	00:37	00:10	01:31	00:45	00:10	01:47	00:36	00:10	01:30
Windsor Villas – The Weston	00:51	00:28	02:00	00:52	00:28	02:04	00:53	00:29	02:13	00:52	00:28	02:01
The Weston – Horstmann Close	00:30	00:19	01:00	00:31	00:19	01:00	00:31	00:19	01:00	00:31	00:19	01:00

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Horstmann Close – Charmouth Road	00:38	00:25	01:10	00:38	00:24	01:10	00:38	00:24	01:10	00:38	00:24	01:10
Charmouth Road – Rudmore Park	00:37	00:22	01:09	00:39	00:23	01:10	00:38	00:23	01:10	00:38	00:23	01:10
Rudmore Park – Newbridge Gardens	00:32	00:20	01:09	00:32	00:20	01:00	00:33	00:20	01:00	00:32	00:20	01:00
Newbridge Gardens – Old Newbridge Hill	00:28	00:19	00:51	00:29	00:19	00:55	00:29	00:20	01:00	00:29	00:19	00:54
Old Newbridge Hill – Twerton Fork	01:13	01:00	01:40	01:28	01:00	02:45	01:45	01:00	03:40	01:24	01:00	02:31
Twerton Fork – The Globe	01:10	00:56	01:40	01:15	00:55	02:00	01:18	00:56	02:10	01:13	00:55	01:57
The Globe – Corston Lane	01:25	00:52	03:04	01:32	00:52	03:55	01:41	00:53	04:25	01:30	00:52	03:42
Corston Lane – The Shallows	01:58	01:00	06:43	02:12	01:00	06:46	02:18	01:01	06:49	02:08	01:00	06:46

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
The Shallows – Tyning Road	01:09	00:48	01:52	01:14	00:48	02:20	01:20	00:48	02:38	01:13	00:48	02:17
Tyning Road – Lansdown Road	00:25	00:08	00:51	00:27	00:09	01:00	00:27	00:09	01:00	00:26	00:09	01:00
Lansdown Road – Norman Road	00:33	00:16	01:00	00:30	00:13	01:00	00:29	00:16	01:00	00:31	00:14	01:00
Norman Road – Copse Road	00:35	00:19	01:03	00:33	00:14	01:06	00:32	00:16	01:00	00:33	00:15	01:06
Copse Road – Pixash Lane	00:42	00:28	01:00	00:41	00:26	01:01	00:39	00:27	00:58	00:41	00:26	01:00
Pixash Lane – Ellsbridge House	00:28	00:14	00:50	00:28	00:10	01:00	00:26	00:10	00:47	00:28	00:10	01:00
Ellsbridge House – Hicks Gate	04:53	03:46	06:10	04:26	03:40	05:30	04:26	03:40	05:28	04:32	03:41	05:41
Hicks Gate – Brislington House	00:34	00:18	00:56	00:35	00:17	01:00	00:36	00:16	01:05	00:35	00:17	01:00

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Brislington House – Emery Road	00:30	00:14	00:53	00:32	00:12	01:02	00:33	00:12	01:07	00:32	00:12	01:00
Emery Road – Flowers Hill	01:14	00:39	02:10	01:54	00:40	04:00	02:15	00:44	04:50	01:44	00:40	03:47
Flowers Hill – Brislington Square	02:29	00:46	05:56	01:57	00:40	03:37	02:11	00:43	04:19	02:05	00:41	04:21
Brislington Square – Eagle Road	01:24	00:34	03:30	00:50	00:24	01:33	00:49	00:29	01:23	00:58	00:28	02:06
Eagle Road – Tramway Road	00:40	00:16	01:27	00:36	00:11	01:15	00:34	00:15	01:09	00:37	00:12	01:19
Tramway Road – Arnos Court	00:28	00:10	01:00	00:26	00:08	01:01	00:26	00:08	01:02	00:27	00:08	01:00
Arnos Court – Arnos Court	00:43	00:12	01:31	00:39	00:11	01:20	00:40	00:11	01:20	00:40	00:12	01:20
Arnos Court – Paintworks	00:30	00:15	01:10	00:29	00:12	01:10	00:30	00:15	01:10	00:29	00:13	01:10
Paintworks – Totterdown Bridge	00:30	00:10	01:00	00:26	00:10	00:51	00:30	00:11	01:00	00:27	00:10	00:55

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Totterdown Bridge – Temple Meads Stn	04:35	02:55	06:35	04:07	02:47	05:41	04:32	03:05	06:07	04:13	02:49	05:53
Temple Meads Stn – Victoria Street	01:02	00:10	01:40	00:54	00:09	01:30	00:58	00:10	01:30	00:56	00:09	01:35
Victoria Street – Bristol Bridge	00:34	00:10	01:11	00:31	00:10	01:06	00:30	00:10	01:00	00:31	00:10	01:10
Bristol Bridge – Wine Street	01:46	00:41	03:10	01:40	00:37	03:00	01:46	00:40	03:00	01:41	00:39	03:00
Wine Street – Bus Station	04:46	02:30	09:17	04:56	02:46	08:58	04:37	02:40	08:20	04:54	02:40	09:01

Table 3 - X39 Bus journey times eastbound

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Bus Station - Wine Street	05:03	02:54	08:52	05:15	03:16	08:23	05:46	03:24	09:43	05:19	03:10	09:00
Wine Street - Bristol Bridge	03:31	01:07	05:42	03:28	00:58	05:50	04:03	01:10	06:20	03:37	01:00	06:00
Bristol Bridge - Victoria Street	00:52	00:26	01:30	00:53	00:24	01:54	01:04	00:24	02:20	00:56	00:24	02:00
Victoria Street - Temple Meads Stn	01:50	00:47	02:57	01:39	00:23	03:20	02:05	00:30	03:57	01:48	00:28	03:29
Temple Meads Stn - Totterdown Bridge	02:36	01:30	03:53	02:15	01:20	03:39	02:34	01:30	04:10	02:25	01:24	03:50
Totterdown Bridge - Paintworks	00:38	00:25	01:08	00:35	00:20	01:01	00:39	00:20	01:10	00:37	00:20	01:06
Paintworks - Arnos Court	00:38	00:15	01:27	00:42	00:10	01:51	00:44	00:09	01:51	00:42	00:10	01:50
Arnos Court - Tramway Road	01:11	00:44	02:10	01:21	00:40	02:42	01:34	00:45	03:30	01:22	00:41	02:50
Tramway Road - Eagle Road	00:30	00:10	01:07	00:28	00:10	01:07	00:34	00:10	01:40	00:30	00:10	01:12

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Eagle Road - Brislington Square	01:04	00:40	02:00	00:58	00:30	01:38	01:04	00:30	02:10	01:01	00:30	01:47
Brislington Square - Flowers Hill	01:11	00:39	02:00	01:10	00:30	02:00	01:14	00:37	02:10	01:11	00:36	02:00
Flowers Hill - Emery Road	00:45	00:10	01:40	00:39	00:10	01:31	00:38	00:10	01:20	00:40	00:10	01:31
Emery Road - Brislington House	01:14	00:47	02:43	01:10	00:47	02:06	01:29	00:48	02:54	01:17	00:47	02:40
Brislington House - Hicks Gate	00:33	00:24	01:00	00:34	00:24	01:06	00:36	00:24	01:09	00:34	00:24	01:06
Hicks Gate - Ellsbridge House	05:06	03:25	09:15	04:25	03:20	06:03	04:15	03:20	05:50	04:32	03:20	07:00
Ellsbridge House - Pixash Lane	01:03	00:31	02:21	00:54	00:31	02:04	00:54	00:30	01:33	00:56	00:31	02:00
Pixash Lane - Copse Road	00:49	00:28	02:10	00:41	00:28	01:39	00:43	00:28	01:41	00:44	00:28	01:56
Copse Road - Norman Road	01:03	00:36	02:22	00:49	00:35	01:34	00:49	00:35	01:38	00:53	00:35	01:51
Norman Road - Tyning Road	01:26	00:40	04:00	01:02	00:40	02:00	01:02	00:40	02:01	01:08	00:40	02:37

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Tyning Road - The Shallows	01:39	00:40	05:00	01:24	00:40	04:00	01:23	00:40	04:20	01:28	00:40	04:21
The Shallows - Dryleaze	02:14	00:58	05:30	02:04	00:59	04:55	01:52	00:58	04:29	02:03	00:58	05:00
Dryleaze - Corston Lane	00:49	00:28	02:20	00:48	00:27	02:30	00:41	00:27	01:41	00:46	00:27	02:20
Corston Lane - The Globe	01:11	00:47	01:57	01:08	00:46	02:11	01:03	00:45	01:40	01:08	00:46	02:00
The Globe - Twerton Fork	01:16	00:48	01:55	01:11	00:47	01:52	01:12	00:48	01:50	01:13	00:48	01:51
Twerton Fork - Newbridge Gardens	01:28	01:15	01:50	01:28	01:15	01:50	01:27	01:15	01:48	01:28	01:15	01:50
Newbridge Gardens - Rudmore Park	00:33	00:20	01:08	00:30	00:20	01:00	00:29	00:20	00:55	00:31	00:20	01:00
Rudmore Park - Charmouth Road	00:34	00:22	01:00	00:34	00:22	01:00	00:32	00:21	00:58	00:33	00:22	00:59
Charmouth Road - Horstmann Close	00:49	00:34	01:21	00:49	00:35	01:20	00:45	00:33	01:11	00:48	00:34	01:20

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Horstmann Close - The Weston	00:48	00:27	01:30	00:45	00:26	01:20	00:46	00:26	01:22	00:46	00:26	01:20
The Weston - Windsor Villas	00:29	00:15	01:10	00:31	00:15	01:20	00:30	00:15	01:16	00:30	00:15	01:16
Windsor Villas - Park Lane	00:44	00:14	01:20	00:43	00:10	01:21	00:46	00:17	01:22	00:44	00:12	01:21
Park Lane - Comfortable Place	00:36	00:13	01:10	00:35	00:10	01:10	00:35	00:14	01:09	00:35	00:10	01:10
Comfortable Place - Nile Street	00:16	00:03	00:44	00:18	00:03	00:45	00:16	00:03	00:47	00:17	00:03	00:45
Nile Street - James Street West	01:09	00:30	01:50	01:10	00:30	01:57	01:11	00:39	01:50	01:10	00:30	01:51
James Street West - James Street West	00:36	00:04	01:20	00:45	00:06	01:38	00:43	00:05	01:33	00:42	00:05	01:31
James Street West - Bus Station	02:28	01:00	06:27	02:40	01:10	05:40	02:20	01:00	04:41	02:32	01:06	05:34

Figure 1 – AVL analysis eastbound Monday - Friday AM peak (07:00 – 10:00) without scheme

Figure 2 – AVL analysis Westbound Monday - Friday AM peak (07:00 – 10:00) without scheme

Figure 3 - AVL analysis eastbound Monday - Friday interpeak (10:00-16:00) without scheme

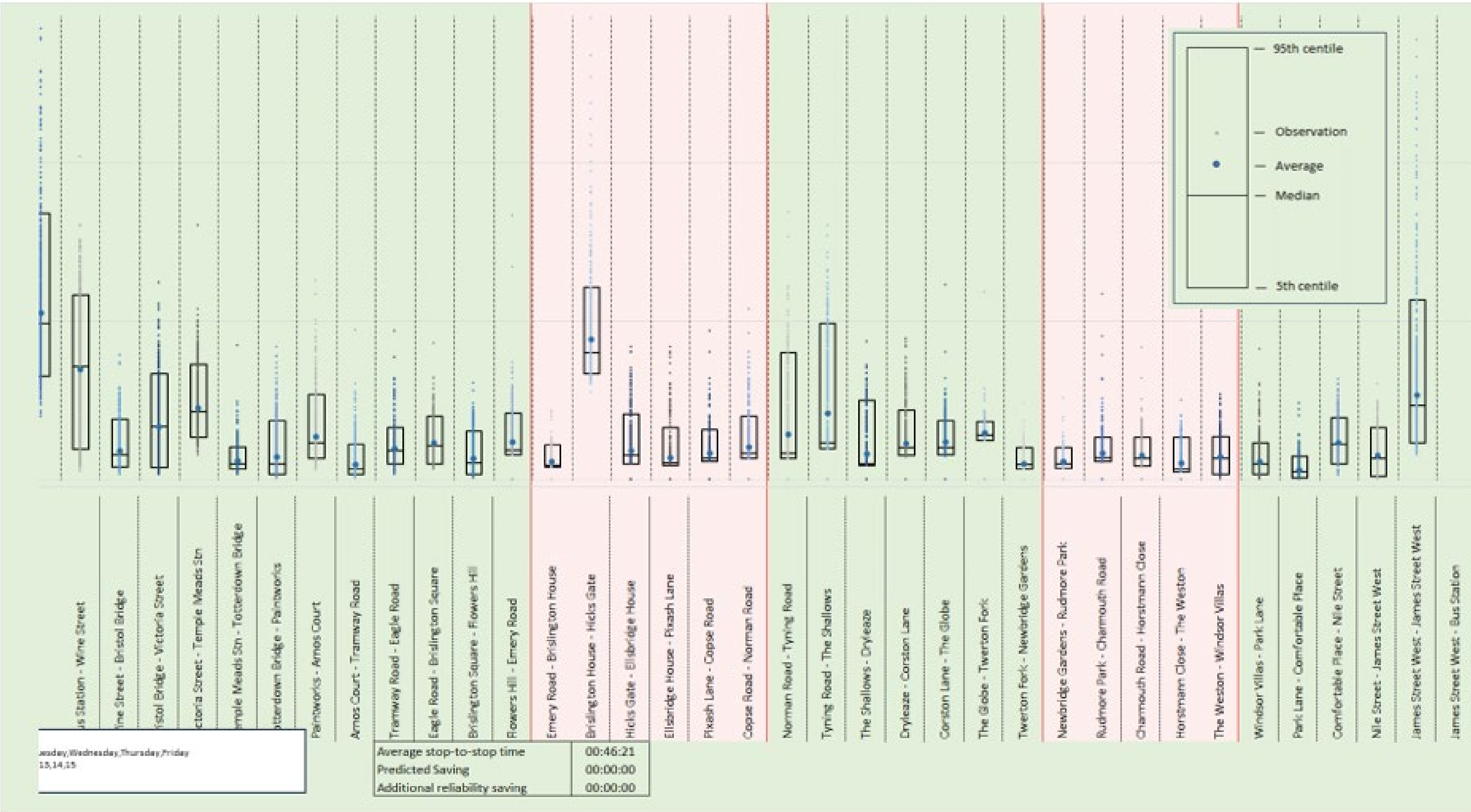


Figure 4 – AVL Analysis westbound Monday - Friday interpeak (10:00-16:00) without scheme

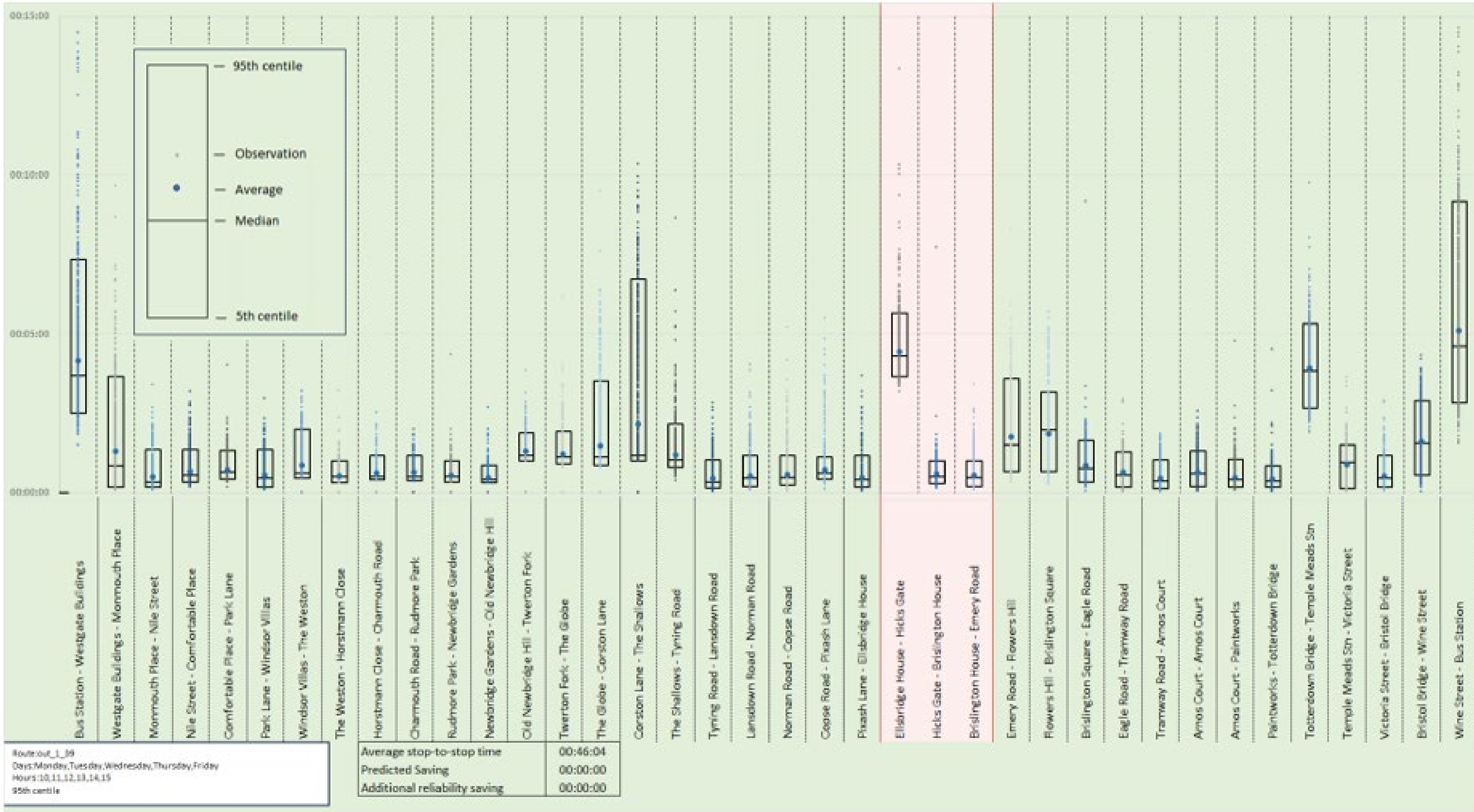


Figure 5 - AVL analysis eastbound Monday - Friday PM peak (16:00-19:00) without scheme

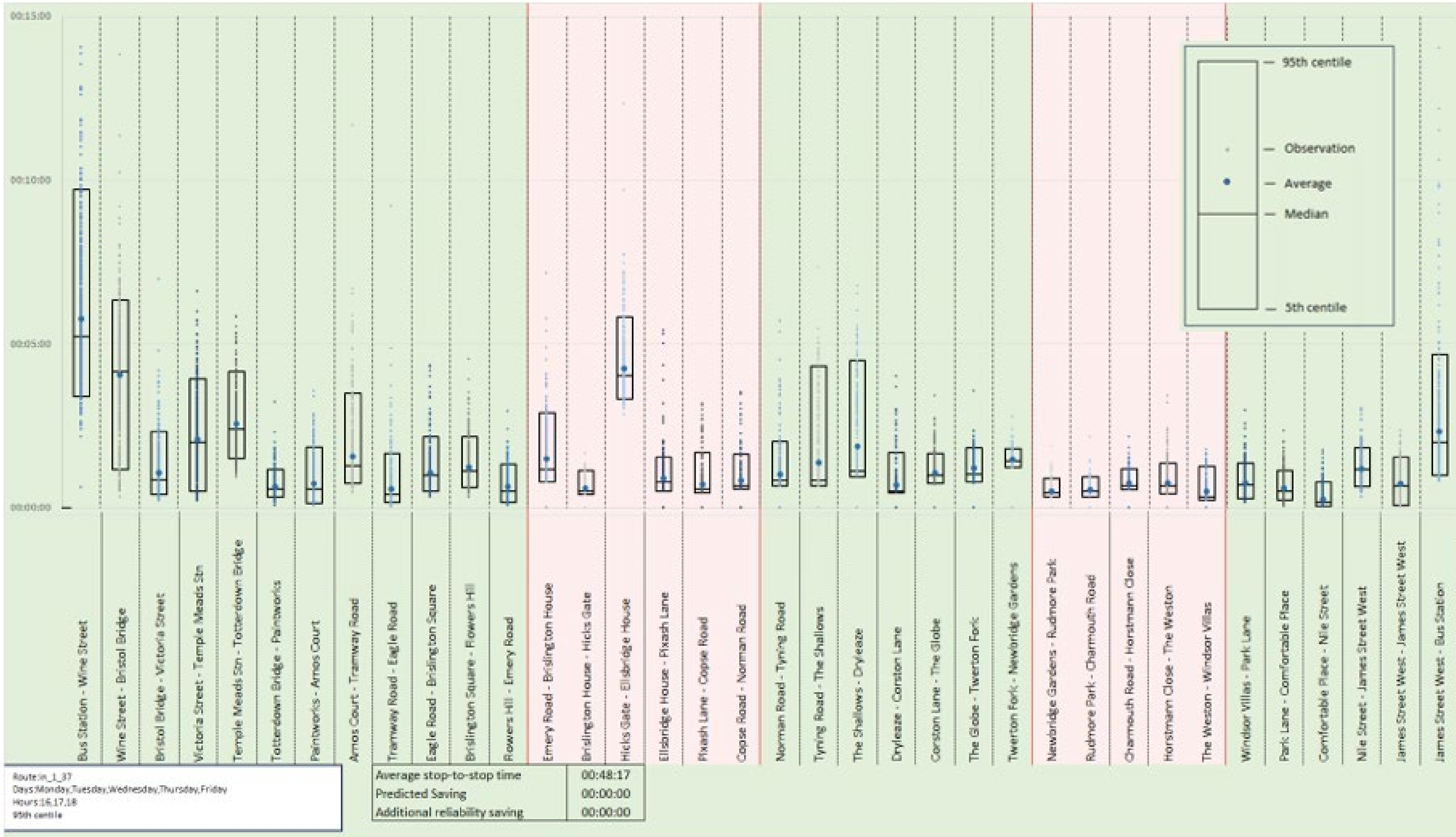


Figure 6 - AVL analysis westbound Monday - Friday PM peak (16:00-19:00) without scheme

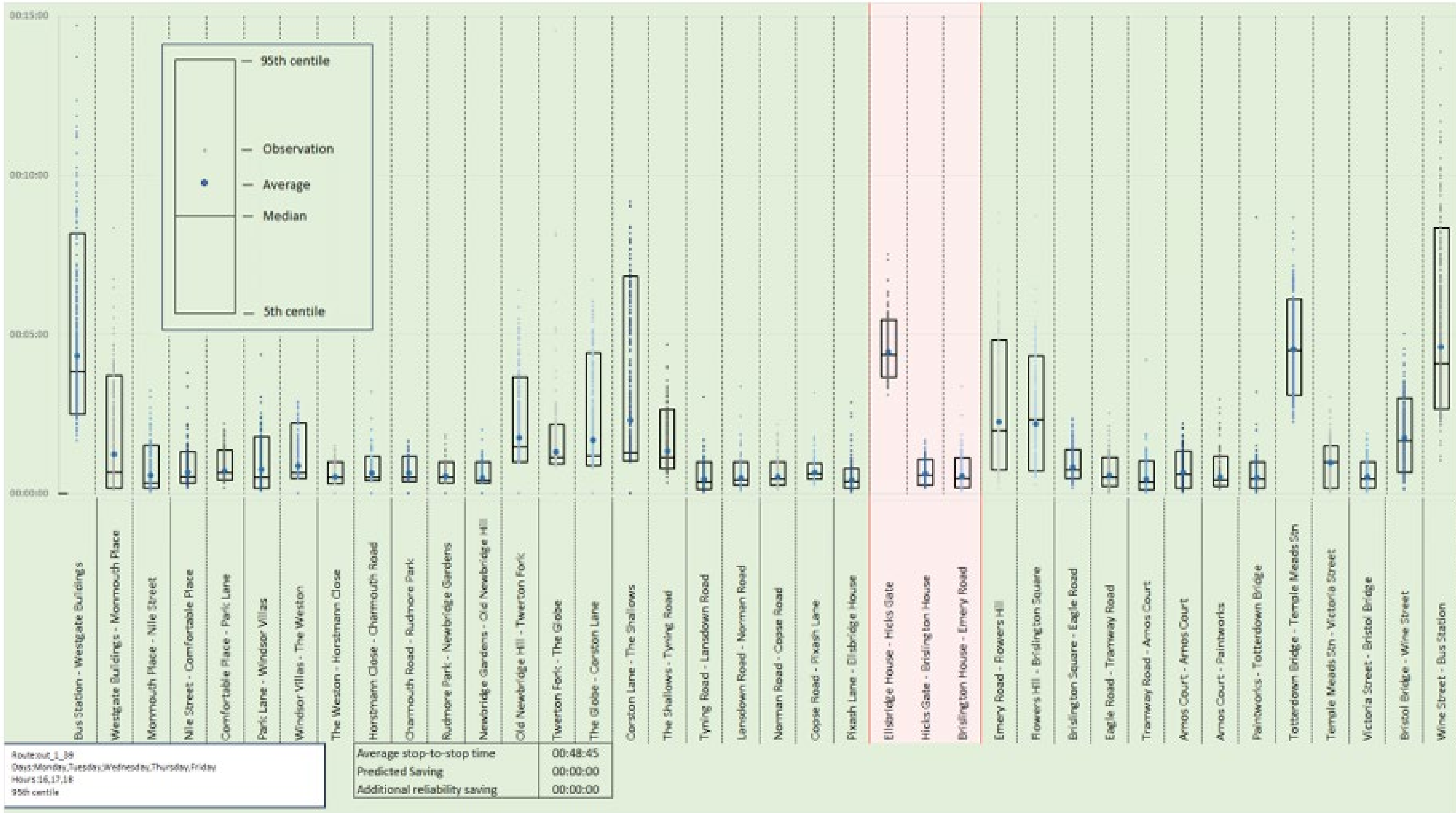
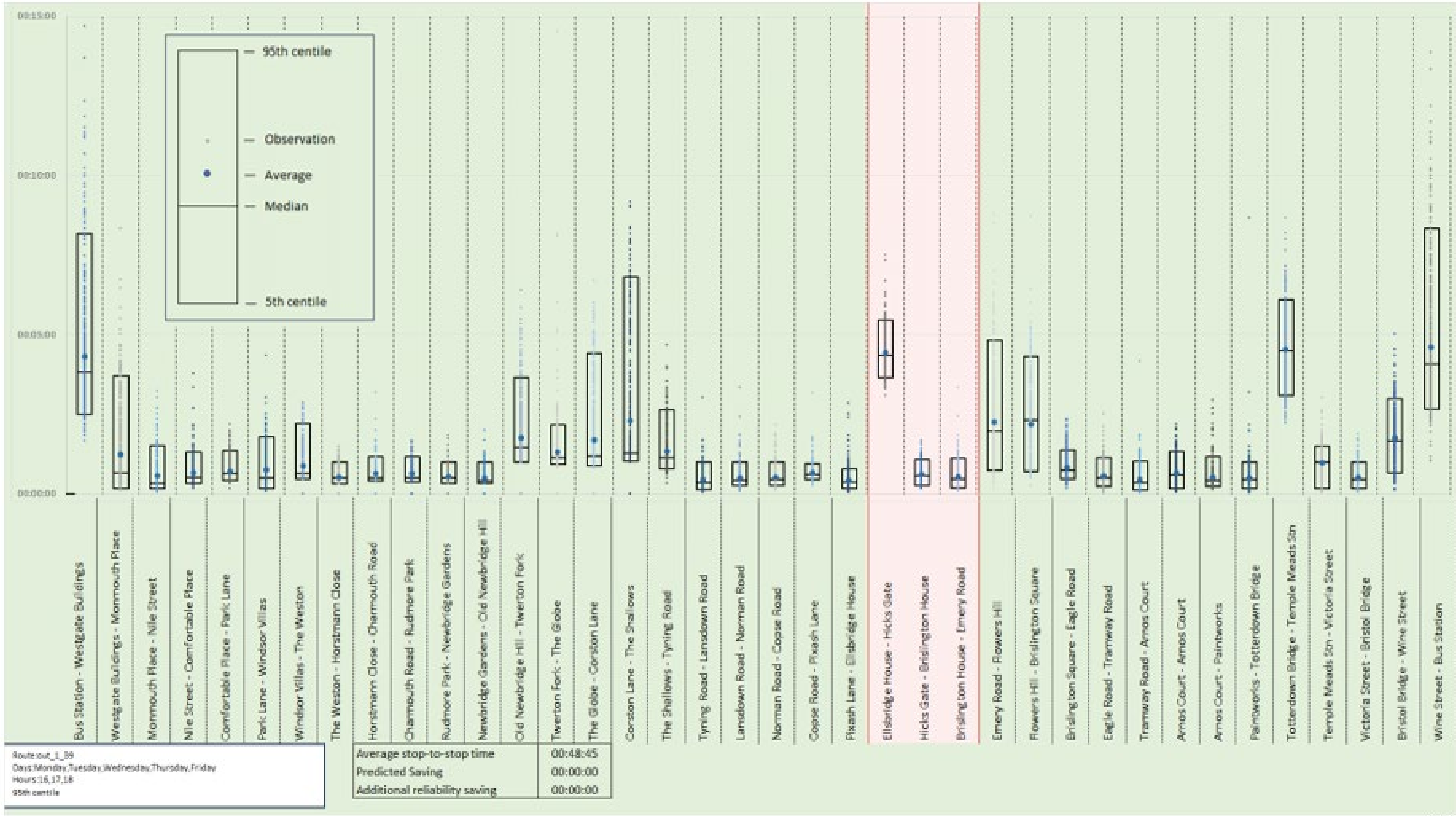


Figure 7 – AVL analysis eastbound Monday – Friday 12 hour (07:00-19:00) without scheme

Figure 8 – AVL analysis westbound Monday - Friday 12 hour (07:00-19:00) without scheme



Potential Impacts of the Scheme

4.1.2. The potential bus journey time savings with the BBSC scheme in place have been calculated by substituting all stop-to-stop time that exceed the 5th centile journey time with the 5th centile journey time value. This produces a new set of stop-to-stop journey times. The scheme designs have been reviewed carefully to ensure only delays where bus lanes are proposed have been removed. The results are given in Table 6 and Table 7 and in Figure 9 to Figure 16.

4.1.3. A summary of potential journey time savings is provided in Table 4 and Table 5.

Table 4 - Potential savings Westbound with scheme

Time period start	Time period end	Average JT	Saving	Change
07:00:00	10:00:00	23:49	04:26	18.6%
10:00:00	16:00:00	21:31	03:17	15.3%
16:00:00	19:00:00	21:12	03:07	14.7%
07:00:00	19:00:00	22:01	03:33	16.1%

Table 5 Potential savings eastbound with scheme

Time Period	Time Period	Average JT	Saving	Change
07:00:00	10:00:00	19:12	01:40	8.7%
10:00:00	16:00:00	19:30	01:26	7.4%
16:00:00	19:00:00	20:13	01:27	7.2%
07:00:00	19:00:00	19:27	01:29	7.6%

4.1.4. The analysis shows that overall savings in excess of 10% of current journey times are possible due to the scheme, though these savings are heavily weighted to the eastbound direction where more bus lanes are proposed to be delivered. The biggest potential savings are between Hicks Gate and Ellsbridge House eastbound which includes the Keynsham Bypass, which typically constitute around a third of the overall potential savings.

4.1.5. In addition to average stop-to-stop savings there is also considerable additional savings due to journey time variability. Noting that a plausible threshold for tolerance of lateness of buses could be one journey late per month (or one journey in 20), these reliability savings could be significant and potentially even larger in magnitude.

Table 6 X39 Bus Journey Times Westbound with Scheme

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Bus Station - Westgate Buildings	03:57	02:18	07:21	04:12	02:30	07:30	04:18	02:30	08:10	04:08	02:27	07:30
Westgate Buildings - Monmouth Place	01:01	00:10	02:53	01:16	00:10	03:40	01:14	00:10	03:42	01:12	00:10	03:30
Monmouth Place - Nile Street	00:30	00:10	01:20	00:31	00:10	01:30	00:33	00:10	01:31	00:31	00:10	01:30
Nile Street - Comfortable Place	00:41	00:20	01:20	00:40	00:20	01:20	00:39	00:20	01:19	00:40	00:20	01:20
Comfortable Place - Park Lane	00:41	00:26	01:15	00:43	00:26	01:20	00:43	00:26	01:21	00:42	00:26	01:20
Park Lane - Windsor Villas	00:31	00:10	01:20	00:37	00:10	01:31	00:45	00:10	01:47	00:36	00:10	01:30
Windsor Villas - The Weston	00:51	00:28	02:00	00:52	00:28	02:04	00:53	00:29	02:13	00:52	00:28	02:01
The Weston - Horstmann Close	00:30	00:19	01:00	00:31	00:19	01:00	00:31	00:19	01:00	00:31	00:19	01:00
Horstmann Close - Charmouth Road	00:38	00:25	01:10	00:38	00:24	01:10	00:38	00:24	01:10	00:38	00:24	01:10

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Charmouth Road - Rudmore Park	00:37	00:22	01:09	00:39	00:23	01:10	00:38	00:23	01:10	00:38	00:23	01:10
Rudmore Park - Newbridge Gardens	00:32	00:20	01:09	00:32	00:20	01:00	00:33	00:20	01:00	00:32	00:20	01:00
Newbridge Gardens - Old Newbridge Hill	00:28	00:19	00:51	00:29	00:19	00:55	00:29	00:20	01:00	00:29	00:19	00:54
Old Newbridge Hill - Twerton Fork	01:13	01:00	01:40	01:28	01:00	02:45	01:45	01:00	03:40	01:24	01:00	02:31
Twerton Fork - The Globe	01:10	00:56	01:40	01:15	00:55	02:00	01:18	00:56	02:10	01:13	00:55	01:57
The Globe - Corston Lane	01:25	00:52	03:04	01:32	00:52	03:55	01:41	00:53	04:25	01:30	00:52	03:42
Corston Lane - The Shallows	01:58	01:00	06:43	02:12	01:00	06:46	02:18	01:01	06:49	02:08	01:00	06:46
The Shallows - Tyning Road	01:09	00:48	01:52	01:14	00:48	02:20	01:20	00:48	02:38	01:13	00:48	02:17

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Tyning Road - Lansdown Road	00:25	00:08	00:51	00:27	00:09	01:00	00:27	00:09	01:00	00:26	00:09	01:00
Lansdown Road - Norman Road	00:33	00:16	01:00	00:30	00:13	01:00	00:29	00:16	01:00	00:31	00:14	01:00
Norman Road - Copse Road	00:35	00:19	01:03	00:33	00:14	01:06	00:32	00:16	01:00	00:33	00:15	01:06
Copse Road - Pixash Lane	00:42	00:28	01:00	00:41	00:26	01:01	00:39	00:27	00:58	00:41	00:26	01:00
Pixash Lane - Ellsbridge House	00:28	00:14	00:50	00:28	00:10	01:00	00:26	00:10	00:47	00:28	00:10	01:00
Ellsbridge House - Hicks Gate	03:46	03:46	03:46	03:40	03:40	03:40	03:40	03:40	03:40	03:41	03:41	03:41
Hicks Gate - Brislington House	00:18	00:18	00:18	00:17	00:17	00:17	00:16	00:16	00:16	00:17	00:17	00:17
Brislington House - Emery Road	00:14	00:14	00:14	00:12	00:12	00:12	00:12	00:12	00:12	00:12	00:12	00:12

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Emery Road - Flowers Hill	01:14	00:39	02:10	01:54	00:40	04:00	02:15	00:44	04:50	01:44	00:40	03:47
Flowers Hill - Brislington Square	02:29	00:46	05:56	01:57	00:40	03:37	02:11	00:43	04:19	02:05	00:41	04:21
Brislington Square - Eagle Road	01:24	00:34	03:30	00:50	00:24	01:33	00:49	00:29	01:23	00:58	00:28	02:06
Eagle Road - Tramway Road	00:40	00:16	01:27	00:36	00:11	01:15	00:34	00:15	01:09	00:37	00:12	01:19
Tramway Road - Arnos Court	00:28	00:10	01:00	00:26	00:08	01:01	00:26	00:08	01:02	00:27	00:08	01:00
Arnos Court - Arnos Court	00:43	00:12	01:31	00:39	00:11	01:20	00:40	00:11	01:20	00:40	00:12	01:20
Arnos Court - Paintworks	00:30	00:15	01:10	00:29	00:12	01:10	00:30	00:15	01:10	00:29	00:13	01:10
Paintworks - Totterdown Bridge	00:30	00:10	01:00	00:26	00:10	00:51	00:30	00:11	01:00	00:27	00:10	00:55
Totterdown Bridge - Temple Meads Stn	04:35	02:55	06:35	04:07	02:47	05:41	04:32	03:05	06:07	04:13	02:49	05:53

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Temple Meads Stn - Victoria Street	01:02	00:10	01:40	00:54	00:09	01:30	00:58	00:10	01:30	00:56	00:09	01:35
Victoria Street - Bristol Bridge	00:34	00:10	01:11	00:31	00:10	01:06	00:30	00:10	01:00	00:31	00:10	01:10
Bristol Bridge - Wine Street	01:46	00:41	03:10	01:40	00:37	03:00	01:46	00:40	03:00	01:41	00:39	03:00
Wine Street - Bus Station	04:46	02:30	09:17	04:56	02:46	08:58	04:37	02:40	08:20	04:54	02:40	09:01

Table 7 - X39 Bus journey times eastbound with scheme

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Bus Station - Wine Street	05:03	02:54	08:52	05:15	03:16	08:23	05:46	03:24	09:43	05:19	03:10	09:00
Wine Street - Bristol Bridge	03:31	01:07	05:42	03:28	00:58	05:50	04:03	01:10	06:20	03:37	01:00	06:00
Bristol Bridge - Victoria Street	00:52	00:26	01:30	00:53	00:24	01:54	01:04	00:24	02:20	00:56	00:24	02:00
Victoria Street - Temple Meads Stn	01:50	00:47	02:57	01:39	00:23	03:20	02:05	00:30	03:57	01:48	00:28	03:29
Temple Meads Stn - Totterdown Bridge	02:36	01:30	03:53	02:15	01:20	03:39	02:34	01:30	04:10	02:25	01:24	03:50
Totterdown Bridge - Paintworks	00:38	00:25	01:08	00:35	00:20	01:01	00:39	00:20	01:10	00:37	00:20	01:06
Paintworks - Arnos Court	00:38	00:15	01:27	00:42	00:10	01:51	00:44	00:09	01:51	00:42	00:10	01:50
Arnos Court - Tramway Road	01:11	00:44	02:10	01:21	00:40	02:42	01:34	00:45	03:30	01:22	00:41	02:50
Tramway Road - Eagle Road	00:30	00:10	01:07	00:28	00:10	01:07	00:34	00:10	01:40	00:30	00:10	01:12

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Eagle Road - Brislington Square	01:04	00:40	02:00	00:58	00:30	01:38	01:04	00:30	02:10	01:01	00:30	01:47
Brislington Square - Flowers Hill	01:11	00:39	02:00	01:10	00:30	02:00	01:14	00:37	02:10	01:11	00:36	02:00
Flowers Hill - Emery Road	00:45	00:10	01:40	00:39	00:10	01:31	00:38	00:10	01:20	00:40	00:10	01:31
Emery Road - Brislington House	01:14	00:47	02:43	01:10	00:47	02:06	01:29	00:48	02:54	01:17	00:47	02:40
Brislington House - Hicks Gate	00:24	00:24	00:24	00:24	00:24	00:24	00:24	00:24	00:24	00:24	00:24	00:24
Hicks Gate - Ellsbridge House	03:25	03:25	03:25	03:20	03:20	03:20	03:20	03:20	03:20	03:20	03:20	03:20
Ellsbridge House - Pixash Lane	00:31	00:31	00:31	00:31	00:31	00:31	00:30	00:30	00:30	00:31	00:31	00:31
Pixash Lane - Copse Road	00:28	00:28	00:28	00:28	00:28	00:28	00:28	00:28	00:28	00:28	00:28	00:28
Copse Road - Norman Road	00:36	00:36	00:36	00:35	00:35	00:35	00:35	00:35	00:35	00:35	00:35	00:35
Norman Road - Tyning Road	01:26	00:40	04:00	01:02	00:40	02:00	01:02	00:40	02:01	01:08	00:40	02:37

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Tyning Road - The Shallows	01:39	00:40	05:00	01:24	00:40	04:00	01:23	00:40	04:20	01:28	00:40	04:21
The Shallows - Dryleaze	02:14	00:58	05:30	02:04	00:59	04:55	01:52	00:58	04:29	02:03	00:58	05:00
Dryleaze - Corston Lane	00:49	00:28	02:20	00:48	00:27	02:30	00:41	00:27	01:41	00:46	00:27	02:20
Corston Lane - The Globe	01:11	00:47	01:57	01:08	00:46	02:11	01:03	00:45	01:40	01:08	00:46	02:00
The Globe - Twerton Fork	01:16	00:48	01:55	01:11	00:47	01:52	01:12	00:48	01:50	01:13	00:48	01:51
Twerton Fork - Newbridge Gardens	01:28	01:15	01:50	01:28	01:15	01:50	01:27	01:15	01:48	01:28	01:15	01:50
Newbridge Gardens - Rudmore Park	00:20	00:20	00:20	00:20	00:20	00:20	00:20	00:20	00:20	00:20	00:20	00:20
Rudmore Park - Charmouth Road	00:22	00:22	00:22	00:22	00:22	00:22	00:21	00:21	00:21	00:22	00:22	00:22
Charmouth Road - Horstmann Close	00:34	00:34	00:34	00:35	00:35	00:35	00:33	00:33	00:33	00:34	00:34	00:34

Stops	Monday – Friday, 07:00 - 10:00 Average	Monday – Friday, 07:00 - 10:00 5th percentile	Monday – Friday, 07:00 - 10:00 95th percentile	Monday – Friday, 10:00-16:00 Average	Monday – Friday, 10:00-16:00 5th percentile	Monday – Friday, 10:00-16:00 95th percentile	Monday – Friday, 16:00-19:00 Average	Monday – Friday, 16:00-19:00 5th percentile	Monday – Friday, 16:00-19:00 95th percentile	Monday – Friday, 07:00-19:00 Average	Monday – Friday, 07:00-19:00 5th percentile	Monday – Friday, 07:00-19:00 95th percentile
Horstmann Close - The Weston	00:27	00:27	00:27	00:26	00:26	00:26	00:26	00:26	00:26	00:26	00:26	00:26
The Weston - Windsor Villas	00:15	00:15	00:15	00:15	00:15	00:15	00:15	00:15	00:15	00:15	00:15	00:15
Windsor Villas - Park Lane	00:44	00:14	01:20	00:43	00:10	01:21	00:46	00:17	01:22	00:44	00:12	01:21
Park Lane - Comfortable Place	00:36	00:13	01:10	00:35	00:10	01:10	00:35	00:14	01:09	00:35	00:10	01:10
Comfortable Place - Nile Street	00:16	00:03	00:44	00:18	00:03	00:45	00:16	00:03	00:47	00:17	00:03	00:45
Nile Street - James Street West	01:09	00:30	01:50	01:10	00:30	01:57	01:11	00:39	01:50	01:10	00:30	01:51
James Street West - James Street West	00:36	00:04	01:20	00:45	00:06	01:38	00:43	00:05	01:33	00:42	00:05	01:31
James Street West - Bus Station	02:28	01:00	06:27	02:40	01:10	05:40	02:20	01:00	04:41	02:32	01:06	05:34

Figure 9 AVL Analysis eastbound Monday - Friday AM peak (07:00 – 10:00) with scheme

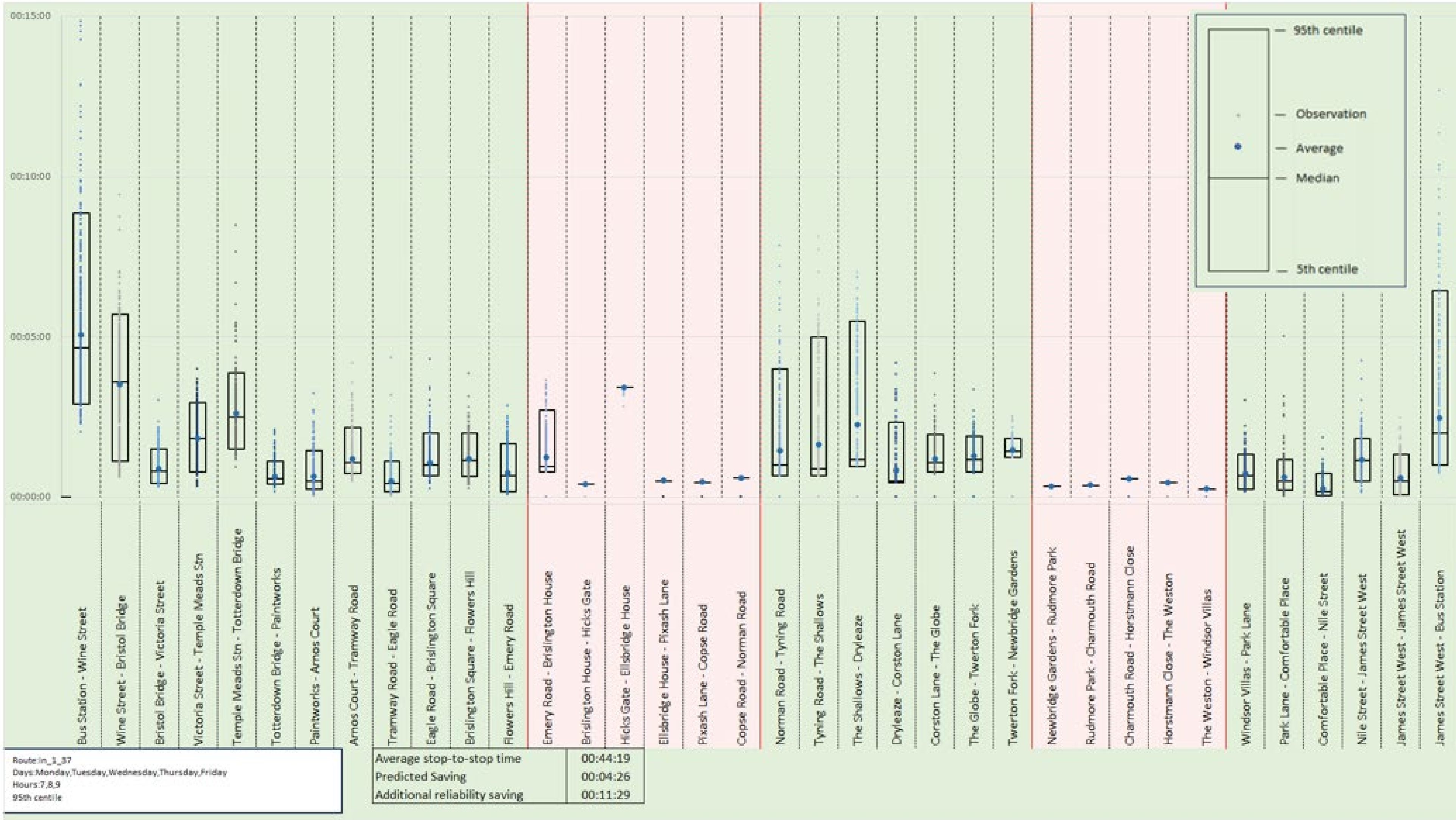
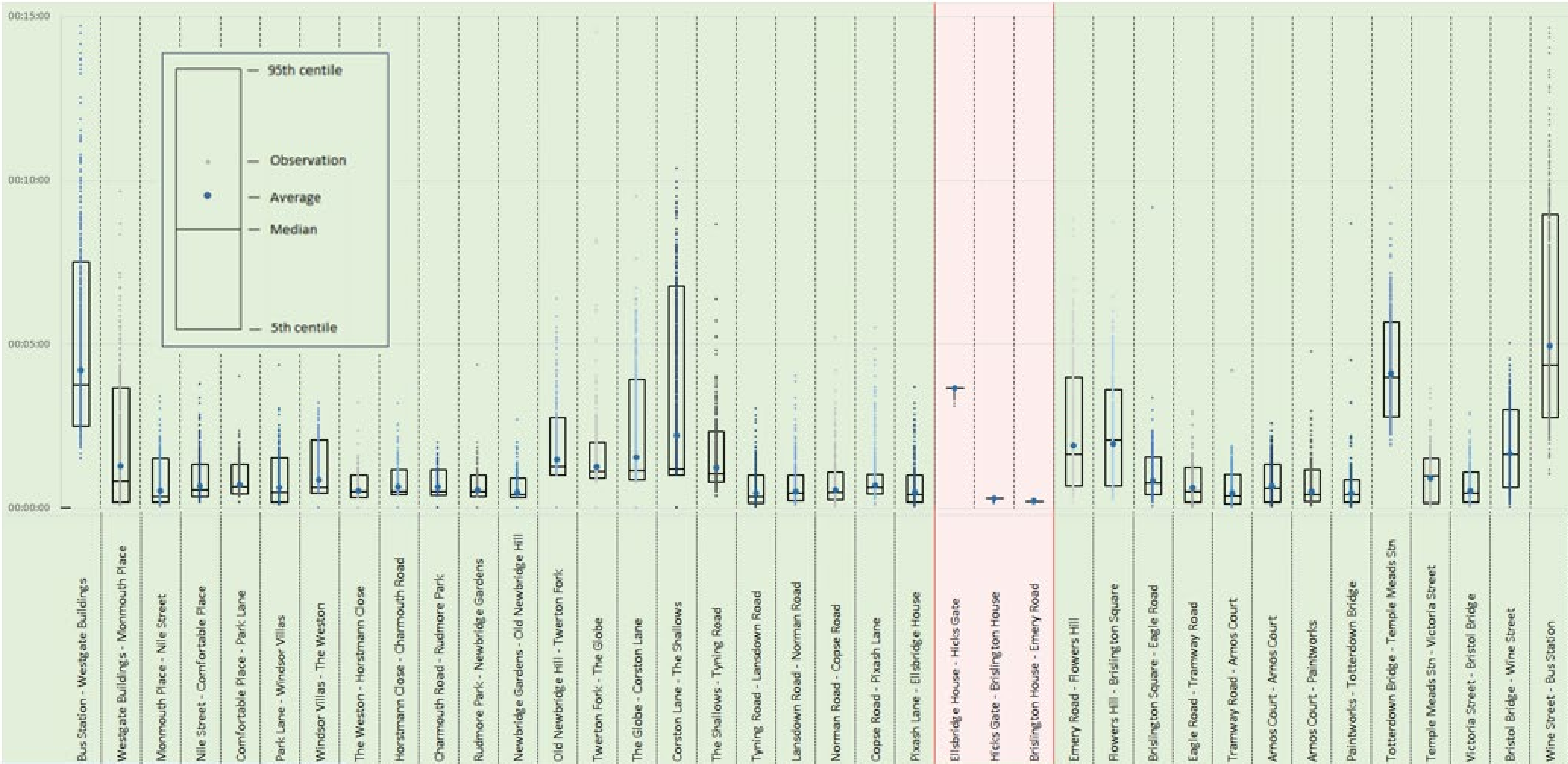


Figure 10 AVL Analysis westbound Monday - Friday AM peak (07:00 – 10:00) with scheme

Average stop-to-stop time	00:45:33
Predicted Saving	00:01:41
Additional reliability saving	00:02:00

Figure 11 AVL Analysis eastbound Monday - Friday interpeak (10:00-16:00) with scheme

Figure 12 AVL Analysis westbound Monday - Friday interpeak (10:00-16:00) with scheme



Average stop-to-stop time	00:45:32
Predicted Saving	00:01:25
Additional reliability saving	00:01:58

Figure 13 AVL Analysis eastbound Monday - Friday PM peak (16:00-19:00) with scheme

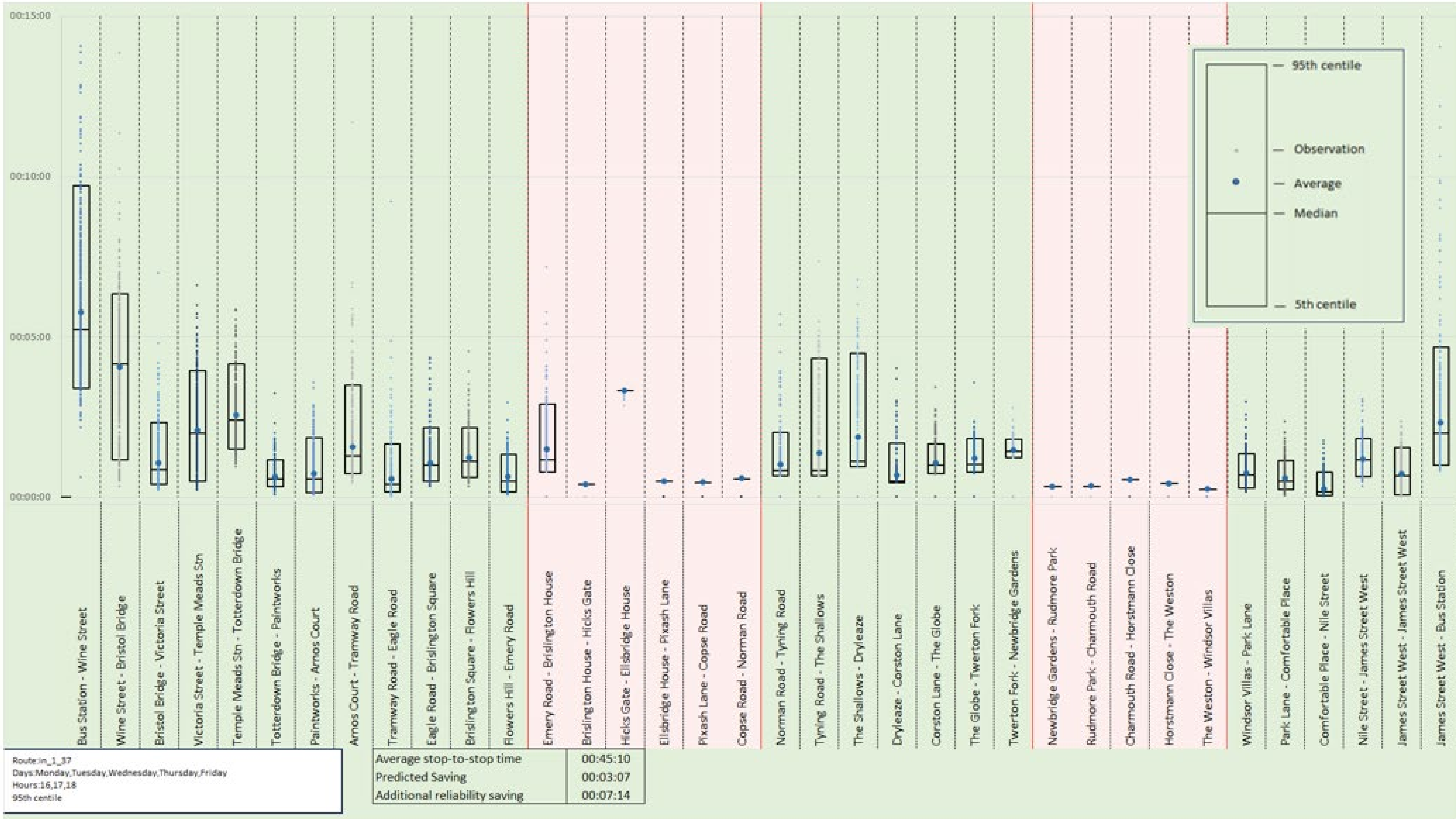


Figure 14 AVL Analysis Westbound Mon-Fri PM Peak (16:00-19:00) with scheme

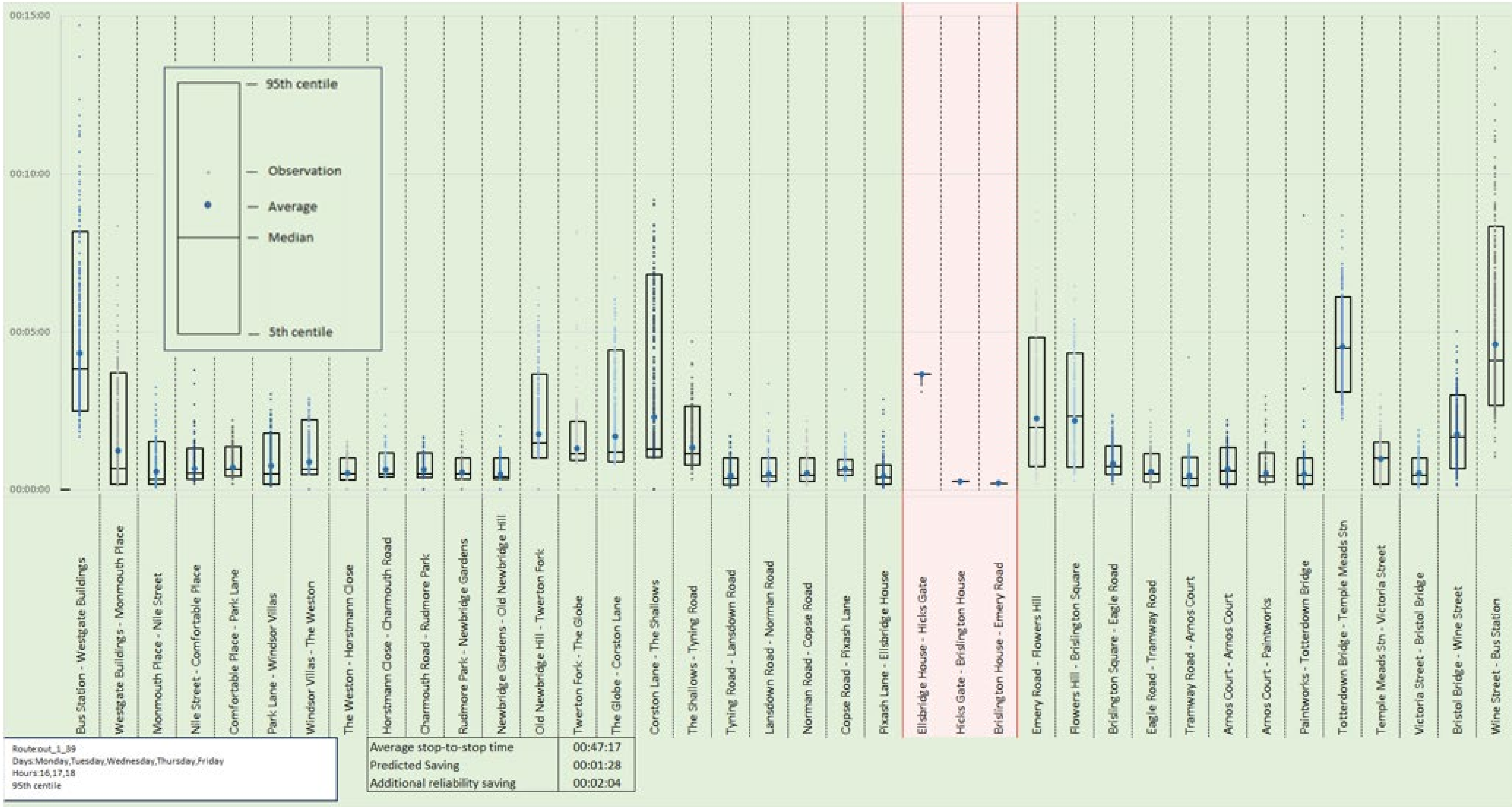


Figure 15 AVL Analysis Eastbound Mon-Fri 12hr (07:00-19:00) with scheme

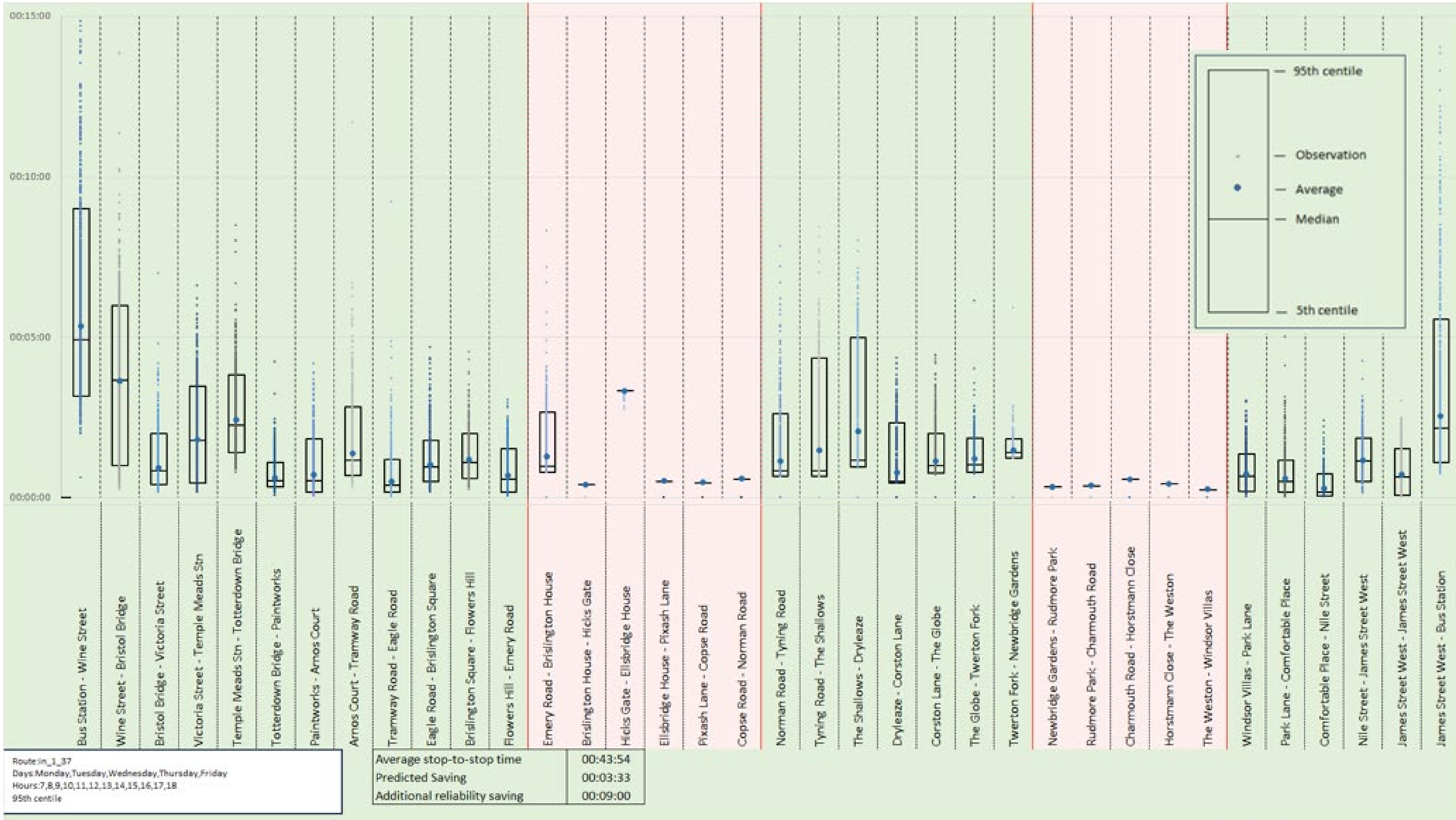
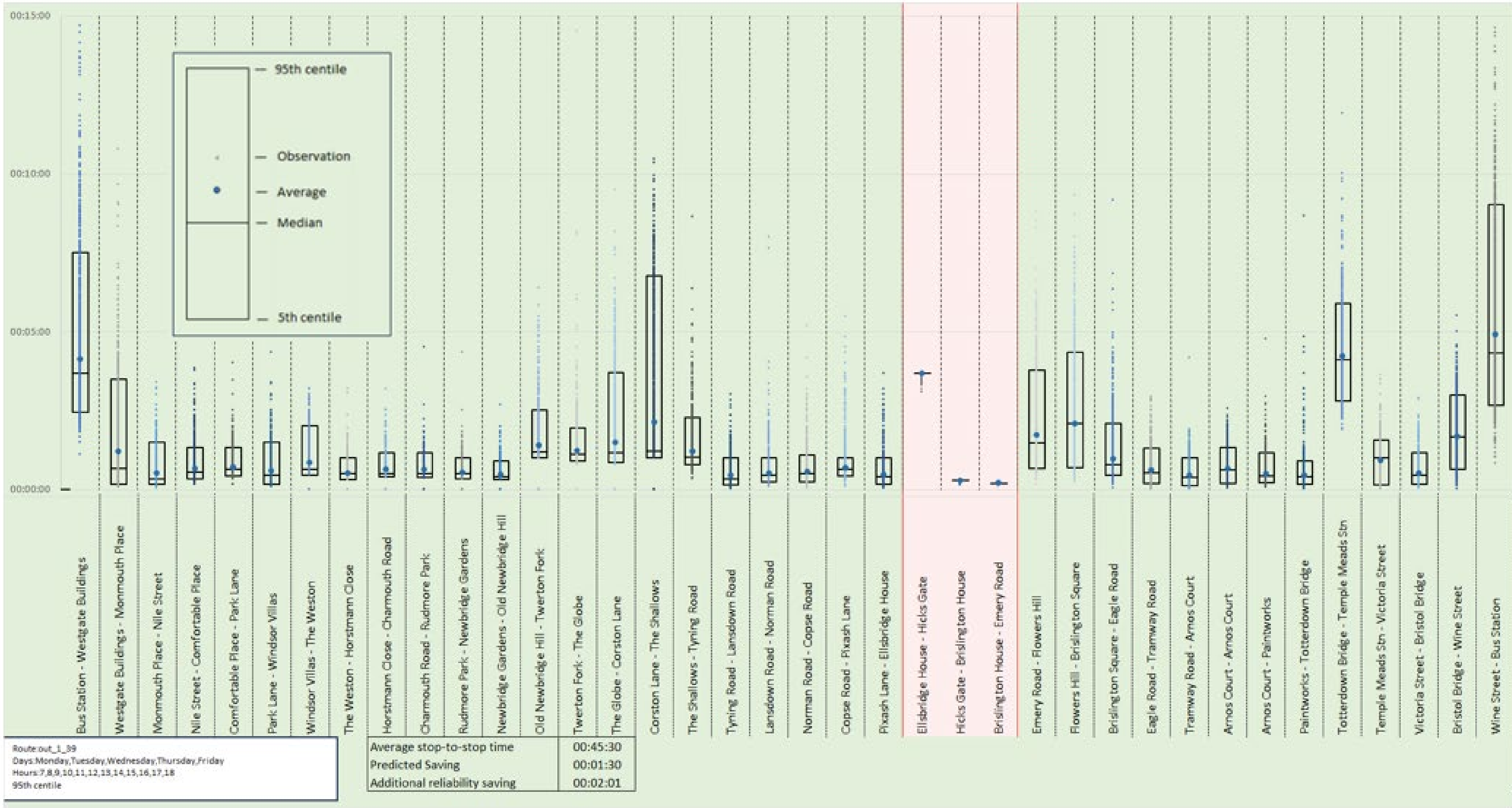


Figure 16 AVL Analysis Westbound Mon-Fri 12hr (07:00-19:00) with scheme



5 Conclusions and summary

5.1 Summary

5.1.1. Automatic Vehicle Location data has been received by WSP from FirstBus for the X39 service in 2023. This data has been analysed to calculate stop-to-stop times experienced by buses travelling along the route for each individual journey. The data has been used to calculate average potential stop-to-stop journey times savings arising from the BBSC scheme and journey time variability in the form of 95th centile journey times savings. Results are presented in both tabular and graphical form so that journey time variability can be understood.

5.2 Conclusions

5.2.1. Potential average journey time saving on a weekday (Mon – Fri) could be up to 16.1% eastbound and 7.7% westbound. For a return journey (Bristol to Bath to Bristol) this represents a 11.9% potential stop-to-stop time saving.

5.2.2. The analysis has been completed in a way that input data can be easily substituted for other services and similar analyses completed. This could allow for the targeting of bus interventions on other corridors in the West of England.

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix AH – Dependency Register

70093741
February 2024

West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix AH – Dependency Register

Type of document (version) Public

Project no. 70093741

Our Ref. No. 70093741

Date: February 2024

WSP

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Phone: +44 117 930 6200

WSP.com

Contents

1 Introduction

1.1.1. The dependency register is a live document that record all projects that may impact on the proposed scheme.

1.1.2. This document cannot be made fully accessible, therefore cannot be published. If you wish to request this document, please contact info@westofengland-ca.gov.uk

Kings Orchard
1 Queen Street
Bristol
BS2 0HQ

wsp.com

West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix B – Identified Proposal for Active Travel

70093741
February 2024

West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix B – Identified Proposal for Active Travel

Type of document (version) Public

Project no. 70093741

Our Ref. No. 70093741

Date: February 2024

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Contents

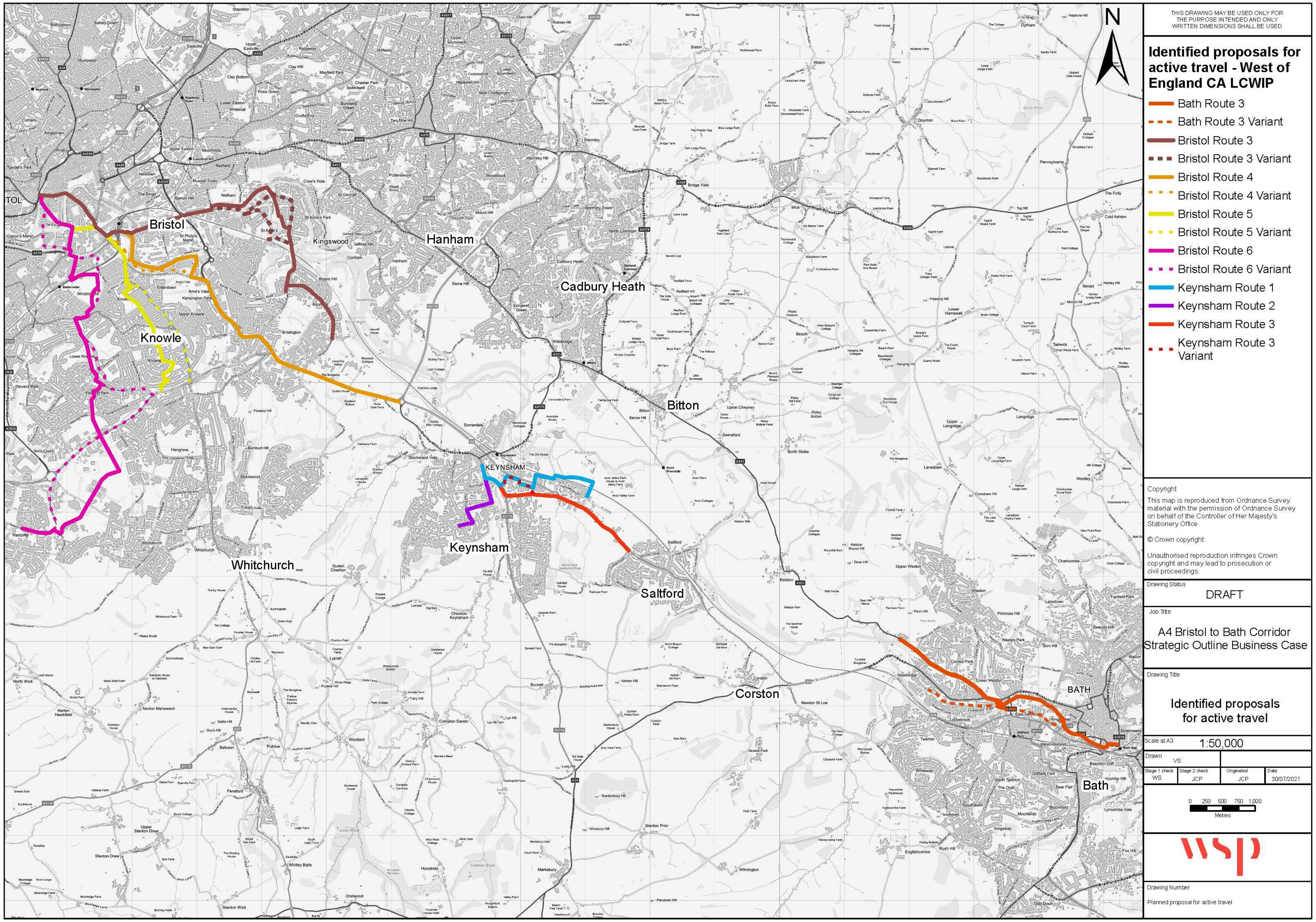
Figures

1 Introduction

1.1.1. The LCWIP sets out a series of proposals to improve the environment for cyclists and pedestrians. The proposals are not, however, funded and hence represent a plan (but not a commitment) for improvements that needs to be funded. The approach has been taken to include all of these plans as part of the potential package of interventions that should be considered to address the issues in the Current Situation.

1.1.2. The proposed improvements within the LCWIP are focused on 30 local high streets and 55 continuous cycle routes. The routes proposed in the LCWIP of relevance to the Bath to Bristol corridor are shown below.

Figure 1-1 – Route identified as part of the LCWIP



West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix C - Economic narrative

70093741
January 2024

West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix C - Economic narrative

Type of document (version) Public

Project no. 70093741

Our Ref. No. 70093741

Date: January 2024

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Quality control

Issue/revision	First issue
Remarks	Final
Date	January 2024
Prepared by	JW, LC
Checked by	LA, GG
Authorised by	SG
Project number	70093741
Report number	OBC Appendix C

Contents

Figures

1 Introduction

1.1.1. The Department for Transport (DfT) Transport Analysis Guidance (TAG) sets out the need for an Economic Narrative to make the case for investment in transport to achieve specific economic objectives. These economic cases can be set nationally (e.g. by the DfT and government, setting transport and wider domestic policy such as Bus Back Better) or more locally (e.g. by a combined or local authority, such as Joint Local Transport Plan 4 created by the West of England Combined Authority). TAG Unit A2-1 (Wider Economic Impacts Appraisal) details how the narrative fits into a business case and how it is used to justify the impacts of the scheme.[1]

1.1.2. Through this process, the narrative defines the scope of the analysis in terms of the impacts that are being considered and the mechanisms through which these are expected to occur. The Economic Narrative therefore sets out the context for the analytical methods that will capture and quantify the expected impacts. The methods will be agreed with the West of England Combined Authority through the Appraisal Specification Report and presented in detail in the Outline Business Case.

1.1.3. The purpose of this Economic Narrative is to articulate why the transport investment is needed on the Bath and North East Somerset (B&NES) section (Projects 2 and 3) of the Bath to Bristol Strategic Corridor (BBSC) Programme to achieve the specified economic objectives and how it is expected to achieve these.

1.1.4. The narrative provides an insight into the economic context of the scheme and covers the following:

- Background to the scheme.
- Policy context and strategic fit of the scheme.
- Local and regional economic context.
- Key characteristics of the transport network.
- The need for intervention.
- Expected impacts of the scheme.

[1] ttps://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/940810/tag-a2-1-wider-economic-impacts-appraisal.pdf

1.1.5. Economic Narratives are now a recognised element of scheme business cases as they allow scheme promoters to set out the economic context in an area before describing the types of economic impacts that are in scope (and therefore included in the Economic Dimension of the OBC).

2 Background to the scheme

2.1 Bath to Bristol strategic corridor

2.1.1. The Bath to Bristol Strategic Corridor (BBSC) Programme is being developed jointly by the West of England Combined Authority (the Combined Authority), Bristol City Council (BCC) and Bath and North East Somerset Council (B&NES). The Programme aims to reduce journey times and increase the use of public transport and promote active travel on the A4 corridor between Bath and Bristol. The Programme also looks to improve connectivity between the A4 and settlements along the corridor including Keynsham, Saltford and Corston, by providing infrastructure to facilitate bus service improvements and encourage active travel. Any subsequent changes to the operation of the bus services along the route will fall under the Bus Service Improvement Plan (BSIP)

2.1.2. The BBSC Programme has been sub-divided into six sections with section 1 forming the Bristol Three Lamps to Emery Road scheme and sections 2-6 forming the B&NES scheme. The three objectives identified for the BBSC Programme are:

- To facilitate economic growth along the corridor by improving the public transport and active travel opportunities. This includes delivering infrastructure which improves access for existing communities and also infrastructure that unlocks new opportunities for sustainable growth.
- Improve public transport infrastructure in the study area to increase the number of people who have access to and use buses to contribute to growing patronage of the X39 (or increase in equivalent new service/bus rapid transit service along the corridor) by at least 24% by 2030
- Improve walking, wheeling and cycling infrastructure in the study area to contribute to increasing the number of people using the corridor for active travel modes including to increase the number of people commuting by walking, cycling and wheeling modes to 25% of total modal share by 2036.

2.1.3. The scope of the programme includes:

- Providing infrastructure improvements to support a high-quality, high-frequency bus service between Bristol and Bath, including new bus lanes and bus stop improvements
- Providing a continuous segregated cycling corridor between Bristol and Bath which meets the requirements of LTN 1/20
- Enhancing cycling and walking connections between local communities along the A4 between Bristol and Bath and the bus service and strategic cycling corridors, including new shared use paths and crossing upgrades
- The relocation of the Bath Road, Brislington Park & Ride to Hicks Gate and the delivery of a new Transport Hub at Hicks Gate (Phase 2).

- Keynsham Hub: A Transport Hub with on carriageway bus stops and at grade crossing of A4, bus shelters provided along with walking/cycling connections to Keynsham town centre and train station.
- Complementary measures required to make the project deliverable including biodiversity enhancements, tree planting, placemaking, cycle parking, signage, etc.

3 Policy context and strategic fit

3.1.1. The Strategic Dimension of the Outline Business Case (OBC) considers in detail the relevant legislation and policy at a national, regional, and local level, identifying how the scheme supports delivery of these ambitions.

3.1.2. The scheme has a strong strategic fit with national, regional, and local plans and policies. The scheme aligns with and contributes to a variety of strategies at every level, most notably on how the transport infrastructure investment will unlock residential and employment growth while reducing congestion and promoting active travel along key routes such as the A4. In addition, the scheme has strong alignment with the decarbonisation agenda which is present at all levels of government – national, regional, and local – as well as within the aims of CRSTS. The B&NES local plan utilises the “doughnut” model, which seeks to balance meeting social needs with keeping within the ecological ceiling. The BBSC scheme as a strong alignment with this.

3.1.3. The following policy documents have been identified to be in alignment with the scheme. These policy documents are listed as they have a main focus on the economy and how the policies will contribute to the economic growth.

3.2 National policies

- National Infrastructure Strategy (NIS, 2020).
- Ten Point Plan for a Green Industrial Revolution (2020).
- National Bus Strategy, ‘Bus Back Better’ (2021).
- National Planning Policy Framework (NPPF) (UK Government, 2021).
- Planning for The Future: A Guide to Working with Highways England on Planning Matters (Highways England, 2015).
- Future of Mobility: Urban Strategy (DfT, 2019).
- Transport Investment Strategy (DfT, 2017).
- Decarbonising Transport (DfT, 2021).
- Net Zero Strategy: Build Back Greener (UK Government, 2021).

3.3 Regional policies

- West of England Local Plan: Joint Local Transport Plan 4 (JLTP4) (2020-36) (West of England Combined Authority, 2020).
- West of England Energy Strategy (West of England Combined Authority 2019).
- West of England Strategic Economic Plan 2015-2030 (West of England Local Enterprise Partnership, 2015).
- West of England COVID-19 Recovery Plan (West of England Combined Authority, 2020).
- West of England Climate and Ecological Strategy and Action Plan (West of England Combined Authority, 2023).

3.4 Local policies

- The Bristol Local Plan (2011-2026)/ Bristol Local Plan Review- Further Consultation November (2022).
- The Bristol Local Plan (2025-2040) (draft).
- B&NES Local Plan (2014-2029) (in effect); B&NES Local Plan (2022-2042) (Regulation 19 (Options) consultation by Q1 2024, before OBC is approved).
- One Shared Vision (2021).
- B&NES Economic Strategy (2014-2030).
- B&NES Economic Strategy (Building the Bath & North East Somerset New Economy) (draft).
- BCC One City Economic Recovery Plan (2020).
- Bristol One City Economic Recovery Statement of Intent 2 (2020).

4 The local and regional economic context

4.1.1. Bristol and B&NES are two unitary authority (UA) areas within the West of England region, governed by the Combined Authority. The Bristol to Emery Road scheme (section 1) falls within the BCC area, whereas sections 2-6, which are the focus of the OBC and this Economic Narrative, are part of B&NES, with the exception of approximately half of section 2.

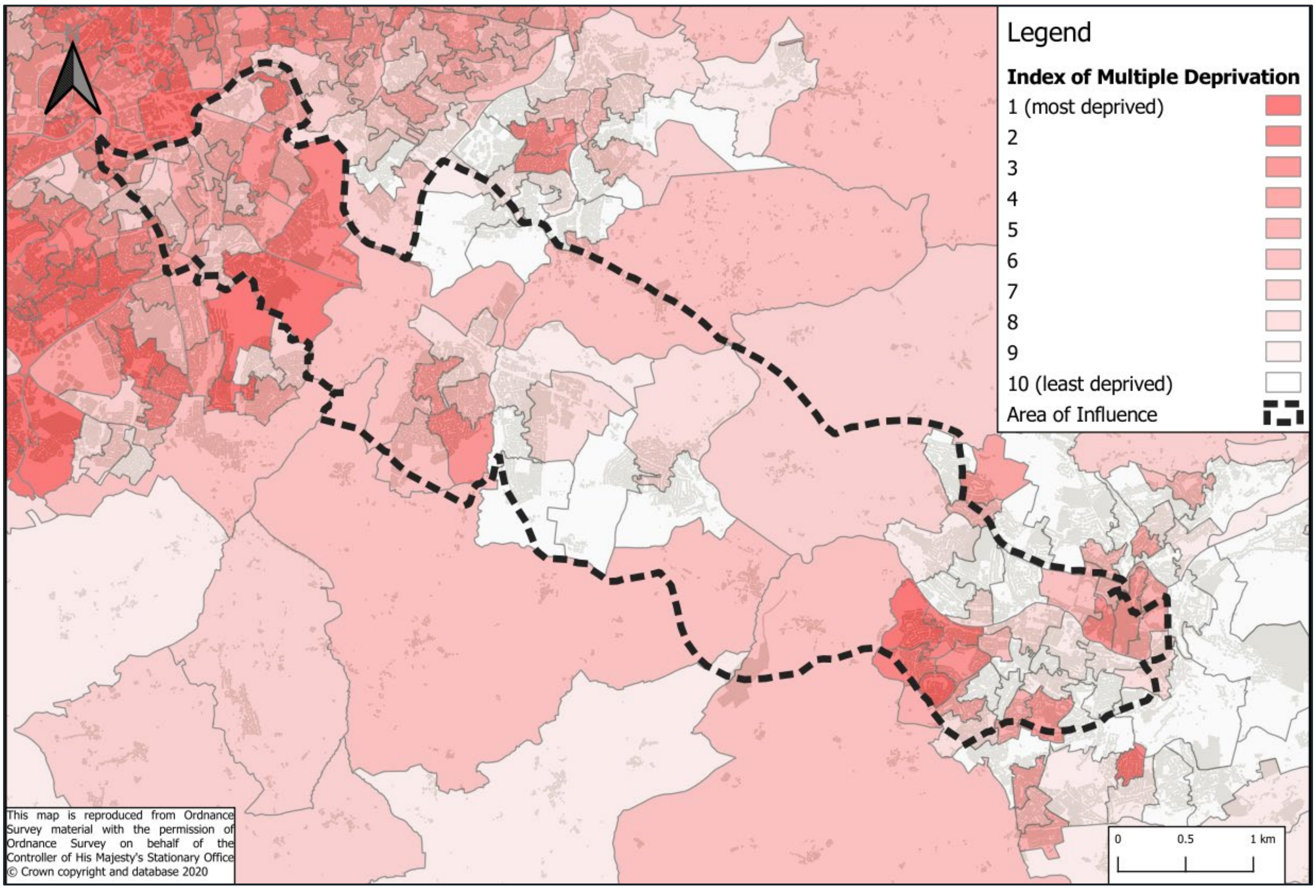
4.2 Population

4.2.1. According to the 2021 Census, the population of Bristol was 472,500, a 10.3% increase compared to the 2011 Census. Within B&NES the 2021 population was 193,400, a 9.9% increase compared to 2011. Both the population of Bristol and B&NES has increased between 2011 and 2021 by a greater percentage than the overall population of the South West (7.8%) and the overall population of England (6.6%).

4.2.2. The population density is higher at the Bristol and Bath ends of the corridor compared to areas along it. Within the corridor itself, the areas of Keynsham and Saltford have the highest population levels.

4.2.3. **Figure 4.1** presents the Indices of Multiple Deprivation (IMD) for 2019 High ranking Lower Super Output Areas (LSOAs) or neighbourhoods which can be referred to as the ‘most deprived’ or as being ‘highly deprived’. There are areas within the corridor which are within the 10% most deprived areas in the country (decile 1 most deprived, decile 10 least deprived). The areas of highest deprivation (decile 1) are Stockwood (Bristol), Twerton (Bath) and Whiteway (Bath). As well as these areas there are further pockets of deprivation at Upper Knowle (Bristol), St Anne's (Bristol), South Keynsham, Kingsmead (Bath), Walcot (Bath), Beechen Cliff (Bath), and Whiteway (Bath). The rest of the corridor falls within the 4 and 7 deciles of deprivation located at either ends of the corridor, as well as along the corridor, including Stockwood, Brislington, Keynsham and Twerton. The BBSC scheme will help address the challenges faced in decile 1 neighbourhoods by driving growth, improving access to health and wellbeing services, increasing active travel, reducing the need for private car ownership, and widening access to employment and education.

Figure 4-1 Indices of multiple deprivation (IMD), 2019



4.3 Housing demand

4.3.1. With the increase in population, the demand for housing will increase. It is estimated that more than 33,755 houses will be required in Bristol over the 10-year period of 2022-2032. This is equivalent to an average of 3,376 dwellings per year.[2] The demand for housing in B&NES is also predicted to increase alongside the growing population. The minimum Local Housing Need figure for B&NES is 676 dwellings per year for the 10-year period of 2021-2031.[3]

[2] Local housing need paper (bristol.gov.uk)
[3] CD-SD027 BANES CS review housing target Dec 2021_0.pdf (bathnes.gov.uk)

4.4 Car dependency

4.4.1. Within the study area of the scheme, there is a high dependency on private cars for travel. There is an average car mode share of 54% when travelling from Bristol to Bath and an average of 77% for the opposite direction. The 2021 census reported that 71% of the working population who travelled to work did so as either the driver or passenger in a car or van.

4.4.2. Improving the efficiency of sustainable modes of travel on the Bath to Bristol corridor will provide the residents with an alternative to travelling by car, in particular for residents unable to access train travel for economic or geographical reasons. The residents will be able to travel along the A4 by bike or walk with the provision of active travel facilities. Overall, the scheme will improve the journey time reliability of the bus services and provide more options for travel for the communities near the corridor. Bristol and B&NES have a lower use of buses for journeys to work than other major cities in combined authorities at 6.1% and 3.4% respectively (compared to 7.3% in Leeds and 4.0% in nearby Calderdale), according to Census 2021 data. Improvements in bus provision will therefore have a significant impact upon the transport options available to the residents around the BBSC scheme.

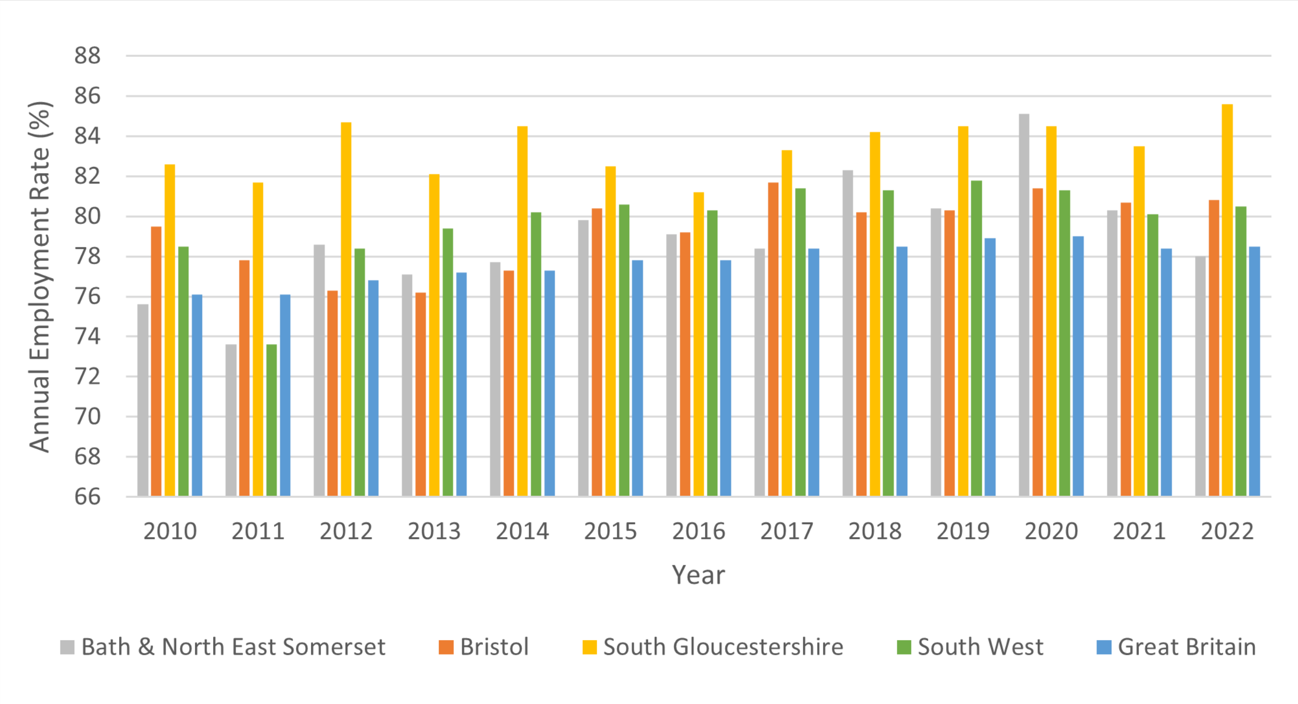
4.5 Employment

4.5.1. There are several large employment sites at either ends of the corridor in the cities, as well as some smaller sites along the corridor. Some of these employment sites include the Bristol Temple Quarter Enterprise Zone (BTQEZ) and St Philip's Marsh Industrial Estate. Within Bath there is the Bath Riverside Enterprise Area.

4.5.2. According to the Census and Labour Market Statistics, the employment rate in BCC and B&NES areas between July 2022 to June 2023 was higher than the national average. [4] The employment rate in BCC is 78.3% which is slightly higher than B&NES (76.9%). The national average during the same period is 75.6%. [5]. **Figure 4.2** shows the rate of employment in BCC, B&NES, South Gloucestershire, South West and Great Britain across the 14 year period from 2010 to 2023. Generally, both BCC and B&NES have had a higher employment rate than the Great Britain rate during this period but have had a lower rate than South Gloucestershire and the South West region.

[4] Nomis Official Census and Labour Market Statistics (Local authority profile)
[5] Employment rate (aged 16 to 64, seasonally adjusted): % - Office for National Statistics (ons.gov.uk)

Figure 4-2 - Annual employment rate – aged 16 to 64 (2010-2023)



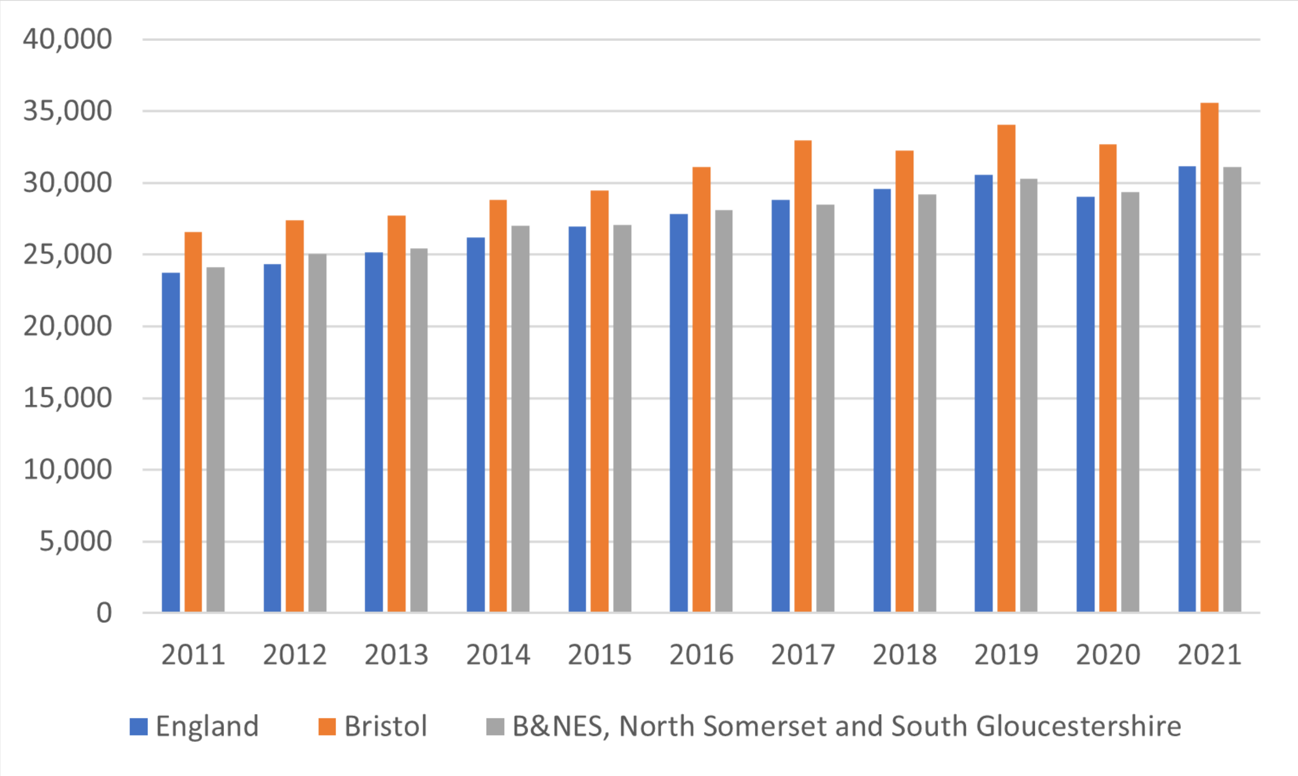
4.5.3. In 2022, the industries with most employees in B&NES were:

- 'Human Health and Social Work Activities' (17.2%)'.
- 'Education' (14%).
- 'Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles' (11.8%).6
- In Bristol, the most popular sectors were:
  - 'Human Health and Social Work Activities' (16.1%).
  - 'Professional, Scientific and Technical Activities' (13.8%).
  - 'Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles' (10.4%).

4.5.4. The West of England Economic Connectivity Report[7] published by the West of England Combined Authority highlighted four main areas of economic development within the region, including business linkages, infrastructure connectivity, movement of people and flow of ideas. Under the section on business linkages, the report suggested that for every £1 of Gross Value Added (GVA) generated by West of England based businesses the rest of the UK gains by about 60p. This shows the economic strength of the region. **Figure 4.3** demonstrates the GVA per head in Bristol, B&NES together with North Somerset (NS) and South Gloucestershire (SG), and England. The GVA per head has been higher in the West of England than England throughout the 10 year period.

[6] Labour Market Profile - Nomis - Official Census and Labour Market Statistics (nomisweb.co.uk)
7 https://www.westofengland-ca.gov.uk/wp-content/uploads/2019/02/6A.-WofE-LIS-Economic-Connectivity-exec-summary.pdf

Figure 4-3 - GVA per head at current basic prices[8], pounds



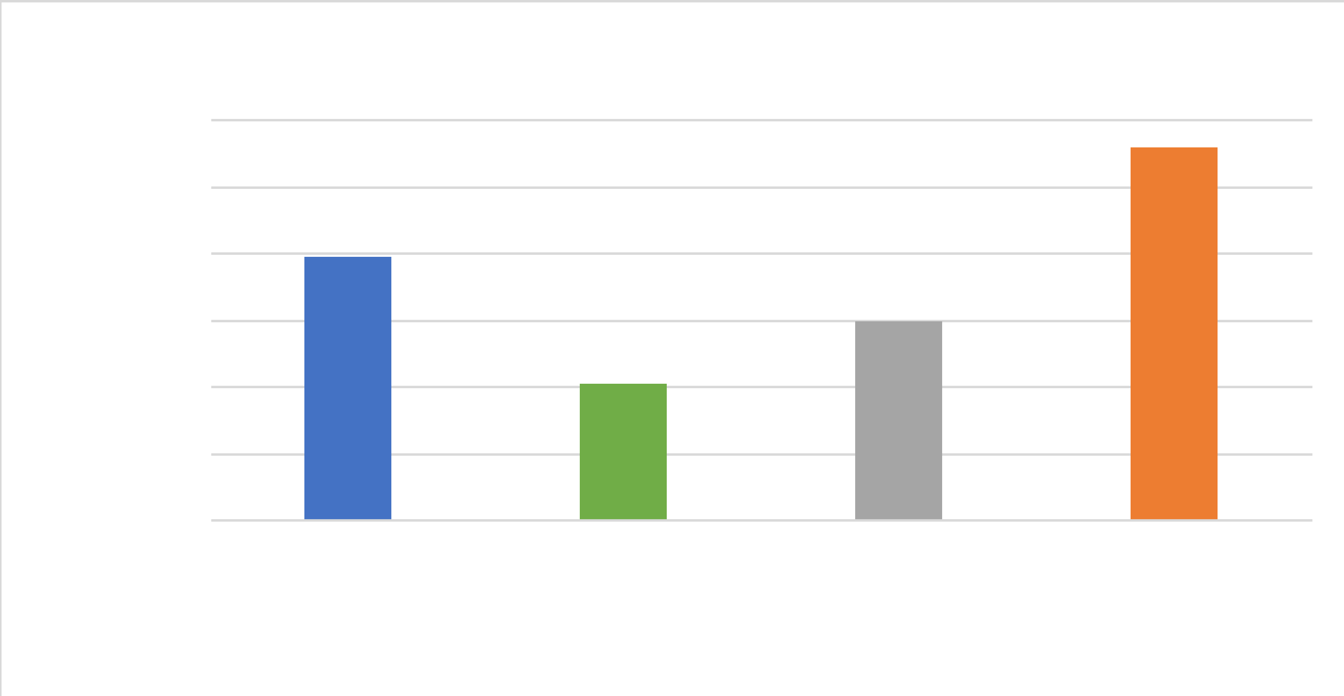
4.5.5. It has been proven that enhanced transport connectivity can boost productivity by enabling workers to have better access to job opportunities whilst businesses have access to a wider pool of skilled labour, as well as improving connectivity between businesses themselves. This is the theory underpinning agglomeration whereby productivity and wages will be enhanced where there is better transport connectivity, though there are often negative effects on congestion and air quality. The BBSC scheme seeks to deliver the positive effects of agglomeration whilst mitigating the negative effects.

4.5.6. Continued economic development is dependent on attracting new businesses and increasing the productivity of existing firms. Providing the necessary supporting infrastructure and upgrading and enhancing the walking, cycling and public transit infrastructure will be essential if the area is to remain competitive, enhance regional labour mobility, support further housing and infrastructural developments and ultimately, help achieve economic growth.

4.5.7. The following figure shows median annual earnings in Bristol, B&NES, the South West and England.

[8] Basic prices are prices that exclude taxes and subsidies on products. Current price refers to prices not adjusted to inflation.

Figure 4-4 – Gross annual pay (Annual Survey of Hours and Earnings 2023 – Table 7.7a)



4.5.8. The figure illustrates that B&NES has a lower gross annual pay than that of England with £29,002, although this is higher than the average for the South West which is £28,058. The gross annual pay in Bristol is slightly higher than in England, at £31,610 in Bristol compared to £29,955 for England. This suggests that Bristol has a comparatively skilled workforce with their population being paid more than the average across England. The South West has a relatively lower gross annual pay compared to B&NES, Bristol and England. B&NES and Bristol are performing comparatively better in terms of salary within the South West. This is an indication that both places have a higher concentration of skilled workforce in the region, although some of the difference may also be due to higher living costs. It is important to further promote the economic growth of both places to induce wider economic growth.

4.5.9. As happened nationally, the COVID-19 pandemic changed working patterns in Bristol. The November 2021 engagement report for BBSC found that 53% of the 1,207 respondents planned to work some days at home and some days at the workplace, with a further 10% planning to continue to fully work from home long term. 26% of respondents planned to continue (21%) or return (5%) to their place of work full time. As a result, fewer journeys will be taken every day along the BBSC with more being taken on a less regular basis by all forms of transport.

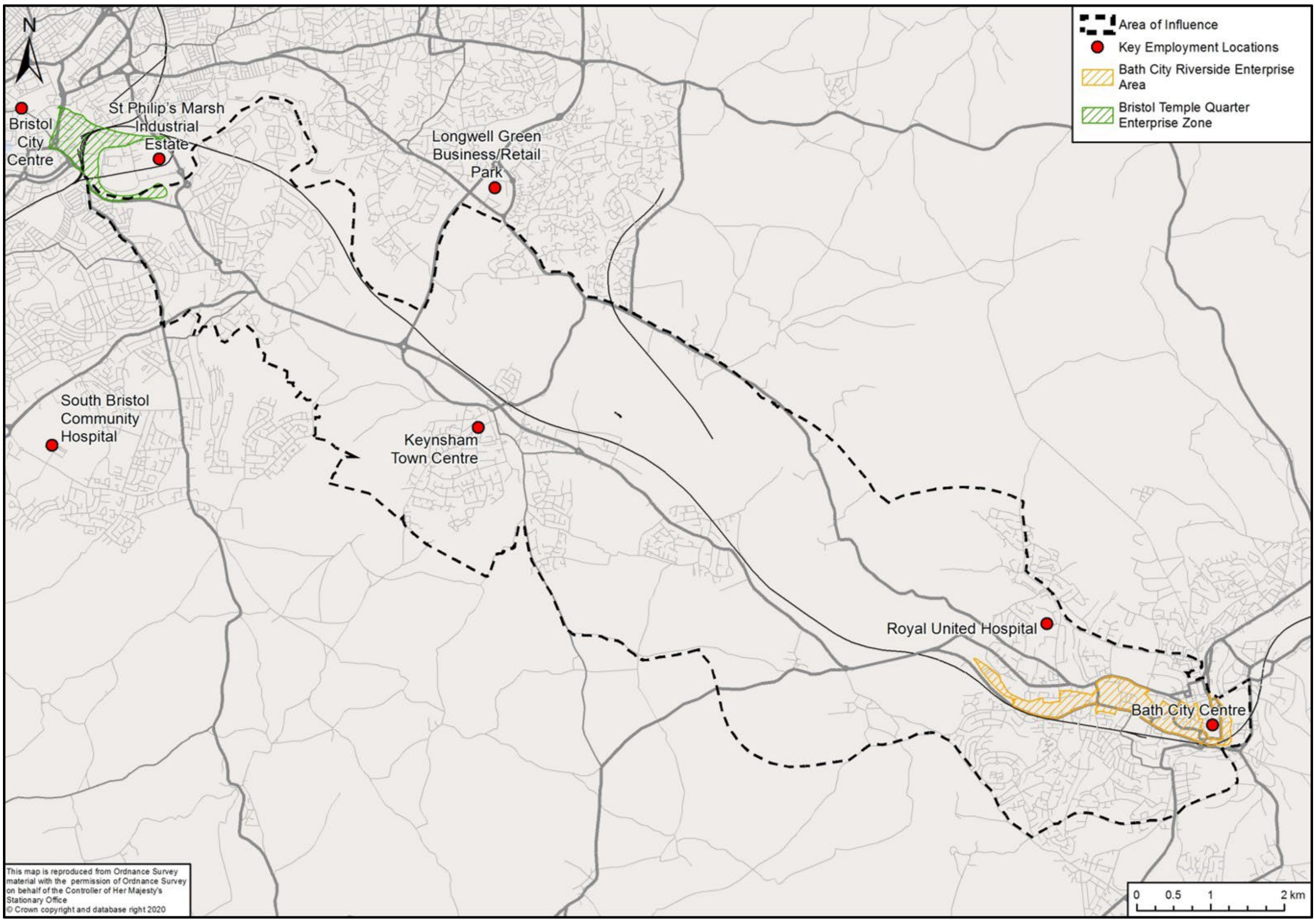
4.5.10. House prices in the South West average £328,668, above the UK average of £291,000 and the England average of £310,000. In B&NES, the average house price is £454,000, whilst in Bristol it is £351,000. The comparatively high cost of living in the area, with both B&NES and Bristol outpricing the South West which itself outprices England and the UK, could mean there are considerable benefits to reducing household spend on transport by facilitating and encouraging more sustainable choices.

4.5.11. The BBSC links employment centres at either end of the corridor to communities in along the corridor and at either end, as well as connecting to current and future employment sites along the corridor. Key employment sites include:

- At the Bristol end of the corridor there is the South Bristol Community Hospital, the Bristol Temple Quarter Enterprise Zone (BTQEZ) and St Philip's Marsh Industrial Estate. The BTQEZ is based around Bristol Temple Meads railway station and includes the University of Bristol's Temple Quarter Campus.
- At the Bath end of the corridor the key employment locations are the Royal United Hospital, businesses in Bath City Centre and the Bath Riverside Enterprise Area.
- Along the corridor, Keynsham Town Centre is home to the main civic office for B&NES, with approximately 2,500 staff located there.
- To the north of the corridor there is the Longwell Green Business Park.

4.5.12. In addition, there are two Enterprise Zones, with one at either end of the corridor. These are shown along with key employment sites in **Figure 4.5**.

Figure 4-5 – Gross annual pay (Annual Survey of Hours and Earnings 2023 – Table 7.7a) - Key employment destinations and Enterprise Zones



5 Key characteristics of the transport network

5.1 Strategic and major road network

5.1.1. The Strategic Road Network (SRN) surrounding Bristol and Bath provides key regional and national access to wider economic areas. The following SRN links are near Bristol and Bath:

- The A36 connects Bath to the M27 and subsequently major ports on the south coast including Portsmouth and Southampton.
- The M32 connects Bristol with London and South Wales.
- The M4 runs from west London to south west Wales, passing north of Bath and Bristol.
- The M5 links the Midlands with the South West. It joins West Bromwich and Exeter, passing the west of Bristol.
- The A46 connects the M4 to Bath.

5.1.2. There is less direct connectivity to the SRN within Bath. Bath is connected to Bristol and its SRN connections via the A36 and the A4.

5.1.3. The Government created the Major Road Network (MRN) to allow for dedicated funding from the National Roads Fund to be used to improve the middle tier of the busiest and most economically important local authority A roads. In July 2019, as the Sub-national Transport Body for the region, Western Gateway, published the Regional Evidence Base and Major Road Network and Large Local Major Scheme Priorities. This included the list of MRN schemes within the region.

5.1.4. The following MRN links are in close strategic proximity to Bristol and Bath:

- The A4 connects central London to Avonmouth via Bath and Bristol. The BBSC Bath to Emery Road scheme focuses on the section of A4 between Bath and Bristol.
- A420 is a major road connecting Bristol to the A46 at Cold Ashton. It is a single carriageway road.
- The A4174 is a primary road connecting the A4 at Durley Hill with the A420, M4, M32, and A38. It is a dual carriageway road.

5.2 Key route network

5.2.1. The Key Route Network (KRN) was developed as a requirement for devolution for the West of England Combined Authority. It was developed in conjunction with North Somerset Council in order to ensure a cohesive network. Roads which are part of the KRN and particularly relevant to BBSC include:

- A431 which runs approximately parallel to the A4, connecting Bristol and Bath via Longwell Green, Bitton, and Kelston.
- A4, which is the site of the BBSC, as well as Durley Hill which connects the A4 to Keynsham.
- A4175 which connects Keynsham to the A431.
- A4174 which connects Keynsham and the A4 to the A431.

- A36 which runs parallel to the A4/A431 into Bath city centre.

5.3 Local highway network

5.3.1. The section covered by the BBSC Programme is part of the MRN and is an integral part of the local road network. Bristol has a more comprehensive road network given its larger size compared to Bath. The local roads within Bristol connect the inner city to the coast and the wider region. In contrast, Bath has a less complex road network with the A36 (continuing towards Bristol to become the A4) being one of the main roads connecting to other areas.

5.3.2. Various local roads provide access to the city centres of Bristol and Bath:

- A4044 is a road within Bristol that separates the inner city centre from the east side of the city. It is connected to other major roads including the A370 and A420.
- A38 is a road running on the periphery of the west side of Bristol's inner city. It runs between Bodmin in Cornwall and Mansfield in Nottinghamshire.
- A3039 is the main road surrounding the east side of Bath City Centre. It connects the Bath Spa Railway Station and runs parallel to River Avon.
- A367 runs on the west side of Bath's city centre connecting to A3039 and A36. It provides access to different parts of the city centre.

5.3.3. The overall daily travel to work demand in the region indicates that there is a substantial amount of commuting demand between B&NES and Bristol, at around 13,000 trips every day.

5.3.4. In 2022 the Annual Average Daily Flow (AADF) on the Keynsham Bypass (between Bristol and Bath) was estimated at 26,386 total motor vehicles[9]. Of these vehicles, approximately 0.07% were buses and only 1% were cyclists.

5.3.5. With the government's goal of reducing carbon emissions, there is a need to encourage active modes of travel and the uptake of public transport. The scheme aims to increase the provision of cycling, pedestrian and public transport facilities along the A4.

5.4 Public transport – rail

5.4.1. Improving accessibility to public transport is one of the objectives of the scheme.

5.4.2. There are four railway stations located along the Bristol and Bath corridor. Bristol Temple Meads is located in central Bristol, near the Bath Bridge Roundabout. The station is part of the Great Western Railway line and provides services running directly to most parts of the UK, including Wales and Scotland. It serves as an important railway interchange and transport hub with onward connectivity to bus services to many parts of the city. The train from Bristol Temple Meads to Bath Spa runs at approximately every 15 minutes. For trains from Bath Spa to Temple Meads, the trains run at every 15 to 30 minutes.

[9] DfT Road Traffic Statistics, site number 6134

5.4.3. Within Bath there are two railway stations, Bath Spa and Oldfield Park. These are situated near the A36 in Bath. Both stations provide direct services to Bristol Temple Meads Station. The trains from Oldfield Park Station to Bristol Temple Meads run between 1 and 3 times per hour in both directions, depending on the time of day. Trains run from Bath Spa to London Paddington at a frequency of approximately two trains per hour. There are also frequent services to Reading, which allows fast connections to Heathrow and Gatwick Airport. The trains run to a variety of other destinations, such as Southampton Central and Cardiff Central.

5.4.4. Keynsham Station is located to the north-east of the Keynsham Bypass, in the middle of the Bristol to Bath corridor. The services from the station provide access to Bristol and Bath as well as Gloucester, Weymouth, and Great Malvern. The service from Keynsham Station to Bath Spa Station runs approximately every 40 minutes. In the opposite direction from Keynsham Station to Bristol, there are two train services every hour one with a 20 minute frequency and the second with a 40 minute frequency.

5.4.5. Improving the efficiency of movements on the A4 can increase the accessibility to these railway stations. By improving bus services and providing more active travel facilities, residents along the A4 can better access the railway stations by different modes of transport.

5.5 Public transport ‐ bus

5.5.1. There are currently bus services from Bristol or Bath that use sections of the A4.

Figure 5-1 – Existing Bus Network

Source: First Bus, Bath to Bristol Network Map

5.5.2. The X39 provided by First Bus connects Bristol to Bath, providing an alternative to travelling by railway. The X39 runs every 15 minutes on a weekday and every 20-30 minutes on weekends. It starts at Bath Bus Station and terminates at Bristol Bus Station. Based on the most recent timetable, the journey between Bath and Bristol and vice versa should take just over an hour.

5.5.3. An interrogation of Automatic Vehicle Locator (AVL) data collected over a three month period in Spring 2023 (April to June inclusive) shows that the services have average delays of 3.5 minutes eastbound and 5 minutes westbound in the morning peak period. In the evening peak period the services have average delays of 3 minutes eastbound and 5 minutes westbound. This is for every stop, therefore the data is showing that every service in the morning period arrives 3.5 mins late for eastbound services and 5 minutes late for westbound services.

5.5.4. Currently the fare falls under the West of England Zone and is £2 for a single and between £3.80 and £4.00 for two trips (return), dependent on distance travelled. This is based on pay on the day tickets. Multi-journey and season tickets are available.

5.5.5. There is no other bus service connecting Keynsham and Saltford to Bath apart from the 39/X39 service, which takes a circuitous route not along the A4. The 39 services only run at the shoulders of the day, before 05.45 and after 18.45 Monday to Friday, before 07.45 and after 18.30 on Saturdays. The X39 service runs between 05.45 and 18.45 Monday to Friday. This service does not run through Keynsham town centre but instead runs along the bypass with the closest bus stops located at Hick's Gate to the west and Ellsbridge House to the east, over two miles and one mile from Keynsham High Street respectively.

5.5.6. There are two services that connect Keynsham to Bath, these are service 349 with a 30 minute frequency and service 522 with an hourly frequency. Service 349 provides a route round Keynsham before returning to Bath while the 522 service connects to Bath via Paulton and Midsomer Norton, with the journey taking 90 minutes.

5.5.7. The U5 service connects St James's Parade with Bath Spa University. It travels along part of the A4 near Bath City Centre. From Monday to Saturday, the service runs every 30 minutes starting from Bath St James's Street West and terminating at Bath Spa University Newton Park Library. On Sunday's, the service is hourly.

6 The need for intervention

6.1.1. The scheme aims to improve sustainable transport connectivity and capacity. This is an intervention that responds directly to the key problems identified in the study area.

6.1.2. Firstly, the Joint Local Transport Plan 4 (JLTP4) has noted the congestion costs in the region adds up to £300m annually and would increase to £800m by 2036. There is an immediate need to alleviate the congestion.

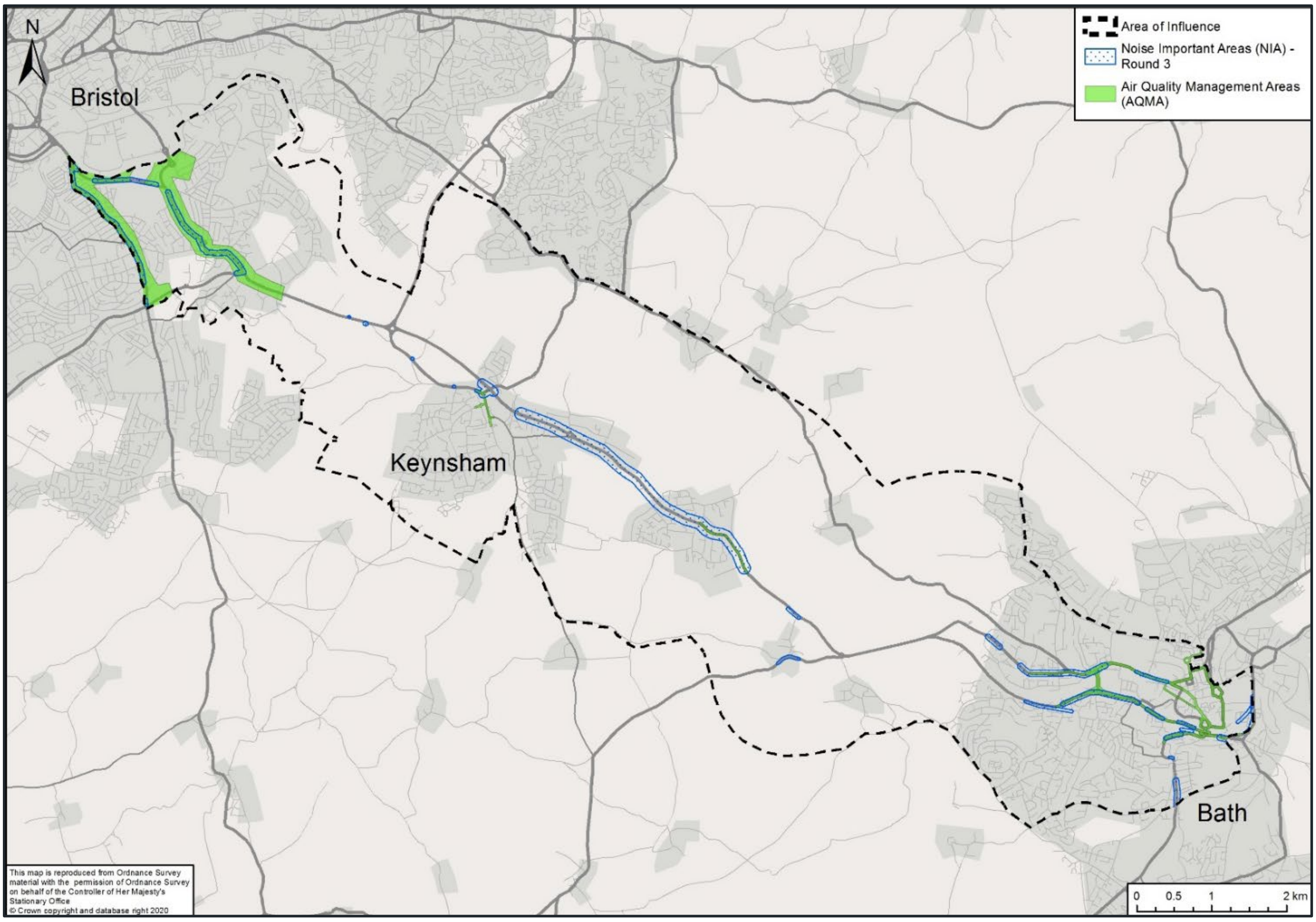
6.1.3. Secondly, a key problem is the long journey times for buses. The bus mode share for journeys to work in B&NES (3.4%) is significantly lower than the 6.1% bus mode share in Bristol.[10] Bristol's share is lower than similar sized cities such as Nottingham (11.8%), Sheffield (7.4%), and Southampton (6.6%). This low uptake of bus mode share along A4 was reflected in the BBSC engagement conducted previously. As part of the BBSC engagement conducted in Summer 2021, 300 responses focussed on issues related to bus and rail improvements. 60% of respondents rated 'bus journey time' as 'poor' or 'average' and 37% of respondents rated 'connections between different bus services on the A4' as 'poor'. This highlights the need to improve the reliability of bus journey times.

6.1.4. Thirdly there is the lack of walking and cycling facilities on the corridor. There are relatively few crossing points along the A4, and crossing points are often indirect. Less than 20% of the A4 has formal cycle facilities supporting cycling along the corridor. Public consultation has reflected a need for improvements to the active travel network. In the Bath Liveable Neighbourhoods consultation (2020), 85% of residents agreed with reducing the dominance of vehicles by using more road space for safer active travel.

6.1.5. Fourth, a large proportion of the BBSC scheme falls within an Air Quality Management Area (AQMA) and/or within a Noise Important Area (NIA) as shown in **Figure 6.1** below. With car transport being a significant contributor to both air and noise pollution, the shift to more sustainable forms of transport such as active travel and public transport has the potential to reduce these negative impacts. The need to manage these sits alongside the need to meet local, regional and national climate objectives, including the West of England Combined Authority's objective to reach net zero by 2030 and the national decarbonisation agenda.

[10] Method of travel to workplace - Census Maps, ONS

Figure 6-1: AQMAs and NIAs around the BBSC site.



6.1.6. The limited sustainable travel infrastructure in the area restricts access to employment and services by means other than the private car. Improving the infrastructure will improve access for all, leading to a wider employment pool for businesses.

7 Impacts of the proposed scheme

7.1.1. The local and regional transport problems affecting the area's economic potential stem from congestion, poor journey time reliability and lack of active travel provisions along key routes such as the A4. The scheme will facilitate modal shift and support achieving the target public transport and active travel mode share. As Bristol and Bath have a relatively skilled workforce in the region, improving the connectivity of both places will further assert the economic status and bring wider economic growth to the region.

7.1.2. In this section, the range of economic impacts (benefits) is described with the Level 1 to Level 3 approach adopted by DfT as part of the Value for Money Framework:

- Level 1: Established monetised impacts, the methods for estimating the impact and monetary value are accepted, well-established and tested. These impacts are used to generate the Initial Benefit Cost Ratio (BCR)
- Level 2: Evolving monetised impacts, there is some evidence to support the estimation of a monetary value but it is less well-established than the Level 1 impacts. These impacts are used to generate the Adjusted BCR
- Level 3: Indicative monetised impacts and non-monetised impacts, for the former monetary valuation methods are not considered widely accepted, and for the latter the estimated magnitude of impact is assessed on the seven-point scale. These impacts are used to inform the overall Value for Money assessment, but do not form part of the Initial or Adjusted BCRs

7.2 Level 1 impacts

7.2.1. The Level 1 impacts which will be considered for this scheme include:

- Journey time changes for public transport and highway users.
- Changes in cost of travel including fares and vehicle operating costs.
- Accidents.
- Physical activity.
- Journey quality.
- Noise.
- Air quality.
- Greenhouse gases.
- Indirect tax revenues.

7.2.2. The scheme aims to improve bus journey times, journey reliability and improve the provision for active modes to increase travel by bike and on foot and improve the quality of infrastructure. The modal shift to active travel will result in health benefits associated with physical activity, reduce greenhouse gas emissions and improve air quality. In addition, there will be journey quality benefits associated with the improved infrastructure for active mode and public transport users.

7.2.3. It is also considered that the speed limit reductions proposed along the corridor may have the effect of reducing accidents along the links. Also improving the walking and cycling infrastructure should reduce accidents involving pedestrians and cyclists.

7.2.4. The improvement in the public transport along the corridor will promote bus as a viable option for travel. The better the connectivity between Bristol and B&NES, the greater the accessibility to employment opportunities. BCC and B&NES contain a skilled labour force with a higher gross annual pay compared to the rest of the South West.

7.2.5. Due to the road-space reallocation to benefit sustainable travel there is likely to be a disbenefit to highway users in terms of delay. This could possibly lead to displacement of traffic to other routes, however this impact to traffic is expected to be minimal as the other routes are narrow country roads are required a large diversion in distance.

7.3 Level 2 impacts

7.3.1. Level 2 impacts include the following three types of wider economic impacts associated with enhanced connectivity:

- Agglomeration improvements (i.e. a localised economy that benefits from the industries being in close proximity – this impact is also known as “static clustering” – the impact being ‘static’ as land use does not change).
- Output change in imperfectly competitive markets (i.e. reducing businesses travel costs such that they can increase output, reduce prices and increase productivity).
- Labour supply (i.e. reduced journey times make it economically advantageous for workers to re-enter the labour market and thus generate GDP and taxation receipts for the Government).

7.3.2. Agglomeration is the main contributor to the wider economic impacts. It attracts businesses and industries to be in close proximity. TAG measures effective density as a proxy for agglomeration and it seeks to measure the impact of changes in generalised travel costs and employment location. This is done using outputs from a transport model calculating generalised travel costs for each journey for all modes and journey purposes.

7.3.3. As the scheme seeks to improve sustainable transport facilities along the corridor, reallocating road space on the existing road network in some locations, the agglomeration impacts are likely to be skewed as the benefits accrued to the improved accessibility for public transport will be offset by the capacity reduction for private vehicular transport. Also, the transport model will not assess the impacts of the improved accessibility for the walking and cycling aspects. Based on this, it is not considered proportionate to undertake the appraisal productivity impacts of the scheme.

7.3.4. A further Level 2 impact is reliability. The impact of the scheme on public transport reliability will be considered as part of the appraisal given this is a core part of what the scheme seeks to deliver. One of the objectives of the scheme is to improve bus journey reliability. As such the scheme is aimed at improving the journey time reliability for public transport (bus) users it is not aimed for all highway users.

For public transport reliability impacts an assessment in line with TAG has been undertaken which uses the lateness against the timetabled journey times for the service for each scenario and modelled period. It compares the Do Minimum to the Do Something to identify what differences in reliability can be associated with the scheme.

7.4 Level 3 impacts

7.4.1. Level 3 economic impacts are those where there is less certainty concerning their robustness and accuracy. This is the reason Level 3 impacts are not included in scheme BCRs. Where justified, however, they are important as they can be used to test the impact on a scheme's Value for Money (VfM) category with the use of DfT guidance on 'switching values'.[11]

7.4.2. The use of switching values enables the extent to which the Present Value of Benefits (or Present Value of Costs) would need to increase or decrease for the Value for Money category of the scheme to change to be identified.

7.4.3. From a wider economic impact perspective, Level 3 impacts cover the following:

- Dependent development – land value uplift (and related external impacts) from new developments unlocked by the transport scheme.
- Outputs from 'supplementary economic modelling' as defined in DfT TAG Unit M5.3. These are as follows:
  - Additionality modelling.
  - S-CGE (general equilibrium) economic modelling.
  - Land Use Transport Interaction (LUTI) modelling.
  - Reduced form economic modelling (i.e. agglomeration modelling as described above but this time with adjustments to the elasticity parameters).

7.4.4. Based on the current context, it is not anticipated that the scheme will unlock specific development sites or induce transformative land use change in the area. Therefore, it is not anticipated to be proportionate to quantify the indicative monetised impacts of the scheme. In discussions held with the Combined Authority, Bristol City Council and Bath and North East Somerset Council it was stated that the potential strategic development locations at Keynsham and Hicks Gate would not be reliant on the BBSC to unlock them.

[11] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/627490/value-for-money-supplementary-guidance-on-categories.pdf (see sections on 'switching value(s)' throughout the document)

7.4.5. As well as the economic impacts considered under Level 3, a range of other, non-monetised impacts can be included. These include the social and environmental impacts of the scheme in terms of security, severance (such as improved connectivity and crossings between and within communities), accessibility, townscape, historic environment, landscape, biodiversity, water environment, affordability, and access to services. A qualitative assessment will be made of these impacts in line with guidance in TAG Units A3 and A4-1. These assessments will inform the overall Value for Money assessment of the scheme.

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix E – AST-BBSC-Core Preferred Option

70093741
February 2024

Public

West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix E – AST-BBSC-Core Preferred Option

Type of document (version) Public

Project no. 70093741

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Date: February 2024

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Contents

1 Introduction

1.1.1. This appendix summarise the findings of the Environment TAG worksheets into one overall table, in a format designed by the Department for Transport.

1.1.2. This document cannot be made fully accessible, therefore cannot be published. If you wish to request this document, please contact info@westofengland-ca.gov.uk

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix F - Social and Distributional Impact Report

70093741
January 2024

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix F - Social and Distributional Impact Report

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Project no. 70093741

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1 Introduction

1.1 Purpose of the Report

1.1.1. This report has been prepared to support the Bath and North East Somerset section of the A4 Bath to Bristol Strategic Corridor programme (BBSC) Outline Business Case (OBC). It sets out the methodology used and provides the results of the distributional impact analysis undertaken as part of the appraisal of the scheme.

1.1.2. The purpose of Distributional Impact (DI) analysis is to attempt to determine how different social groups are impacted by proposed infrastructure (and investment), positively or negatively. The Department for Transport's (DfT's) Transport Analysis Guidance (TAG) Unit A4.2 'Distributional Impact Appraisal' (2020), provides the guidance to be used and within that contains eight appraisal indicators which should be considered. These relate to different appraisal categories typically found within an appraisal of scheme impacts, reported on within an Economic Dimension of an OBC, namely:

- User benefits
- Noise
- Air quality
- Accidents
- Security
- Severance
- Accessibility
- Personal affordability

1.1.3. More detail is provided about these categories in the scope section.

1.1.4. The social groups focus on vulnerable groups identified within the Equalities Act, and relate to age, ethnicity, those with disabilities, gender, and economic categories. The TAG guidance sets out the type of analysis and recommends datasets to use during the analysis of these welfare impacts upon those groups.

1.1.5. The distribution of impacts amongst different social groups is important due to the way they experience transport investment in infrastructure and services differently. For example, people with access to a car may experience fewer benefits to those without a car for an intervention that improves local public transport services. It is important to consider vulnerable groups and demonstrate that they are not disadvantaged further by receiving a disproportionately low share of the scheme's benefits, or a disproportionately high share of the disbenefits.

1.2 Report Structure

1.2.1. This report is structured by providing a scheme background before detailing a three-step approach for each indicator:

- Step 1 – Screening Process:
  - Identification of likely impacts for each indicator.
- Step 2 – Assessment:
  - Confirmation of the area impacted by the transport intervention (impact area)
  - Identification of social groups in the impact area; and
  - Identification of amenities in the impact area.
- Step 3 – Appraisal of Impacts:
  - Core analysis of the impacts; and
  - Full appraisal of Distributional Impacts (DI) and input into an Appraisal Summary Table (AST)

1.3 Scheme Background

1.3.1. As part of the DfT's City Regional Sustainable Transport Settlement (CRSTS), the West of England Combined Authority was awarded £540m to improve sustainable transport provision in the region. A key flagship project within this award was developing and delivering the BBSC. The overall objective of the programme is to deliver bus priority measures to the A4 from the Bristol City Centre to Bath City Centre to improve existing services journey times as shown in **Figure 1-1**.

1.3.2. The improvements to the A4 corridor focus on improving access and reducing journey times and improving reliability for bus users, cyclists and pedestrians (including walking and wheeling users) through the provision of:

- Providing infrastructure improvements to support a high-quality, high frequency bus service between Bristol and Bath
- Changes to the operations of bus services along the corridor
- A continuous segregated cycling corridor between Bristol and Bath
- Cycling and walking connections between local communities along the A4 between Bristol and Bath and the new bus service and strategic cycling corridors

1.3.3. The BBSC programme has been split into two parts with the section within Bristol being developed and assessed separately to the Bath and North-East Somerset section. This DI covers the section between Emery Road to the east of Bristol City Centre and Bath. The route follows the A4 until the outskirts of Bath where it then follows the A4 Newbridge Road.

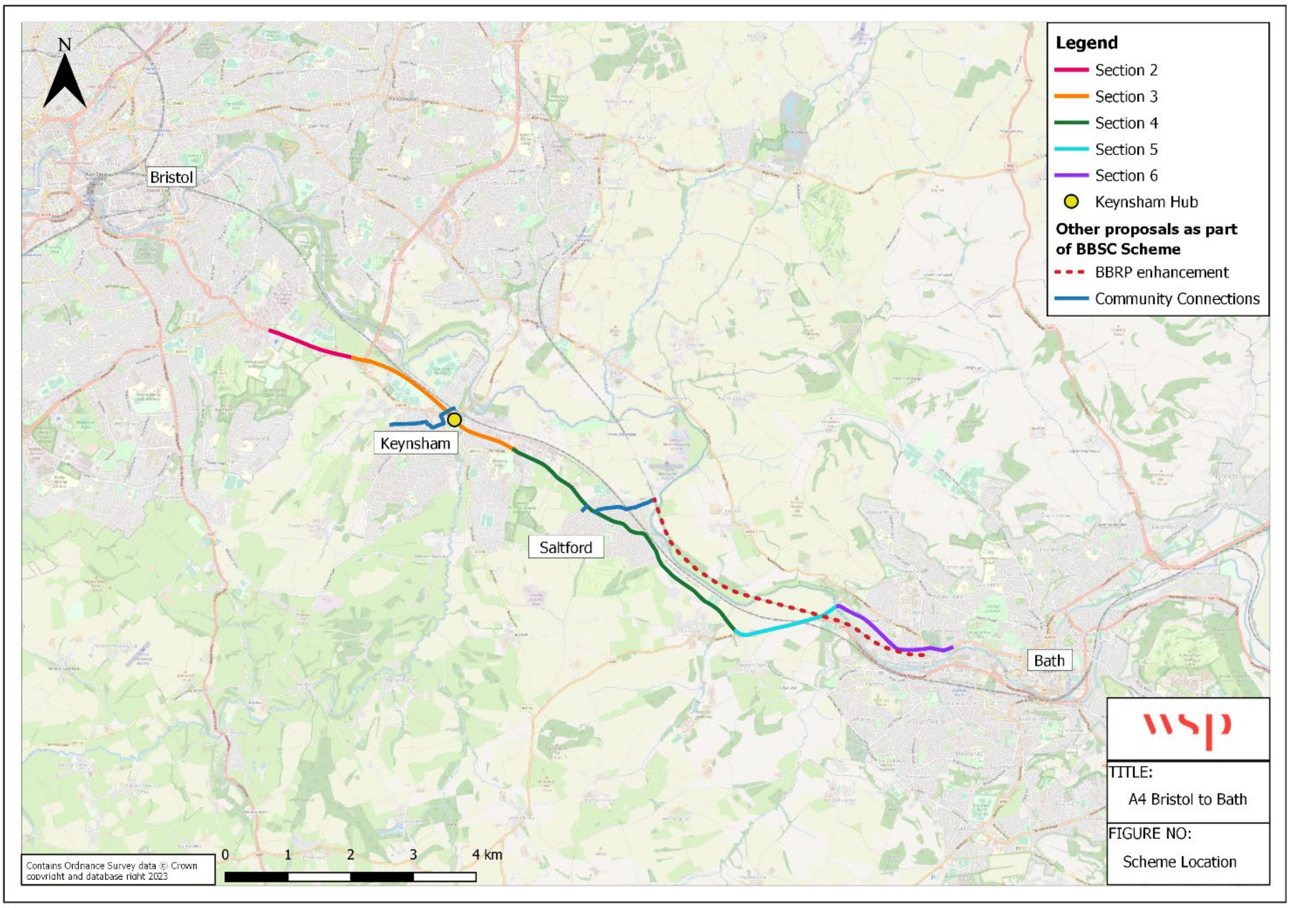
1.3.4. The scheme to be delivered for the B&NES section of the BBSC consists of different elements which have been combined to form a package of measures. These elements include bus infrastructure improvements along the corridor, active travel infrastructure improvements along the corridor, a transport hub at Keynsham, and active travel infrastructure improvements from the corridor into the neighbouring urban areas, providing better connections to the corridor itself. As the OBC is centred around the infrastructure requirements on the corridor the costs and benefits of this only will be included within the economic appraisal. Improvements to the operating model of the service(s) on this corridor are being considered as part of the separate but completement Bus Service Improvement Plan (BSIP) and therefore the costs (and benefits) will be captured as part of this workstream as opposed to BBSC.

1.3.5. In parallel to the BBSC programme, the Combined Authority is developing Future4WEST, a Mass Transit programme for the region, which also considers options for sustainable travel on the corridor between Bristol and Bath. Given the significant overlap the two programmes are being developed in close collaboration by the Combined Authority and unitary authorities (UAs). However, the BBSC is not dependent on Future4WEST progressing and is being developed (and appraised) as a stand-alone programme.

1.3.6. There are other projects being developed within the Bristol and Bath areas which, whilst not dependent on BBSC, will connect to the scheme to improve the overall connectivity, these include:

- B&NES Liveable Neighbourhoods which aims to improve residential streets and encourage safe, active and more sustainable forms of travel, such as walking, wheeling and cycling.
- CRSTS Bath Sustainable Walking & Cycling Links (BSWCL), which will improve the infrastructure for pedestrians and cyclists travelling between residential areas to the east / west of Bath to the city centre.
- CRSTS Bath City Centre, which will improve active travel infrastructure and provide greater bus priority in the vicinity of the bus station.
- Circulation Path for the City of Bath, which will set out a plan for the use of street space across the city.

Figure 1-1 - Scheme Location



1.4 Scheme Description

1.4.1. The whole corridor is divided into six sections for the development of the scheme which is primarily focused on developing a bus corridor, interchanges and promoting active travel along the corridor. This SDI encompass Sections 2 to 6, which are part of the OBC programme and is referred to as 'the scheme'. It should be noted that Section 6 ends just east of Windsor Bridge Road in Bath as the section of the corridor between Nile Street and the bus station is covered by the Bath City Centre Sustainable Transport Project, which also forms part of the wider CRSTS Programme. The considered proposals have been listed below for developing the A4 Bristol and Bath corridor.

1.4.2. The interventions which are shortlisted as a part of both the options are:

- Bus priority infrastructure
- KeynshamHub
- Strategic Cycling Options
- Community Connections
- Bristol to Bath Railway Path (BBRP) enhancements

Section 2: Emery Road to Hicks Gate

- Segregated bi-directional cycle lane to south of carriageway with crossing facilities.
- Continuous bus lanes eastbound and southbound from P&R junction to Hicks Gate, not Emery Road due to tie in to into Bristol section proposals and traffic constraints.

Section 3: Hicks Gate to Broadmead Roundabout

- Continuous bus lane eastbound and westbound along Keynsham Bypass and continuous segregated shared use path to south of carriageway.

Section 4: Broadmead Roundabout to Globe Roundabout

- Changes to Broadmead Roundabout to facilitate bus priority.
- Shared use path/segregated cycleway provided to south of carriageway.
- Eastbound bus lane Broadmead to Grange Road, shared use path/segregated cycleway provided to south of carriageway.

Section 5: Globe Roundabout to Twerton Fork

- Junction upgrades for bus priority
- Shared use path provided to north of carriageway between Globe Roundabout and Newbridge Road ties into existing connection to BBRP.
- Shared use path provided to north of carriageway between Globe Roundabout and Newbridge Road ties into existing connection to BBRP. Constraints at bridges mean full segregated walking/cycling provision is unlikely to be achievable.

Section 6: Twerton Fork to Bath City Centre (Midland Road)

- Eastbound bus lane between Newbridge P&R and Midland Road

Other proposals identified.

- Hicks Gate: Bus Stop Enhancement on Corridor and improved access to bus stops
- Keynsham Hub: Transport Hub with on carriageway bus stops and at grade crossing of A4, bus shelters provided along with walking/cycling connections to Keynsham town centre and train station.
- Bristol to Bath Railway Path (BBRP) Saltford Section: Upgrade of existing connections (Norman Road & High Street), potential walking/cycling crossing upgrades
- Saltford, Manor Road: walking/cycling provision and crossing upgrades (removed following engagement)
- Keynsham Centre and connection to train station: Junction upgrades, connections to proposed Keynsham Transport Hub
- BBRP Extension, Bath: an off-road route along the western section between Brassmill Lane and Station Road, travels along Station Road down the hill and re-joins the existing route along the river

1.5 Scope of Social and Distributional Impacts

1.5.1. The appraisal of DI focuses on eight specific impacts, as detailed above, with more detail provided in **Table 1-1**.

Table 1-1 - The Eight Social and Distributional Impacts

TAG Unit	Summary of Importance
User Benefits (TAG Unit A4.2.2)	It is important to gain an understanding of the distribution of user benefits by social group and by area. This analysis assists in understanding how user benefits accrue to different groups in society and across a geographic area. Analysing a wider area outside of the immediate vicinity of the intervention is vital as user benefits are often generated significantly beyond the immediate area of the scheme. Note that DI analysis is only applicable for individuals and not in-work trips experienced by businesses.
Noise (TAG Unit A4.2.3)	It is important to understand the distributional effects of changes to noise generated by the transport intervention – both in terms of improvements and deterioration. Changes in noise levels resulting from the intervention will be experienced to varying extents in different areas and by different groups of people. It is therefore important to understand the noise-related social and distributional impacts of a scheme
Air Quality (TAG Unit A4.2.4)	Changes in emission levels resulting from the transport intervention will vary by location and social group. It is therefore important to understand the distribution of air quality changes – both in terms of improvements and deteriorations.
Accidents (TAG Unit A4.2.5)	Transport schemes can have significant impacts on safety and accidents and as these issues can have varying impacts on different areas and social groups, it is important to understand the specific impacts of an individual scheme.
Severance (TAG Unit A4.2.6)	Transport interventions can result in changes to levels of severance within the transport network through influencing traffic flows and providing new infrastructure. As severance issues impact on different social groups and areas to differing extents, it is important to analyse how individual scheme will alter levels of severance.
Security (TAG Unit A4.2.7)	Transport schemes can have impacts on personal security (both real and perceived) and these benefits can differ according to area and social group. It is, therefore, important to gain an understanding of the social and distributional impacts of the transport intervention from the personal security perspective.
Accessibility (TAG Unit A4.2.8)	Access to services often presents significant difficulties to certain social groups and those living remotely. Transport interventions can have an impact of the ability of people to access services they require.

TAG Unit	Summary of Importance
Personal Affordability (TAG Unit A4.2.9)	Changes in costs (both increases and reductions) need to be assessed in terms of understanding the social and distributional effects. Any changes in transport costs due to changes to the transport network could impact on the lower income groups.

1.5.2. **Table 1-2** sets out the groups of people to be identified in the analysis for each of the indicators listed.

Table 1 2 - Social Groups and DI Indicators

Social Group	User Benefits	Noise	Air Quality	Accidents	Severance	Security	Accessibility	Personal Affordability
Income Distribution	Yes	Yes	Yes	Not applicable	Not applicable	Not applicable	Not applicable	Yes
Children (proportion of population aged under 16)	Not applicable	Yes	Yes	Yes	Yes	Not applicable	Not applicable	Not applicable
Young Adults (proportion of population aged 16-25	Not applicable	Not applicable	Not applicable	Yes	Not applicable	Not applicable	Not applicable	Not applicable
Older People (proportion of population aged over 70)	Not applicable	Yes	Not applicable	Yes	Yes	Not applicable	Not applicable	Not applicable
Proportion of population with a disability	Not applicable	Not applicable	Not applicable	Not applicable	Yes	Not applicable	Not applicable	Not applicable
Proportion of population of Black and Minority Ethnic (BME) origin	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Proportion of households without access to a car	Not applicable	Not applicable	Not applicable	Not applicable	Yes	Not applicable	Not applicable	Not applicable
Carers (proportion of households with dependent children)	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

1.5.3. **Table 1-3** sets out the general scoring method of distributional impacts for identified social groups.

1.6 Social Impact Analysis

Methodology

1.6.1. Social impacts consider the overall impact of transport interventions on different indicators such as numbers of accidents, physical activity, security, severance, journey quality, option and non-use value and accessibility. The analysis is undertaken in accordance with TAG guidance Unit A4.1 and is a constituent of the Appraisal Summary Table (AST). Both beneficial and/or adverse impacts of transport interventions are considered, along with the identification of social groups likely to be affected.

Table 1-2 - General System for Grading of Distributional Impacts for each of the Identified Social Groups

Impact	Assessment
Beneficial and the population impacted is significantly greater than the proportion of the group in the total population	Large Beneficial (three ticks)
Beneficial and the population impacted is broadly in line with the proportion of the group in the total population	Moderate Beneficial (two ticks)
Beneficial and the population impacted is smaller than the proportion of the group in the total population	Slight Beneficial (one tick)
There are no significant benefits or disbenefits experienced by the group for the specified impact	Neutral
Adverse and the population impacted is smaller than the proportion of the group in the total population	Slight Adverse (one cross)
Adverse and the population impacted is broadly in line with the proportion of the group in the total population	Moderate Adverse (two crosses)
Adverse and the population impacted is significantly greater than the proportion of the group in the total population	Large Adverse (Three Crosses)

1.6.2. **Table 1-4** below summarises the social impact assessment for the proposed scheme.

Table 1-3 - Social Impact Analysis

Assessed Indicator	Summary of the Key Impact	Assessment
Accidents	The scheme has the potential to decrease overall number of car trips due to improved public transport facilities and sustainable community connections. The COBALT assessment has reported a benefit of £1.78 million giving an assessment score of 'Slight Beneficial'.	Slight Beneficial
Physical activity	Compared to the existing active travel infrastructure, a continuous track for cyclists and pedestrian between both the town centres is proposed. Due to this, it is expected that the number of active travel users along the corridor is to increase.	Moderate Beneficial
Security	Since the scheme is focused towards improving the public transport infrastructure, a slight benefit in the security for the public transport (PT) users are anticipated as compared to the existing scenario.	Slight Beneficial
Severance	The scheme is expected to decrease the private car traffic between the town centres of Bristol and Bath. The new active travel infrastructure and improved connections to public transport facilities will reduce the severance of vulnerable groups to access the amenities like bus stops, community centres, hospital etc. Considering the extent of the scheme and the number of people affected, Severance is scored as Moderate Beneficial.	Moderate Beneficial
Journey Quality	The scheme will improve current journey ambience for movements between Bristol and Bath. The new interventions enhance the journey experience for public transport users, cyclists and pedestrians.	Moderate Beneficial
Option and non-use value	The improved bus priority and active travel connections proposed as part of the scheme will give more options for the users to choose their mode of travel, giving a moderately beneficial impact.	Moderate Beneficial
Accessibility	The schedule of the existing bus route X39 is modified to meet the existing and future demand of the users. But there are no new routes proposed along the corridor. The active travel infrastructure is expected to increase along the corridor. Hence, the social impact is scored as 'Slightly Beneficial'	Slight Beneficial
Personal affordability	While the scheme is expected to reduce peak hour delay for all modes and improve journey time reliability, highway users experience a disbenefit in the fuel costs due to longer journey time. The improvements in public transport and active travel infrastructure will result in a slight severance for the highway users. Consequently, for population in low income quintile who cannot afford a car, the improved public transport corridor will give them a more affordable option to travel. Therefore, personal affordability is scored as a Neutral impact.	Neutral

1.7 Initial Screening

1.7.1. An initial screening assessment has been undertaken to consider the likely positive and negative impacts of the eight DI indicators listed in **Table 1-5**.

1.7.2. The findings from the initial screening are presented in the proforma (Appendix A) which identifies which indicators should be appraised in more detail and provides recommendations, where appropriate for further analysis. The screening proforma is summarised in **Table 1-5**.

1.7.3. The screening process found that no further quantitative assessment was required for security as the Scheme is not anticipated to have any impact on public transport security through a change in public transport waiting/interchange facilities or access to such facilities which would likely affect user perceptions of personal security (the focus on the impact analysis method described in TAG).

1.7.4. Similarly, no further quantitative assessment was required for accessibility because the Scheme does not bring about changes to public transport in the form of rerouting, timings or frequency.

Table 1-4 - Summary of Proforma

DI Indicator	Likely DI Impact	Recommendation
User Benefits	Yes	Proceed to Step 2
Noise	Yes	Proceed to Step 2
Air Quality	Yes	Proceed to Step 2
Accidents	Yes	Proceed to Step 2
Security	Yes	Proceed to Step 2
Severance	Yes	Proceed to Step 2
Accessibility	Yes	Qualitative Assessments to be undertaken
Affordability	Yes	Proceed to Step 2

1.7.5. Following the initial screening process, and prior to undertaking the actual DI Appraisal, TAG Unit A4.2 states that a full screening should be progressed. This is provided for each DI indicator in the following sections.

2 User Benefits

2.1 Introduction

2.1.1. User benefits of transport schemes are experienced differently by different social groups geographically. The distributional impact analysis of user benefits is described below.

2.2 Screening (Step 1)

2.2.1. Within the screening process, user benefit DI analysis is required where user benefits have been appraised for the scheme using the DfT's Transport User Benefit Appraisal (TUBA) software, which is the case for the BBSC scheme.

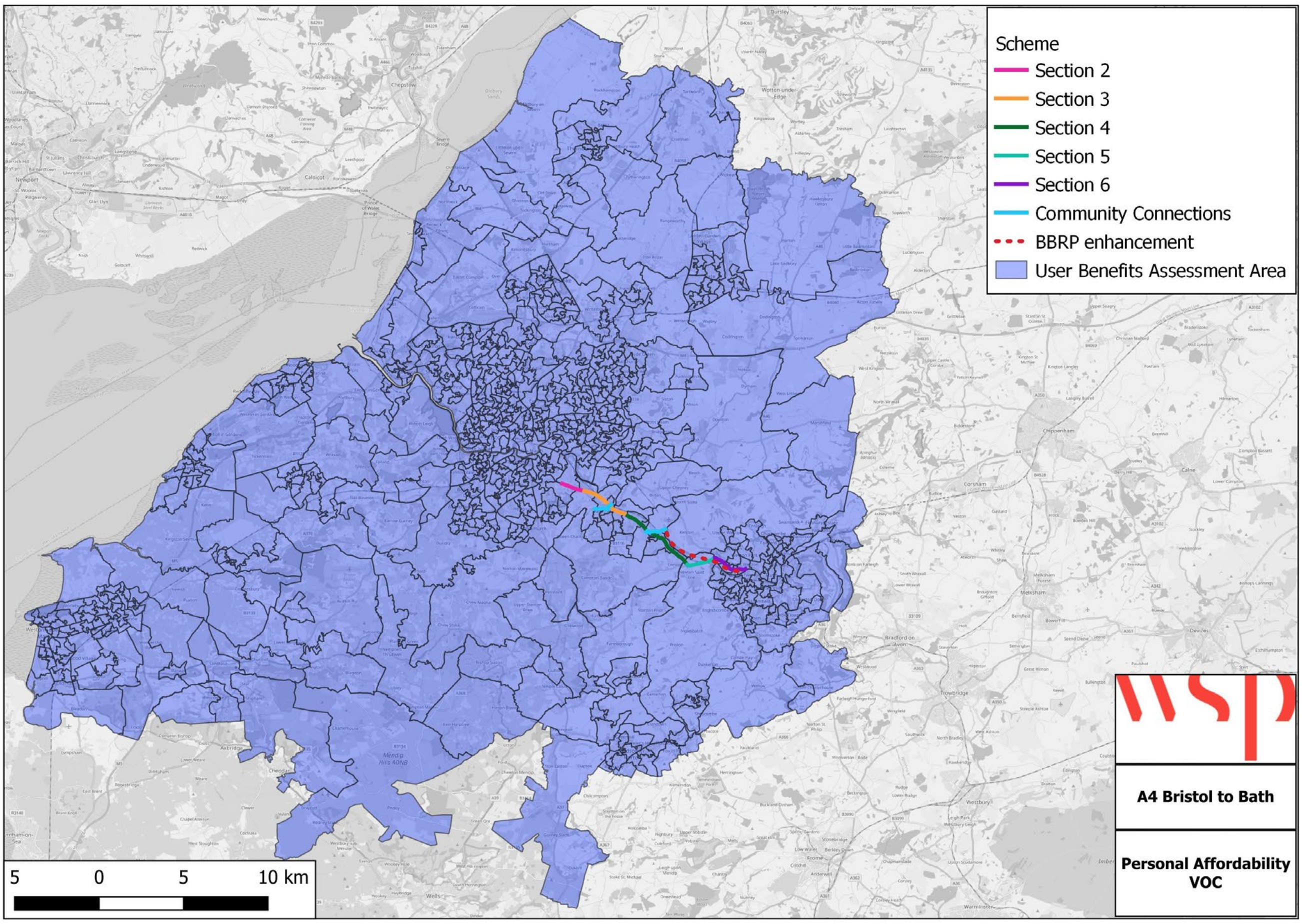
2.2.2. An initial screening proforma was completed which assessed the user benefits using TUBA where they have been quantified in conjunction with a spatially disaggregate transport model.

2.2.3. TUBA calculates user benefits from the differences in travel times, vehicles operating costs (VOCs) and user charges between the Do-Minimum and Do-Something model scenarios. The outputs can then be used to spatially identify an impact (benefit) per head of the population as a result of the scheme and assess the areas that will have the most significant impacts in relation to income distribution for people living within the impact area.

2.3 Assessment – Areas of Impact (Step 2a)

2.3.1. The impact area for user benefits is defined as the area of detailed modelling within the West of England Regional Transport Model (WERTM), covering the whole A4 corridor from Bath to Bristol. The transport model sectors were used to define the DI study area, as this would provide a defined area where impacts could be quantified. The area is considered robust enough to capture the impacts expected due to the scheme. **Figure 2-1** depicts the assessment impact area.

Figure 2-1 - Assessment Impact Area



2.4 Assessment – Identification of Social Groups in Impact Area (Step 2b)

2.4.1. It is important to understand the distribution of user income within the impact area. To achieve this, the income domain from the Index for Multiple Deprivation (IMD) 2019 has been mapped at Lower Super Output Area (LSOA) level throughout the scheme area.

2.4.2. User benefits from the TUBA assessment, for commute and other purposes only (non-business), have been converted from model zones to LSOAs to allow for comparison to the IMD income domain data. The conversion of benefits from model zone to LSOA has been undertaken using the Ordnance Survey Codepoints (Postcodes) 2020 dataset to derive proportions for splitting model zone benefits into LSOAs based on population distribution.

2.4.3. The distribution of income groups within the impact area is summarised in Appendix C.

2.4.4. **Figure 2-2** presents a visual representation of the income domain quintiles throughout the impact area at LSOA level.

Figure 2-2 - IMD Income Domain

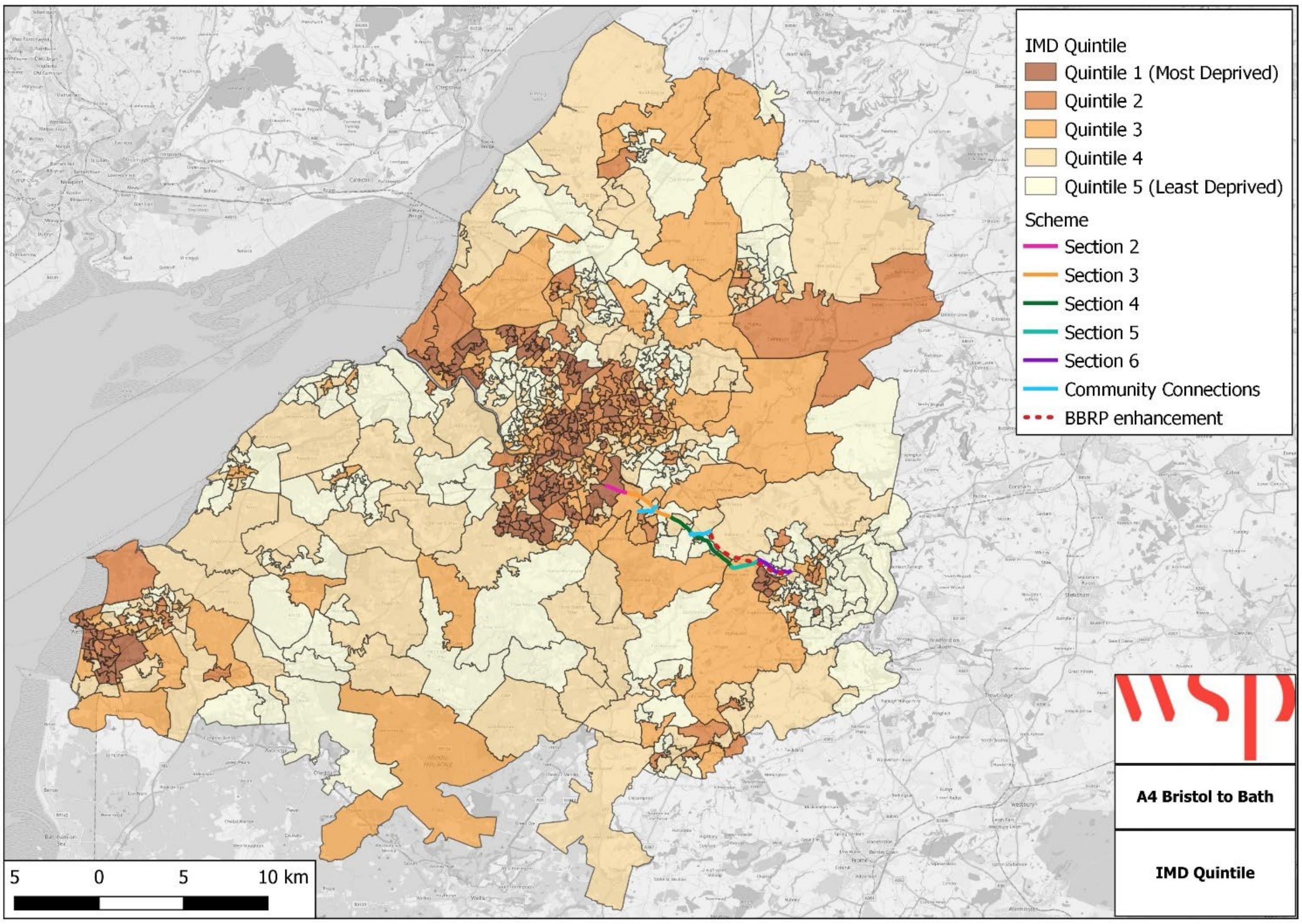
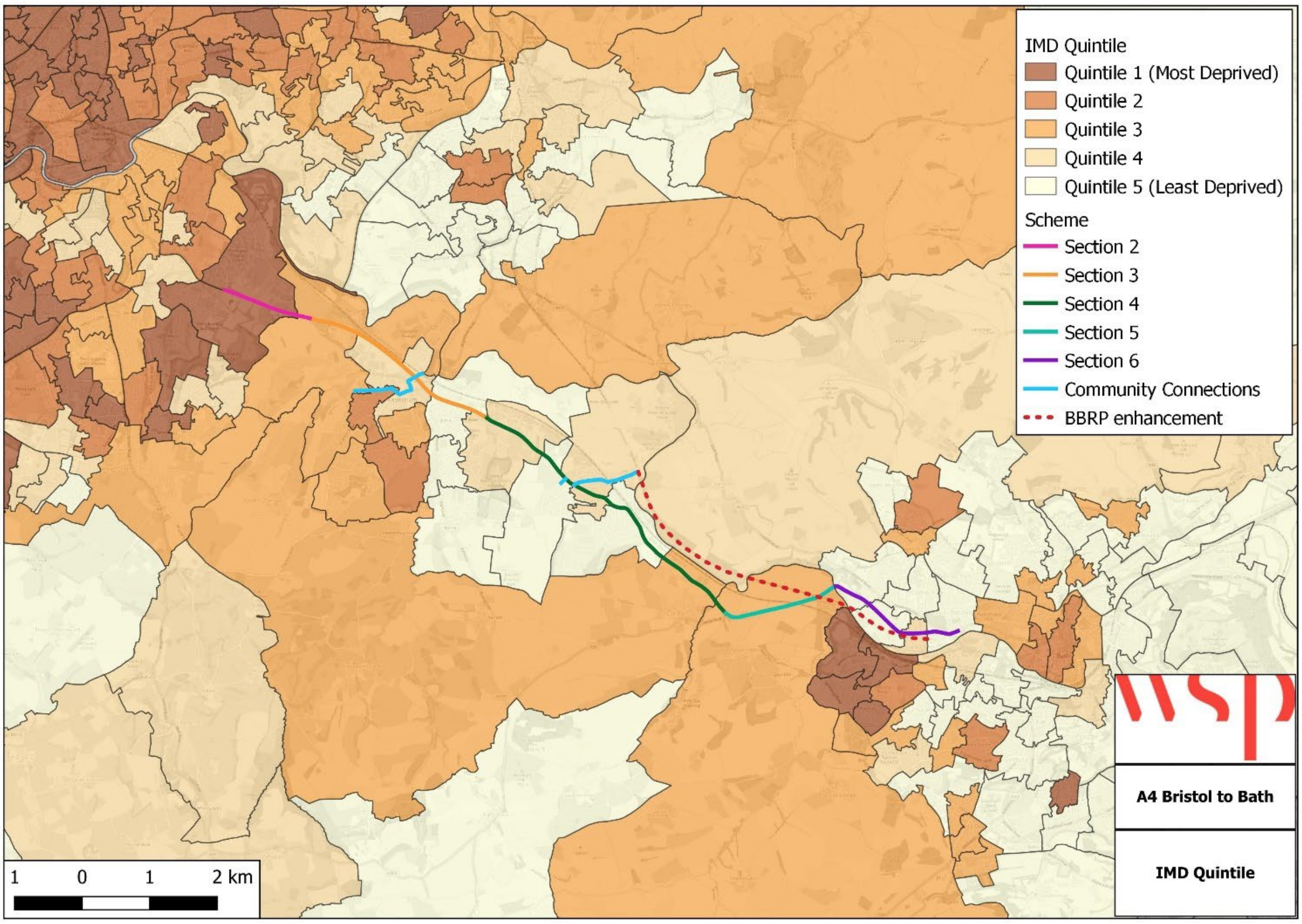


Figure 2-3 - IMD Quintile disaggregated at LSOA level focused on Impact Area



2.5 Appraisal of Impacts (Step 3)

2.5.1. TUBA has calculated and monetised the impacts associated with the journey time change and this has been disaggregated into highway users and Public Transport (PT) users separately. For the final appraisal, the impacts are combined and assessed to give a DI scoring.

Highway Users

2.5.2. The provision of bus priority and the active travel connections is expected to cause a slight increase in the severance for highway users and this has resulted in a journey time disbenefit of £0.45 million.

2.5.3. **Table 2-1** shows the distribution of highway user benefits/disbenefits across the population within the scheme area by national income deprivation quintile.

Table 2-1 – Highway user benefits/disbenefits distributed across the population by deprivation quintile.

User benefits	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%
Total user benefits of LSOA's within impact area (£M)	Not applicable	0.04	0.26	Not applicable	Not applicable
Total user disbenefits of LSOA's within impact area (£M)	0.54	Not applicable	Not applicable	0.19	-0.02
Share of user benefits within impact area	Not applicable	13%	87%	Not applicable	Not applicable
Share of user disbenefits within impact area	71%	Not applicable	Not applicable	25%	3%
Population	57,037	46,833	60,666	77,123	94,601
Share of population in the impact area	17%	14%	18%	23%	28%
Assessment	**Large adverse**	**Moderate Beneficial**	**Large Beneficial**	**Large Adverse**	**Slight Beneficial**

Figure 2-4 – Highway User Benefits disaggregated at LSOA level

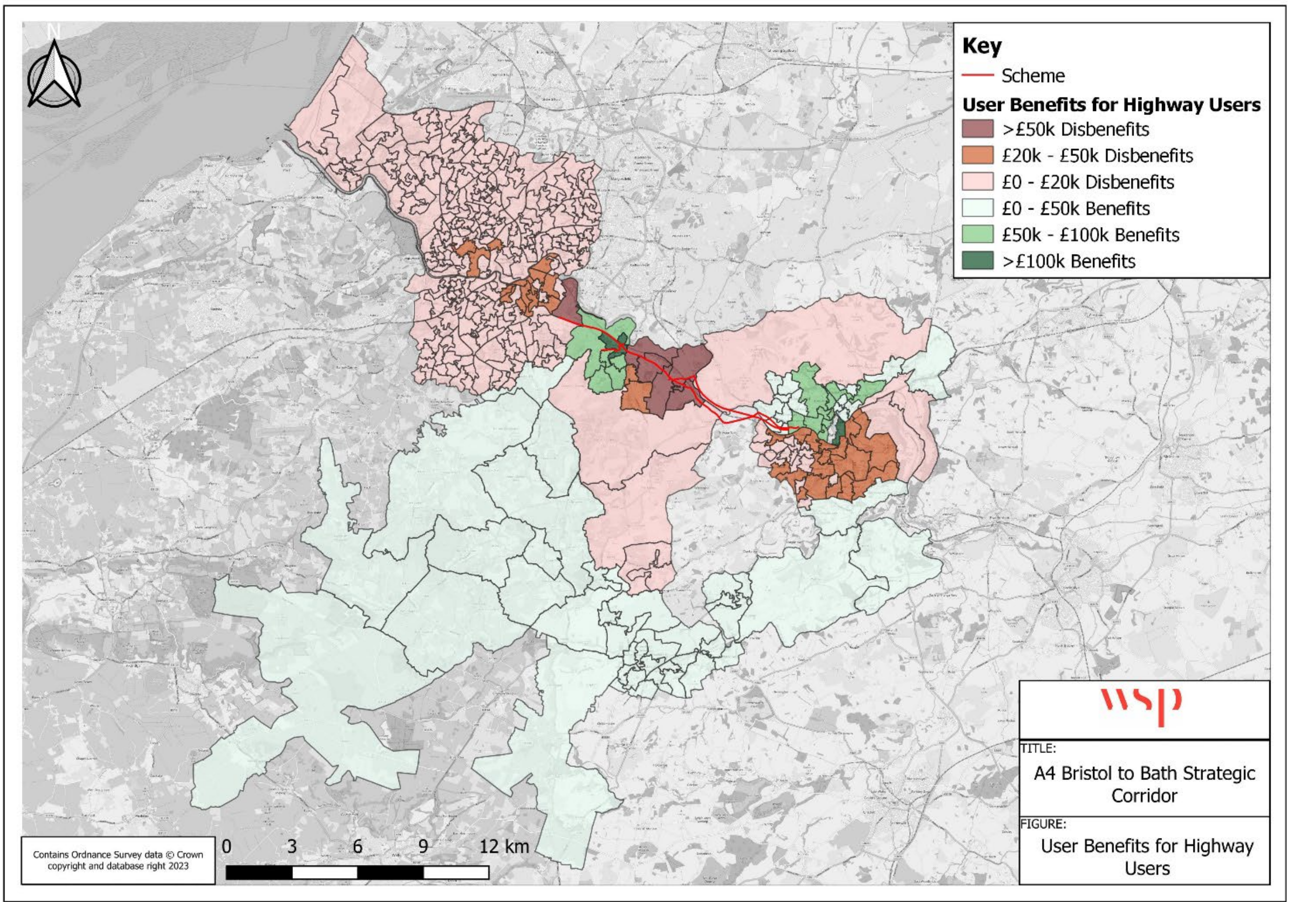


Figure 2-5 – Highway User Benefits disaggregated at LSOA level focused on Impact Area

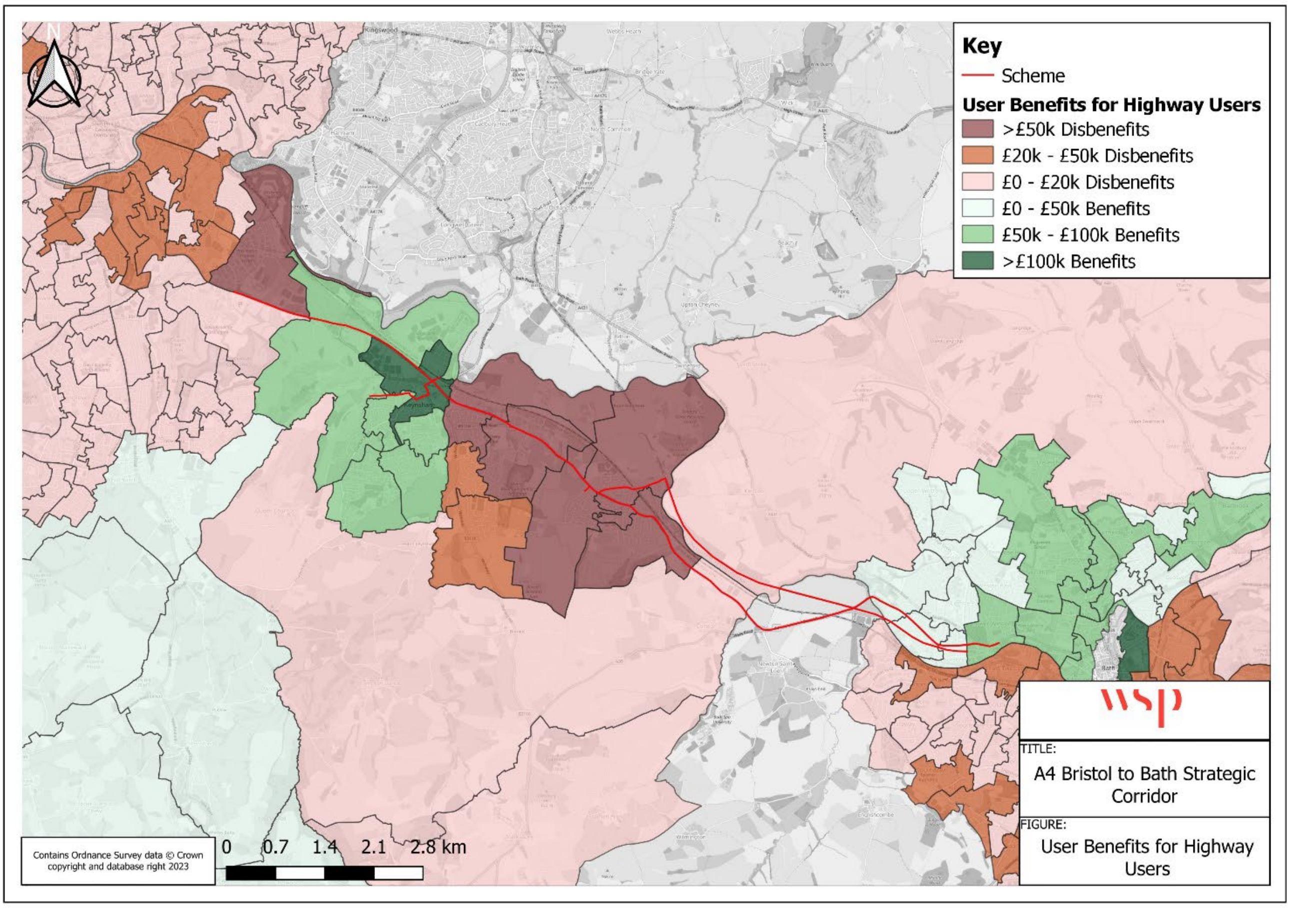


Figure 2-6 – Highway User Benefits per Person disaggregated at LSOA level

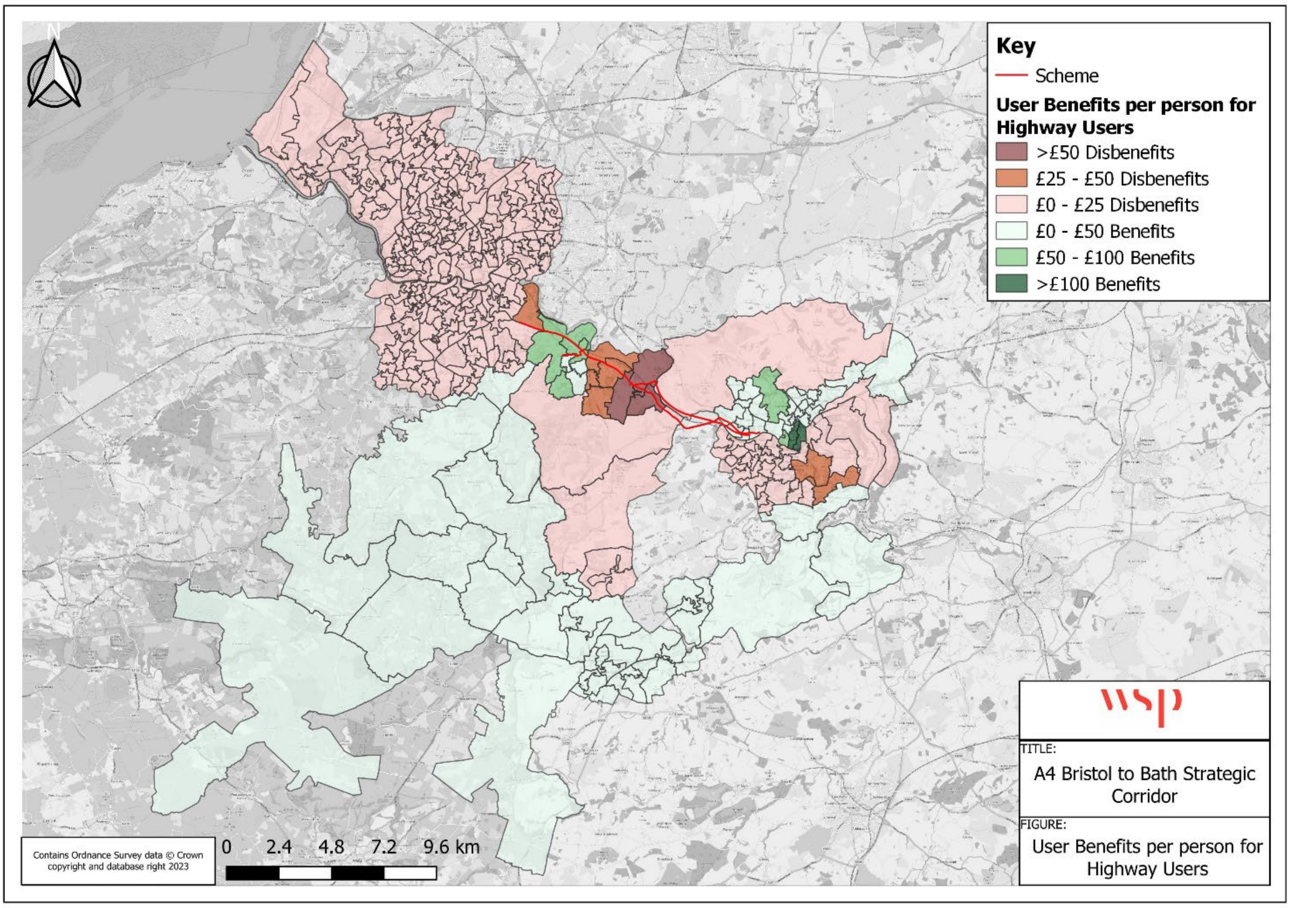
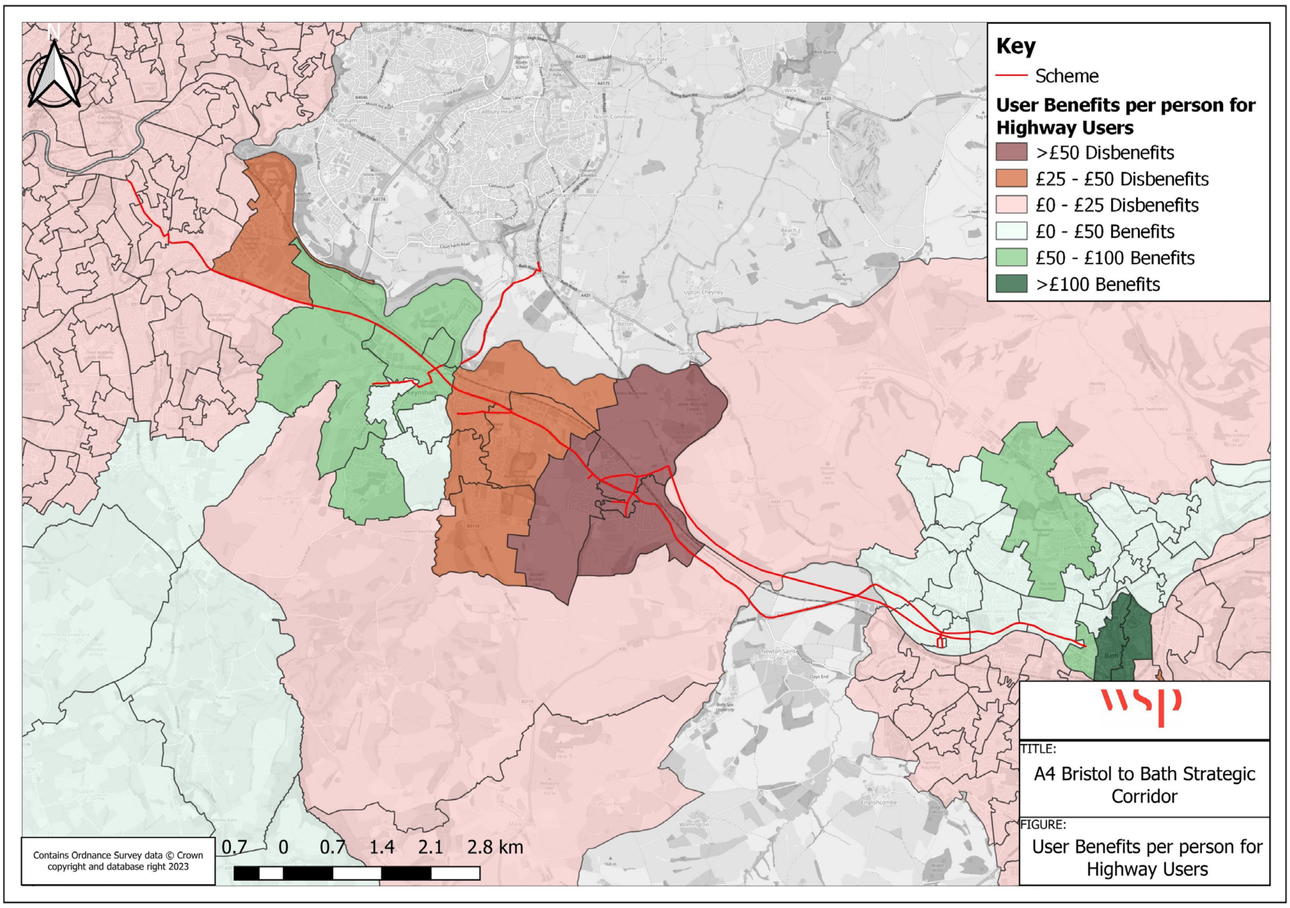


Figure 2-7 – Highway User Benefits per Person disaggregated at LSOA level focused on Impact Area



2.5.4. **Figure 2-8** and **2-9** depicts the distribution of highway user benefits across IMD Quintiles and comparison of share of benefits with share of population in the Impact area respectively.

Figure 2-8 - Distribution of Highway User benefits across IMD Quintile

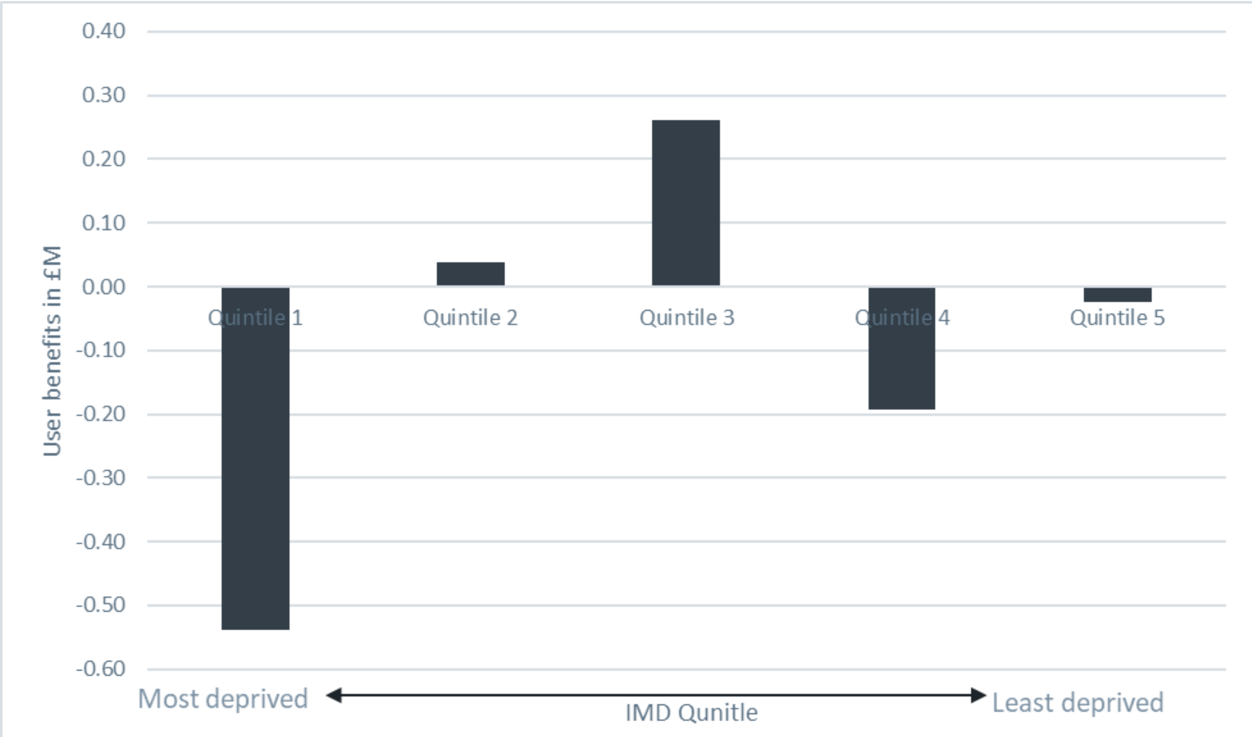
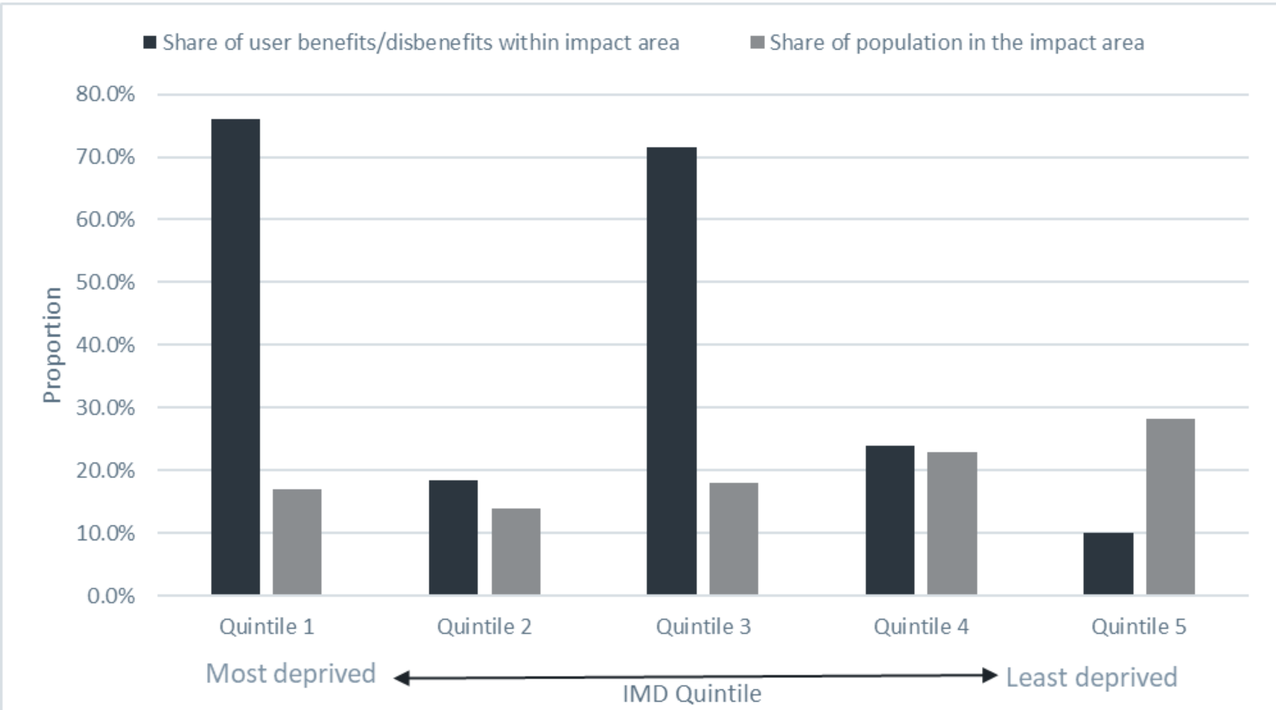


Figure 2-9 - Comparison of Share of Highway user benefits/disbenefits with share of population in the Impact area



2.5.5. Quintiles 2,3 and 5 experiences benefits while Quintiles 1 and 4 experiences disbenefits.

2.5.6. Out of the three quintiles experiencing a benefit, the majority of the benefits (72%) are accrued by people within the mid-income quintile (Quintile 3) resulting in a Large Beneficial impact, followed by second most deprived Quintile 2 (18%). The maximum share of population in the impact area (28%) belongs to least deprived Quintile 5 and experiences benefits which are 5% or more lower than the proportion of the group in the total population resulting in a Slight Beneficial impact.

2.5.7. The scheme proposal will generate some disbenefits to the highway users as the scheme focuses on enhancing the public transport and active travel connections. Therefore, highway users will experience slight severance associated with these improvements leading to more travel time.

2.5.8. The adverse impact is primarily felt by residents in the most economically deprived areas (Quintile 1), as they will face greater challenges in affording a car journey. As the scheme focuses more on bus priority and active travel connections, highway users are anticipated to accrue some disbenefits and the population in quintile 1, being most deprived will find it more costly to afford a highway journey as compared to the before scheme scenario. However, the improvements in active travel provision and public transport infrastructure will open up other methods of travel.

PT users

2.5.9. For PT users, the scheme will result in bus travel time improvements along the A4 corridor giving a journey time benefit of £6 million.

2.5.10. **Table 2-2** shows the distribution of PT user benefits/disbenefits across the population within the scheme area by national income deprivation quintile.

Table 2-2 - User Benefits Distributional Analysis distributed across the population by deprivation quintile.

User benefits	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%
Total user benefits of LSOA's within impact area (£M)	0.76	1.38	1.94	0.91	0.87
Share of user benefits within impact area	13%	24%	33%	16%	15%
Population	57,037	46,833	60,666	77,123	94,601
Share of population in the impact area	17%	14%	18%	23%	28%
Assessment	Slight Beneficial	Large Beneficial	Large Beneficial	Slight Beneficial	Slight Beneficial

Figure 2-10 – PT User Benefits disaggregated at LSOA level

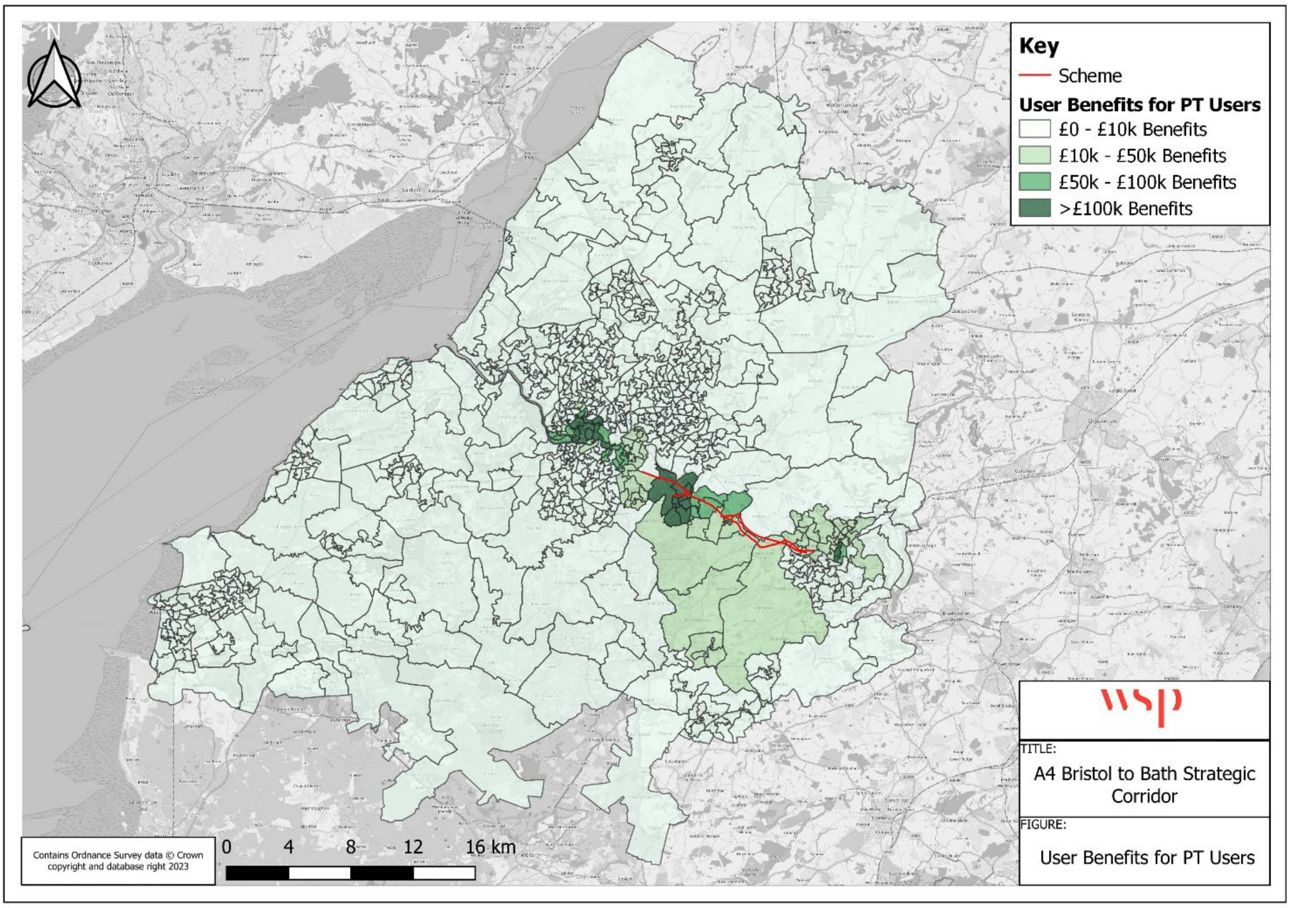


Figure 2-11 – PT User Benefits disaggregated at LSOA level focused on Impact Area

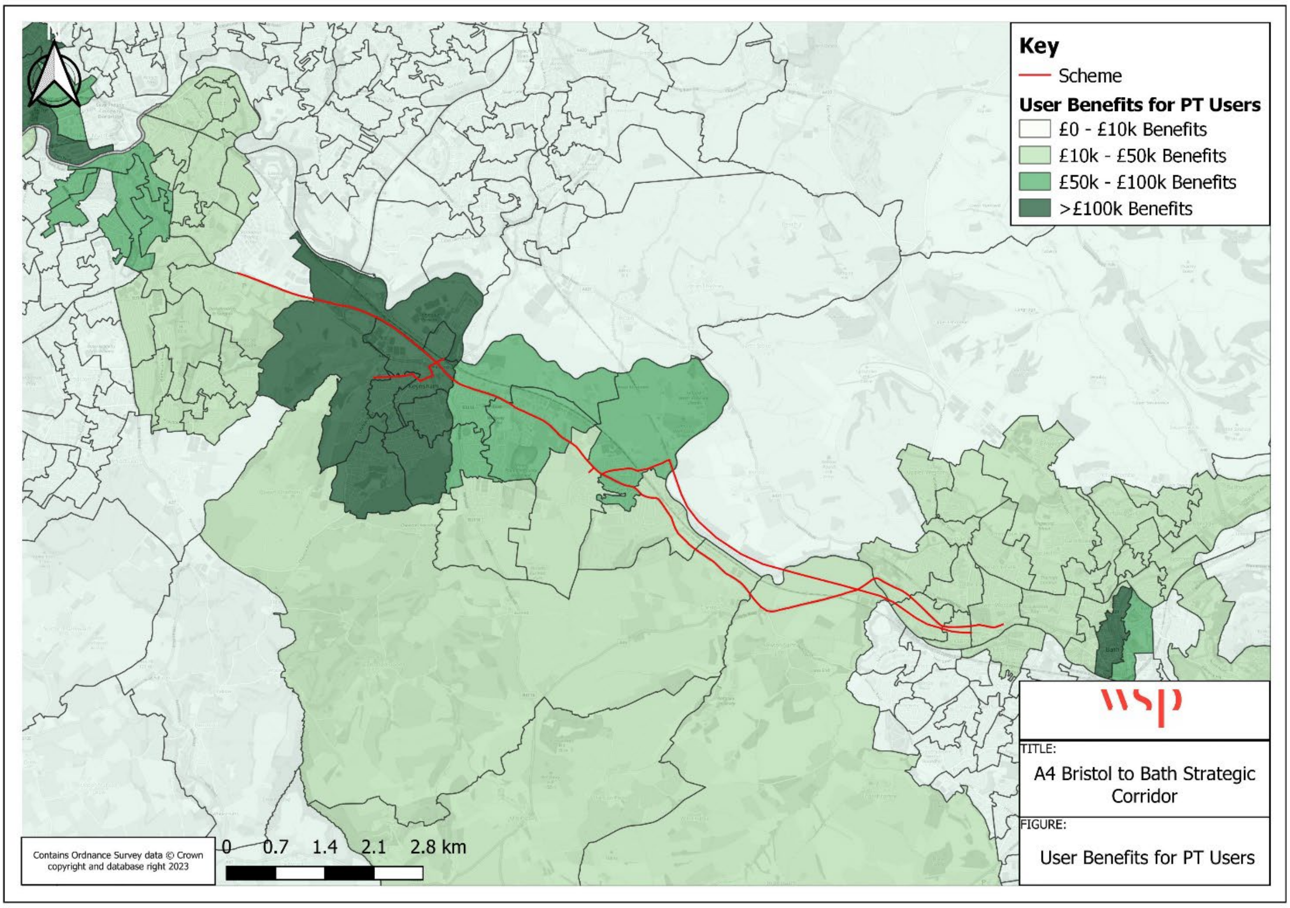


Figure 2-12 – PT User Benefits per Person disaggregated at LSOA level

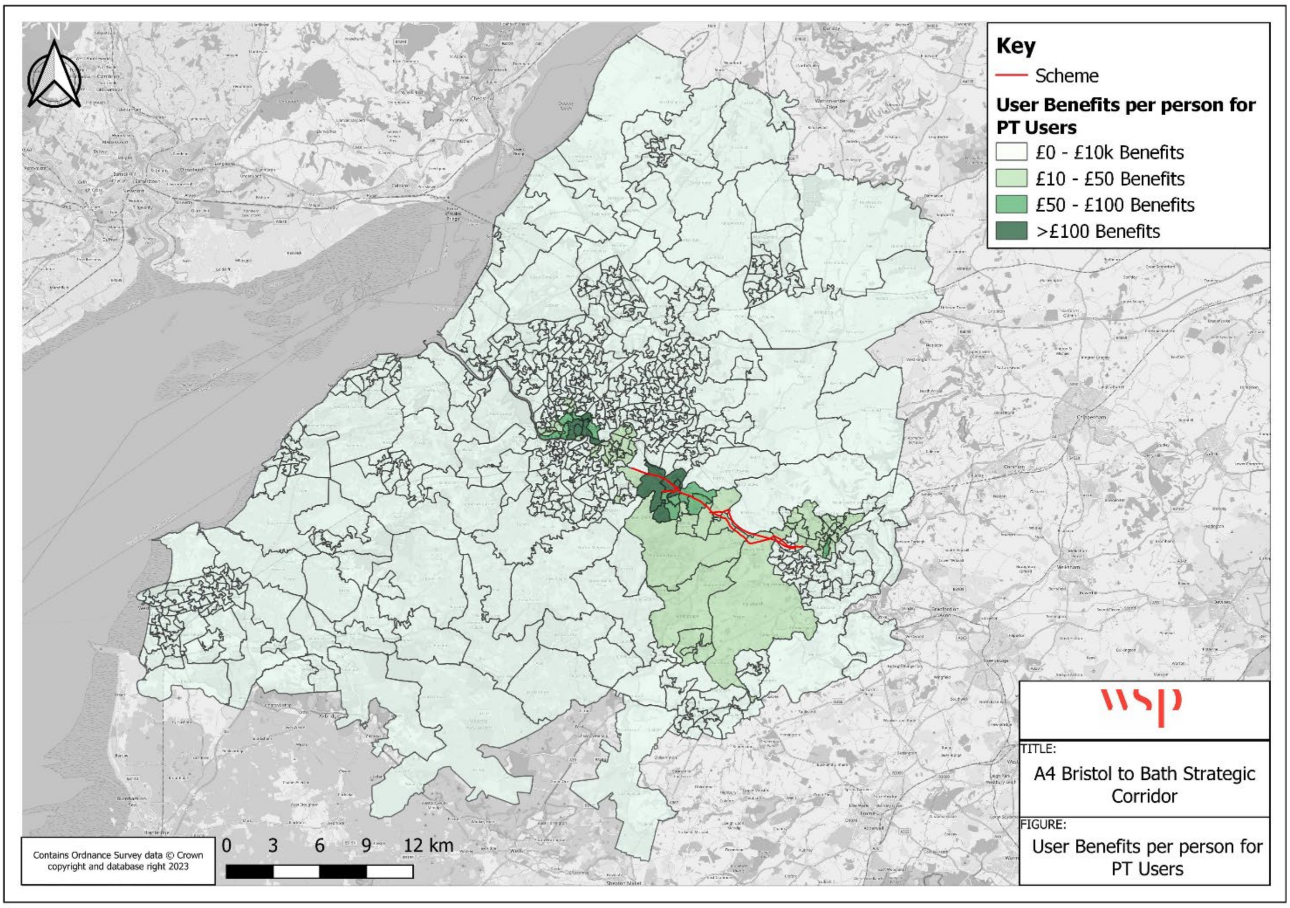
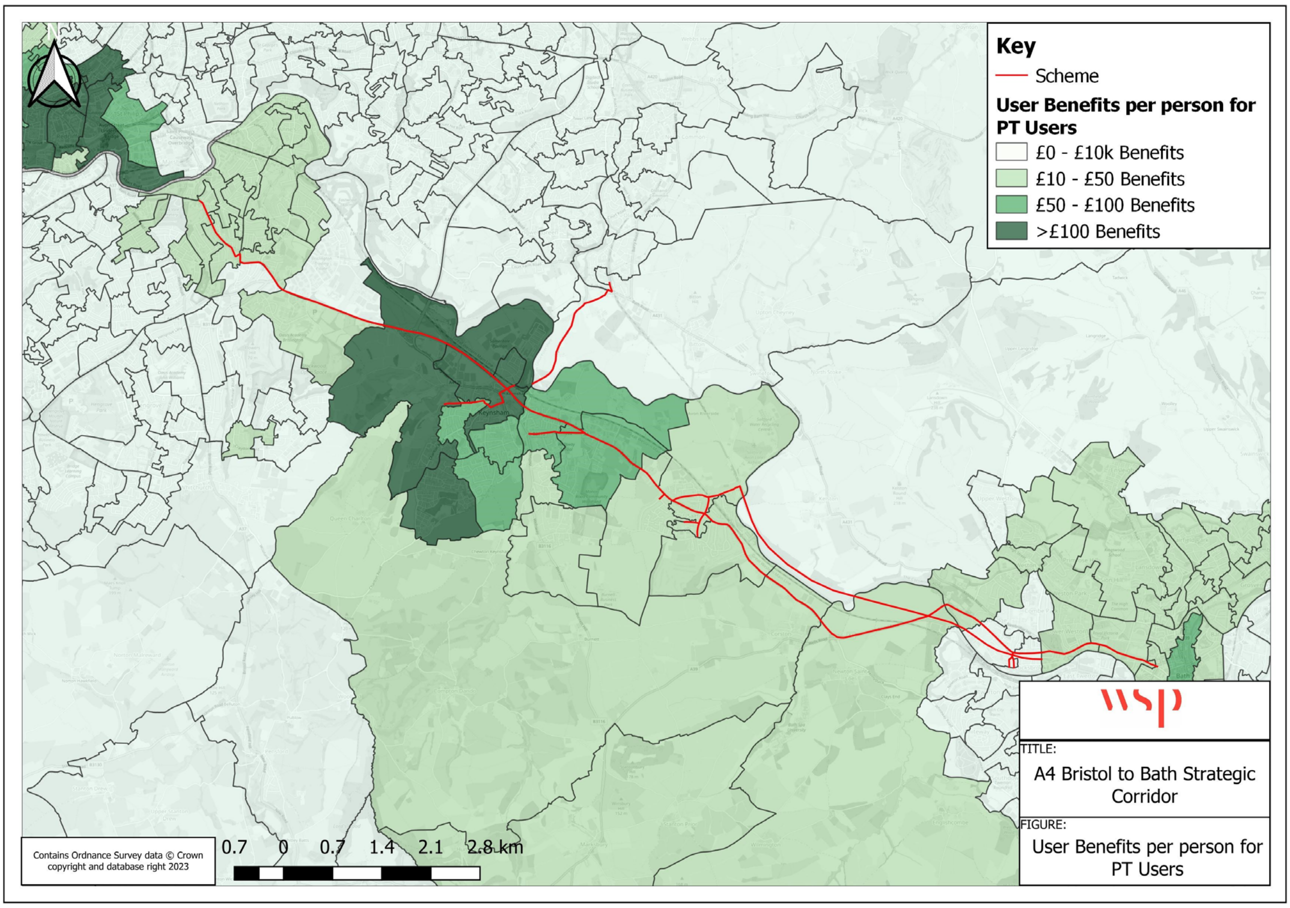


Figure 2-13 – PT User Benefits per Person disaggregated at LSOA level focused on Impact Area



2.5.11. **Figure 2-14** and **2-15** depicts the distribution of PT user benefits across IMD Quintiles and comparison of share of benefits with share of population in the Impact area respectively.

Figure 2-14 - Distribution of PT User benefits across IMD Quintile

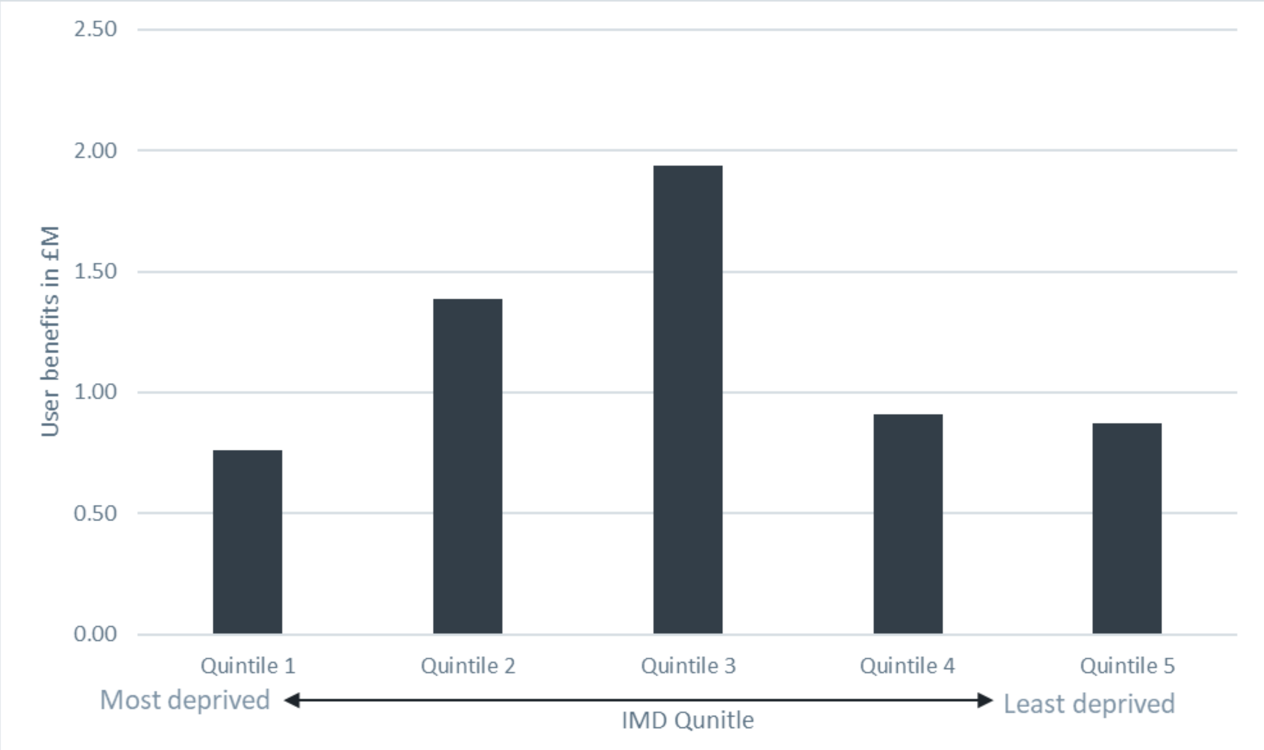
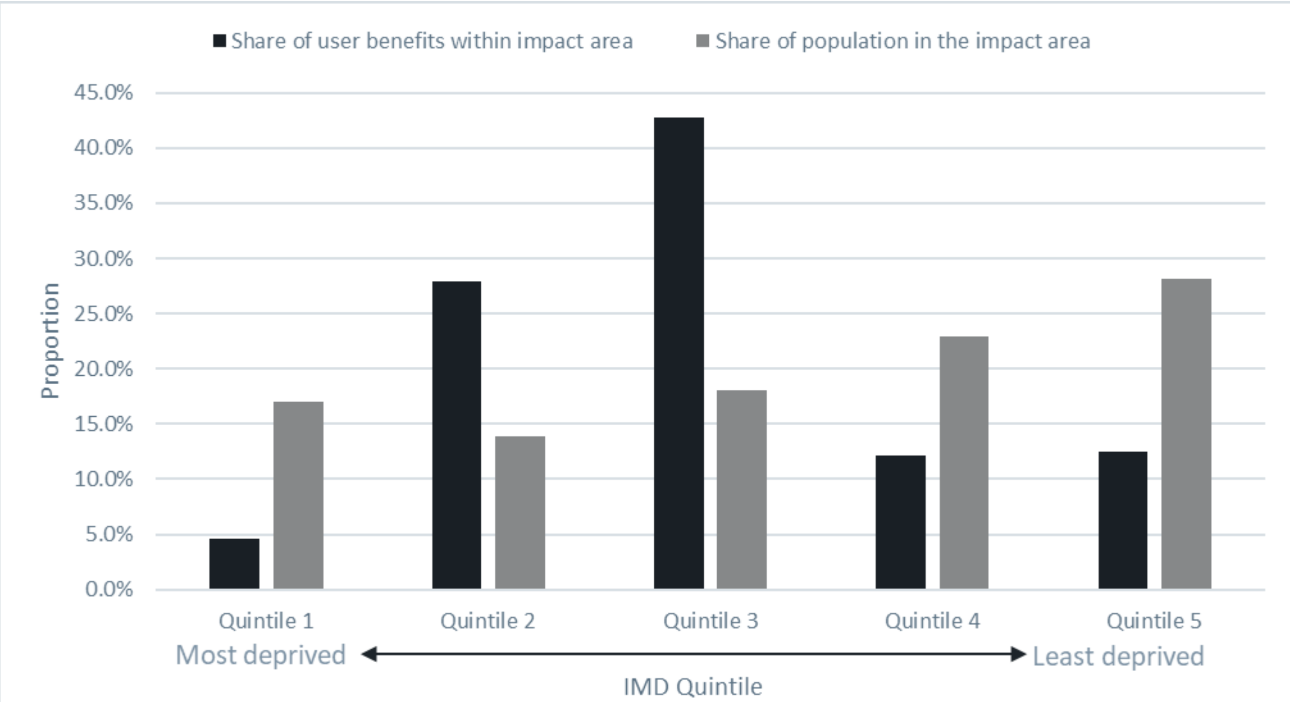


Figure 2-15 - Comparison of Share of PT benefits with share of population in the Impact area



2.5.12. All the quintiles experience a benefit from the scheme. The majority of the benefits (33%) are accrued by people within the mid-income quintile (Quintile 3) within the impact area followed by quintile 2 (24%), whereas those in the most deprived areas (Quintile 1) and the least deprived areas (Quintile 4 and 5) experience a smaller than expected proportion of benefits.

2.5.13. The scheme, as outlined in the preceding sections, primarily focuses on enhancing bus corridors and active travel connections. Consequently, proposed improvements such as speed reduction and reallocating a lane from general traffic to accommodate buses and active travel connections are anticipated to cause disruption for highway users, leading to increased travel time and generating disbenefits amounting to -£0.25 million. However, these drawbacks are expected to be counterbalanced by the scheme's positive impacts on public transportation (PT), with PT user benefits estimated at £6 million.

2.5.14. The implementation of bus priority measures aims to reduce travel time for buses commuting from Bath to Bristol. Furthermore, there are secondary effects on overall journey time, as alterations in travel times along the A4 corridor may influence interconnectivity with other services, reducing interchange times. As such, the DI is in overall appraised as **Slight Beneficial.**

3 Noise

3.1 Introduction

3.1.1. This section presents the noise appraisal for the Proposed Scheme, required to identify any potential constraints in relation to noise to help inform the OBC. This includes a summary of the baseline conditions, appraisal methodology and the likely operational impacts of the Proposed Scheme on noise sensitive receptors within 100m from the corridor.

3.2 Screening (Step 1)

3.2.1. It is anticipated that the scheme would generate a reduction in noise for many existing properties along the corridor with expected decrease in private vehicles. Overall, it is anticipated the scheme would generate a positive monetised impact for noise.

Appraisal methodology

3.2.2. The appraisal has been completed in accordance with the TAG Unit A3 Environmental Impact Appraisal guidance for Noise Impacts. The methodology references the Design Manual for Roads and Bridges (DMRB) LA 111 Noise and vibration guidance where appropriate, however, this is not a full assessment under DMRB LA 111, as a proportionate appraisal has been undertaken, with the scope and methodology being tailored to support the OBC.

3.2.3. With regards to noise impacts, the TAG Unit A3 impact appraisal used to focus on annoyance, however, this emphasis has now shifted in light of growing evidence on the links between environmental noise and health outcomes. The Department for Energy, Food, and Rural Affairs (Defra) has produced guidance on transport-related noise using an ‘impact pathway’ approach to include:

- Annoyance;
- Sleep disturbance; and
- Health impact, including heart disease (acute myocardial infarction, or AMI), stress and dementia.

3.2.4. These impact pathways are reflected in the TAG workbook, with financial values assigned to each based on the noise levels predicted with and without the scheme.

3.2.5. The TAG A3 methodology includes five steps as follows:

- Scoping;
- Quantification of noise impacts;
- Estimation of the affected population;
- Monetary valuation of changes in noise impact; and
- Consideration of the distributional impacts of changes in noise.

3.2.6. The key stage is the quantification of noise impacts whereby noise levels are predicted at each receptor in the study area (further details of which are set out below).

3.2.7. In order to quantify the noise level changes at each property, receptor specific noise level calculations have been undertaken for the following scenarios:

- Do-minimum 2027 without the scheme
- Do-something 2027 with the scheme
- Do-minimum 2042 without the scheme
- Do-something 2042 with the scheme

3.2.8. Noise levels are calculated at every façade of each residential building in the study area. The façade subject to the greatest magnitude of change has been used in the analysis in line with the guidance in DMRB LA 111. Noise levels have been calculated in the 3D modelling software CadnaA adopting the methodology set out within the Calculation of Road Traffic Noise (CRTN) document.

3.3 Assessment (Step 2)

3.3.1. The study area has been based on an area 100m from the scheme.

3.3.2. Existing residential receptors within the study area have been identified using OS AddressBase® data. A total number of 1382 dwellings are located within the main study area and have, therefore, been included within the assessment.

3.3.3. It has been assumed that the scheme will be surfaced with hot rolled asphalt.

Existing Environment (Baseline)

3.3.4. The existing baseline noise climate will consist of mainly road traffic noise from the existing roads along the scheme corridor.

Brief evaluation of Topic Related Constraints

3.3.5. The key constraints and impacts identified by the appraisal are:

- Potential increase in road traffic noise

3.4 Appraisal of Impact (Step 3)

3.4.1. The results of the noise appraisal are summarised below. These have been generated by analysing data for each residential receptor based on the façade with the greatest magnitude of noise change:

- In the forecast year, 12 households would experience an increase in daytime noise, whilst 882 households would experience a decrease in daytime noise.
- In the forecast year, 6 households would experience an increase in night-time noise, whilst 578 households would experience a decrease in night-time noise.
- The overall appraisal indicates that the operation of the Proposed Scheme is likely to generate a beneficial noise impact and that the 'net present value of change in noise' is calculated to be £5,526,327.

- The impact pathways described earlier in this section have been assessed. The following net present values have been calculated for all pathways:
  - Sleep disturbance: £2,396,277
  - Amenity: £2,098,327
  - AMI: £571,150
  - Stroke: £183,621
  - Dementia: £276,952.

3.4.2. Paragraph 2.2.7 of TAG Unit A3 states “As well as through the monetisation process described in step three below, night noise impacts should be assessed by determining the number of households where the WHO Interim Night Noise Target of 55 dB L_{night} noise level is exceeded for the last forecast year in the with and without scheme cases”.

3.4.3. In the Do-minimum forecast year 285 receptors are predicted to exceed the target value of 55 dB L_{night}. In the Do-something forecast year 291 receptors are predicted to exceed the target value of 55 dB L_{night}.

Social and Distributional Impact

3.4.4. Income Domain data from the Ministry of Housing, Communities & Local Government[1] were used to classify each lower layer super output area (LSOA) within the noise study area into deprivation quintiles (0-20% being most deprived, 80-100% being least deprived).

3.4.5. All relevant receptors (residential, education, hospitals, and care homes) within 100 metres of the road corridor were included in the DI analysis.

3.4.6. The Distributional Impact (DI) Analysis requires identification of the number of receptors in each Income Domain quintile that experience an improvement, worsening or no change in noise.

3.4.7. The respective noise benefits / disbenefits are assessed for each Income Domain quintile, in relation to the share of the number of modelled properties within each domain. Each quintile is then given an overall Assessment Score. The results are shown in **Table 3-1**.

3.4.8. The results of the assessment indicate that noise levels are predicted to improve in each of the income domains for the forecast year of the Proposed Scheme (2042). This includes a moderate beneficial change in the two most deprived areas.

1 https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019

Table 3-1 – Noise DI Analysis

IoD Income Domain Quintile %	0-20	20-40	40-60	60-80	80-100	Total
Households with increased noise [A]	0	0	0	4	1	5
Households with decreased noise [B]	4	4	6	645	176	835
Households with no change in noise level [C]	2	2	209	970	639	1822
Net number of winners/losers [D] = [B]-[A]	4	4	6	641	175	-
Total number of winners / losers across all groups [E] = ∑[D]	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	830
Net winners/losers in each area as percentage of total [F] = [D] / [E]	0%	0%	1%	77%	21%	100%
Share of total population of study area	0%	0%	8%	61%	31%	100%
Assessment	Moderate Beneficial	Moderate Beneficial	Slight Beneficial	Large Benficial	Slight Beneficial	Not applicable

4 Air Quality

4.1 Introduction

4.1.1. This section presents the Air Quality appraisal for the Proposed Scheme, required to identify any potential constraints in relation to air quality to help inform the OBC. This includes a summary of the baseline conditions, methodology and the likely operational impacts of the Proposed Scheme on the environmental features.

4.2 Screening (Step 1)

4.2.1. It is anticipated that there will be some benefits to air quality as a result of the Public Transport service along the corridor, improvement of Active Travel infrastructure and reduction in private vehicles.

Appraisal Methodology

4.2.2. The appraisal will consider the effect of the scheme on the surrounding area during the construction and operational phases. It is expected that with the modal shift and reduction in congestion there will be a potential overall beneficial impact on air quality. Given the potential off-line nature of parts of the scheme route, there may be some areas where an impact occurs.

4.2.3. The appraisal methodology includes a quantitative appraisal of air quality impacts in accordance with TAG Unit A3, Section 3, and the appraisal includes:

- Scoping to determine the study area for assessment;
- Quantification of air quality impacts;
- Appraisal of local air quality impacts;
- Appraisal of regional air quality impacts;
- Monetary valuation of air quality impacts; and
- Consideration of the distributional impacts of air quality changes.

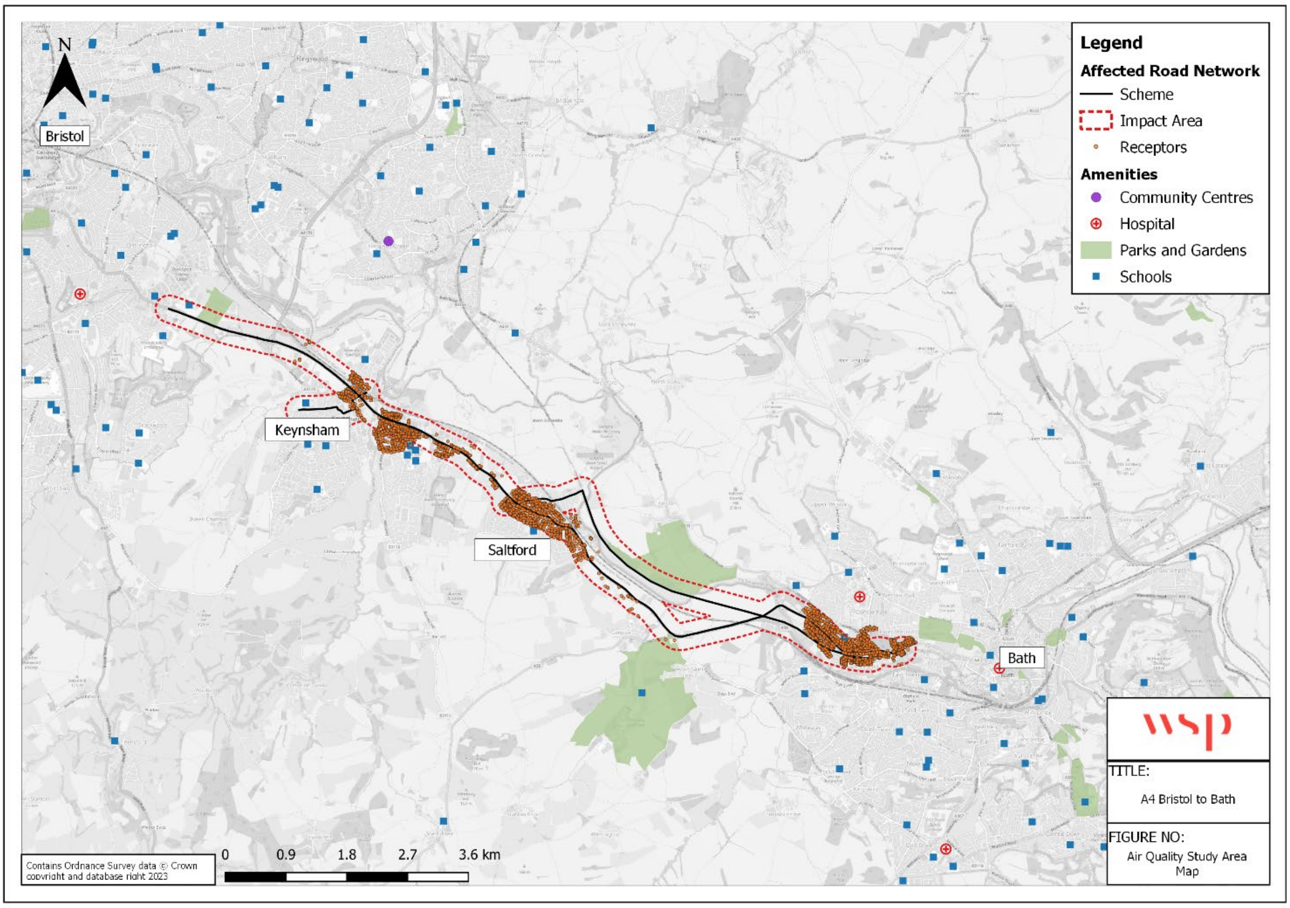
4.2.4. The air quality appraisal will use the traffic model to determine the appraisal area, where traffic flows are predicted to undergo significant change due to the scheme. The traffic change criteria are:

- annual average daily traffic (AADT) >=1,000; or
- heavy duty vehicle (HDV) AADT >=200; or
- a change in speed band; or
- a change in carriageway alignment by >=5m.

4.2.5. The annual average daily traffic flows, average speed (km/h) and percentage heavy goods vehicle data will be required from the traffic models for the base year and future years (opening year and design year) with and without scheme scenarios.

4.2.6. For each option, the study area over which air quality impacts will be considered will be limited to corridors extending 200 metres either side of the potential affected road network (ARN) as illustrated in **Figure 4.1**. The ARN is defined in accordance with TAG Unit A3. The quantification of changes in concentrations at properties within the study area as a result of the scheme will be calculated.

Figure 4-1 – Air Quality Study Area



4.3 Assessment (Step 2)

Existing Environment (Baseline)

4.3.1. There are four Air Quality Management Areas (AQMA) within 200m of the affected links of the BBSC corridor. The Keynsham AQMA and Saltford AQMAs were both declared, in 2010 and 2013 respectively, for exceedances of the annual mean nitrogen dioxide (NO2) objective. The Bath AQMA was also declared in 2013 for exceedances of both the hourly mean NO2 objective and the annual mean NO2 objective. The Bristol AQMA was declared in 2011 for the hourly and annual mean NO2 objectives as well as the daily mean particulate matter (PM10) objective.

4.3.2. The B&NES 2022 local monitoring data show that there were no exceedances of annual mean NO2 concentrations within the 200m of the affected links. The measured annual mean concentrations are ranged from 9.7µg/m3 to 31.9µg/m3. There is no BCC monitoring sites within the 200m of the affected links.

Brief evaluation of Topic Related Constraints

4.3.3. The scheme is along the busy A-road (A4), which has an average traffic volume (AADT) of approximately 26,000 vehicles in 2022. The local monitoring data shown that the annual mean NO2 concentrations at Keynsham A4 are well within the air quality objective in the past five years (2018-2022).

4.3.4. The Proposed Scheme has the potential to change traffic on the local road network, with subsequent effects for local air quality (notably on concentrations of NO2 and PM2.5).

4.4 Appraisal Of Impact (Step 3)

Summary of Results

4.4.1. Air quality modelling was utilised to predict the potential impact of changes to vehicle emissions on air pollutant concentrations (NO2 and PM2.5) at the identified sensitive receptors. A summary of the modelled impacts in the Proposed Scheme opening and design years is provided in **Table 4-1**.

Table 4-1 – Summary of potential impact on air pollutant concentration at identified sensitive receptors.

Impact	**No. of Receptors**	**No. of Receptors**	**No. of Receptors**	**No. of Receptors**
year	2029	2029	2042	2042
Pollutant	NO_2	$PM_{2.5}$	NO_2	$PM_{2.5}$
Improvement	3533	2782	3549	2754
Worsening	725	809	723	838
No change	143	810	129	809

4.4.2. The local air quality modelling predicted that annual mean concentrations of NO_2 would improve (decrease) at 80% (2029) and 81% (2042) of the 4,401 identified receptors, worsen (increase) at 16% (2029) and 16% (2042), with no change at 3% (2029) and 3% (2042) of receptors. With respect to $PM_{2.5}$, annual mean concentrations are predicted to improve at 63% (2029) and 63% (2042) of receptors, worsen at 18% (2029) and 19% (2042), with no change at 18% (2029) and 18% (2042) of receptors, with the Proposed Scheme in operation.

4.4.3. The local air quality assessment has demonstrated that more sensitive receptors would benefit from reduced concentrations of key pollutants (NO2 and PM2.5) compared to those that would experience increases in concentrations, as a result of implementing the

Proposed Scheme. This is predominantly attributed to the Proposed Scheme reducing traffic from the existing A4 road and associated link roads, thereby reducing vehicle emissions from the existing A4 Therefore, more receptors will experience an air quality benefit than those that will experience a worsening.

4.4.4. The change in total mass emissions of vehicle pollutants resulting from the Proposed Scheme has been assessed, focussed on emissions of NO_x, PM_{10}, and $PM_{2.5}$, which can have air quality impacts on a regional, national, or international scale. The results of the assessment are summarised in **Table 4-2**.

Table 4-2 – Regional air pollutant emissions impacts

Scenario and year	Regional Emission (Tonnes / Year) NO_x	Regional Emission (Tonnes / Year) PM_{10}	Regional Emission (Tonnes / Year) $PM_{2.5}$
DM (2029)	13.1	2.9	1.6
DS (2029)	11.4	2.7	1.5
Change (2029)	-1.7	-0.25	-0.1
% Change (2029)	-12.9%	-8.6%	-8.5%
DM (2042)	12.3	3.0	1.7
DS (2042)	10.8	2.7	1.5
Change (2042)	-1.5	-0.2	-0.1
% Change (2042)	-12.2%	-8.3%	-8.1%

4.4.5. The regional emissions assessment has demonstrated that emissions of NO_x and particulate matter would decrease as a result of implementing the Proposed Scheme relative to the Do-Minimum scenario. The predicted decrease in total mass emissions is attributed to the reduced number of vehicles travelled on the road network with the Proposed Scheme in operation.

Value of Change in Air Quality

4.4.6. The value of change in air quality is based on the total of the present value of change in NO2 and PM2.5 (local air quality) and change in NOx emissions over a 60-year appraisal period (2027 – 2087). A positive value reflects a net benefit (i.e., air quality improvement).

4.4.7. The total value of change in air quality for the Proposed Scheme is calculated to be £206,369 (net benefit), thus representing a slight improvement in air quality with the Proposed Scheme being implemented.

Social and Distributional Impact

4.4.8. Income Domain data from the Ministry of Housing, Communities & Local Government[2] were used to classify each lower layer super output area (LSOA) within the air quality study area into deprivation quintiles (0-20% being most deprived, 80-100% being least deprived).

4.4.9. All relevant receptors (residential, education, hospitals and care homes) within 200 metres of the affected road network were included in the DI analysis.

4.4.10. The Distributional Impact (DI) Analysis requires identification of the number of receptors in each Income Domain quintile that experience an improvement, worsening or no change in air quality, specifically NO_2 and $PM_{2.5}$.

4.4.11. The respective air quality benefits / disbenefits are assessed for each Income Domain quintile, in relation to the share of the number of modelled properties within each domain. Each quintile is then given an overall Assessment Score. The results are shown in **Table 4-3** for NO_2 and **Table 4-4** for $PM_{2.5}$ for opening year (2029).

[2] https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019

Table 4-3 – Air Quality (NO2) DI Analysis (Opening Year 2029)

IoD Income Domain Quintile %	0-20	20-40	40-60	60-80	80-100	Total
Number of properties with improved air quality [A]	560	1012	903	337	721	3533
Number of properties with no change in air quality [B]	72	5	18	46	2	143
Number of properties with worse air quality [C]	411	46	116	128	24	725
Number of net winners / losers [D] = [A] – [C]	149	966	787	209	697	-
Total number of winners / losers across all groups [E] = ∑[D]	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	2808
Net winners/losers in each area as percentage of total [F] = [D] / [E]	5%	34%	28%	7%	25%	100%
Share of total population of study area	24%	24%	24%	12%	17%	100%
Assessment	Slight Beneficial	Large Beneficial	Moderate Beneficial	Slight Beneficial	Moderate Beneficial	Not applicable

4.4.12. The results of the assessment indicate that local air quality, with respect to concentrations of annual mean NO_2, is predicted to improve in each of the income domains for the opening year of the Proposed Scheme (2029). This includes a slight beneficial change in the most deprived areas; and a large beneficial change in the second most deprived area. The least deprived area likely to have a moderate beneficial change.

Table 4-4 – Air Quality (PM2.5) DI Analysis (Opening Year 2029)

IoD Income Domain Quintile %	0-20	20-40	40-60	60-80	80-100	Total
Number of properties with improved air quality [A]	7	892	883	321	679	2782
Number of properties with no change in air quality [B]	356	135	120	132	67	810
Number of properties with worse air quality [C]	680	36	34	58	1	809
Number of net winners / losers [D] = [A] – [C]	-673	856	849	263	678	No data
Total number of winners / losers across all groups [E] = ∑[D]	No data	No data	No data	No data	No data	1973
Net winners/losers in each area as percentage of total [F] = [D] / [E]	-34%	43%	43%	13%	34%	100%
Share of total population of study area	24%	24%	24%	12%	17%	100%
Assessment	Large Adverse	Large Beneficial	Large Beneficial	Moderate Beneficial	Large Beneficial	No data

4.4.13. The results of the $PM_{2.5}$ assessment indicate that air quality, with respect to concentrations of annual mean $PM_{2.5}$, is predicted to improve in each of the income domain quintiles for the opening year of the Proposed Scheme (2029), except the most deprived domain, which has predicted to experience a large adverse change. All other income groups will experience a moderate to large beneficial change.

4.4.14. A total of 7 schools and nurseries were identified in the air quality study area. The change in traffic-related air pollutant concentrations, NO_2 and $PM_{2.5}$, was reported for each of these schools, based on the local air quality assessment results for the Proposed Scheme opening year (2029). The predicted results with respect to NO_2 and $PM_{2.5}$ are presented in **Table 4-5**.

Table 4-5 – School air pollutant concentration and impacts

ID	Class	Address	NO_x DM	NO DS	NO Change	NO Impact	$PM_{2.5}$ DM	$PM_{2.5}$ DS	$PM_{2.5}$ Change	$PM_{2.5}$ Impact
85578	CE04SS	I K B Academy, 68, Ikb Studio School, Bath Road, 0, Keynsham, BS31 1SP	7.62	7.56	-0.06	Improve	8.10	8.08	-0.02	Improve
1916	CE02	26, Pirates And Princesses Day Nursery, High Street, 0, Keynsham, BS31 1DQ	11.40	11.20	-0.20	Improve	9.21	9.19	-0.02	Improve
34752	CE03	Infant Building, Newbridge Primary School, Charmouth Road, Newbridge, Bath, BA1 3LL	9.99	9.96	-0.03	Improve	8.52	8.52	0	No Change
33633	CE03	Junior Building, Newbridge Primary School, Charmouth Road, Newbridge, Bath, BA1 3LL	9.92	9.88	-0.04	Improve	8.50	8.50	0	No Change
34847	CE03PS	Newbridge Primary School, Newbridge Primary School, Charmouth Road, Newbridge, Bath, BA1 3LL	9.93	9.90	-0.03	Improve	8.51	8.50	-0.01	Improve
70347	CE02	Snapdragons Nursery, Ellsbridge House, Bath Road, Keynsham, BS31 1TL	8.74	8.84	0.10	Worsen	8.48	8.43	-0.05	Improve
67192	CE02	Tiddlers Day Nursery, 480, Tiddlers Day Nursery, Bath Road, Saltford, BS31 3DJ	9.37	9.09	-0.28	Improve	8.12	8.09	-0.03	Improve

4.4.15. Of the schools and nurseries identified within the air quality study area, Table 4-5 demonstrates that one is predicted to experience a slight worsening change in annual mean concentrations of NO_2 in the Proposed Scheme opening year (2029), with the other six experiencing a slight beneficial change. None of the identified nurseries/schools are expected to experience an adverse change in levels of NO_2 in the Do-Something scenario relative to the Do-Minimum scenario.

4.4.16. With respect to annual mean $PM_{2.5}$ concentrations, **Table 4-5** shows that five schools are predicted to experience a negligible beneficial change and two schools with no changes in the opening year of the Proposed Scheme versus the Do-Minimum scenario.

5 Accidents

5.1.1. Most accidents related to transport occur on the road network. There is also a strong link between vulnerable groups and deprivation (according to TAG). Further to this, it is noted that a child from a more deprived area is more likely to be involved in a fatal road accident than a child from a higher social class.

5.1.2. Any intervention that results in increases to traffic levels and speeds or reduces physical separation between people and traffic can give rise to increases in accidents.

5.1.3. The approach for the DI appraisal of accidents uses data from the COBA-LT accident appraisal, in addition to STATS 19 data from the DfT's Road Casualties online database for 2016 to 2022 (excluding the Covid-19 affected years 2020 and 2021).

5.1.4. The approach identifies the screening process (Step 1) before identifying the accident locations (Step 2a). Step 2b assesses any impacts on vulnerable groups while Step 2c identifies any amenities within the impact area that are likely to be used by these vulnerable groups.

5.1.5. A full appraisal is carried out in Step 3 to determine the impacts.

5.2 Screening (Step 1)

5.2.1. The scheme is expected to change vehicle flows, speed and HDV use in addition to a shift in the number of pedestrians and cyclists (+/- 10%) using the local road network and creates a new road alignment (the bypass), therefore a full distributional accident assessment is considered appropriate.

5.3 Assessment – Areas of Impact (Step 2a)

5.3.1. The impact area has been defined from the COBALT analysis and includes key modelled network links within 1km of the scheme that will be directly affected.

5.3.2. Forecast changes in accidents from the COBALT assessment were analysed to identify all links within the impact area with a change in accident rate of +/- 10%, as shown in **Figure 5-2**. All links that changed by 10% or more were displayed within GIS along with the observed accident locations categorised by severity for years 2016 to 2022 (excluding 2020 and 2021).

5.4 Assessment - Identification of Vulnerable Groups in Impact Area (Step 2b)

5.4.1. Within the impact area, there are a number of vulnerable groups including children and older people. In addition, vulnerable users such as pedestrians, cyclists and motorcyclists are assessed along with young male drivers and those living within the IMD most 5% deprived areas.

5.4.2. **Table 5-1** details the proportion of the population under 16 and 70+ in the impact area. This analysis indicates that the proportion of children and proportion of older people in the impact area are slightly lower than National and Regional proportion of Vulnerable Groups.

Table 5-1 - Proportion of Vulnerable Groups in Population of Impact Area

Vulnerable Group	Impact Area	Bristol and Bath	England and Wales
Older People (Aged 70+)	14.1%	15.1%	13.6%
Children (Aged Under 16)	21.8%	22.3%	23.1%

5.5 Assessment – Amenities in the Impact Area (step 2c)

5.5.1. The concentration of vulnerable groups is not only dependant on the resident population but also on local amenities within the impact area that may attract visitors from vulnerable groups.

5.5.2. The amenities including schools, health facilities and local attractions have been identified within 1km of the scheme. The locations of amenities in the impact area are shown in **Figure 5-2**.

5.5.3. The proportion of children, young adults and older people in the impact area, and amenities within the impact area for this assessment are summarised in Appendix C.

5.6 Appraisal of Impact: Core Analysis (Step 3A)

5.6.1. The distributional impact appraisal of accidents uses STATS19 data from the DfT's Road Casualties online database for the five-year period between 2016 and 2022, excluding the years 2020 and 2021.

5.6.2. The number of casualties on the main roads in the impact area are shown in **Table 5-2**. As there were 280 casualties recorded in the impact area from 2016- 2022 (excluding 2020 and 2021), a detailed appraisal will be conducted. This appraisal will involve consideration of the impact of the Scheme on each vulnerable group, identified in Step 2b, for each main road in the impact area where there were recorded accidents 2016- 2022 (excluding 2020 and 2021).

5.6.3. It should be noted that conducting a road by road analysis will inevitably lead to small numbers of casualties on the individual links, meaning that the proportion of casualties from each vulnerable group may not be statistically strong or indicate a particular issue in that area due to small sample sizes.

Table 5-2 - 2016-2022 (excluding 2020,2021) Casualties in Impact Area by Road

Roads in Impact Area	Total Casualties
A4 Bath Road (N)	103
Keynsham By-Pass	11
A4 Bath Road (S)	48
Lower Bristol Road	43
Newbridge Road	13
Total	218

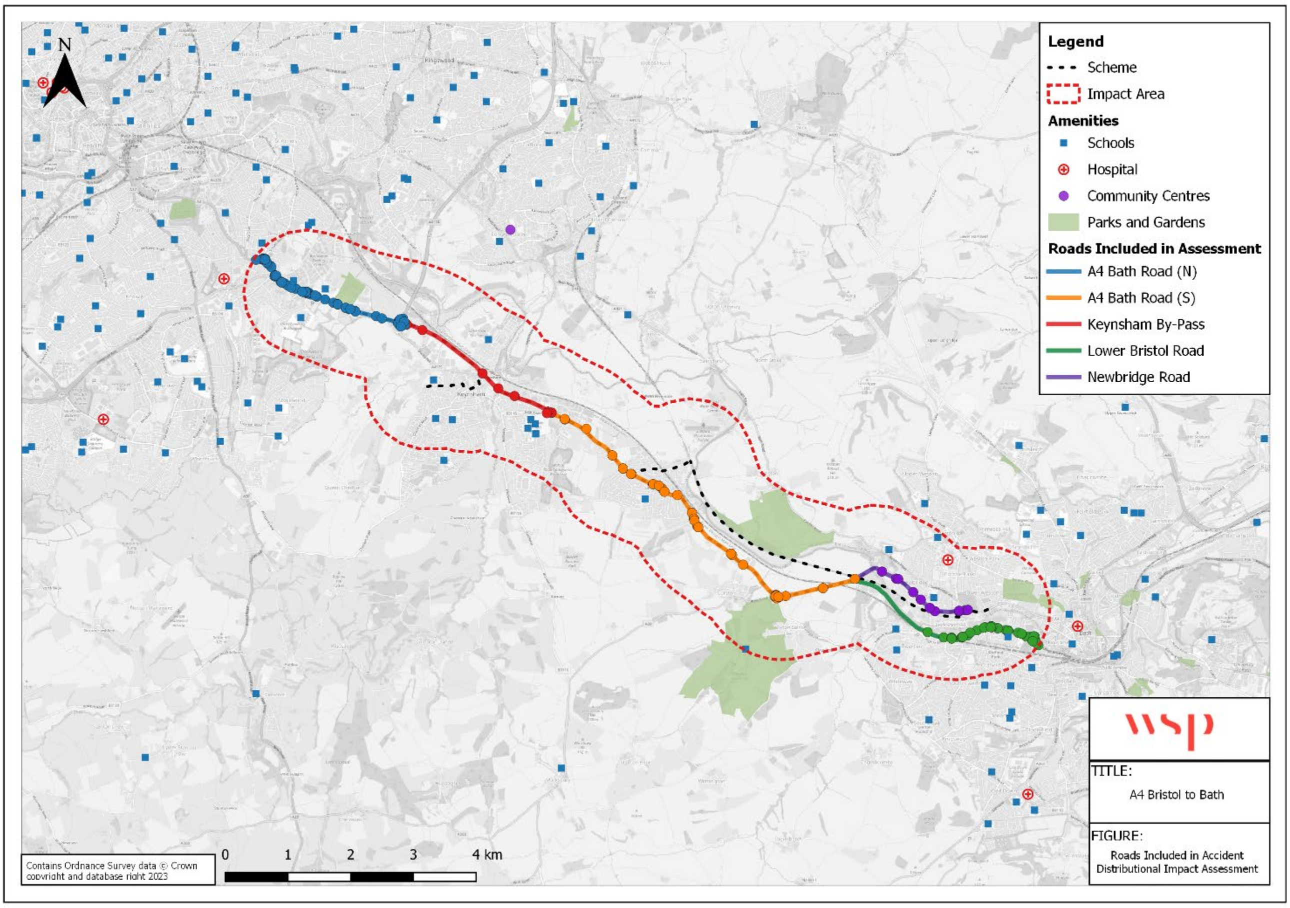
5.6.4. **Table 5-3** shows the breakdown of the casualties by vulnerable group.

Table 5-3 - Casualities by vulnerable group

Casualties	Children under 16	Age 70 and over	Pedestrians	Cyclists	Motor-cyclists	Young Male Driver
Casualties	20	7	25	31	44	18

5.6.5. The roads included in the accident assessment, including a breakdown of A4 into 5 major roads, is shown in **Figure 5-1**. As the plan shows, not all accident locations in the impact area were included in the analysis. This is due to some accidents occurring in off-road locations such as car parks and on small residential streets that were not included in the traffic model and therefore could not be included in the COBALT assessment.

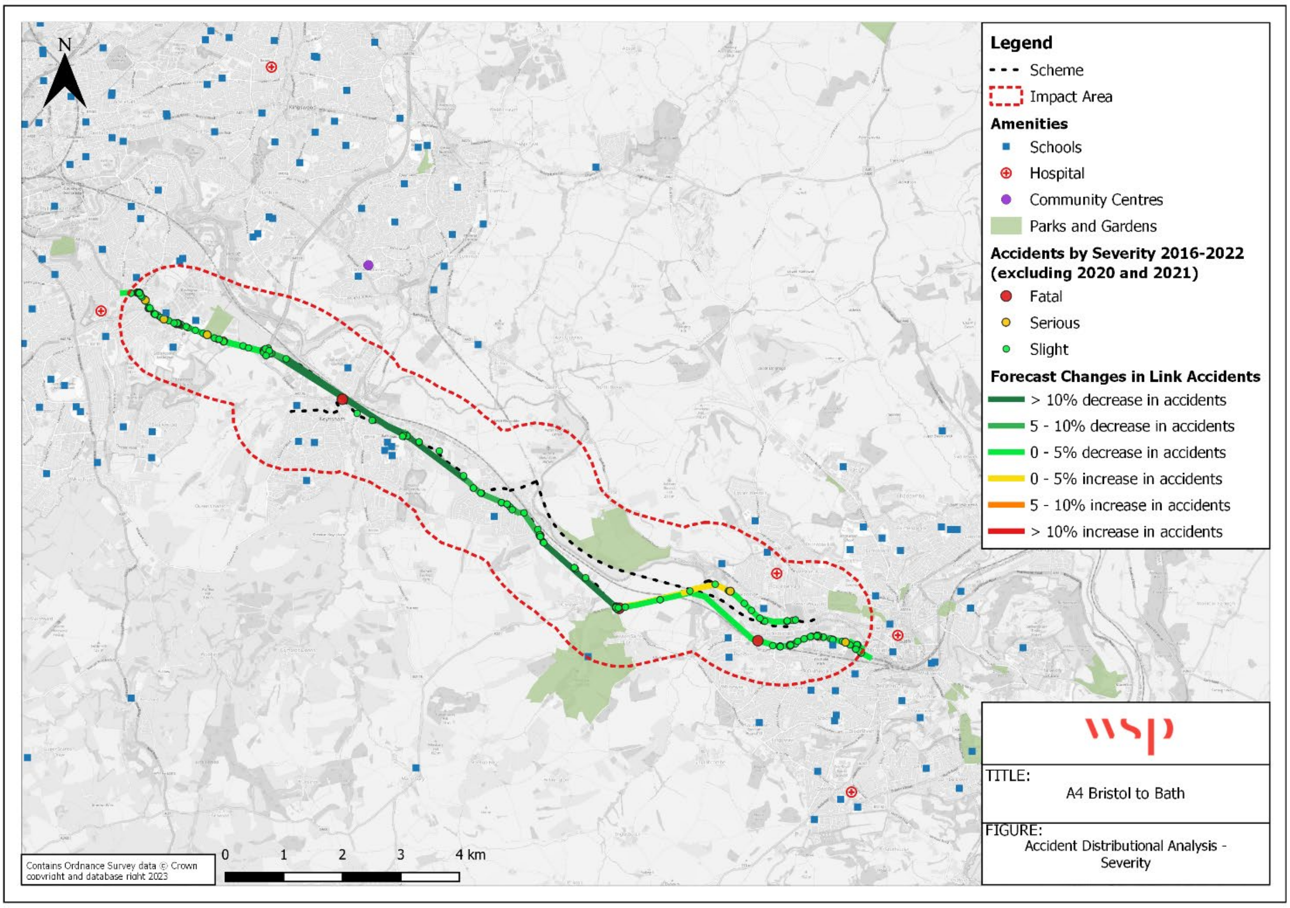
Figure 5-1 - Roads in Accident Distributional Impact Assessment



5.6.6. As discussed in Step 2a, accident locations have been plotted on a map by severity alongside the links that experience a -/+10% change in accident rates based on the COBA-LT analysis (**Figure 5-2**). **Figure 5-2** illustrates that the A4 Bath Road (N) has seen the highest number of casualties, with the Scheme leading to a reduction of 0 to 5% in accidents along this route.

5.6.7. This information has been combined with 2021 Census data and further casualty data from STATS19 to understand the potential impact of the Scheme on each vulnerable group in the following sections.

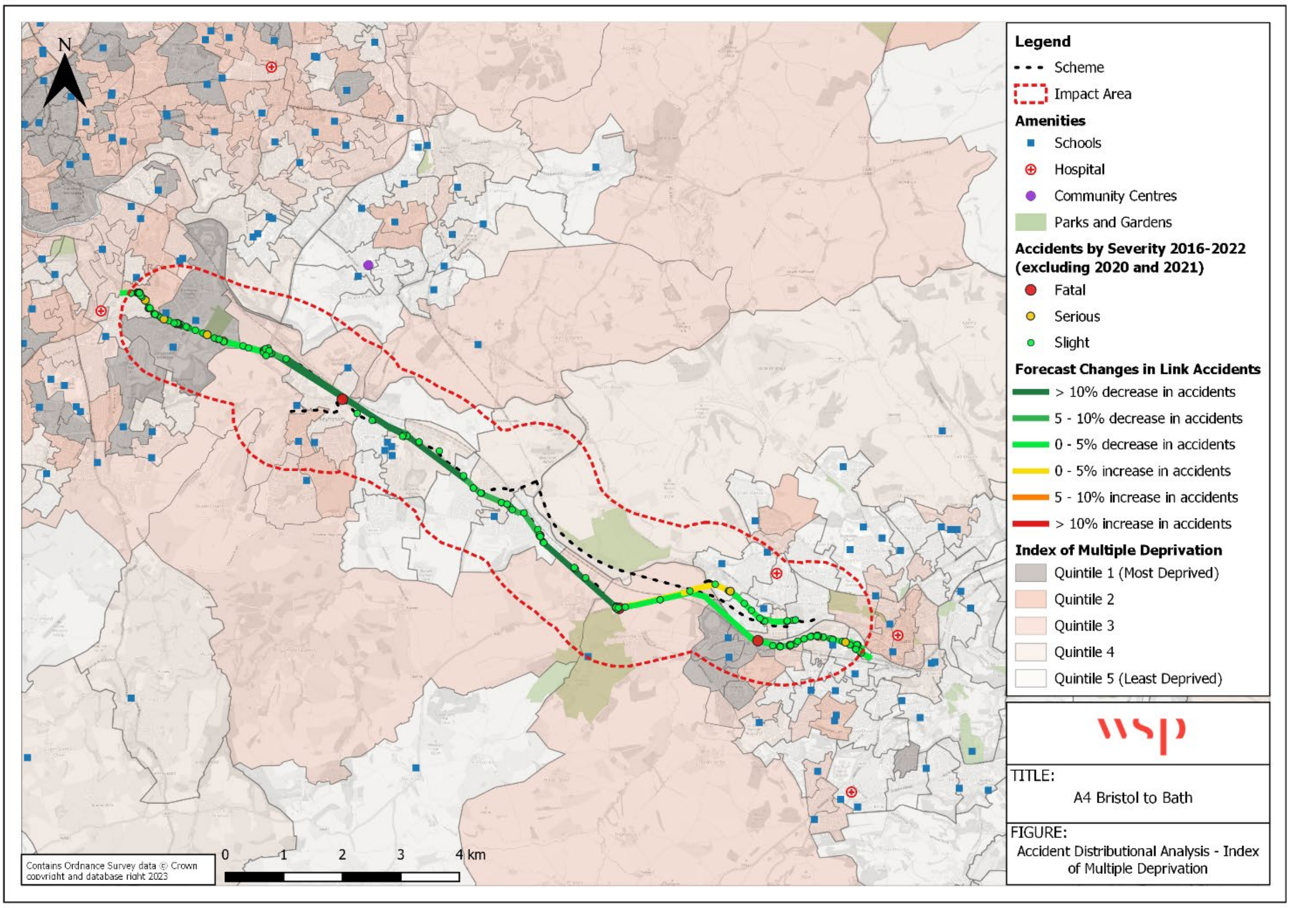
Figure 5-2 - Links with +/-10% Change in Accident Rates and STATS19 Data 2016-2022 by Severity



Impact on Areas of Deprivation

5.6.8. **Figure 5-3** shows the observed distribution of accidents and forecast change in accidents in the impact area alongside the Index of Multiple Deprivation (2019) ranking for each LSOA in the area. As can be seen in the figure, most of the impact area falls within the lowest quintile of the rankings. The COBALT results indicate that the Scheme has a varying impact on accidents across the impact area, with some links forecast to experience a reduction in accidents and some an increase.

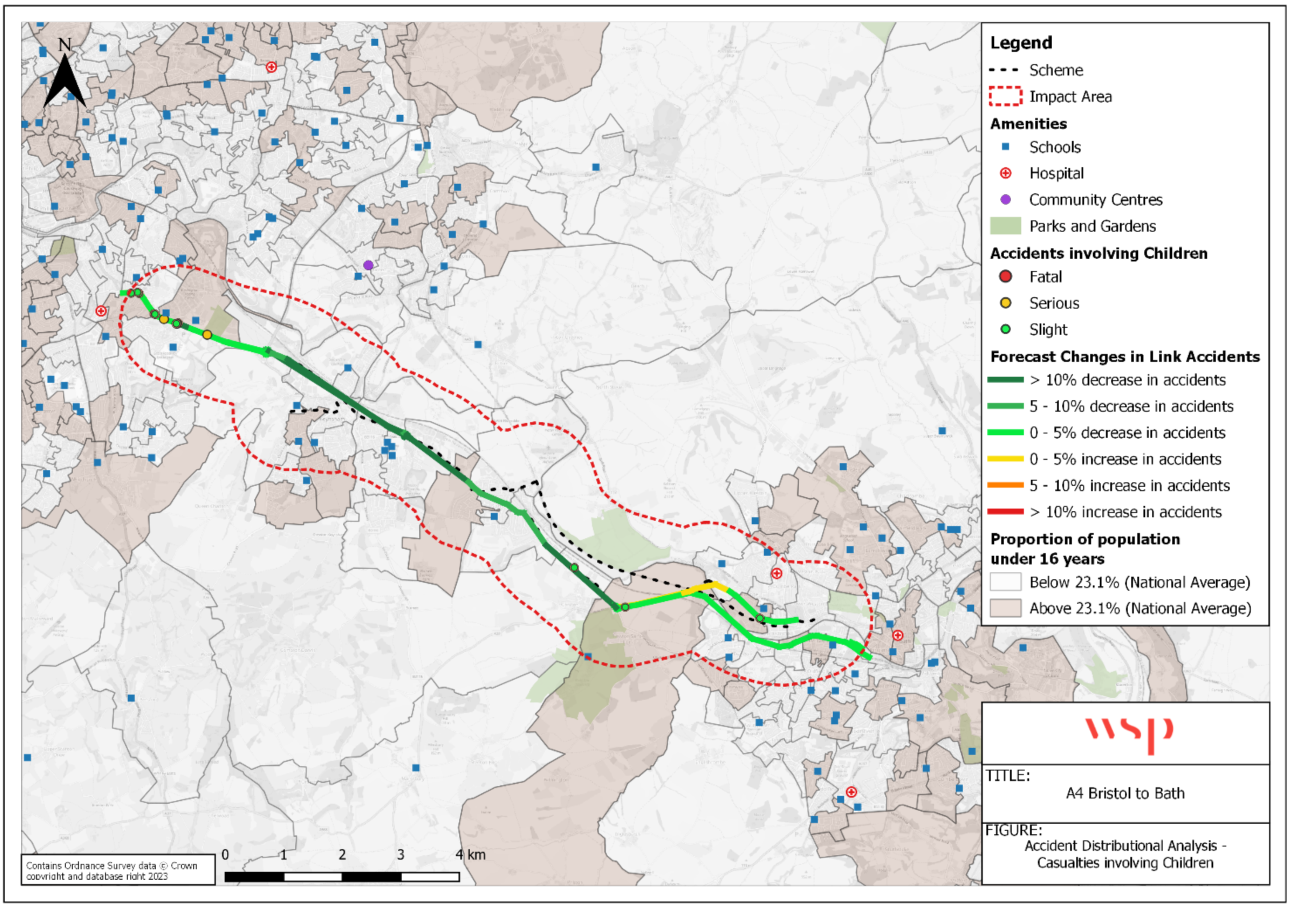
Figure 5-3 - Accidents Distributional Analysis - Index of Multiple Deprivation



Impact on Children

5.6.9. The distribution of accidents involving casualties under 16 is shown in **Figure 5-4** alongside amenities used by children, such as schools and parks. Highlighted areas on the figure show LSOAs with a higher than national average proportion of children in the population (>23.1%). The figure shows that some portion of the impact area has a higher-than-average proportion of children in the population and that amenities likely to be used by children are clustered near the west of town.

Figure 5-4 - Accidents Distributional Analysis - Casualties for the under 16 age category



5.6.10. **Table 5-4** shows the calculations undertaken to derive an assessment score for the impact of the Scheme on accidents involving children. The proportion of casualties for the children in the under 16 age categories on the main roads in the impact area is compared with national average to understand if children are significantly affected by accidents at any location. The casualty proportions are used in combination with the forecast change in accidents, derived from the COBALT assessment, to assign a score to each road. The scoring is undertaken using the criteria set out in Table 11 of TAG Unit A4-2.

5.6.11. Of the accidents in the impact area, 9% of casualties reported were under 16, which is higher than the national average of 7%.

5.6.12. The individual link assessments resulted in a range of scores, with Keynsham Bypass having an assessment score of Moderate Beneficial. When calculated using the weighted mean, the average score across all links assessed remains **Slight Beneficial.**

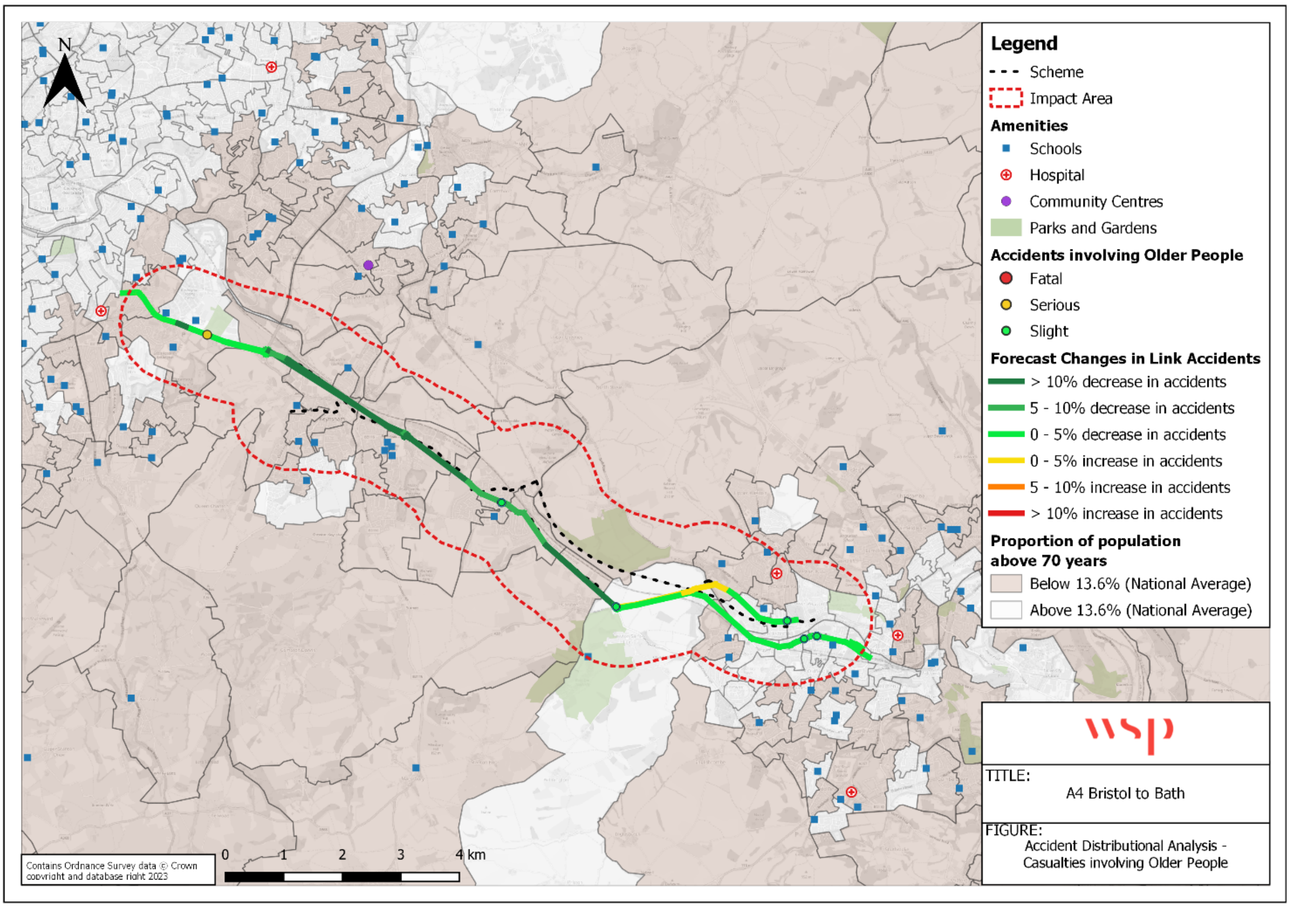
Table 5-4 - Scheme Assessment – Casualties under 16

Roads in Impact Area	Total Casualties	% Casualties under 16 Impact Area	% Casualties under 16 National	COBALT Forecast Change in Accidents	Assessment
A4 Bath Road (N)	16	15.5%	7%	0 to 5% decrease in accidents along the stretch	Slight Beneficial
Keynsham By-Pass	0	0.0%	7%	>10% decrease in accident along the stretch	Moderate Beneficial
A4 Bath Road (S)	3	6.3%	7%	5 to 10% decrease in accident along the stretch	Slight Beneficial
Lower Bristol Road	0	0.0%	7%	0 to 5% decrease in accidents along the stretch	Neutral
Newbridge Road	1	7.7%	7%	0 to 5% decrease in accidents along the stretch	Neutral

Impact on Older People

5.6.13. The distribution of accidents involving casualties for the 70 and over age category is shown in **Figure 5-5** alongside amenities likely to attract people, such as health centres and retail areas. Highlighted areas on the figure show LSOAs with a higher than national average proportion of old people in population (>13.6%).

Figure 5-5 - Accidents Distributional Analysis – Casualties for ages 70 and over



5.6.14. **Table 5-5** shows the calculations undertaken to derive an assessment score for the impact of the Scheme on accidents involving older people. The proportion of casualties for the 70 and over age category on the main roads in the impact area is compared with national average to understand if older people are significantly affected by accidents at any location.

5.6.15. Across all accidents in the assessment period, 3% of all casualties in the impact area were in the 70 and over age category, which is lower than the national average of 7%.

5.6.16. The individual link assessments resulted in a range of scores, with the Keynsham By-Pass giving a Moderate Beneficial impact and the south section of A4 Bath Road having a Slight Beneficial impact. Other roads like Lower Bristol Road, Newbridge Road and the north section of the A4 Bath Road show a very minimal change in the accident rate (0%-5%). Therefore, when calculated using the weighted mean, the average score across all links assessed was **Neutral**.

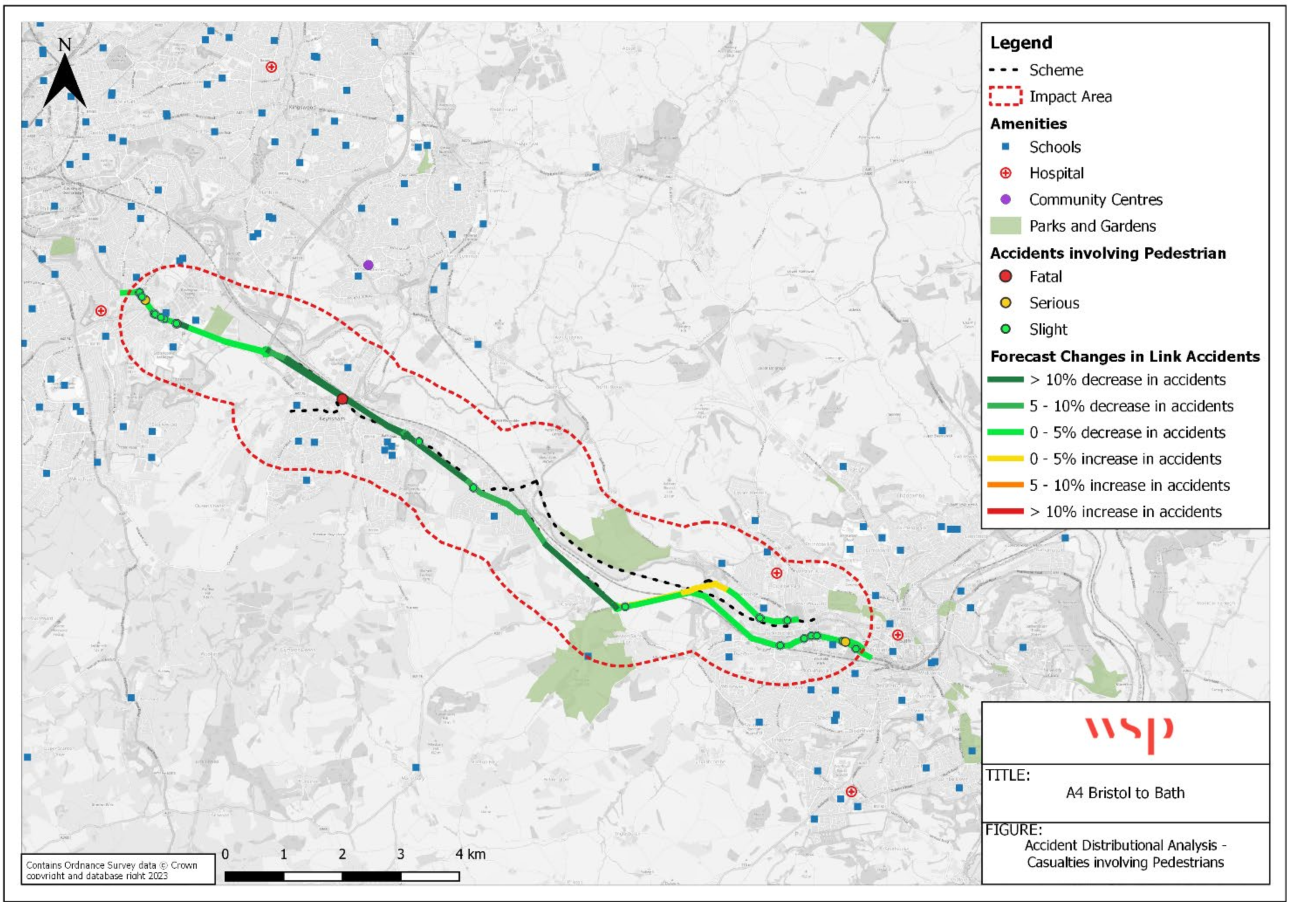
Table 5-5 - Scheme Assessment – Casualties 70+

Roads in Impact Area	Total Casualties	% Casualties 70+ Impact Area	% Casualties 70+ National	COBALT Forecast Change in Accidents	Assessment
A4 Bath Road (N)	1	1.0%	7%	0 to 5% decrease in accidents along the stretch	Neutral
Keynsham By-Pass	0	0.0%	7%	>10% decrease in accident along the stretch	Moderate Beneficial
A4 Bath Road (S)	3	6.3%	7%	5 to 10% decrease in accident along the stretch	Slight Beneficial
Lower Bristol Road	2	4.7%	7%	0 to 5% decrease in accidents along the stretch	Neutral
Newbridge Road	1	7.7%	7%	0 to 5% decrease in accidents along the stretch	Neutral

Impact on Pedestrians

5.6.17. Recorded accidents involving pedestrian casualties are shown in **Figure 5-6** alongside amenities that may generate pedestrian trips. The forecast change in accidents, calculated using COBALT accident analysis software, is also included at an individual link level.

Figure 5-6 - Accidents Distributional Analysis - Pedestrian Casualties



5.6.18. The proportion of casualties that are pedestrians in the impact area is 11.5%, which are greater than the national average (10%).

5.6.19. The individual link assessments resulted in a range of scores, with Keynsham By-Pass considered to have a Moderate Beneficial impact and rest of the road section in the A4 stretch assessed to have a Slight Beneficial impact. When calculated using the weighted mean, the average score across all links assessed was **Slight Beneficial**.

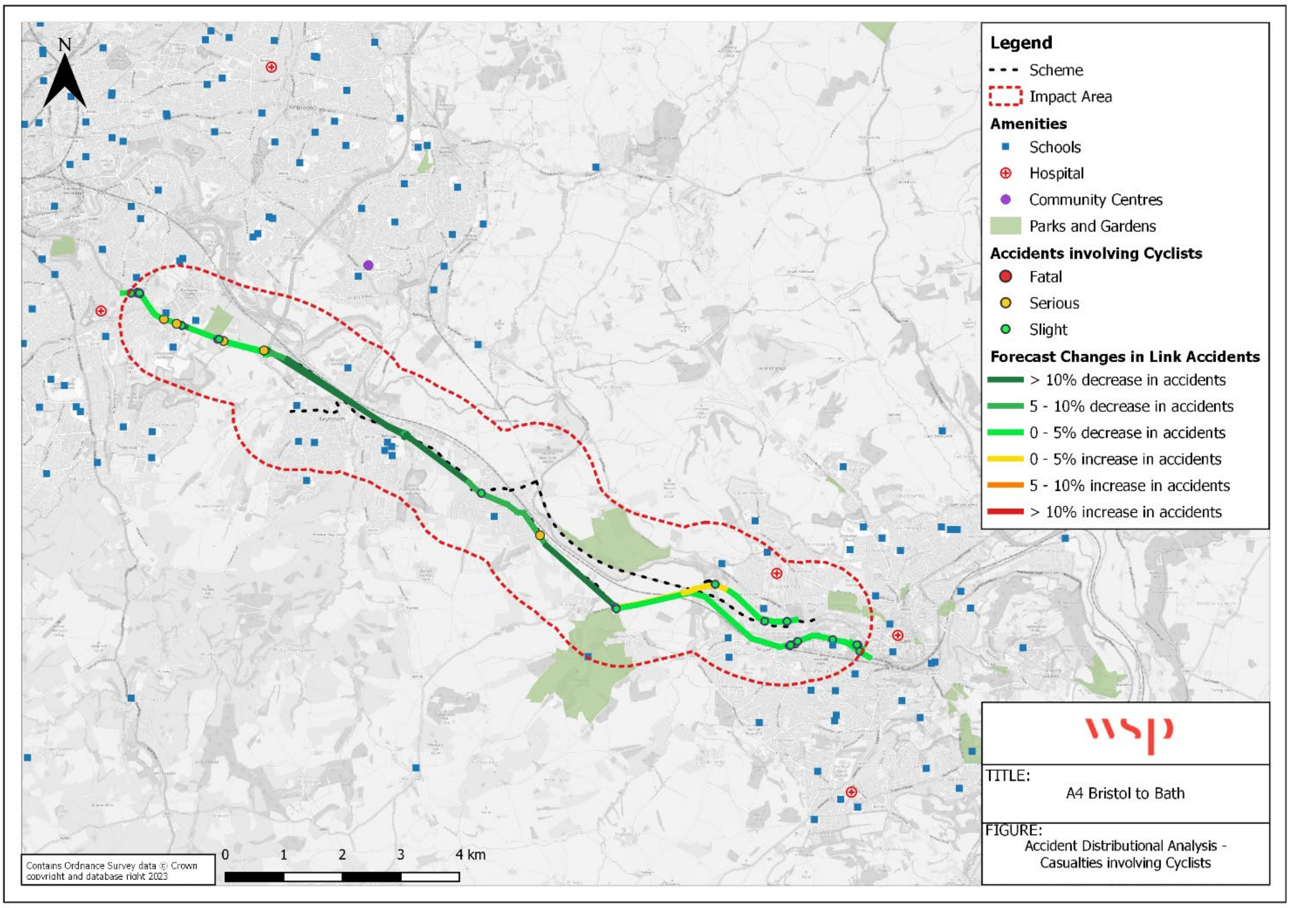
Table 5-6 - Scheme Assessment – Pedestrian Casualties

Roads in Impact Area	Total Casualties	% Pedestrian Casualties Impact Area	% Pedestrian Casualties National	COBALT Forecast Change in Accidents	Assessment
A4 Bath Road (N)	10	9.7%	10%	0 to 5% decrease in accidents along the stretch	Slight Beneficial
Keynsham By-Pass	1	9.1%	10%	>10% decrease in accident along the stretch	Moderate Beneficial
A4 Bath Road (S)	4	8.3%	10%	5 to 10% decrease in accident along the stretch	Slight Beneficial
Lower Bristol Road	7	16.3%	10%	0 to 5% decrease in accidents along the stretch	Slight Beneficial
Newbridge Road	3	23.1%	10%	0 to 5% decrease in accidents along the stretch	Slight Beneficial

Impact on Cyclists

5.6.20. Recorded accidents involving casualties on bicycles are shown in **Figure 5-7** alongside amenities that may generate cycle trips. The forecast change in accidents, calculated using COBALT accident analysis software, is also included at an individual link level.

Figure 5-7 - Accidents Distributional Analysis - Cyclist Casualties



5.6.21. Figure 5-6 presents the analysis undertaken to assess the impact of the Scheme on accidents involving cyclists.

5.6.22. The proportion of casualties on bicycles in the impact area is significantly higher than national average, at 14% compared to the national average of 9%.

5.6.23. When calculated using the weighted mean, the average score across all links assessed was **Slight Beneficial.**

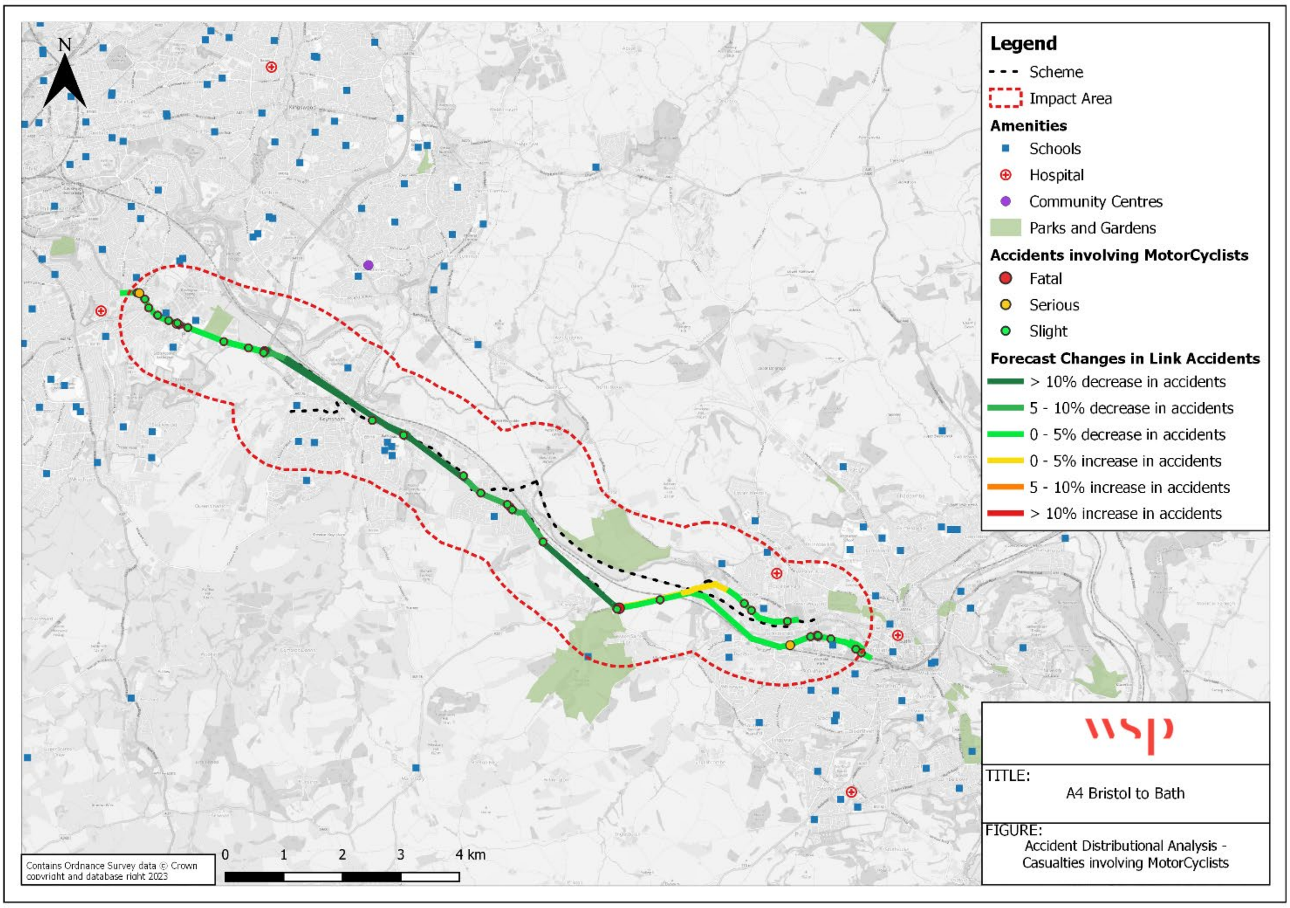
Table 5-7 - Scheme Assessment – Cyclist Casualties

Roads in Impact Area	Total Casualties	% Cyclist Casualties Impact Area	% Cyclist Casualties National	COBALT Forecast Change in Accidents	Assessment
A4 Bath Road (N)	15	14.6%	9%	0 to 5% decrease in accidents along the stretch	Slight Beneficial
Keynsham By-Pass	0	0.0%	9%	>10% decrease in accident along the stretch	Moderate Beneficial
A4 Bath Road (S)	4	8.3%	9%	5 to 10% decrease in accident along the stretch	Slight Beneficial
Lower Bristol Road	9	20.9%	9%	0 to 5% decrease in accidents along the stretch	Slight Beneficial
Newbridge Road	3	23.1%	9%	0 to 5% decrease in accidents along the stretch	Slight Beneficial

Impact on Motorcyclists

5.6.24. **Figure 5-8** shows the recorded accidents involving motorcycles and amenities that attract people within the local area. The forecast change in accidents is also shown for links within the impact area.

Figure 5-8 - Accidents Distributional Analysis - Motorcyclist Casualties



5.6.25. **Figure 5-7** compares the proportion of casualties on motorcycles for accidents in the impact area and nationally, in order to identify any locations with significantly high values.

5.6.26. The overall proportion of casualties on motorcycles in the impact area is 20% which is greater than the national average of 12%.

5.6.27. The individual link assessments resulted in a beneficial impact on all the roads, with the Keynsham By-Pass and A4 Bath Road(S) (which contains the largest proportion of accidents having a Large Beneficial and Moderate Beneficial impact respectively. Other roads resulted in an assessment score of Slight Beneficial. When calculated using the weighted mean, the average score across all links assessed was assessed as **Slight Beneficial.**

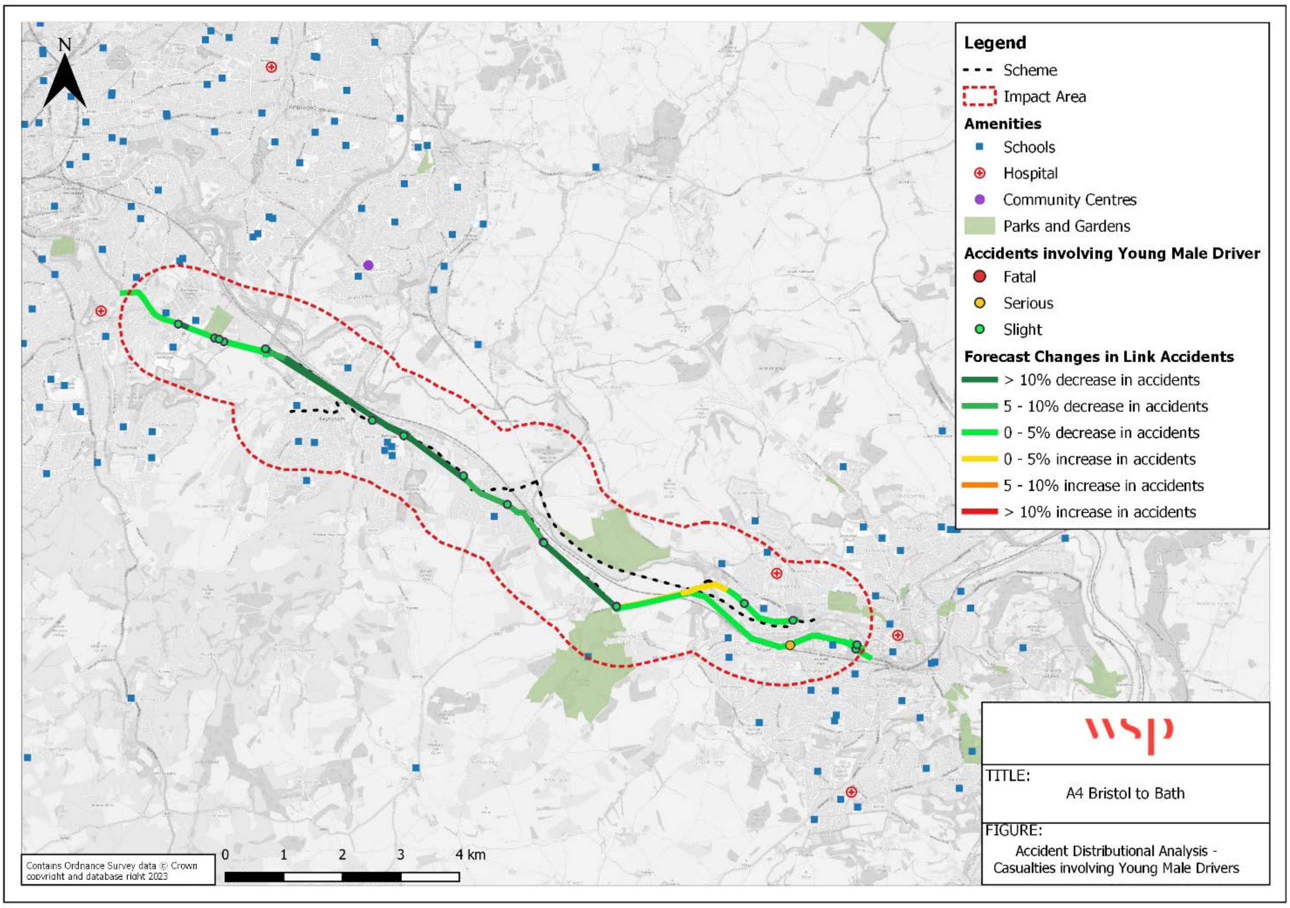
Table 5-8 - Scheme Assessment – Motorcyclist Casualties

Roads in Impact Area	Total Casualties	% Motorcyclist Casualties Impact Area	% Motorcyclist Casualties National	COBALT Forecast Change in Accidents	Assessment
A4 Bath Road (N)	19	18.4%	12%	0 to 5% decrease in accidents along the stretch	Slight Beneficial
Keynsham By-Pass	2	18.2%	12%	>10% decrease in accident along the stretch	Large Beneficial
A4 Bath Road (S)	12	25.0%	12%	5 to 10% decrease in accident along the stretch	Moderate Beneficial
Lower Bristol Road	8	18.6%	12%	0 to 5% decrease in accidents along the stretch	Slight Beneficial
Newbridge Road	3	23.1%	12%	0 to 5% decrease in accidents along the stretch	Slight Beneficial

Impact on Young Male Drivers

5.6.28. The locations of accidents involving young male drivers are displayed in **Figure 5-9** with local amenities and the forecast change in accidents for links in the impact area.

Figure 5-9 - Accidents Distributional Analysis - Young Male Driver Casualties



5.6.29. The calculations undertaken to score the impact of the Scheme on accidents involving young male driver casualties are shown in Figure 5-8. The proportion of casualties that are young male drivers for accidents within the impact area is compared to the national average by road type to aid in the identification of local issues for particular vulnerable groups.

5.6.30. The overall proportion of young male driver casualties in the area is below national average, 8.3% compared to 12%.

5.6.31. The individual link assessments resulted in a range of scores, with the Keynsham By-Pass having Large Beneficial impact while the other roads ranged from Slight Beneficial to Neutral. When calculated using the weighted mean, the average score across all links assessed was **Neutral**.

Table 5-9 - Scheme Assessment – Young Male Driver Casualties

Roads in Impact Area	Total Casualties	% Young Male Driver Casualties Impact Area	% Young Male Driver Casualties National	COBALT Forecast Change in Accidents	Assessment
A4 Bath Road (N)	5	4.9%	12%	0 to 5% decrease in accidents along the stretch	Neutral
Keynsham By-Pass	2	18.2%	12%	>10% decrease in accident along the stretch	Large Beneficial
A4 Bath Road (S)	6	12.5%	12%	5 to 10% decrease in accident along the stretch	Slight Beneficial
Lower Bristol Road	3	7.2%	12%	0 to 5% decrease in accidents along the stretch	Neutral
Newbridge Road	2	15.4%	12%	0 to 5% decrease in accidents along the stretch	Neutral

5.7 Appraisal of Impact: Full Appraisal and Summary (Step 3b)

5.7.1. The results from each of the individual vulnerable group assessments are summarised in **Table 5-10** by road and group. The A4 Bath to Bristol corridor is the major road in the impact area with the highest traffic volume and where 218 casualties were reported between the years 2016-2022 (excluding 2020,2021). With the implementation of the scheme, the accident rate is expected to reduce significantly (>10% reduction) on the vulnerable stretch of A4 section like Keynsham Bypass and the South section of A4 Bath Road, where the maximum number of accidents were reported.

5.7.2. Proposed infrastructure improvements like continuous segregated cycling corridor between Bristol and Bath, cycling and walking connections between local communities along the A4 between Bristol and Bath reduces the risk of accidents involving the vulnerable groups like Children below 16 years, pedestrians, cyclists and Motorcyclists. As such, the DI is assessed as **'Slight Beneficial'** for these categories of population.

5.7.3. Other social groups like Older people above 70 years and Young Male drivers were assessed to have a **Neutral** impact.

Table 5-10 - Assessment of Road Users and Social Groups

Road	Children	Older People	Young Male Drivers	Pedestrians	Cyclists	M/cyclists
A4 Bath Road (N)	Slight Beneficial	Neutral	Neutral	Slight Beneficial	Slight Beneficial	Slight Beneficial
Keynsham By-Pass	Moderate Beneficial	Moderate Beneficial	Large Beneficial	Moderate Beneficial	Moderate Beneficial	Large Beneficial
A4 Bath Road (S)	Slight Beneficial	Slight Beneficial	Slight Beneficial	Slight Beneficial	Slight Beneficial	Moderate Beneficial
Lower Bristol Road	Slight Beneficial	Neutral	Neutral	Slight Beneficial	Slight Beneficial	Slight Beneficial
Newbridge Road	Neutral	Neutral	Neutral	Slight Beneficial	Slight Beneficial	Slight Beneficial
Overall	Slight Beneficial	Neutral	Neutral	Slight Beneficial	Slight Beneficial	Slight Beneficial

6 Security

6.1.1. DfT TAG Unit A4.2 states that there are several groups with particular concerns about their personal security especially while using public transport. These include women, younger people, older people, people with disabilities and those from ethnic minority communities.

6.1.2. As given in TAG, section 7.1.1, public transport users tend to be from lower income groups, therefore impacts on households in different income bands is recommended to be considered for distributional security impact assessment.

6.2 Screening

6.2.1. The delivery of transport schemes and interventions may affect the level of both real and perceived security for transport users. In line with TAG Unit A4.1, a qualitative assessment will be undertaken to consider the changes in security due to the scheme. The impact will be reported on the standard 7-point scale.

6.3 Qualitative appraisal

6.3.1. There are few existing security elements available on the corridor with discontinued cycle tracks and pedestrian footpaths. Currently the only security element present is the segregation from the existing motorised traffic.

6.3.2. The lack of existing facilities, along with concerns about the walking and cycle safety, is putting people off choosing to walk or cycle along the corridor.

6.3.3. There are improvements proposed for public transport facilities along the corridor along with the proposed Keynsham Transport Hub with on carriageway bus stops and at grade crossing of A4. There are bus shelters that will be provided along with walking/cycling connections to Keynsham town centre and train station. Along with the public transport, the cycle tracks and footpaths are also proposed to provide improved connectivity and quality thus enhancing the security of the users and commuters along the corridor. Therefore, security is scored as ‘Slight Beneficial’.

7 Severance

7.1.1. Community severance is defined as the separation of residents from facilities and services they use within their community caused by substantial changes in transport infrastructure or by changes in traffic flows. Severance will only be problematic where either vehicle flows are significant enough to impede pedestrian movement across a road or where infrastructure presents a physical barrier to movement.

7.1.2. The A4 between Bath and Bristol is congested, with all sections having above 8,000 vehicles per day and some having above 15,000 vehicles per day. The congestion will thus reduce the free flow of pedestrians on this corridor. There are amenities like parks, gardens, schools, retail, and commercial units in proximity to the corridor and accessing these becomes a challenge. An assessment of severance to establish the impact of changes to traffic flow on pedestrians was undertaken in line with TAG Unit A4.2.

7.2 Screening

7.2.1. Severance impacts were assessed by considering the scheme proposal as and forecast changes in vehicle flow. It is expected that the private vehicle usage will reduce between the city centres especially with the increase of Public Transport connectivity and active travel infrastructure along the road. This will reduce the severance of the communities and neighbourhoods along the corridors especially around the towns of Keynsham and Saltford.

7.2.2. There are some roads within the impact area that would experience potential changes in severance as a result of increase or decrease in traffic volumes. Therefore, it is appropriate to examine these areas further to understand the severance impacts on vulnerable groups.

7.3 Assessment – Areas of Impact (Step 2a)

7.3.1. The impact area has been defined through the severance analysis guidance described within TAG, which uses a 1km buffer applied around the scheme. Within this 1km buffer, changes in severance as a result of changes to road alignments, road closures, infrastructure and vehicle flow were assessed. Although there are links outside of the 1km buffer that experience changes in the above, the assessment only focuses on the local area where the most concentrated impacts are anticipated.

7.4 Assessment - Identification of Social Groups in Impact Area (Step 2b)

7.4.1. Vulnerable groups are particularly sensitive to the effects of severance. Within these vulnerable group **Table 7-1** shows the proportion of these vulnerable groups within the scheme area along with regional and national comparisons.

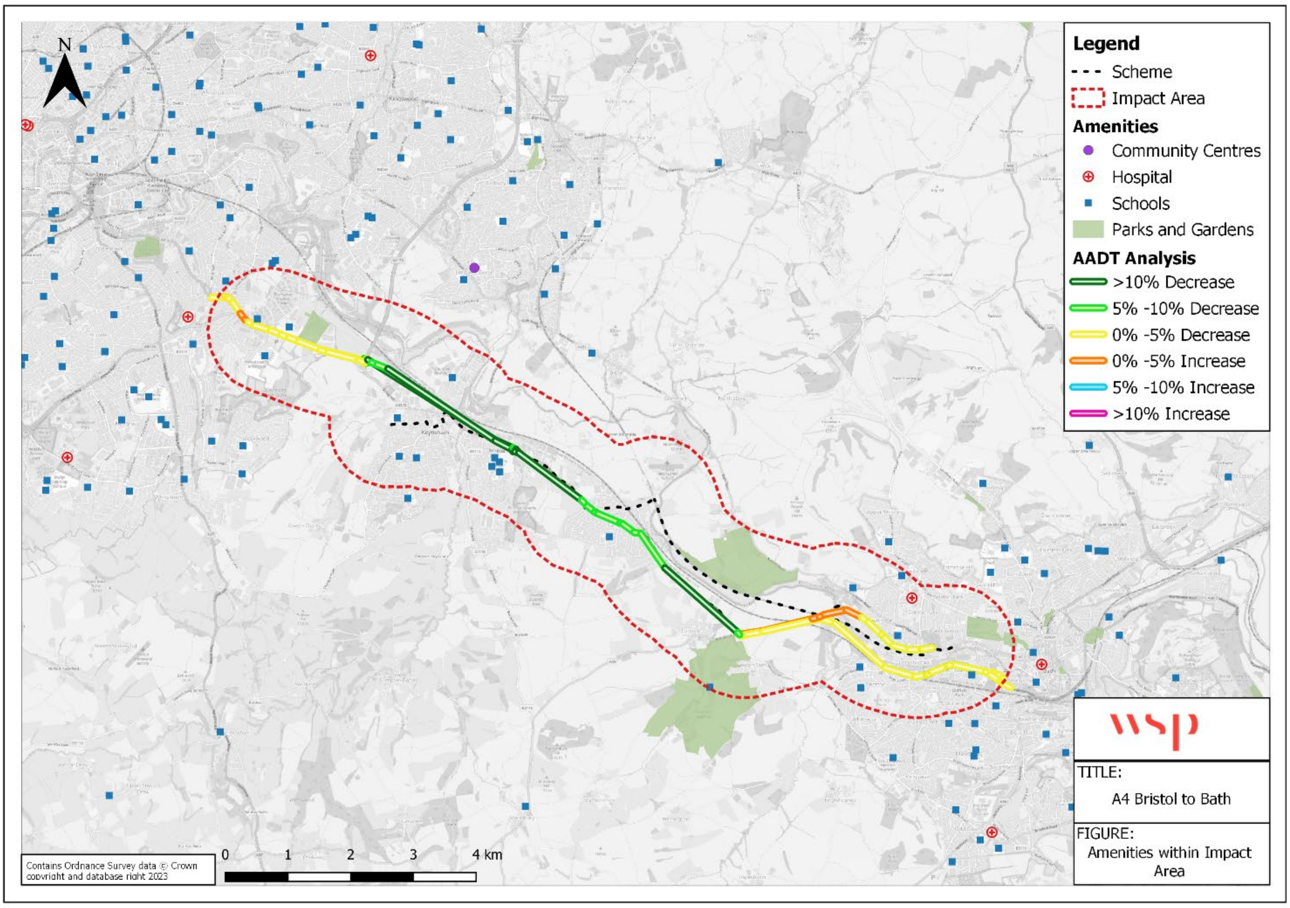
Table 7-1 - Vulnerable Groups

Vulnerable Group	% Impact Area	% Bath and Bristol	% England
Older People (Aged 70+)	14.1%	15.1%	13.6%
Children (Aged Under 16)	21.8%	22.3%	23.1%
No Car Households	9.1%	7.7%	23.3%
Residents with long-term health problems or disabilities	17.2%	17.4%	17.5%

7.5 Assessment – Amenities in the Impact Area (step 2c)

7.5.1. The severance impact area contains a significant number of local amenities (**Figure 7-1**) that are likely to generate trips from the wider area in addition to local residents. These include two Primary schools, one Secondary school, offices and few shops and restaurants along A4.

Figure 7-1 - Amenities within Impact Area and Traffic Flow Changes



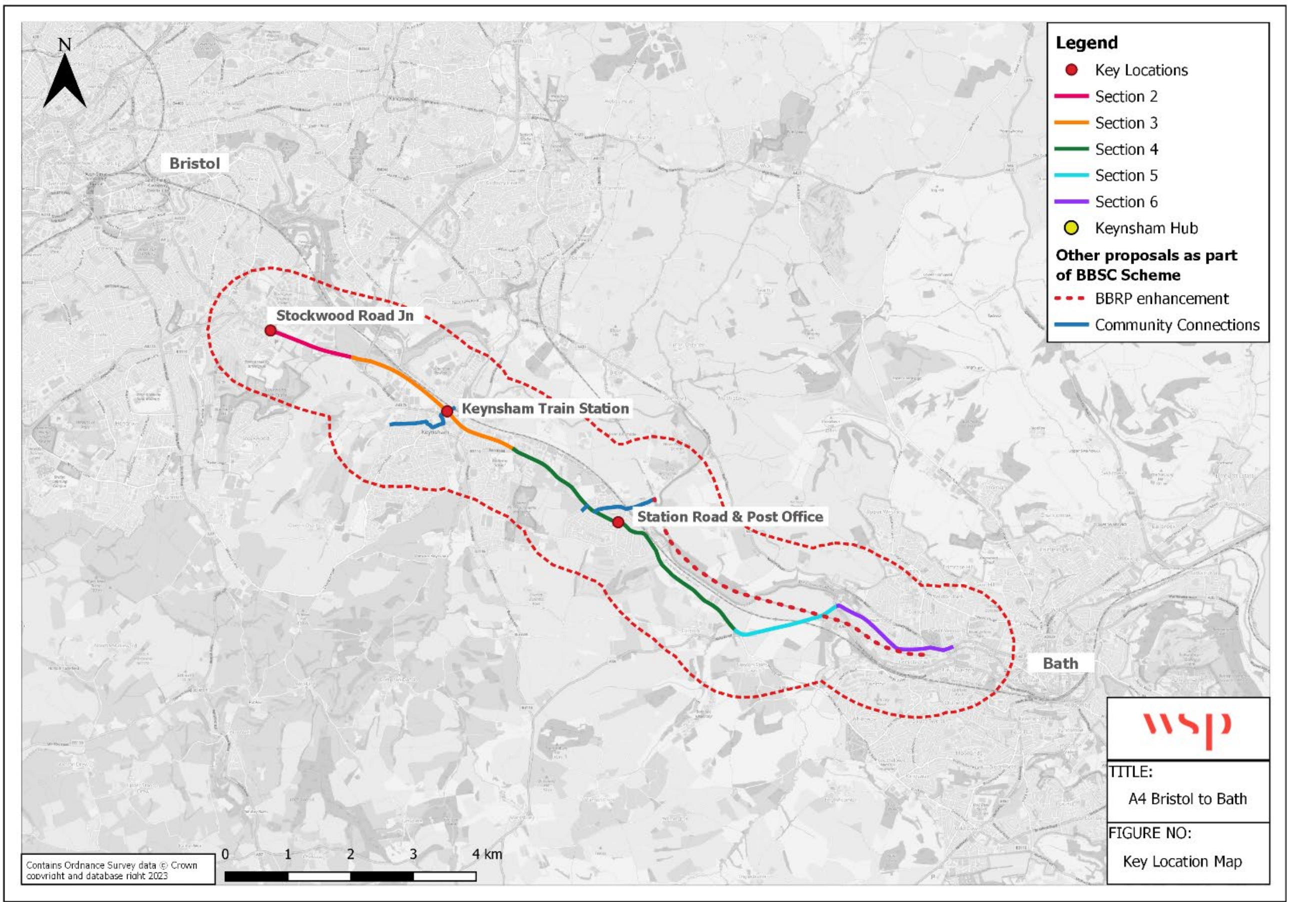
7.5.2. The proportion of children, older people, people with disabilities and households without access to a car in the impact area, and amenities within the impact area for this assessment are summarised in Appendix C.

7.6 Appraisal of Impact (Step 3)

7.6.1. The assessment of severance includes locations within 1km of the scheme where the road network experiences changes in traffic flows and where there are concentrations of people in vulnerable groups. Changes in vehicle flow have the potential to impact on people's ability to access schools and other amenities, in addition to affecting the permeability of roads.

7.6.2. An existing pedestrian crossing point on the Bath Road/Stockwood Road junction, Keynsham train station and Saltford Library and Post office were identified as key locations (**Figure 7.2**) within 1km of the scheme alignment to inform the analysis of impacts as a result of the scheme. A high-quality, high-capacity bus service with good interchanges to other modes and services, supported by walking and cycling connections linking communities to the new service, will help provide improved sustainable transport connectivity thus reducing the high car usage along the A4 between Bristol and Bath. As such, the scheme is anticipated to reduce the severance caused due to the congestion on A4.

Figure 7-2 - Key Locations for Appraisal of Impact

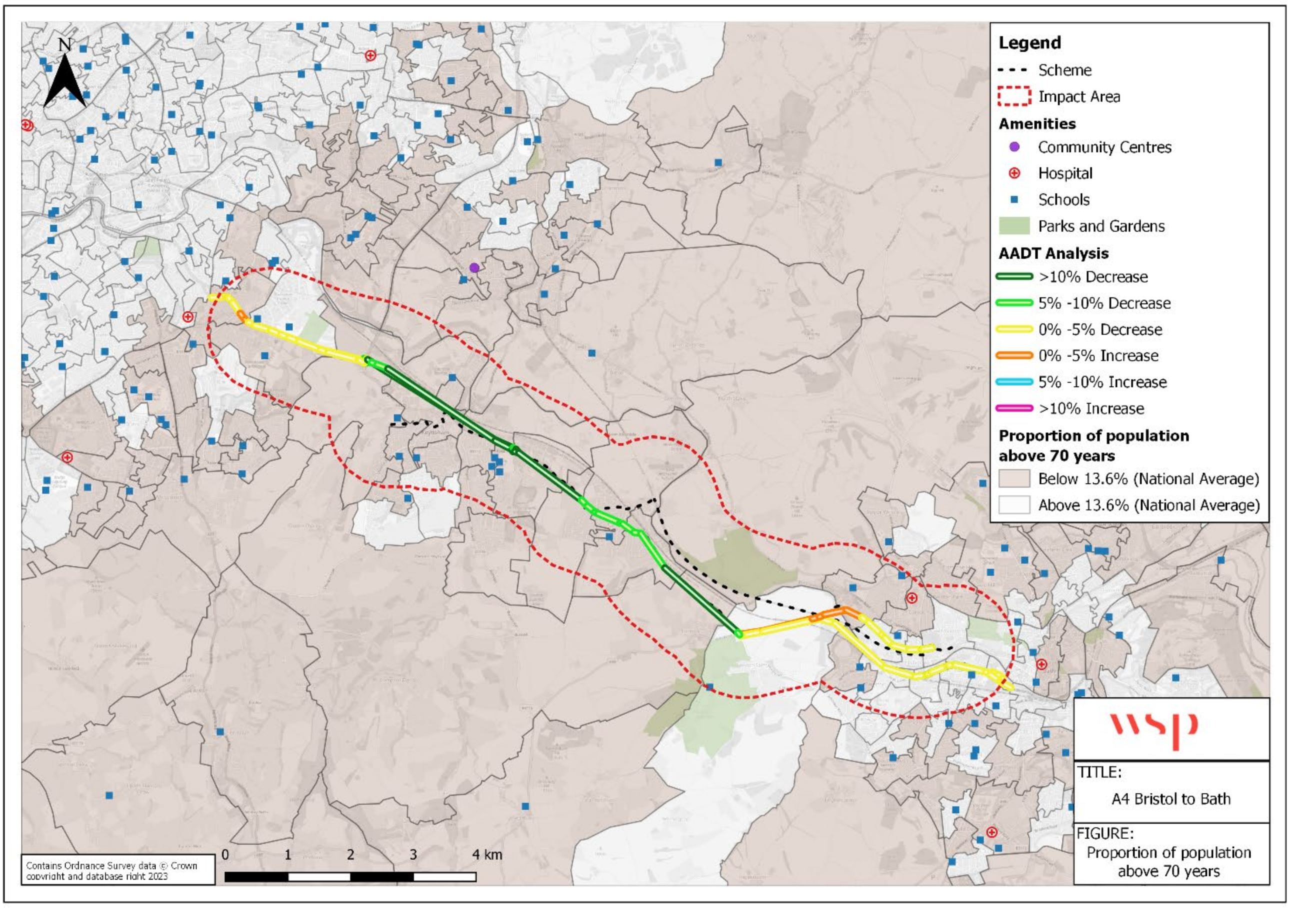


7.6.3. To assess the potential impact of severance directly caused by changes in traffic flows, an 800m buffer was applied to the key locations to capture the proportion of vulnerable groups living within a reasonable walking distance. The severance worksheet in Appendix B details the number of people in vulnerable groups likely to be affected by change in severance, as a result of the scheme. This assessment of the numbers of vulnerable people was subsequently used to appraise severance.

7.6.4. As a result of the BBSC scheme, the pattern of traffic flow change on the network is characterised by a reduction in traffic flow on the existing A4 stretch between Bath to Bristol. The section between the Hicks Gate roundabout and the A39/A4 Bristol Road junction experiences a >10% reduction in the AADT due to the introduction of the scheme.

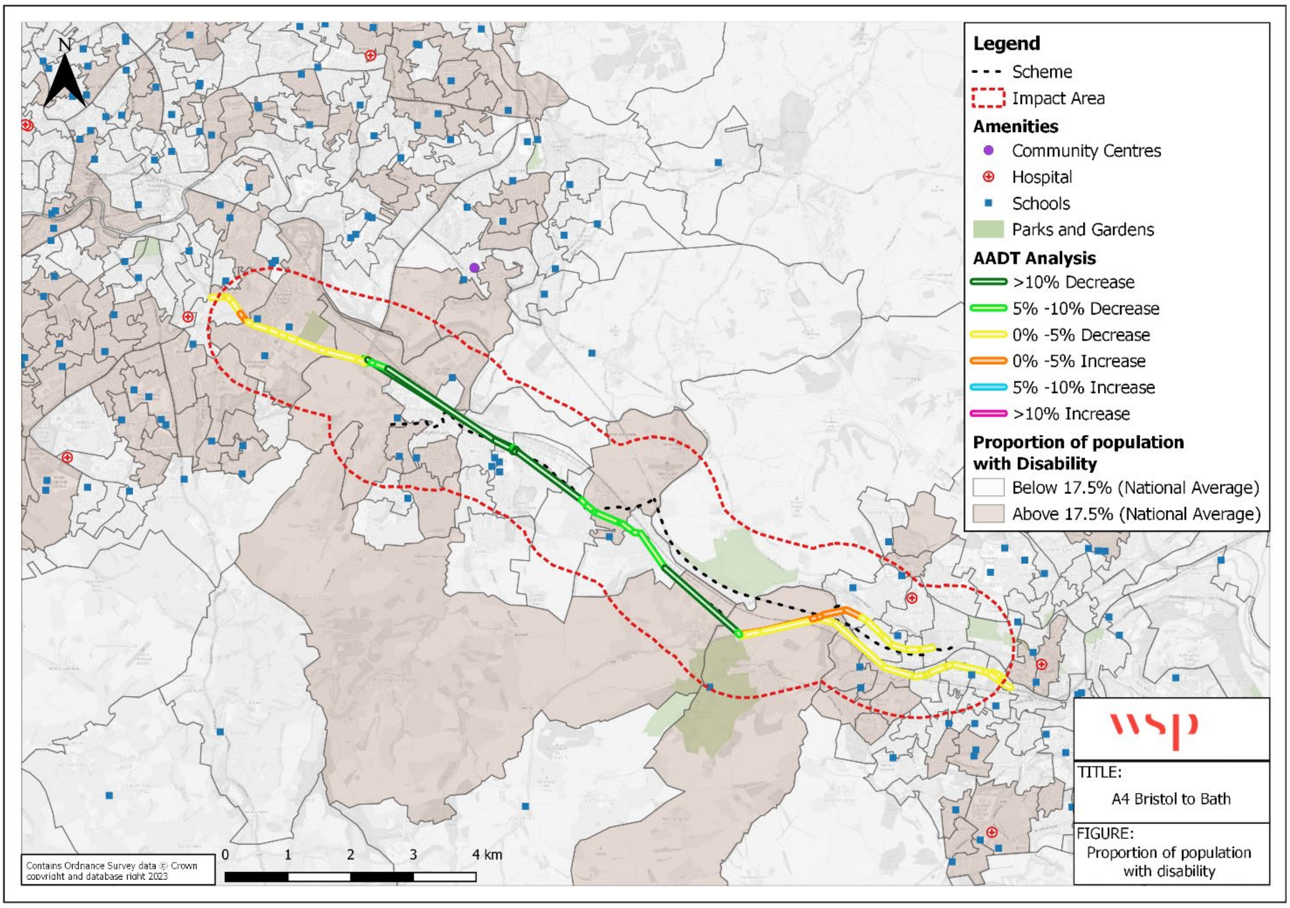
7.6.5. During the severance assessment, the populations of vulnerable groups at output area level have been examined to identify any areas where there are high concentrations close to links where vehicle flows are expected to significantly increase of decrease as shown in **Figures 7-3** to **7-6.**

Figure 7-3 - Distribution of Traffic Flow Changes against Concentrations of Older People (Aged over 70)



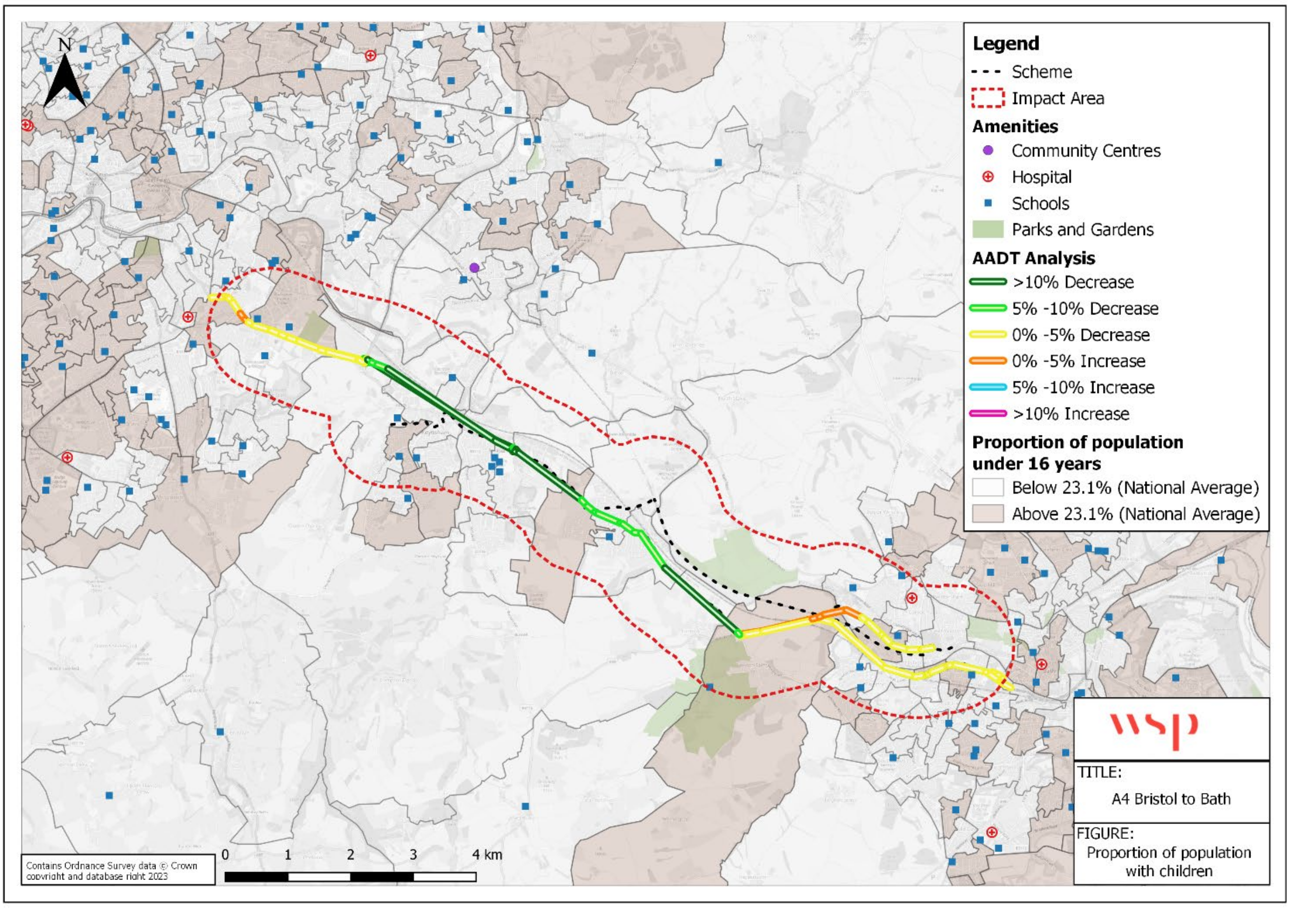
7.6.6. All the three key locations have LSOAs with the proportion of older people aged above 70 years greater than the proportion of national average. Also, the link near to the Bath Road/Stockwood Road junction results in a 0%-5% decrease in the AADT flow, resulting in an overall Slight Beneficial impact. Links in proximity to the Keynsham train station and Saltford Library and Post office shows a >10% decrease in the AADT flow resulting in a Large Beneficial impact.

Figure 7-4 - Distribution of Traffic Flow Changes against Concentrations of People with a Disability



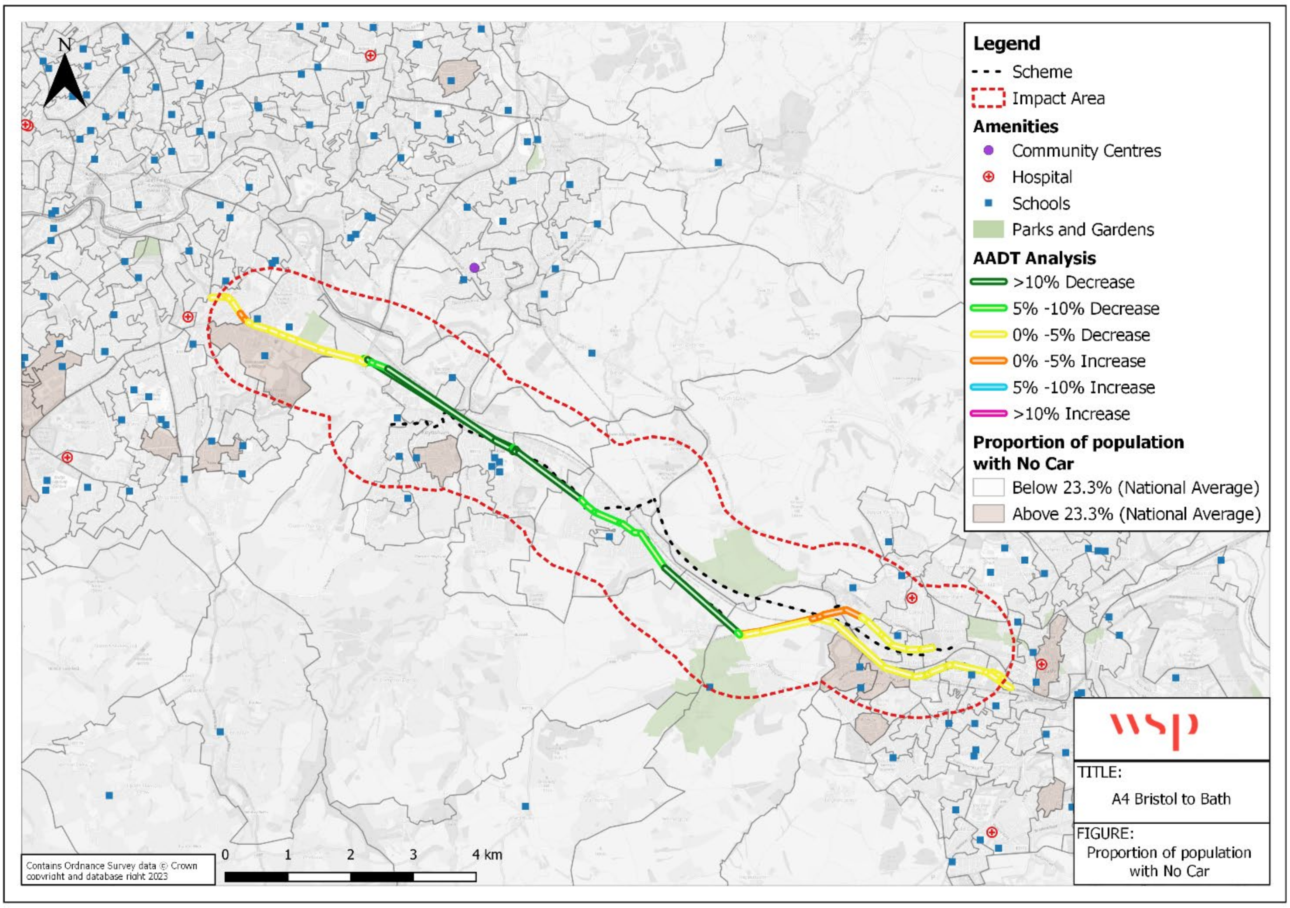
7.6.7. There are majority of the LSOAs near the Bath Road/Stockwood Road junction with proportion of disability greater than the national average. However, the percentage decrease in AADT anticipated due to the scheme is less than 5% giving a Moderate Beneficial impact. For the impact area within the Keynsham train station, most of the LSOAs have proportion of disability lesser than the national average thus giving a Slight Beneficial impact. For the impact area within the Saltford Library and Post office, there are equal number of LSOAs with proportion of disabled population greater than and lesser than the national average resulting in a Neutral impact.

Figure 7-5 - Distribution of Traffic Flow Changes against Concentrations of Children (Aged under 16)



7.6.8. Although the proportion of children below 16 years is lesser than the national average, there are many schools near to the key locations and also within the 1km of the scheme buffer. Therefore, these schools are also likely to attract the children from the region outside the impact area boundary. The link near to the Bath Road/Stockwood Road junction thus results in a Slight beneficial impact and on the other two key locations, a Moderate Beneficial impact is anticipated due to >10% decrease in AADT.

Figure 7-6 - Distribution of Traffic Flow Changes against Concentrations No Car Households



7.6.9. All the major key locations have majority of the LSOAs with proportion of No car households lesser than the national average. As the scheme focuses more on the improvements associated with public transport and active travel connections, this category of the vulnerable group is anticipated to receive the maximum benefits. However, as the proportion of this population to accrue the benefits is less, DI is assessed as Slight Beneficial.

7.6.10. **Table 7-2** provides a summary of the severance assessment for vulnerable groups within the impact area, which overall is considered to be **Moderate Beneficial**.

Table 7-2 – Severance Benefit Assessment at key locations for vulnerable groups

Key location	Children	Older People	People with a Disability	Population with no car
Bath Road/Stockwood Road junction	Slight Beneficial	Slight Beneficial	Moderate Beneficial	Slight Beneficial
Keynsham train station	Moderate Beneficial	Large Beneficial	Slight Beneficial	Slight Beneficial
Saltford Library and Post office	Moderate Beneficial	Large Beneficial	**Neutral**	Slight Beneficial

8 Accessibility

8.1.1. Accessibility in the context of distributional impacts, focuses on the public transport accessibility aspect of accessing employment, services and social networks (TAG Unit A4.2). This provides a holistic approach to considering the accessibility needs of different groups of people, taking into a wide range of factors, including journey times to reach key destinations.

8.1.2. The corridor majorly connects between Bristol and Bath town centres which is also an active bus route. While there is a provision of bus priority being proposed as part of the scheme along this route, the scheme does not inherently provide for any change in public transport accessibility as there are no proposed changes in routing or timings of current public transport services. On this basis, DI for accessibility has been undertaken qualitatively.

8.2 Appraisal of Impact

8.2.1. A high frequency bus priority corridor that provides reliable journey times and consistent performance gives the opportunity to address the existing identified issues with the Bath to Bristol movements and has the potential to deliver modal shift from the high levels of intra and inter-urban travel by private car.

8.2.2. The scheme connects the town centres of Keynsham and Saltford along the corridor with special enhancements routes such as Community Connections and BBRP, which improve the accessibility of the corridor giving a **Slightly Beneficial'** impact for the users accessing the route.

9 Personal Affordability

9.1.1. In line with TAG, the personal affordability impacts of the scheme have been considered. Changes in transport costs have the potential to disproportionately affect areas where there are few or no travel alternatives, particularly in areas where income levels preclude car ownership. As a result, impact on travel to work, education and affordable food for example can be expected. These impacts are likely to be exacerbated in areas with low income, low car ownership and a high elderly population.

9.2 Screening (Step 1)

9.2.1. The only element assessed for the affordability impact appraisal was fuel and non-fuel operating costs (TUBA benefit) as shown in **Table 9-1**, as the other impacts were not considered to be relevant (or would occur) as a result of the scheme. A full appraisal of fuel and non-fuel costs were however required, due to the anticipated changes in journey speeds, mode shift and congestion as a result of the BBSC scheme.

Table 9-1 - Screening of personal affordability impact appraisal

Mode	Cost Change	Cost Change Expected	Change Captured in TUBA	Impact
Car	Car fuel and non-fuel cost	Yes	Yes	Changes due to congestion relief and rerouting
Car	Road user charges	No	No	Not applicable
Car	Public parking charges	No	No	Not applicable
Car	Other car charge/costs	No	No	Not applicable
Public Transport	Bus fares	Yes	Yes	Not applicable
Public Transport	Rail fares	No	No	Not applicable
Public Transport	Rapid transit fares	No	No	Not applicable
Public Transport	Mode shift between public transport modes due to change in supply	Yes	No	Not applicable
Public Transport	Concessionary fares	No	No	Not applicable
Public Transport	Other public transport charges/costs	Yes	No	Not applicable

Mode	Cost Change	Cost Change Expected	Change Captured in TUBA	Impact
Non-motorised modes	Walking costs	No	No	Not applicable
Non-motorised modes	Cycling costs	No	No	Not applicable

9.2.2. As a TUBA appraisal has been undertaken for the Scheme, the results of this assessment have been used as the basis for the personal affordability analysis.

9.3 Assessment – Areas of impact (Step 2a)

9.3.1. The impact area for the personal affordability distributional appraisal is defined as the area of detailed modelled within the WERTM transport model. This impact area covers the area in which users cost of travel is being directly affected by the scheme.

9.4 Assessment – Identification of social groups in the impact area (Step 2b)

9.4.1. In line with the TAG methodology, the primary group of interest is people on low incomes. The income domain from the Index for Multiple Deprivation (IMD) 2019 has been mapped at Lower Super Output Area (LSOA) level throughout the scheme area.

9.4.2. Vehicle Operating Costs (fuel and non-fuel) from the TUBA assessment, for commute and other purposes only (non-business), have been converted from model zones to LSOA to allow for comparison to the IMD income domain data. The conversion of benefits from model zone to LSOA has been undertaken using the Ordnance Survey Codepoints (Postcodes) 2020 dataset to derive proportions for splitting model zone benefits into LSOAs based on population distribution.

9.4.3. The distribution of income groups in the impact area is summarised in Appendix C.

9.5 Appraisal of Impact (Step 3)

9.5.1. Overall, there would be a disbenefit of £0.8 million in car fuel and non-fuel costs. **Table 9-2** provides a distributional assessment of fuel and non-fuel costs across the five IMD income domains, in line with TAG Unit 4.2. The assessment for each group is based on whether the intervention generates an overall benefit or disbenefit and the share of the benefit / disbenefit that a group receives in relation to its proportion of the population. The scoring is the same as that in the user benefit analysis and uses the method of comparing the proportion of benefits/ disbenefits realised by a specific group to the proportion of the population made up by that group (+/-5%).

Table 9-2 - Distribution of Personal Affordability disbenefits by Income Deprivation Quintile

Indicator	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%
Total VOC disbenefits of LSOA's within impact area (£M)	-0.04	-0.05	-0.09	-0.10	-0.41
Share of disbenefits within impact area	5%	7%	13%	15%	60%
Population	57,037	46,833	60,666	77,123	94,601
Share of population in the impact area	17%	14%	18%	23%	28%
Assessment	Slight Adverse	Slight Adverse	Moderate Adverse	Slight Adverse	Large Adverse

Figure 9-1 – Distribution of VOC disbenefits across IMD Quintile

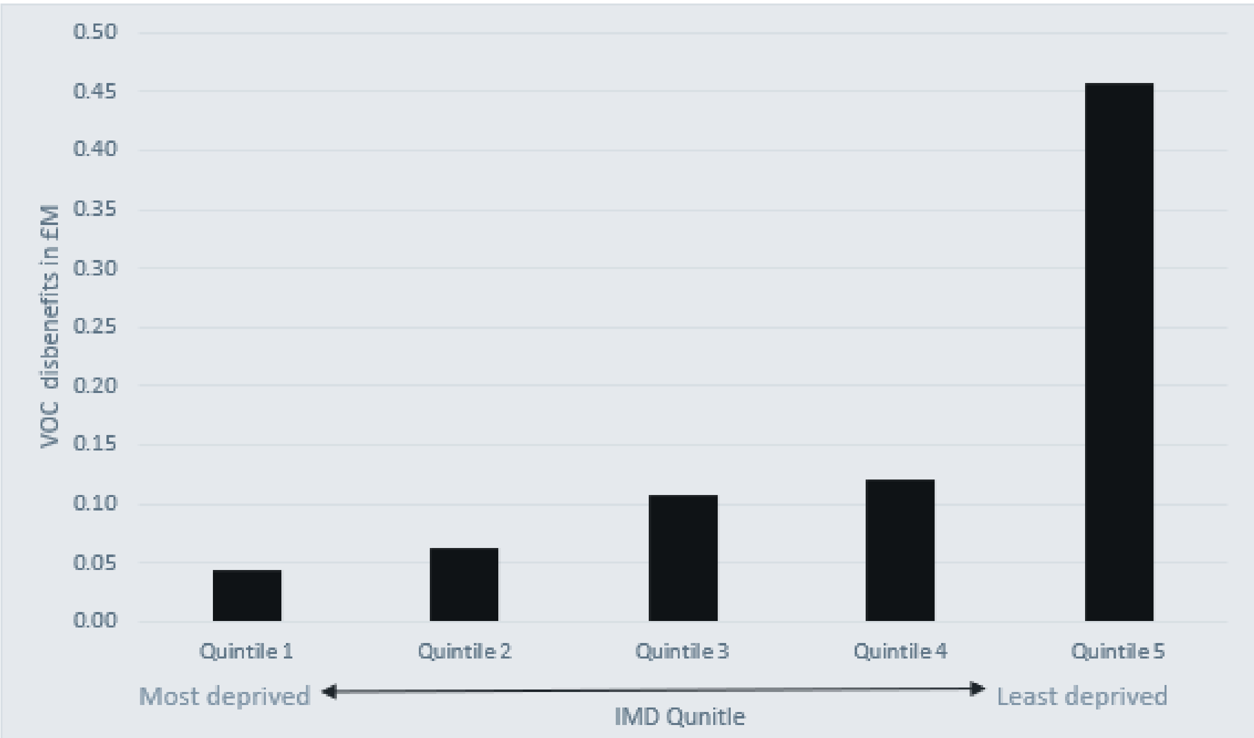
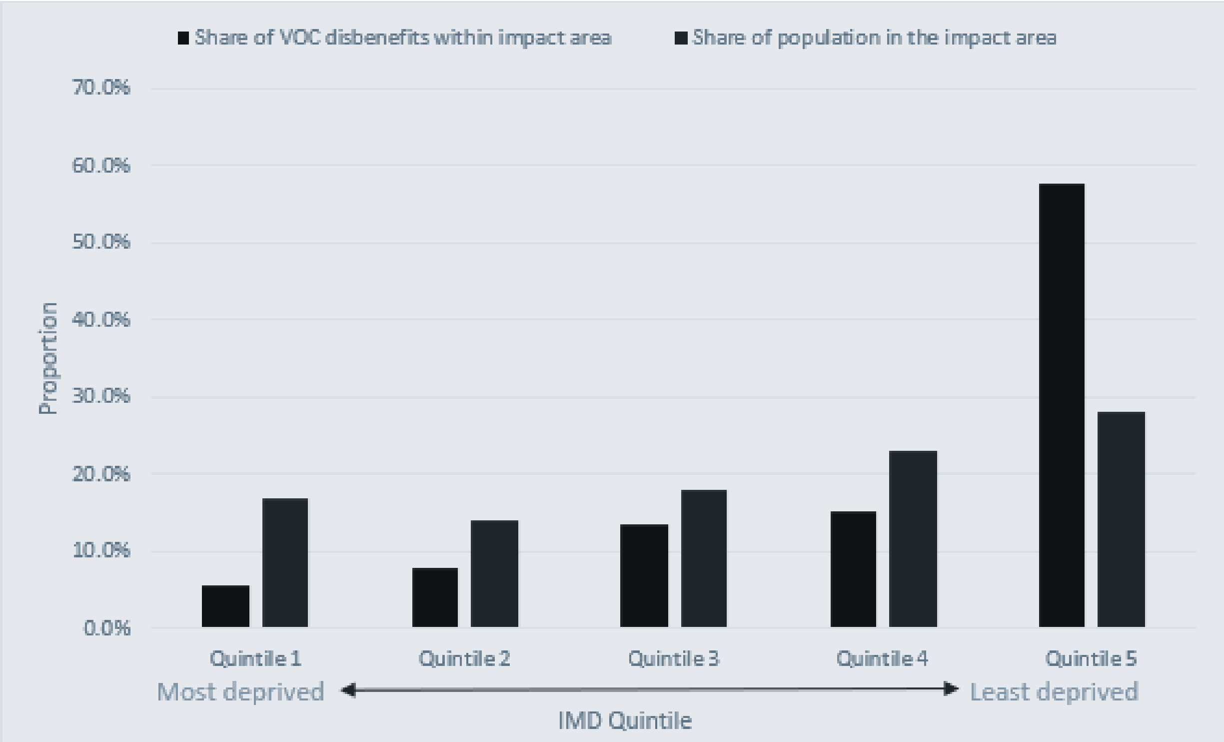


Figure 9-2 – Comparison of Share of VOC disbenefits with share of population in the Impact area



9.5.2. The distributional impact of personal affordability shows that the scheme leads to a VOC disbenefit in all the quintiles. Those in the least deprived income quintile (income quintile 5) experience a considerably higher than expected proportion of disbenefits (60%), whereas those in the most deprived areas (quintile 1) experience a smaller than expected proportion of disbenefits (5%).

9.5.3. The distributional impact shows that the scheme leads to an increase in VOC causing larger dis-benefits in the major and middle-income sectors of the local population, who are more associated with car journeys and the fuel costs incurred.

9.5.4. As the majority of the income quintiles (Quintile 1,2 and 4) experience a Slight disbenefit, the DI for personal affordability is appraised as Slight Adverse.

9.5.5. The personal affordability disbenefits distributed by LSOA are presented in Figure 9-3.

Figure 9-3 - Personal Affordability Benefits disaggregated at LSOA level

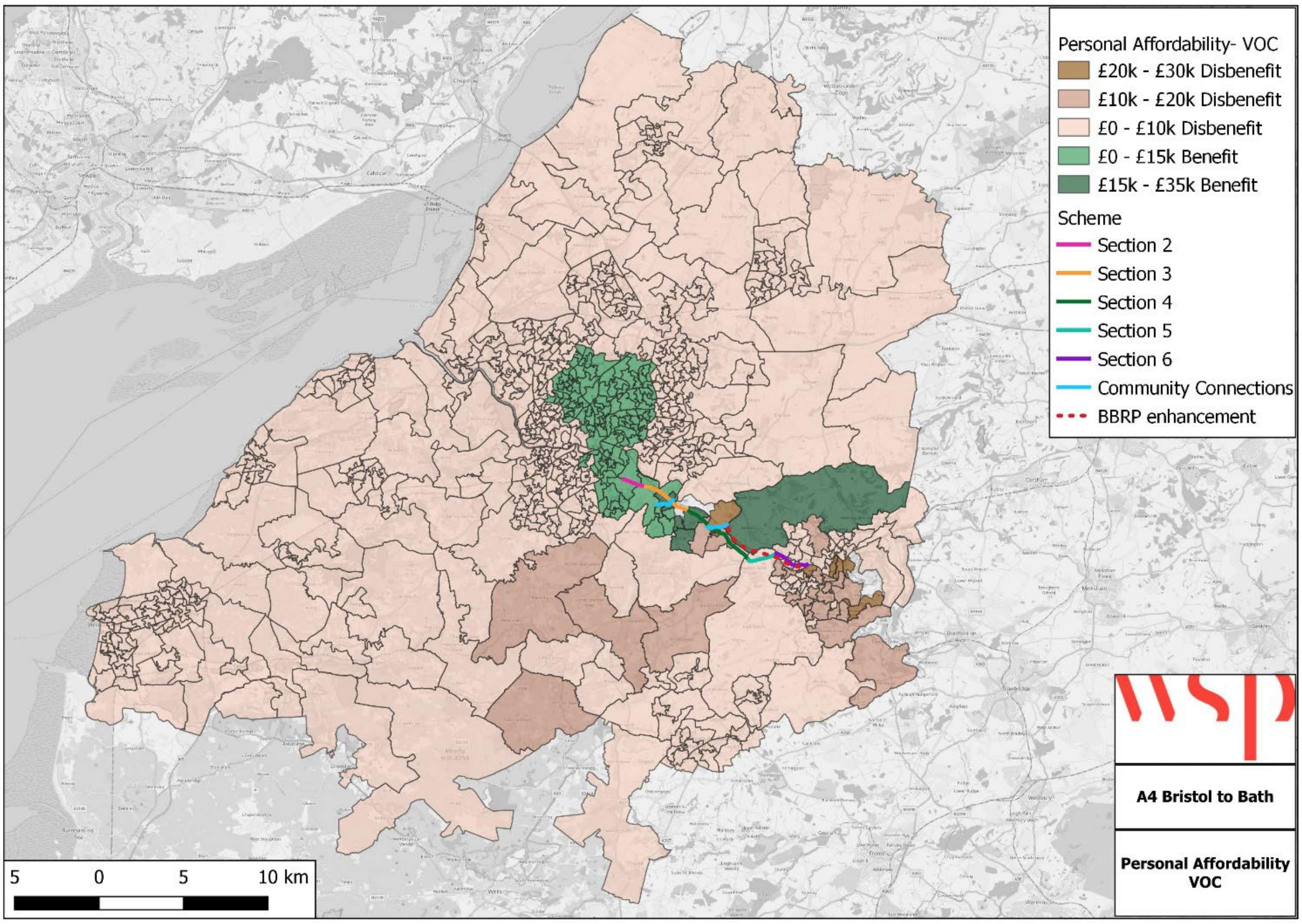


Figure 9-4 - Personal Affordability Benefits - Vehicle Operating Costs disaggregated at LSOA level focused on Impact Area

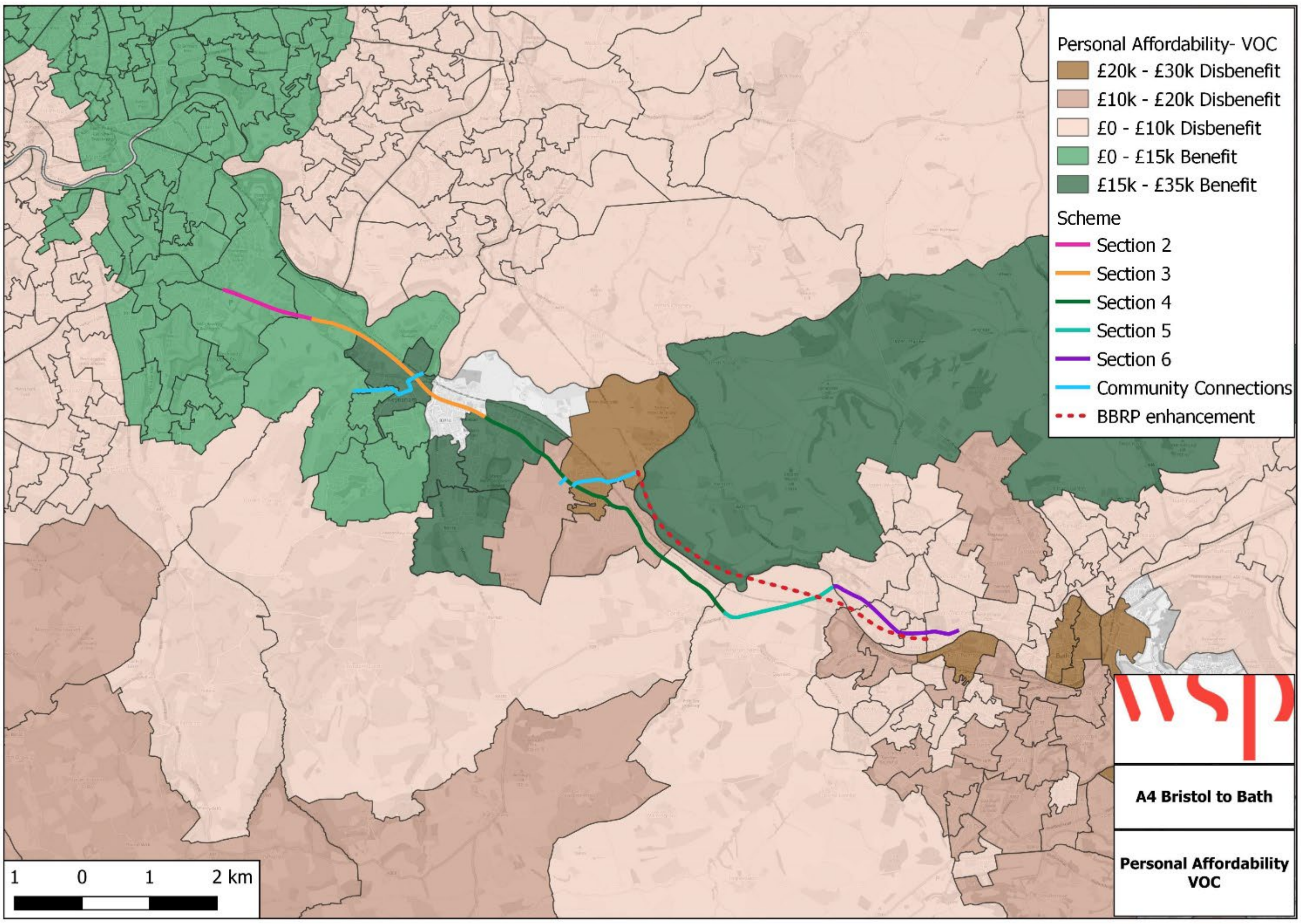


Figure 9-5 - Personal Affordability Benefits - Vehicle Operating Costs per Person disaggregated at LSOA level

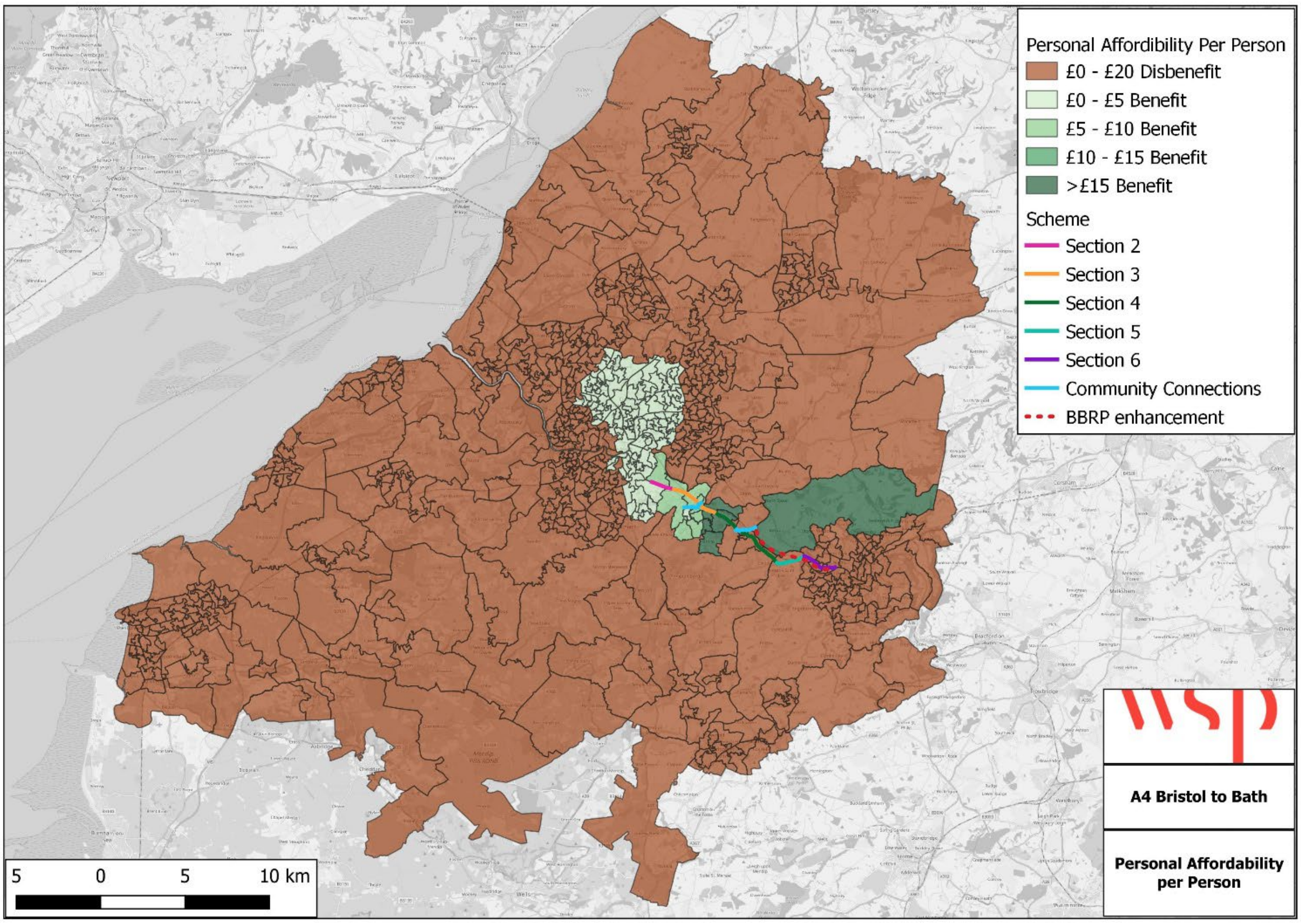
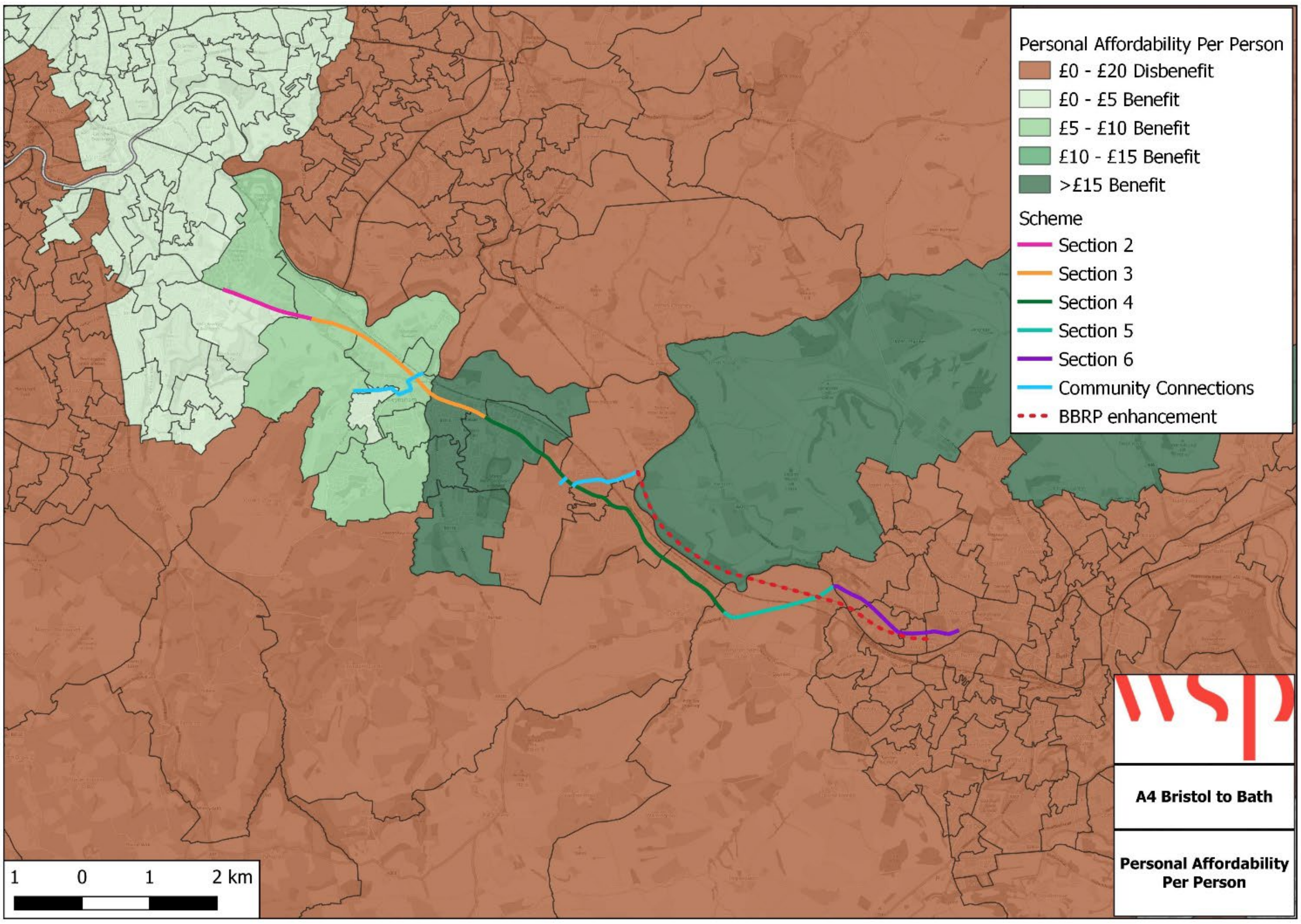


Figure 9-6 - Personal Affordability Benefits - Vehicle Operating Costs per Person disaggregated at LSOA level focused at Impact Area



10 DI ASSESSMENT SUMMARY

Impact	Seven Point Scale assessment	Summary
User Benefits	Slight Beneficial	For highway users, the scheme proposal will generate some disbenefits to the highway users as the scheme focuses on enhancing the public transport and active travel connections. Therefore, highway users will experience slight severance associated with these improvements leading to more travel time. The adverse impact is primarily felt by residents in the most economically deprived areas (Quintile 1 with 71% disbenefits), as they will face greater challenges in affording a car journey. For PT users. all the quintiles experience a benefit from the scheme. The majority of the benefits (33%) are accrued by people within the mid-income quintile (Quintile 3) within the impact area followed by quintile 2 (24%), whereas those in the most deprived areas (Quintile 1) and the least deprived areas (Quintile 4 and 5) experience a smaller than expected proportion of benefits. DI in overall appraised as Slight Beneficial as the drawbacks related to the highway users are expected to be counterbalanced by the scheme's positive impacts on public transportation (PT), with PT user benefits estimated at £6 million. The implementation of bus priority measures aims to reduce travel time for buses commuting from Bath to Bristol. Furthermore, there are secondary effects on overall journey time, as alterations in travel times along the A4 corridor may influence interconnectivity with other services, reducing interchange times.
Noise	Moderate Beneficial	In the forecast year, 12 households would experience an increase in daytime noise, whilst 882 households would experience a decrease in daytime noise and 6 households would experience an increase in night-time noise, whilst 578 households would experience a decrease in night-time noise. The overall appraisal indicates that the operation of the Proposed Scheme is likely to generate a beneficial noise impact and indicated that noise levels are predicted to improve in each of the income domains for the forecast year of the Proposed Scheme (2042). This includes a moderate beneficial change in the two most deprived areas.

Impact	Seven Point Scale assessment	Summary
Air Quality	NO_2:- Moderate Beneficial $PM_{2.5}$: Large Beneficial	The local air quality assessment has demonstrated that more sensitive receptors would benefit from reduced concentrations of key pollutants (NO2 and PM2.5) compared to those that would experience increases in concentrations, as a result of implementing the Proposed Scheme. This is predominantly attributed to the Proposed Scheme reducing traffic from the existing A4 road and associated link roads, thereby reducing vehicle emissions from the existing A4 Therefore, more receptors will experience an air quality benefit than those that will experience a worsening. NO_2:- The results of the assessment indicate that local air quality, with respect to concentrations of annual mean NO_2, is predicted to improve in each of the income domains for the opening year of the Proposed Scheme (2029). This includes a slight beneficial change in the most deprived areas; and a large beneficial change in the second most deprived area. The least deprived area likely to have a moderate beneficial change. $PM_{2.5}$: The results of the $PM_{2.5}$ assessment indicate that air quality, with respect to concentrations of annual mean $PM_{2.5}$, is predicted to improve in each of the income domain quintiles for the opening year of the Proposed Scheme (2029), except the most deprived domain, which has predicted to experience a large adverse change. All other income groups will experience a moderate to large beneficial change.
Accidents	Slight Beneficial	It is expected that the accident rate will be reduced significantly (>10% reduction) on the vulnerable stretch of A4 section like Keynsham Bypass and the South Section of A4 Bath Road, where maximum number of accidents were reported. Proposed infrastructure improvements like continuous segregated cycling corridor between Bristol and Bath, cycling and walking connections between local communities and BBRP enhancements along the A4 between Bristol and Bath reduces the risk of accidents involving the vulnerable groups like Children below 16 years, pedestrians, cyclists and Motorcyclists. As such, the DI is assessed as ‘Slight Beneficial’ for these categories of population. Other social groups like Older people above 70 years and Young Male drivers were assessed to have a Neutral impact.

Impact	Seven Point Scale assessment	Summary
Affordability	Slight Adverse	From the DI analysis of affordability, it can be concluded that all income quintiles receive a disbenefit in affordability due to an increase in the vehicle operating costs with the Scheme in place. • The vehicle operating cost dis-benefits are mainly distributed among the Quintile 5 with 60%. • Around 5% and 7% of the disbenefits (i.e. increase in costs) are forecast to be experienced by people living in the most deprived category (Quintile 1 and Quintile 2 respectively). • The 13% of disbenefits are forecast to be experienced by people living in Quintile 3 which is in proportion to the share of the population. • Quintile 4 receive a disbenefit of 15%. Also, all the quintiles are anticipated to experience dis-benefits which are 5% or more lower than the proportion of the group in the total population, the user benefit DI has been appraised as Slight Adverse.
Severance	Moderate Beneficial	The road network experiences significant changes (>10%) in traffic in the 1km impact area The section between the Hicks Gate roundabout and the A39/A4 Bristol Road junction experiences a >10% reduction in the AADT due to the introduction of the scheme. All the other key locations Bath Road/ Stockwood Road Junction, Keynsham Train Station and Saltford Library and Post Office are expected a reduction of 5%-10% in AADT for all the vulnerable groups. The overall DI assessment on severance is considered to be 'Moderate Beneficial' due to the positive impacts of the new interventions of the scheme
Security	Slight Beneficial	The lack of existing facilities, along with concerns about the walking and cycle safety, is putting people off choosing to walk or cycle along the corridor. There are improvements proposed for public transport facilities along the corridor along with the interchanges and connections to bus stops. Along with the public transport, the cycle tracks and footpaths are also proposed with better connectivity and improved quality thus enhancing the security measures of the users and commuters along the corridor. Therefore, security is scored as 'Slight Beneficial'.

Impact	Seven Point Scale assessment	Summary
Accessibility	Slight Beneficial	A high frequency bus priority corridor that provides reliable journey times and consistent performance gives the opportunity to address the existing identified issues with the Bath to Bristol movements and has the potential to deliver modal shift from the high levels of intra and inter-urban travel by private car. The scheme connects the town centres of Keynsham and Saltford along the corridor with special enhancements routes such as Community Connections and BBRP, which improve the accessibility of the corridor giving a **Slightly Beneficial'** impact for the users accessing the route.

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix K – Quantified Risk Assessment (QRA) Summary

70093741-QRA
February 2024

West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix K – Quantified Risk Assessment (QRA) Summary

Type of document (version) Public

Project no. 70093741

Our Ref. No. 70093741-QRA

Date: February 2024

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Contents

1 Introduction

1.1.1. This appendix summarises the outputs of the Quantified Risk Assessment.

1.1.2. This document cannot be made fully accessible, therefore cannot be published. If you wish to request this document, please contact info@westofengland-ca.gov.uk

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix L - Cost Estimates

West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix L - Cost Estimates

Type of document (version) Confidential

Project no. 70093741

Our Ref. No. 70093741

Date: February 2024

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Contents

Tables

Figures

1 Introduction

1.1.1. This appendix contains the cost estimates for the different corridor sections, as well as the community connections. This appendix is structured as follows:

- Costs for Corridor Sections
- Costs for Community Connections
- Costs for Bristol to Bath Railway Path (BBRP)

1.1.2. These costs feed into the main Outline Business Case documents.

1.2 Pricing Notes

1.2.1. Estimates have been adjusted to the mid-point of construction which has been assumed at 4Q 2026. We have used BCIS Tender Price Indices data for our inflation figures until 4Q 2026. Estimates have been based upon drawing numbers as detailed and viewing on Google maps. All the drawings are included in standalone Appendix M.

1.3 Exclusions

- Legal issues
- VAT
- Land take / CPO
- Planning and approval changes
- Taxes and levies
- Licenses and all associated costs and fees
- Changes in legislation and any form of applicable standards
- Costs associated with invasive and/or protected species

1.4 Assumptions

1.4.1. All assumptions are included within the estimates.

2 Scheme Corridor Sections

2.1 Section 2 Emery Road to Hicks Gate Roundabout

2.1.1. Table 2-1 details the documents used for this costing estimate.

Table 2-1 – Document Register used for Section 2 costing

Document Title	Document Reference
Section 2 Emery Road To Hicks Gate Roundabout (Option 1)	70093741-WSP-S2-XX-DR-LP-201-01

2.1.2. Figure 2-1 includes the costing summary, which adds up to £6,660,703 without risk, optimism bias and inflation, and £9,559,441 when accounting for risk, optimism bias and inflation.

Figure 2-1 - Section 2 Costing Summary

Item Description	
Direct Construction Costs	
Base Construction Cost	£3,281,135
Indirect Construction Costs	
Main Contractor's Preliminaries, Traffic Management and Overheads and Profit	£1,476,511
Indirect Non-Construction Costs	
STATS Diversions	£951,529
Professional Fees	£951,529
Total excl. Risk, Optimism Bias and Inflation	**£6,660,703**
Risk / Contingency / Optimism Bias	£1,998,211
Inflation	£900,527
Total	**£9,559,441**
Total cost	**£9,559,441**

2.1.3. Figure 2-2 and 2-3 show the detailed costing breakdown.

Figure 2-2 - Detailed Cost Estimate for Section 2, Part 1 of 2

WECA
Feasibility Design Cost Estimate
Section 2 - Emery Road To Hicks Gate Roundabout - Option 1

70093741
11 May 2023
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Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Series 200: Site Clearance					
General site clearance	Urban Zone	1.26	ha	£7,513.37	£9,467
Kerb removal		2,050	m	£10	£20,500
Island Removal		32	m2	£21.71	£695
Allowance for site clearance items not identified at this stage		1	item	£10,000	£10,000
Series 500: Drainage					
Drains					
Pipes		3,392	m	£105	£354,566
Chambers & Gullies					
Gully proposal	Road gully	68	no	£805	£54,611
Series 600: Earthworks					
Excavation					
Excavation of material	Cycle track and footpath	3,125	m3	£14.87	£46,466
Excavation of material	Shared use	57	m3	£14.87	£845
Excavation of material	Online Bus stop	79	m3	£14.87	£1,172
Excavation of material	Pedestrian and Cyclist waiting area	18	m3	£14.87	£262
Excavation of material	Verge/Buffer	830	m3	£14.87	£12,348
Excavation of material	Traffic Island	13	m3	£14.87	£190
Excavation of material	Carriageway widening	942	m3	£14.87	£14,008
Hard material					
Extra over for hard material	Existing footpath	4,108	m3	£21.71	£89,193
Extra over for hard material	Existing Raised Table	13	m3	£21.71	£278
Extra over for hard material	Exisitng footpath cleared for verge	830	m3	£21.71	£18,028
Disposal					
Disposal		5,063	m3	£8.24	£41,731
Transport to tip	Assume 10km to nearest tip	50,632	m3/km	£4.12	£208,654
Landscaping					
Topsoil	150mm depth	311	m3	£31.62	£9,847
Subsoil	250mm depth	519	m3	£11.84	£6,143
Compaction of fill		830	m3	£1.26	£1,047
Series 700: Pavements					
Sub-base					
350mm type 1		1,570	m2	£25.97	£40,773
Base course					
150mm base course		1,570	m2	£65.40	£102,683
Binder course					
60mm binder course	Carriageway plane and inlay	11,032	m2	£28.88	£318,549
60mm binder course	Bus Lane	6,780	m2	£28.88	£195,773
60mm binder course	Proposed Side road entry	510	m2	£28.88	£14,726
60mm binder course	Widening	1,570	m2	£28.88	£45,342
Surface course					
40mm surface course	Carriageway plane and inlay	11,032	m2	£25.13	£277,190
40mm surface course	Bus Lane	6,780	m2	£25.13	£170,354
40mm surface course	Proposed Side road entry	510	m2	£25.13	£12,814
40mm surface course	Widening	1,570	m2	£25.13	£39,454
Cold milling					
Milling pavement		18,322	m2	£25.45	£466,295
Disposal		1,832	m3	£6.99	£12,807
Transport to tip	Assume 10km to nearest tip	18,322	m3/km	£3.50	£64,127
Tack coat					
Tack coat		41,354	m2	£1.27	£52,520
Series 1100: Kerbs, footways and paved areas					
Kerbing					
Kerb - HB		3,073	m	£21.61	£66,408
Kerb - BN		239	m	£18.94	£4,527
Kerb - Transition		80	no	£34.98	£2,798
Foundations to kerbs		3,392	m	£6.59	£22,353
Edging	Edging to Verge/ Buffer	1,345	m	£21.61	£29,061
Footpath					
Footpath surfacing, binder and surface course	Segregated pedestrian footway	4,370	m2	£29.45	£128,697
Footpath surfacing, binder and surface course	Shared use path	142	m2	£29.45	£4,182
Footpath surfacing, binder and surface course	Two-way cycle track	3,442	m2	£29.45	£101,367
Footpath surfacing, binder and surface course	Online Bus Stop	197	m2	£29.45	£5,802
Footpath surfacing, binder and surface course	Pedestrian/Cyclist waiting area	44	m2	£29.45	£1,296

Figure 2-3 - Detailed Cost Estimate for Section 2, Part 2 of 2

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Feasibility Design Cost Estimate | 11 May 2023
Section 2 - Emery Road To Hicks Gate Roundabout - Option 1 | 1

Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Sub-base for footpath surfacing		8,195	m2	£7.09	£58,103
Tactile/tramline paving		160	m2	£120.00	£19,200
Corduroy Paving		6	m2	£120.00	£720
Series 1200: Traffic signs and road markings					
Road markings					
Allowances for road markings		1	item	£10,000	£10,000
Road signs					
Allowance for road signs		1	item	£5,000	£5,000
Traffic signal installations					
Proposed Pedestrian crossing		4	no	£10,000	£40,000
Series 1600: Piling and Embedded Retaining Walls					
Retaining walls					
Retaining wall	Assume 3m height, rock gabions	363	m2	£130	£47,190
Series 2500: Special Commissioned Structures					
Other					
Bus Stop	Green top bus shelter	1	item	£20,000	£20,000
Series 3000: Landscape and ecology					
Landscaping					
Grass seeding	Spreading	2,076	m2	£0.23	£477
Grass seeding	Raking	2,076	m2	£0.09	£187
Grass seeding	Rolling	2,076	m2	£0.04	£83
Grass seeding	Pre-seeding activities	2,076	m2	£0.11	£228
				sub-total	£3,281,135
	Main Contractor's Preliminaries, Traffic Management and Overheads and Profit			45%	£1,476,511
				sub-total	£4,757,645
	STATS Diversions			20%	£951,529
	Professional Fees			20%	£951,529
				sub-total	£6,660,703
	Risk / Contingency / Optimism Bias			30%	£1,998,211
				sub-total	£8,658,914
	Inflation			10.40%	£900,527
	Inflation Contingency (@3% per annum)				£0
Total Indicative Estimate				**Total**	**£9,559,441**

2.2 Section 3 Hicks Gate Roundabout to Broadmead Roundabout

2.2.1. Table 2-2 details the documents used for this costing estimate.

Table 2-2 – Document Register used for Section 3 costing

Document Title	Document Reference
Section 3 (Sheet 1 of 3) Hicks Gate Roundabout To Broadmead Roundabout (Option 2)	70093741-WSP-S3-XX-DR-LP-302-01
Section 3 (Sheet 2 of 3) Hicks Gate Roundabout To Broadmead Roundabout (Option 2)	70093741-WSP-S3-XX-DR-LP-302-02
Section 3 (Sheet 3 of 3) Hicks Gate Roundabout To Broadmead Roundabout (Option 2)	70093741-WSP-S3-XX-DR-LP-302-03

2.2.2. Figure 2-4 includes the costing summary, which adds up to £3,289,007 when accounting for risk, optimism bias and inflation.

Figure 2-4 - Section 3 Costing Summary

Item Description	
Direct Construction Costs	
Base Construction Cost	£1,128,902
Indirect Construction Costs	
Main Contractor's Preliminaries, Traffic Management and Overheads and Profit	£508,006
Indirect Non-Construction Costs	
STATS Diversions	£327,382
Professional Fees	£327,382
Total excl. Risk, Optimism Bias and Inflation	
Risk	£687,502
Inflation	£309,834
Total	**£3,289,007**
Total cost	**£3,289,007**

2.2.3. Figure 2-5 and 2-6 show the detailed costing breakdown.

Figure 2-5 - Detailed Cost Estimate for Section 3, Part 1 of 2

WECA
Feasibility Design Cost Estimate
Section 3 - Option 2

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Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Series 200: Site Clearance					
General site clearance	Urban Zone	0.50	ha	£7,513.57	£3,757
Kerb removal		355	m	£10.00	£3,550
Safety barrier removal		340	m	£54.34	£18,476
Allowance for site clearance items not identified at this stage		1	item	£20,000.00	£20,000
Series 500: Drainage					
Drains					
Pipes		360	m	£105	£37,631
Chambers & Gullies					
Gully proposal	Road gully	7	no	£805	£5,796
Series 600: Earthworks					
Excavation					
Excavation of material	Proposed bus lane carriageway	390	m3	£14.87	£5,799
Excavation of material	Proposed side road entry	38	m3	£14.87	£565
Excavation of material	Paved areas	882	m3	£14.87	£13,115
Excavation of material	Bus stop area	3,340	m3	£14.87	£49,666
Excavation of material	Verge/Buffer	300	m3	£14.87	£4,461
Excavation of material	Indicative pathway options	470	m3	£14.87	£6,989
Hard material					
Extra over for hard material			m3	£21.71	
Disposal					
Disposal		5,420	m3	£8.24	£44,672
Transport to tip	Assume 10km to nearest tip	54,200	m3/km	£4.12	£223,358
Landscaping					
Topsoil	150mm depth	111	m3	£31.62	£3,510
Subsoil	250mm depth	185	m3	£11.84	£2,190
Compaction of fill		296	m3	£1.26	£373
Series 700: Pavements					
Sub-base					
350mm type 1	Proposed bus lane carriageway	650	m2	£25.97	£16,881
350mm type 1	Proposed side road entry	62	m2	£25.97	£1,610
Base course					
150mm base course	Proposed bus lane carriageway	650	m2	£65.40	£42,512
150mm base course	Proposed side road entry	62	m2	£65.40	£4,055
Binder course					
60mm binder course	Proposed bus lane carriageway	650	m2	£28.88	£18,769
60mm binder course	Proposed side road entry	62	m2	£28.88	£1,790
Surface course					
40mm surface course	Proposed bus lane carriageway	650	m2	£25.13	£16,332
40mm surface course	Proposed side road entry	62	m2	£25.13	£1,558
Tack coat					
Tack coat		2,136	m2	£1.27	£2,713
Series 1100: Kerbs, footways and paved areas					
Kerbing					
Kerb - HB		330	m	£23.68	£7,813
Kerb - BN		40	m	£20.77	£831
Kerb - Transition		20	no	£38.52	£770
Kerb - Trief		290	m	£135.28	£39,232
Foundations to kerbs		680	m	£7.33	£4,981
Edging		700	m	£8.94	£6,255
Foundations to edgings		700	m	£3.56	£2,489
Footpath					
Footpath surfacing, binder and surface course	Segregated pedestrian footway	335	m2	£29.45	£9,866
Footpath surfacing, binder and surface course	Shared use path	705	m2	£29.45	£20,762
Footpath surfacing, binder and surface course	Two-way cycle track	335	m2	£29.45	£9,866
Footpath surfacing, binder and surface course	Online Bus Stop	480	m2	£29.45	£14,136
Footpath surfacing, binder and surface course	Pedestrian/Cyclist waiting area	115	m2	£29.45	£3,387
Footpath surfacing, binder and surface course	Outside waiting area	235	m2	£29.45	£6,921
Sub-base for footpath surfacing		2,205	m2	£7.09	£15,633
Tactile/tramline paving		70	m2	£120.00	£8,400
Indicative pathway options		1,170	m2	£29.45	£34,451
Sub-base for footpath surfacing		1,170	m2	£7.09	£8,296
Series 1200: Traffic signs and road markings					
Road markings					
Allowance for road markings		1	item	£20,000.00	£20,000
Road signs					
Allowance for road signs		1	item	£5,000.00	£5,000
Traffic signal installations					

Figure 2-6 - Detailed Cost Estimate for Section 3, Part 2 of 2

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Feasibility Design Cost Estimate
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Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Parallel Crossing		3	no	£10,000.00	£30,000
Series 1600: Piling and Embedded Retaining Walls					
Retaining walls					
Retaining wall	Assume 3m height, rock gabions	200	m	£130.00	£26,000
Series 2500: Special Commissioned Structures					
Other					
Bus Stop	Green top bus shelter	3	no	£10,000.00	£30,000
Bike storage		1	no	£5,000.00	£5,000
Café and toilets		1	no	£215,000.00	£215,000
Awning with solar panels		1	no	£50,000.00	£50,000
Series 3000: Landscape and ecology					
Landscaping					
Grass seeding	Spreading	740	m2	£0.23	£170
Grass seeding	Raking	740	m2	£0.09	£67
Grass seeding	Rolling	740	m2	£0.04	£30
Grass seeding	Pre-seeding activities	740	m2	£0.11	£81
Vegetation clearance		1,670	m2	£2.00	£3,340
				sub-total	£1,128,902
	Main Contractor's Preliminaries, Traffic Management and Overheads and Profit			45.00%	£508,006
				sub-total	£1,636,908
	STATS Diversions			20.00%	£327,382
	Professional Fees			20.00%	£327,382
				sub-total	£2,291,672
	Risk			30.00%	£687,502
				sub-total	£2,979,173
	Inflation			10.40%	£309,834
	Inflation Contingency (@3% per annum)			0.00%	£0
Total Indicative Estimate				**Total**	**£3,289,007**

Section 3B Durley Hill Route

2.2.4. When costing Section 3B additional exclusions have been made for Drainange and Street lighting.

2.2.5. Table 2-3 details the documents used for this costing estimate.

Table 2-3 – Document Register used for Section 3B costing

Document Title	Document Reference
Section 3B Durley Hill Active Travel Route	70093741-WSP-S3B-XX-DR-LP-301B-01

2.2.6. Figure 2-7 includes the costing summary, which adds up to £4,379,697 when accounting for risk, optimism bias and inflation.

Figure 2-7 - Section 3B Durley Hill Costing Summary

Item Description	
Direct Construction Costs	
Base Construction Cost	£1,503,265
Indirect Construction Costs	
Main Contractor's Preliminaries, Traffic Management and Overheads and Profit	£676,469
Indirect Non-Construction Costs	
Utilities	£435,947
Professional Fees	£435,947
Total excl. Risk, Optimism Bias and Inflation	**£3,051,628**
Risk	£915,488
Inflation	£412,580
Total	**£4,379,697**
Total cost	**£4,379,697**

2.2.7. Figure 2-8 and 2-9 show the detailed costing breakdown.

Figure 2-8 - Detailed Cost Estimate for Section 3B, Part 1 of 2

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Feasibility Design Cost Estimate
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Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Series 200: Site Clearance					
General site clearance		0.70	ha	£7,513.37	£5,259
Kerb removal		2,300	m	£10.00	£23,000
Allowance for site clearance items not identified at this stage		1	item	£20,000.00	£20,000
Series 600: Earthworks					
Excavation					
Excavation of material	Shared use	130	m3	£16.14	£2,098
Excavation of material	Cycleway on existing carriageway	360	m3	£16.14	£5,810
Excavation of material	Carriageway widening	280	m3	£16.14	£4,519
Excavation of material	Cycleway on existing footpath	100	m3	£16.14	£1,614
Excavation of material	Footpath on existing footpath	120	m3	£16.14	£1,937
Excavation of material	Traffic island	8	m3	£16.14	£129
Hard material					
Extra over for hard material	Shared use	130	m3	£23.66	£3,076
Extra over for hard material	Cycleway on existing carriageway	360	m3	£23.66	£8,518
Extra over for hard material	Carriageway widening	280	m3	£23.66	£6,625
Extra over for hard material	Cycleway on existing footpath	100	m3	£23.66	£2,366
Extra over for hard material	Footpath on existing footpath	120	m3	£23.66	£2,839
Extra over for hard material	Traffic island	8	m3	£23.66	£189
Disposal					
Disposal		998	m3	£8.24	£8,226
Transport to tip	Assume 10km to nearest tip	9,980	m3/km	£4.12	£41,128
Landscaping					
Topsoil	150mm depth	60	m3	£31.62	£1,897
Subsoil	250mm depth	100	m3	£11.84	£1,184
Compaction of fill		160	m3	£1.26	£202
Series 700: Pavements					
Binder course					
60mm binder course	Carriageway	480	m2	£28.88	£13,860
60mm binder course	Side road entry	590	m2	£28.88	£17,036
60mm binder course	Resurfacing	9,100	m2	£28.88	£262,763
Surface course					
40mm surface course	Carriageway	480	m2	£25.13	£12,060
40mm surface course	Side road entry	590	m2	£25.13	£14,824
40mm surface course	Resurfacing	9,100	m2	£25.13	£228,647
Subbase					
200mm subbase	Carriageway	480	m2	£18.65	£8,952
Base course					
250mm base	Carriageway	480	m2	£74.85	£35,928
Cold milling					
Milling pavement		9,690	m2	£25.45	£246,611
Disposal		969	m3	£6.99	£6,773
Transport to tip	Assume 10km to nearest tip	9,690	m3/km	£3.50	£33,915
Tack coat					
Tack coat		21,300	m2	£1.27	£27,051
Series 1100: Kerbs, footways and paved areas					
Kerbing					
Kerb - HB		3,150	m	£21.61	£68,072
Kerb - BN		35	m	£18.94	£663
Kerb - Transition		22	no	£34.98	£770
Edging		270	m	£9.48	£2,560
Foundations to kerbs		3,207	m	£6.59	£21,134
Foundations to edging		270	m	£3.65	£984
Footpath					
Footpath surfacing, binder and surface course	Cycleway surfacing	3,910	m2	£29.45	£115,150
Footpath surfacing, binder and surface course	Shared use path	1,300	m2	£29.45	£38,279
Footpath surfacing, binder and surface course	Footpath	405	m2	£29.45	£11,925
Sub-base for footpath surfacing	150mm	5,615	m2	£7.09	£39,810
Tactile Paving		60	m2	£120.00	£7,200
Series 1200: Traffic signs and road markings					
Road markings					
Allowance for road markings		1	item	£2,000.00	£2,000
Road signs					
Allowance for sign and post		1	item	£5,000.00	£5,000
Series 2500: Special Commissioned structures					
Retaining wall					
Retaining wall		675	m3	£208.16	£140,505

Figure 2-9 - Detailed Cost Estimate for Section 3B, Part 2 of 2

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Feasibility Design Cost Estimate
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Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Series 3000: Landscape and ecology					
Landscaping					
Grass seeding	Spreading	380	m2	£0.23	£87
Grass seeding	Raking	380	m2	£0.09	£34
Grass seeding	Rolling	380	m2	£0.04	£15
Grass seeding	Pre-seeding activities	380	m2	£0.11	£42
				sub-total	£1,503,265
	Main Contractor's Preliminaries, Traffic Management and Overheads and Profit			45.00%	£676,469
				sub-total	£2,179,734
	Utilities			20.00%	£435,947
	Professional Fees			20.00%	£435,947
				sub-total	£3,051,628
	Risk			30.00%	£915,488
				sub-total	£3,967,117
	Inflation			10.40%	£412,580
	Inflation Contingency (@3% per annum)			0.00%	£0
Total Indicative Estimate				**Total**	**£4,379,697**

2.3 Section 4 Broadmead Roundabout to Saltford

2.3.1. Table 2-4 details the documents used for this costing estimate.

Table 2-4 – Document Register used for Section 4 costing

Document Title	Document Reference
Section 4 - Part 01 Broadmead Roundabout To Saltford Option 2	70093741-WSP-S4-XX-DR-LP-402-01
Section 4 - Part 01 Broadmead Roundabout To Saltford Option 2	70093741-WSP-S4-XX-DR-LP-402-02

2.3.2. Figure 2-10 includes the costing summary, which is £5,610,035 when accounting for risk, optimism bias and inflation.

Figure 2-10 - Section 4 Costing Summary

Item Description	
Direct Construction Costs	
Base Construction Cost	£1,788,020
Indirect Construction Costs	
Main Contractor's Preliminaries, Traffic Management and Overheads and Profit	£804,609
Indirect Non-Construction Costs	
STATS Diversions	£518,526
Professional Fees	£518,526
Total excl. Risk, Optimism Bias and Inflation	**£3,629,681**
Risk / Contingency / Optimism Bias	£1,451,872
Inflation	£528,482
Total	**£5,610,035**
Total cost	**£5,610,035**

2.3.3. Figure 2-11 and 2-12 show the detailed costing breakdown.

Figure 2-11 - Detailed Cost Estimate for Section 4, Part 1 of 2

WECA
Feasibility Design Cost Estimate
Section 4 - Broadmead Roundabout to Saltford - Option 2

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11 May 2023
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Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Series 200: Site Clearance					
General site clearance		2.00	ha	£6,700.73	£13,401
Kerb removal		2,620	m	£10	£26,200
Allowance for site clearance items not identified at this stage		1	item	£10,000	£10,000
Series 500: Drainage					
Drains					
Pipes		1,544	m	£105	£161,394
Chambers & Gullies					
Proposed Gullies		31	no	£805	£24,858
Series 600: Earthworks					
Excavation					
Excavation of material	Pedestrian footway	375	m3	£14.87	£5,576
Excavation of material	Shared use path	865	m3	£14.87	£12,864
Excavation of material	Two way cycle track	790	m3	£14.87	£11,749
Excavation of material	Bus stop	20	m3	£14.87	£297
Excavation of material	Pedestrian waiting	10	m3	£14.87	£149
Excavation of material	Verge area	360	m3	£14.87	£5,354
Excavation of material	Bus lane carriageway		m3	£14.87	
Hard material					
Extra over for hard material		2,410	m3	£21.71	£52,321
Disposal					
Disposal		2,410	m3	£6.99	£16,846
Transport to tip	Assume 10km to nearest tip	24,100	m3/km	£3.50	£84,350
Landscaping					
Topsoil	150mm depth	135	m3	£31.62	£4,269
Subsoil	250mm depth	225	m3	£11.84	£2,663
Compaction of fill		360	m3	£1.26	£454
Series 700: Pavements					
Sub-base					
250mm type 1	Bus lane carriageway		m2	£20.21	
Base course					
150mm base course	Bus lane carriageway		m2	£65.40	
Binder course					
60mm binder course	Carriageway resurfacing	8,830	m2	£28.88	£254,966
60mm binder course	Proposed side road entry	260	m2	£28.88	£7,508
60mm binder course	Bus lane carriageway		m2	£28.88	
Surface course					
40mm surface course	Carriageway resurfacing	8,830	m2	£25.13	£221,863
40mm surface course	Proposed side road entry	260	m2	£25.13	£6,533
40mm surface course	Bus lane carriageway		m2	£25.13	
Cold milling					
Milling pavement		9,090	m2	£25.45	£231,341
Disposal		1,331	m3	£6.99	£9,304
Transport to tip	Assume 10km to nearest tip	13,310	m3/km	£3.50	£46,585
Tack coat					
Tack coat		18,180	m2	£1.27	£23,089
Series 1100: Kerbs, footways and paved areas					
Kerbing					
Kerb - HB		1,405	m	£23.68	£33,263
Kerb - BN		105	m	£20.77	£2,180
Kerb - Transition		34	no	£38.52	£1,310
Foundations to kerbs		1,544	m	£7.33	£11,310
Footpath					
Footpath surfacing, binder and surface course	Pedestrian footway	935	m2	£31.90	£29,825
Footpath surfacing, binder and surface course	Shared use path	2,160	m2	£31.90	£68,900
Footpath surfacing, binder and surface course	Two way cycle track	1,970	m2	£31.90	£62,839
Footpath surfacing, binder and surface course	Bus stop	50	m2	£31.90	£1,595
Footpath surfacing, binder and surface course	Pedestrian waiting	25	m2	£31.90	£797
Sub-base for footpath surfacing		5,140	m2	£7.46	£38,360
Tactile paving		185	m2	£120.00	£22,200
Series 1200: Traffic signs and road markings					
Road markings					
Allowance for road marking		1	item	£10,000	£10,000
Road signs					
Allowance for road signs		1	item	£20,000	£20,000
Traffic signal installations					

Figure 2-12 - Detailed Cost Estimate for Section 4, Part 2 of 2

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Section 4 - Broadmead Roundabout to Saltford - Option 2 | 1

Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Toucan crossing		3	no	£70,000	£210,000
Bus shelter					
Bus shelter		2	no	£20,000	£40,000
Series 3000: Landscape and ecology					
Landscaping					
Grass seeding	Spreading	900	m2	£0.23	£207
Grass seeding	Raking	900	m2	£0.09	£81
Grass seeding	Rolling	900	m2	£0.04	£36
Grass seeding	Pre-seeding activities	900	m2	£0.11	£99
Tree planting	Root balled trees, acer platanoides, 8-10cm	18	no	£60.27	£1,085
				sub-total	£1,788,020
	Main Contractor's Preliminaries, Traffic Management and Overheads and Profit			45%	£804,609
				sub-total	£2,592,629
	STATS Diversions			20%	£518,526
	Professional Fees			20%	£518,526
				sub-total	£3,629,681
	Risk / Contingency / Optimism Bias			40%	£1,451,872
				sub-total	£5,081,553
	Inflation			10.40%	£528,482
	Inflation Contingency (@3% per annum)				£0
Total Indicative Estimate				**Total**	**£5,610,035**

2.4 Section 5 The Globe to Twerton Fork

2.4.1. Table 2-5 details the documents used for this costing estimate.

Table 2-5 – Document Register used for Section 5 costing

Document Title	Document Reference
Section 5 (Option 1) The Globe Roundabout To Twerton Fork	70081974-WSP-2-001

2.4.2. Figure 2-13 includes the costing summary, which is £9,000,841 when accounting for risk, optimism bias and inflation.

Figure 2-13 - Section 5 Costing Summary

Item Description	
Direct Construction Costs	
Base Construction Cost	£3,089,404
Indirect Construction Costs	
Main Contractor's Preliminaries, Traffic Management and Overheads and Profit	£1,390,232
Indirect Non-Construction Costs	
STATS Diversions	£895,927
Professional Fees	£895,927
Total excl. Risk, Optimism Bias and Inflation	
Risk / Contingency / Optimism Bias	£1,881,447
Inflation	£847,905
Total	**£9,000,841**
Total cost	**£9,000,841**

2.4.3. Figure 2-14 and 2-15 show the detailed costing breakdown.

Figure 2-14 - Detailed Cost Estimate for Section 5, Part 1 of 2

WECA
Feasibility Design Cost Estimate
Section 5 - The Globe Roundabout To Twerton Fork - Option 1

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Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Series 200: Site Clearance					
General site clearance	Urban Zone	1.59	ha	£7,513.37	£11,946
Kerb removal		115	m	£10.00	£1,147
Allowance for site clearance items not identified at this stage		1	item	£10,000.00	£10,000
Series 500: Drainage					
Drains					
Pipes		4,369	m	£105	£456,686
Chambers & Gullies					
Gully proposal	Road gully	87	no	£805	£70,340
Series 600: Earthworks					
Excavation					
Excavation of material	Footpath	149	m3	£14.87	£2,222
Excavation of material	Shared use	1,855	m3	£14.87	£27,579
Excavation of material	Verge/Buffer	1,266	m3	£7.49	£9,478
Excavation of material	Full carriageway construction	230	m3	£14.87	£3,420
Hard material					
Extra over for hard material	Existing footpath	3,270	m3	£21.71	£70,990
Extra over for hard material	Exisitng footpath cleared for verge	1,266	m3	£21.71	£27,480
Disposal					
Disposal		3,500	m3	£8.24	£28,846
Transport to tip	Assume 10km to nearest tip	34,999	m3/km	£4.12	£144,231
Landscaping					
Topsoil	150mm depth	475	m3	£31.62	£15,010
Subsoil	250mm depth	791	m3	£11.84	£9,364
Compaction of fill		1,266	m3	£1.26	£1,596
Series 700: Pavements					
Sub-base					
350mm type 1		382	m2	£25.97	£9,921
Base course					
150mm base course		382	m2	£65.40	£24,984
Binder course					
60mm binder course	Carriageway plane and Inlay	18,486	m2	£28.88	£533,784
60mm binder course	Bus Lane	338	m2	£28.88	£9,757
60mm binder course	Proposed Side road entry	23	m2	£28.88	£651
Surface course					
40mm surface course	Carriageway plane and Inlay	18,486	m2	£25.13	£464,480
40mm surface course	Bus Lane	338	m2	£25.13	£8,490
40mm surface course	Proposed Side road entry	23	m2	£25.13	£567
Cold milling					
Milling pavement		18,846	m2	£25.45	£479,643
Disposal		1,885	m3	£6.99	£13,174
Transport to tip	Assume 10km to nearest tip	18,846	m3/km	£3.50	£65,963
Tack coat					
Tack coat		18,846	m2	£1.27	£23,935
Series 1100: Kerbs, footways and paved areas					
Kerbing					
Kerb - HB		3,164	m	£21.61	£68,378
Kerb - Edging		1,143	m	£21.61	£24,706
Kerb - BN		50	m	£18.94	£938
Kerb - Transition		12	no	£34.98	£420
Foundations to kerbs		4,369	m	£6.59	£28,791
Footpath					
Footpath surfacing, binder and surface course	Segregated pedestrian footway	374	m2	£29.45	£11,001
Footpath surfacing, binder and surface course	Shared use path	4,637	m2	£29.45	£136,552
Sub-base for footpath surfacing		5,010	m2	£7.09	£35,523
Tactile/tramline paving		53	m2	£120.00	£6,353
Corduroy Paving		15	m2	£120.00	£1,799
Series 1200: Traffic signs and road markings					
Road markings					
Allowance for Road markings		1	no	£4,000.00	£4,000
Lettering and Symbols					
Arrows		18	no	£36.04	£649
Double headed arrows		8	no	£91.85	£735
Lettering - White		29	no	£14.78	£429
Lettering - Yellow		28	no	£12.78	£358
Road signs					
Allowance for road signs		1	item	£5,000.00	£5,000
Traffic signal installations					
Parallel Crossing		2	no	£10,000.00	£20,000

Figure 2-15 - Detailed Cost Estimate for Section 5, Part 2 of 2

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Section 5 - The Globe Roundabout To Twerton Fork - Option 1 | 1

Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Toucan Crossing		3	no	£70,000.00	£210,000
Series 2500: Special Commissioned Structures					
Other					
Bridge (Section 5 option 1)	Approximate estimate span 40m	1	item	£6,600.00	£6,600
Series 3000: Landscape and ecology					
Landscaping					
Grass seeding	Spreading	3,164	m2	£0.23	£728
Grass seeding	Raking	3,164	m2	£0.09	£285
Grass seeding	Rolling	3,164	m2	£0.04	£127
Grass seeding	Pre-seeding activities	3,164	m2	£0.11	£348
				sub-total	£3,089,404
	Main Contractor's Preliminaries, Traffic Management and Overheads and Profit			45%	£1,390,232
				sub-total	£4,479,635
	STATS Diversions			20%	£895,927
	Professional Fees			20%	£895,927
				sub-total	£6,271,489
	Risk / Contingency / Optimism Bias			30%	£1,881,447
				sub-total	£8,152,936
	Inflation			10.40%	£847,905
	Inflation Contingency (@3% per annum)			0.00%	£0
Total Indicative Estimate				**Total**	**£9,000,841**

2.5 Section 6 Newbridge Park and Ride to Upper Bristol Road / A3604 Junction

2.5.1. Table 2-6 details the documents used for this costing estimate.

Table 2-6 – Document Register used for Section 6 costing

Document Title	Document Reference
Section 6 (Sheet 2 of 2) Newbridge Park & Ride to Upper Bristol Road/A3604 Junction (Option 2)	70093741-WSP-S6-XX-DR-LP-602-01
Section 6 (Sheet 1 of 2) Newbridge Park & Ride to Upper Bristol Road/A3604 Junction (Option 2)	70093741-WSP-S6-XX-DR-LP-602-02

2.5.2. Figure 2-16 includes the costing summary, which is £2,233,540 when accounting for risk, optimism bias and inflation.

Figure 2-16 - Section 6 Costing Summary

Item Description	
Direct Construction Costs	
Base Construction Cost	£766,629
Indirect Construction Costs	
Main Contractor's Preliminaries, Traffic Management and Overheads and Profit	£344,983
Indirect Non-Construction Costs	
STATS Diversions	£222,322
Professional Fees	£222,322
Total excl. Risk, Optimism Bias and Inflation	**£1,556,257**
Risk / Contingency / Optimism Bias	£466,877
Inflation (Mid Point of Construction 3Q 2024)	£210,406
Total	**£2,233,540**
Total cost	**£2,233,540**

2.5.3. Figure 2-17 shows the detailed costing breakdown.

Figure 2-17 - Detailed Cost Estimate for Section 6

WECA
Feasibility Design Cost Estimate
Section 6 - Option 2 - Jan 24 Rev

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Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Series 200: Site Clearance					
General site clearance	Urban Zone	0.20	ha	£7,513.37	£1,503
Kerb removal		1,033	m	£10.00	£10,330
Allowance for site clearance items not identified at this stage		1	item	£10,000.00	£10,000
Series 500: Drainage					
Drains					
Pipes		1,005	m	£105	£105,053
Chambers & Gullies					
Proposed Gully		35	no	£805	£28,175
Series 600: Earthworks					
Excavation					
Excavation of material	Existing footpath	73	m3	£14.87	£1,086
Excavation of material	Traffic Island	4	m3	£14.87	£59
Excavation of material	Verge	58	m3	£14.87	£855
Hard material					
Extra over for hard material	Existing footpath	73	m3	£21.71	£1,585
Extra over for hard material	Traffic Island	4	m3	£21.71	£87
Disposal					
Disposal		135	m3	£8.24	£1,109
Transport to tip	Assume 10km to nearest tip	1,345	m3/km	£4.12	£5,543
Series 700: Pavements					
Surface course					
40mm surface course	Red surfacing to bus lane	1,585	m2	£25.13	£39,825
Cold milling					
Milling pavement		1,585	m2	£25.45	£40,338
Disposal		159	m3	£6.99	£1,108
Transport to tip	Assume 10km to nearest tip	1,585	m3/km	£3.50	£5,548
Tack coat					
Tack coat		1,585	m2	£1.27	£2,013
Plane out existing layers of asphalt		1,585	m2	£25	£39,625
Disposal of existing layers		63	m3	£7	£443
Transport to tip (assume 10km to nearest tip)		634	m3/km	£4	£2,219
Series 1100: Kerbs, footways and paved areas					
Kerbing					
Kerb - HB		976	m	£21.61	£21,091
Kerb - BN		21	m	£18.94	£398
Kerb - Transition		8	no	£34.98	£280
Kerb - Trief		61	m	£128.30	£7,826
Foundations to kerbs		1,005	m	£6.59	£6,623
Footpath					
Footpath surfacing, binder and surface course	Shared use path	277	m2	£29.45	£8,158
Sub-base for footpath surfacing		277	m2	£7.09	£1,964
Footpath surfacing, binder and surface course	Assummed footway infill	97	m2	£29.45	£2,857
Sub-base for footpath surfacing		97	m2	£7.09	£688
Tactile		62	m2	£120.00	£7,440
Tramline paving		10	m2	£120.00	£1,200
Series 1200: Traffic signs and road markings					
Road markings					
Road Markings - white		1,684	m	£2.23	£3,755
Road Markings - Double yellow		145	m	£1.67	£242
Road Markings - Bus hatching	Composite rate	6	no	£250.00	£1,500
Lettering and Symbols					
Give way triangles		3	no	£36.04	£108
Double headed arrows		3	no	£66.52	£200
Lettering and symbols - White		54	no	£14.78	£798
Road signs					
Allowance for road signs		1	item	£5,000.00	£5,000
Traffic signal installations					
Signalised crossing		4	no	£100,000.00	£400,000
				sub-total	£766,629
	Main Contractor's Preliminaries, Traffic Management and Overheads and Profit			45%	£344,983
				sub-total	£1,111,612
	STATS Diversions			20%	£222,322
	Professional Fees			20%	£222,322
				sub-total	£1,556,257
	Risk / Contingency / Optimism Bias			30%	£466,877
				sub-total	£2,023,134
	Inflation			10.40%	£210,406
	Inflation Contingency (@3% per annum)			0.00%	£0
Total Indicative Estimate				**Total**	**£2,233,540**

3 Community Connections Costs

3.1 Community Connection Area 1 Keynsham

3.1.1. Table 3-1 details the documents used for this costing estimate.

Table 3-1 – Document Register used for Section 6 costing

Document Title	Document Reference
Community Connections Area 1-Option 1 (Station Road, High Street)	70093741-WSP-CC-DR-C-061

3.1.2. Figure 3-1 includes the costing summary, which is £642,709 when accounting for risk, optimism bias and inflation.

Figure 3-1 – Community Connection Area 1 Costing Summary

Item Description	
Direct Construction Costs	
Base Construction Cost	£220,600
Indirect Construction Costs	
Main Contractor's Preliminaries, Traffic Management and Overheads and Profit	£99,270
Indirect Non-Construction Costs	
STATS Diversions	£63,974
Professional Fees	£63,974
Total excl. Risk, Optimism Bias and Inflation	**£447,818**
Risk	£134,346
Inflation	£60,545
Total	**£642,709**
Total cost	**£642,709**

3.1.3. Figure 3-2 shows the detailed costing breakdown.

Figure 3-2 - Detailed Cost Estimate for Community Connection Area 1

WECA
Feasibility Design Cost Estimate
Community Connections - Area 1 - Option 1

70093741
09 June 2023
1

Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Series 200: Site Clearance					
General site clearance	Urban Zone	0.10	ha	£7,513.37	£751
Kerb removal		750	m	£10	£7,500
Allowance for site clearance items not identified at this stage		1	item	£10,000	£10,000
Series 400: Road Restraint Systems					
Pedestrian guardrail		85	m	£393	£33,400
Series 500: Drainage					
Drains					
Pipes		780	m	£105	£81,533
Chambers & Gullies					
Gully proposal	Road gully	16	no	£805	£12,558
Series 600: Earthworks					
Excavation					
Excavation of material	Footpath extension	25	m3	£14.87	£372
Excavation of material	Shared use	47	m3	£14.87	£699
Hard material					
Extra over for hard material	Footpath extension	25	m3	£21.71	£543
Extra over for hard material	Shared use	47	m3	£21.71	£1,020
Disposal					
Disposal		72	m3	£8.24	£593
Transport to tip	Assume 10km to nearest tip	720	m3/km	£4.12	£2,967
Series 1100: Kerbs, footways and paved areas					
Kerbing					
Kerb - HB		765	m	£21.61	£16,532
Kerb - BN		10	m	£18.94	£189
Kerb - Transition		4	no	£34.98	£140
Foundations to kerbs		779	m	£6.59	£5,134
Footpath					
Footpath surfacing, binder and surface course	Footpath extension	250	m2	£29.45	£7,363
Footpath surfacing, binder and surface course	Shared use path	470	m2	£29.45	£13,842
Sub-base for footpath surfacing		720	m2	£7.09	£5,105
Tactile/tramline paving		3	m2	£120.00	£360
Series 1200: Traffic signs and road markings					
Road markings					
Allowances for road markings		1	item	£5,000	£5,000
Road signs					
Allowance for road signs		1	item	£5,000	£5,000
Traffic signal installations					
Proposed zebra crossing		1	no	£10,000	£10,000
				sub-total	£220,600
	Main Contractor's Preliminaries, Traffic Management and Overheads and Profit			45%	£99,270
				sub-total	£319,870
	STATS Diversions			20%	£63,974
	Professional Fees			20%	£63,974
				sub-total	£447,818
	Risk			30%	£134,346
				sub-total	£582,164
	Inflation			10.40%	£60,545
	Inflation Contingency (@3% per annum)				£0
Total Indicative Estimate				**Total**	**£642,709**

3.2 Community Connection Area 4 Saltford

3.2.1. Table 3-2 details the documents used for this costing estimate.

Table 3-2 – Document Register used for Community Connection Area 4 costing

Document Title	Document Reference
Community Connections Area 4 (High Street, Norman Road)	70093741-WSP-CC-DR-C-064

3.2.2. Figure 3-3 includes the costing summary, which is £808,696 when accounting for risk, optimism bias and inflation.

Figure 3-3 – Community Connection Area 4 Costing Summary

Item Description	
Direct Construction Costs	
Base Construction Cost	£277,573
Indirect Construction Costs	
Main Contractor's Preliminaries, Traffic Management and Overheads and Profit	£124,908
Indirect Non-Construction Costs	
STATS Diversions	£80,496
Professional Fees	£80,496
Total excl. Risk, Optimism Bias and Inflation	**£563,473**
Risk	£169,042
Inflation	£76,182
Total	**£808,696**
Total cost	**£808,696**

3.2.3. Figure 3-4 shows the detailed costing breakdown.

Figure 3-4 - Detailed Cost Estimate for Community Connection Area 4

	WECA Feasibility Design Cost Estimate Community Connections - Area 4				70093741 09 June 2023 1
Item Description	**Notes / Assumptions**	**Quantity**	**Unit**	**Rate**	**Total**
Series 200: Site Clearance					
General site clearance	Urban Zone	0.13	ha	£7,513.37	£977
Kerb removal		170	m	£10	£1,700
Allowance for site clearance items not identified at this stage		1	item	£10,000	£10,000
Series 500: Drainage					
Drains					
Pipes		170	m	£105	£17,770
Chambers & Gullies					
Gully proposal	Road gully	3	no	£805	£2,737
Series 600: Earthworks					
Excavation					
Excavation of material	Footpath extension	2	m3	£14.87	£30
Excavation of material	Raised table and ramp	131	m3	£14.87	£1,948
Hard material					
Extra over for hard material	Existing footpath	2	m3	£21.71	£43
Extra over for hard material	Existing Raised Table	131	m3	£21.71	£2,844
Disposal					
Disposal		133	m3	£8.24	£1,096
Transport to tip	Assume 10km to nearest tip	1,330	m3/km	£4.12	£5,481
Series 700: Pavements					
Binder course					
60mm binder course	Raised table	1,135	m2	£28.88	£32,773
60mm binder course	Ramp	175	m2	£28.88	£5,053
Surface course					
40mm surface course	Raised table	1,135	m2	£25.13	£28,518
40mm surface course	Ramp	175	m2	£25.13	£4,397
Cold milling					
Milling pavement		1,310	m2	£25.45	£33,340
Disposal		2,620	m3	£6.99	£18,314
Transport to tip	Assume 10km to nearest tip	26,200	m3/km	£3.50	£91,700
Tack coat					
Tack coat		2,620	m2	£1.27	£3,327
Series 1100: Kerbs, footways and paved areas					
Kerbing					
Kerb - HB		170	m	£21.61	£3,674
Foundations to kerbs		170	m	£6.59	£1,120
Footpath					
Footpath surfacing, binder and surface course	Footpath extension	20	m2	£29.45	£589
Sub-base for footpath surfacing		20	m2	£7.09	£142
Series 1200: Traffic signs and road markings					
Road markings					
Allowances for road markings		1	item	£5,000	£5,000
Road signs					
Allowance for road signs		1	item	£5,000	£5,000
				sub-total	£277,573
	Main Contractor's Preliminaries, Traffic Management and Overheads and Profit			45%	£124,908
				sub-total	£402,481
	STATS Diversions			20%	£80,496
	Professional Fees			20%	£80,496
				sub-total	£563,473
	Risk			30%	£169,042
				sub-total	£732,515
	Inflation			10.40%	£76,182
	Inflation Contingency (@3% per annum)				£0
Total Indicative Estimate				**Total**	**£808,696**

4 BBRP Connections Costs

4.1 Bird in Hand Connection

4.1.1. Table 4-1 details the documents used for this costing estimate.

Table 4-1 – Document Register used for Bird in Hand Connection costing

Document Title	Document Reference
BBRP Section 1 Bird in Hand Connection in Saltford	70093741-WSP-BBRP-XX-DP-LP-S1-01

4.1.2. Figure 4-1 includes the costing summary, which is £794,300 when accounting for risk, optimism bias and inflation.

Figure 4-1 – Bird in Hand Connection costing summary

Item Description	
Direct Construction Costs	
Base Construction Cost	£272,632
Indirect Construction Costs	
Main Contractor's Preliminaries, Traffic Management and Overheads and Profit	£122,684
Indirect Non-Construction Costs	
STATS Diversions	£79,063
Professional Fees	£79,063
Total excl. Risk, Optimism Bias and Inflation	**£553,442**
Risk	£166,033
Inflation	£74,825
Total	**£794,300**
Total cost	**£794,300**

4.1.3. Figure 4-2 shows the detailed costing breakdown.

Figure 4-2 - Detailed Cost Estimate for Bird in Hand Connection

WECA
Feasibility Design Cost Estimate
Section 1 - Bird In Hand Connection

70093741
08 February 2024
1

Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Series 200: Site Clearance					
General site clearance		0.20	ha	£7,878.71	£1,576
Vegetation clearance and tree removal		1.00	item	£20,000.00	£20,000
Allowance for site clearance items not identified at this stage		1	item	£10,000.00	£10,000
Series 600: Earthworks					
Excavation					
Excavation of material	Footpath	140	m3	£14.87	£2,082
Excavation of material	Boardwalk area clearance	130	m3	£14.87	£1,933
Disposal					
Disposal		270	m3	£8.24	£2,225
Transport to tip	Assume 10km to nearest tip	2,700	m3/km	£4.12	£11,127
Series 1100: Kerbs, footways and paved areas					
Kerbing					
Kerb - Edging		260	m	£21.61	£5,619
Foundations to kerbs		260	m	£3.65	£948
Footpath					
Footpath gravel		705	m2	£17.20	£12,124
Sub-base for footpath		705	m2	£7.09	£4,998
Series 2500: Special structures					
Boardwalk structure		1	item	£200,000.00	£200,000
				sub-total	£272,632
	Main Contractor's Preliminaries, Traffic Management and Overheads and Profit			45%	£122,684
				sub-total	£395,316
	STATS Diversions			20%	£79,063
	Professional Fees			20%	£79,063
				sub-total	£553,442
	Risk			30%	£166,033
				sub-total	£719,475
	Inflation			10.40%	£74,825
	Inflation Contingency (@3% per annum)			0.00%	£0
Total Indicative Estimate				**Total**	**£794,300**

4.2 Brassmill Lane Connection

4.2.1. Additional exclusions have been made for Drainange and Street lighting.

4.2.2. Table 4-2 details the documents used for this costing estimate.

Table 4-2 – Document Register used for Brassmill Lane Connection costing

Document Title	Document Reference
BBRP Section 3 Connection between Brassmill Lane and Fieldings Road Foodbridge	70093741-WSP-BBRP-XX-DR-LP-S3-01

4.2.3. Figure 4-3 includes the costing summary, which is £1,172,660 when accounting for risk, optimism bias and inflation.

Figure 4-3 – Brassmill Lane Connection costing summary

Item Description	
Direct Construction Costs	
Base Construction Cost	£402,498
Indirect Construction Costs	
Main Contractor's Preliminaries, Traffic Management and Overheads and Profit	£181,124
Indirect Non-Construction Costs	
Utilities	£116,724
Professional Fees	£116,724
Total excl. Risk, Optimism Bias and Inflation	**£817,070**
Risk	£245,121
Inflation	£110,468
Total	**£1,172,660**
Total cost	**£1,172,660**

4.2.4. Figure 4-4 and 4-5 shows the detailed costing breakdown.

Figure 4-4 - Detailed Cost Estimate for Brassmill Lane Connection, Part 1 of 2

WECA | 70093741
Feasibility Design Cost Estimate | 26 January 2024
BBRP - Extension between Brassmill Lane and Fieldings Road Footbridge | 1

Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Series 200: Site Clearance					
General site clearance		0.55	ha	£7,513.37	£4,132
Kerb removal		220	m	£10.00	£2,200
Allowance for site clearance items not identified at this stage		1	item	£20,000.00	£20,000
Series 600: Earthworks					
Excavation					
Excavation of material	Existing path resurfaced	22	m3	£16.14	£355
Excavation of material	Footway widening	9	m3	£16.14	£145
Excavation of material	Standard construction	320	m3	£16.14	£5,165
Excavation of material	Path widening	24	m3	£16.14	£387
Excavation of material	Resurfacing	35	m3	£16.14	£565
Excavation of material	Limestone dust path option	145	m3	£16.14	£2,340
Hard material					
Extra over for hard material	Existing path resurfaced	22	m3	£23.66	£521
Extra over for hard material	Footway widening	9	m3	£23.66	£213
Extra over for hard material	Standard construction	320	m3	£23.66	£7,571
Extra over for hard material	Path widening	24	m3	£23.66	£568
Extra over for hard material	Resurfacing	35	m3	£23.66	£828
Disposal					
Disposal		555	m3	£8.24	£4,574
Transport to tip	Assume 10km to nearest tip	5,550	m3/km	£4.12	£22,872
Landscaping					
Topsoil	150mm depth	45	m3	£31.62	£1,423
Subsoil	250mm depth	75	m3	£11.84	£888
Compaction of fill		120	m3	£1.26	£151
Series 700: Pavements					
Binder course					
60mm binder course	Plane and inlay	1,275	m2	£28.88	£36,816
60mm binder course	Ramp	90	m2	£28.88	£2,599
60mm binder course	Road crossing	10	m2	£28.88	£289
Surface course					
40mm surface course	Plane and inlay	1,275	m2	£25.13	£32,036
40mm surface course	Ramp	90	m2	£25.13	£2,261
40mm surface course	Road crossing	10	m2	£25.13	£251
Base course					
250mm base	Ramp	90	m2	£74.85	£6,737
250mm base	Road crossing	10	m2	£74.85	£749
Cold milling					
Milling pavement		1,275	m2	£25.45	£32,449
Disposal		128	m3	£6.99	£891
Transport to tip	Assume 10km to nearest tip	1,275	m3/km	£3.50	£4,463
Tack coat					
Tack coat		2,840	m2	£1.27	£3,607
Series 1100: Kerbs, footways and paved areas					
Kerbing					
Kerb - HB		130	m	£21.61	£2,809
Kerb - BN		50	m	£18.94	£947
Kerb - Transition		26	no	£34.98	£909
Edging		1,090	m	£9.48	£10,333
Foundations to kerbs		206	m	£6.59	£1,358
Foundations to edging		1,090	m	£3.65	£3,974
Footpath					
Footpath surfacing, binder and surface course	Existing path resurfaced	220	m2	£29.45	£6,479
Footpath surfacing, binder and surface course	Footway widening	90	m2	£29.45	£2,650
Footpath surfacing, binder and surface course	Standard construction	800	m2	£29.45	£23,556
Footpath surfacing, binder and surface course	Path widening	60	m2	£29.45	£1,767
Footpath surfacing, binder and surface course	Resurfacing	350	m2	£29.45	£10,306
Footpath surfacing, limestone dust option		1,450	m2	£12.37	£17,932
Terram		1,450	m2	£4.87	£7,056
Sub-base for footpath surfacing	150mm	950	m2	£7.09	£6,736
Tactile Paving		20	m2	£120.00	£2,400
Series 1200: Traffic signs and road markings					
Road markings					
Allowance for road markings		1	item	£2,000.00	£2,000
Road signs					
Allowance for sign and post		1	item	£5,000.00	£5,000
Crossing					
Controlled crossing		1	item	£50,000.00	£50,000

Figure 4-5 - Detailed Cost Estimate for Brassmill Lane Connection, Part 2 of 2

WECA
Feasibility Design Cost Estimate
BBRP - Extension between Brassmill Lane and Fieldings Road Footbridge

70093741
26 January 2024
1

Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Series 2500: Special Commissioned structures					
Retaining wall					
Retaining wall		135	m3	£208.16	£28,101
Series 3000: Landscape and ecology					
Landscaping					
Grass seeding	Spreading	300	m2	£0.23	£69
Grass seeding	Raking	300	m2	£0.09	£27
Grass seeding	Rolling	300	m2	£0.04	£12
Grass seeding	Pre-seeding activities	300	m2	£0.11	£33
Allowance for vegetation clearance		1	item	£10,000.00	£10,000
Allowance for tree removal		1	item	£10,000.00	£10,000
				sub-total	£402,498
	Main Contractor's Preliminaries, Traffic Management and Overheads and Profit			45.00%	£181,124
				sub-total	£583,622
	Utilities			20.00%	£116,724
	Professional Fees			20.00%	£116,724
				sub-total	£817,070
	Risk			30.00%	£245,121
				sub-total	£1,062,192
	Inflation			10.40%	£110,468
	Inflation Contingency (@3% per annum)			0.00%	£0
Total Indicative Estimate				**Total**	**£1,172,660**

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix M – Scheme Drawings

West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix M – Scheme Drawings

Type of document (version) Confidential

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Contents

1 Introduction

1.1.1. This appendix contains the latest scheme drawings. This covered the following proposals:

- Section 2 Emery Road to Hicks Gate: Segregated bi-directional cycle lane, continuous bus lanes from P&R junction to Hicks Gate.
- Section 3 Hicks Gate to Broadmead roundabout: Continuous bus lane along Keynsham Bypass and a reduced speed limit This section also includes Keynsham Hub: a transport Hub with on carriageway bus stops and at grade crossing of A4, bus shelters provided along with walking, wheeling, and cycling connections to Keynsham town centre and train station. The Durley Hill route introduces segregated bi-directional cycle lanes and shared facilities. The Station Road & High Street connection creates shared use facilities with a reduced speed limit.
- Section 4 Broadmead roundabout to Globe roundabout; Bus lane Broadmead to Grange Road, shared use path/segregated cycleway, bus and cycle improvements to existing facilities.
- Section 5 Globe roundabout to Twerton Fork (Newbridge): Shared use path (including improvements to existing facilities) provided between Globe Roundabout and Newbridge Road ties into existing connection to BBRP.
- Section 6 Twerton Fork (Newbridge) to Bath centre: Bus lane between Newbridge P&R and Locksbrook Place.

1.1.2. These proposals are further discussed in the main Outline Business Case.

2 Scheme drawings

Figure 2-1 - 70093741-WSP-S2-XX-DR-LP-201-01

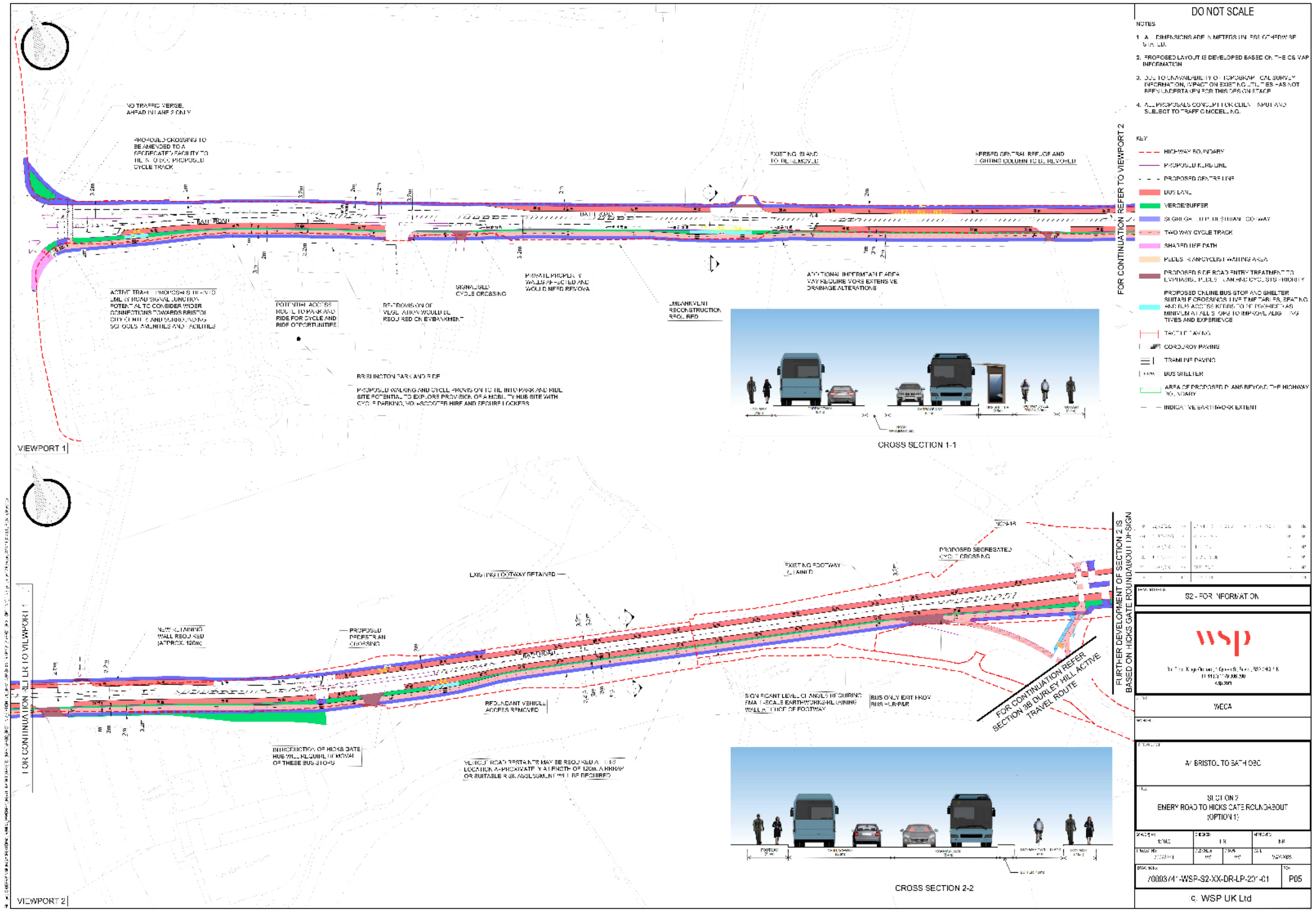


Figure 2-2 - 70093741-WSP-S3-XX-DR-LP-302-01

Figure 2-3 - 70093741-WSP-S3-XX-DR-LP-302-02

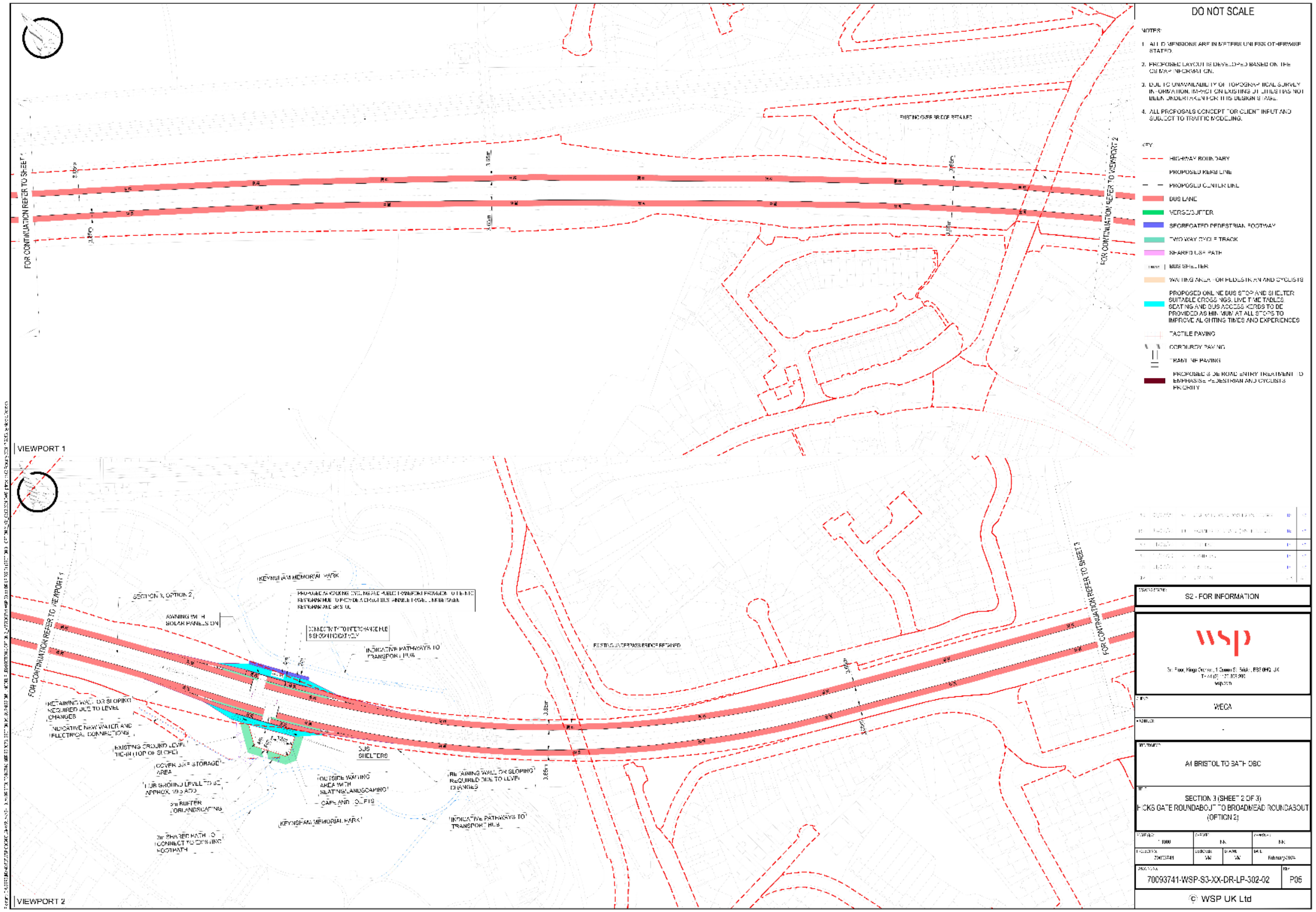


Figure 2-4 - 70093741-WSP-S3-XX-DR-LP-302-03

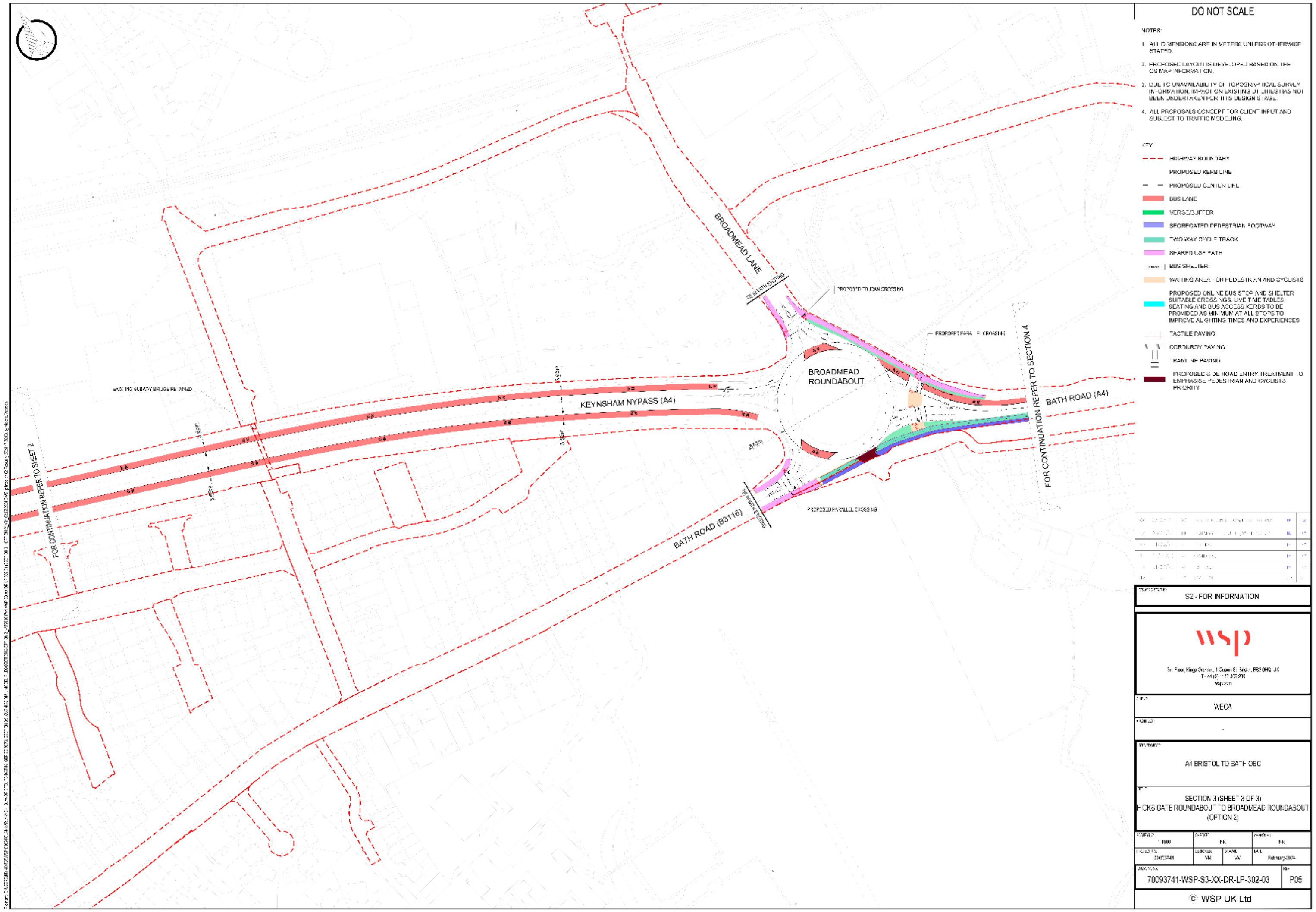


Figure 2-5 - 70093741-WSP-S3B-XX-DR-LP-301B-01

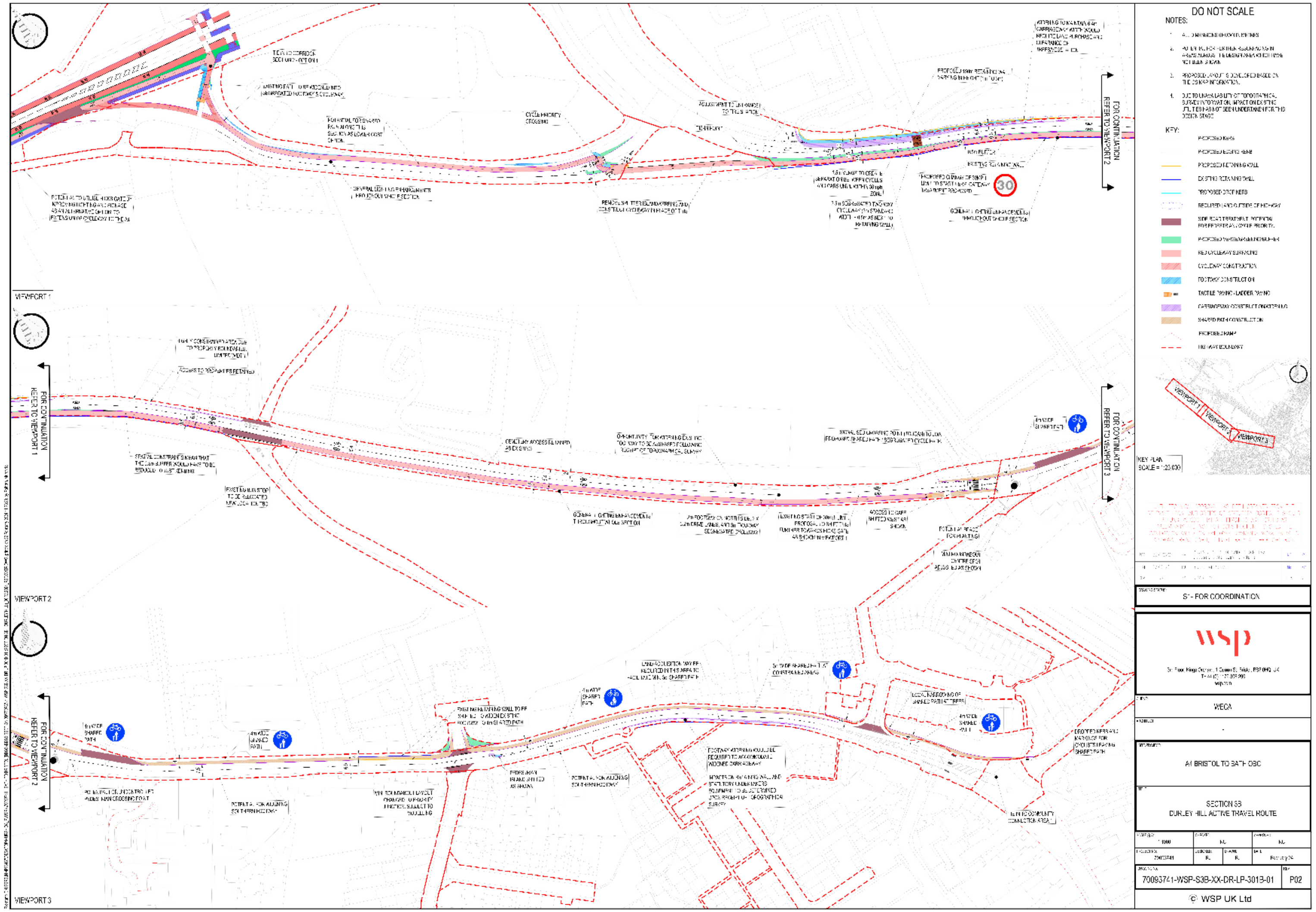


Figure 2-6 - 70093741-WSP-CC-DR-C-061

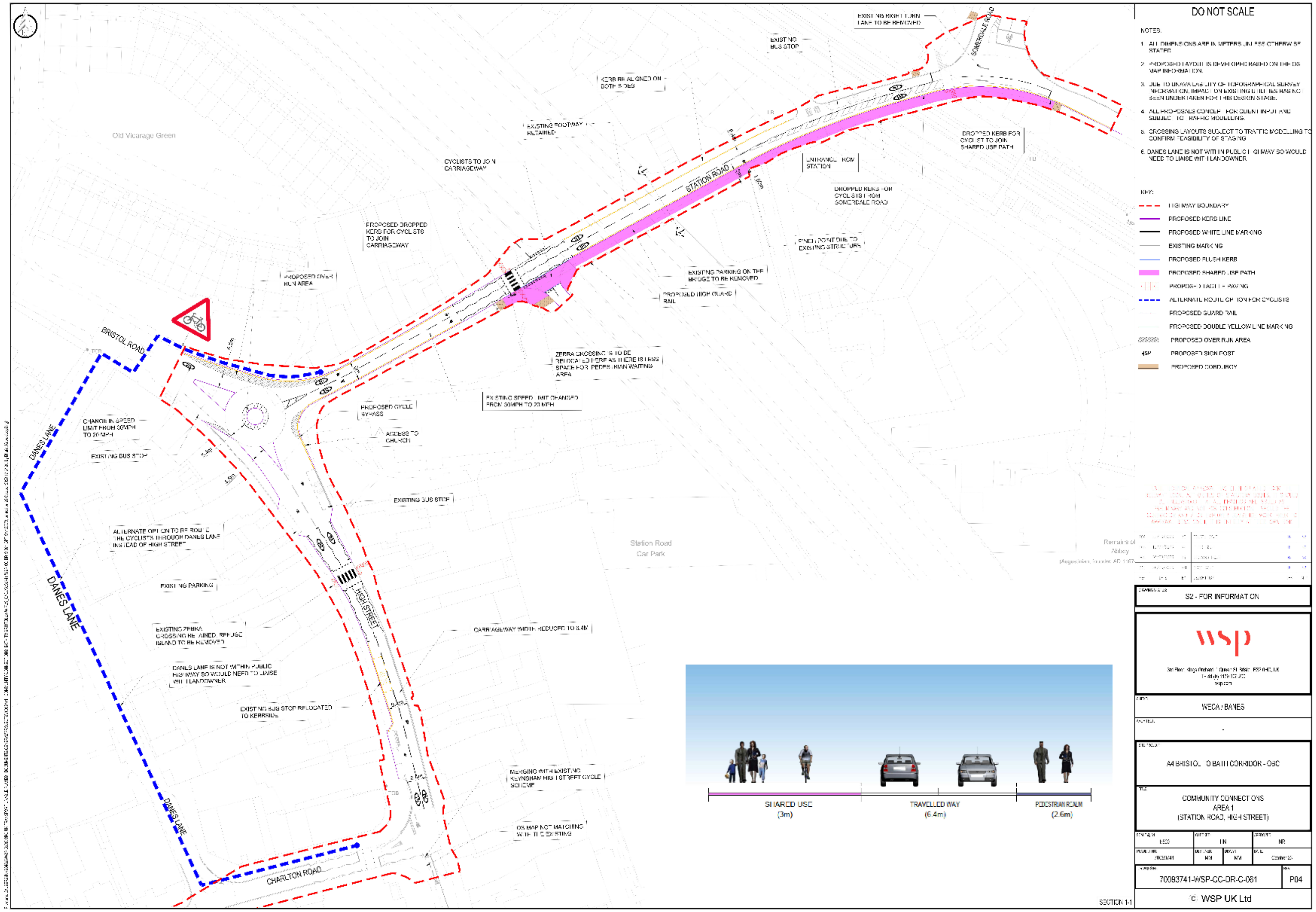


Figure 2-7 - 70093741-WSP-S4-XX-DR-LP-402-01

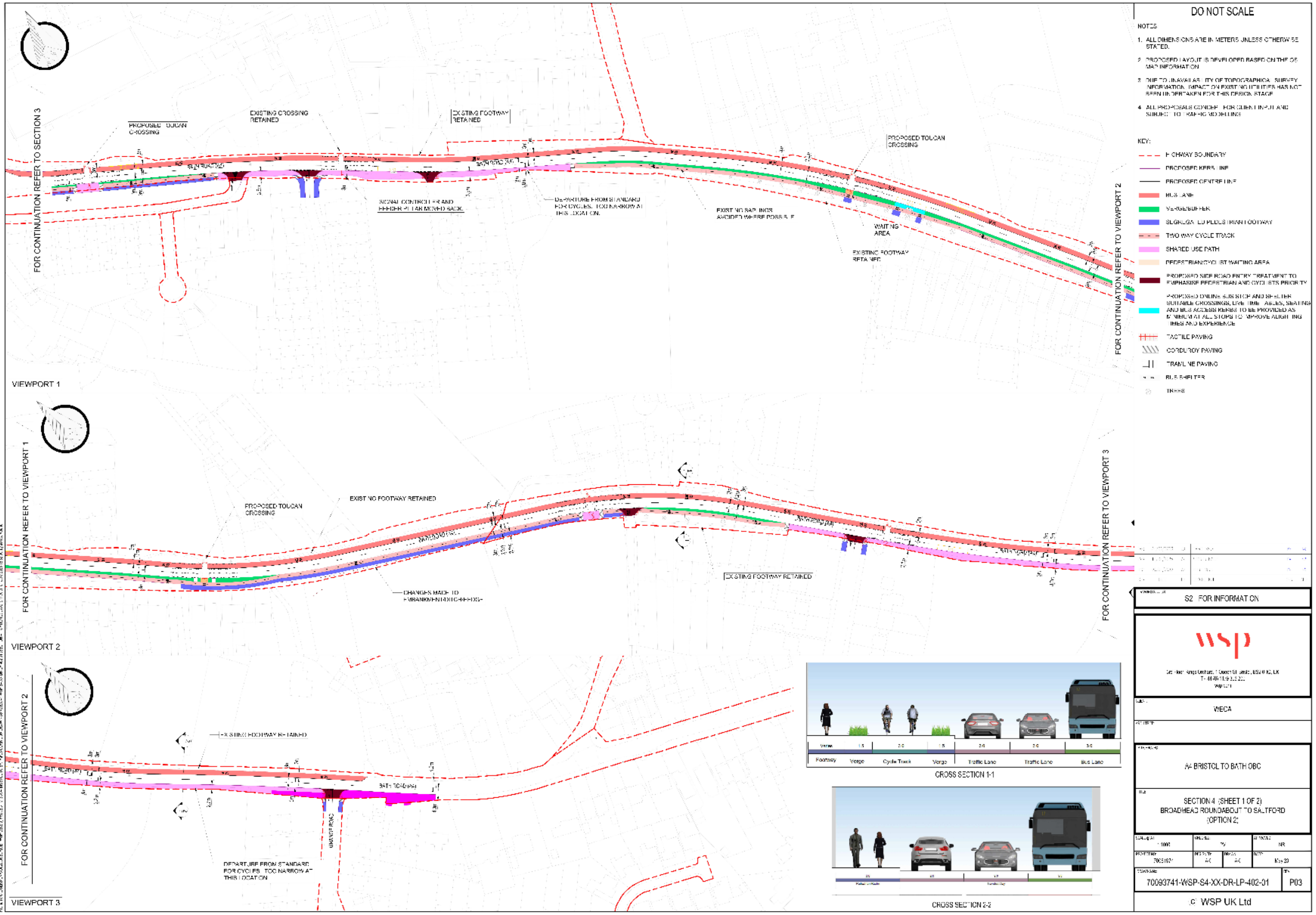


Figure 2-8 - 70093741-WSP-S4-XX-DR-LP-402-02

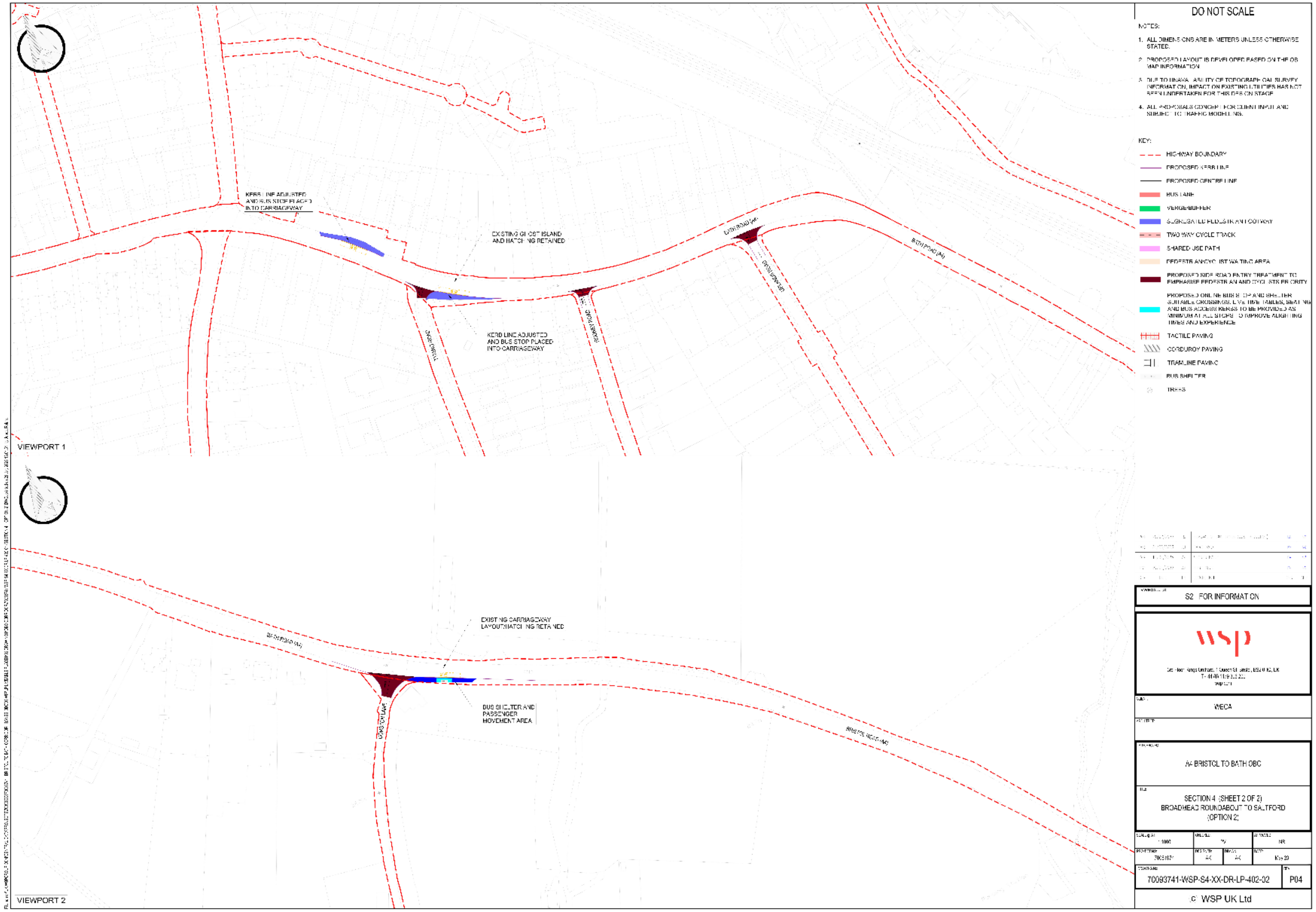


Figure 2-9 - 70093741-WSP-CC-DR-C-064

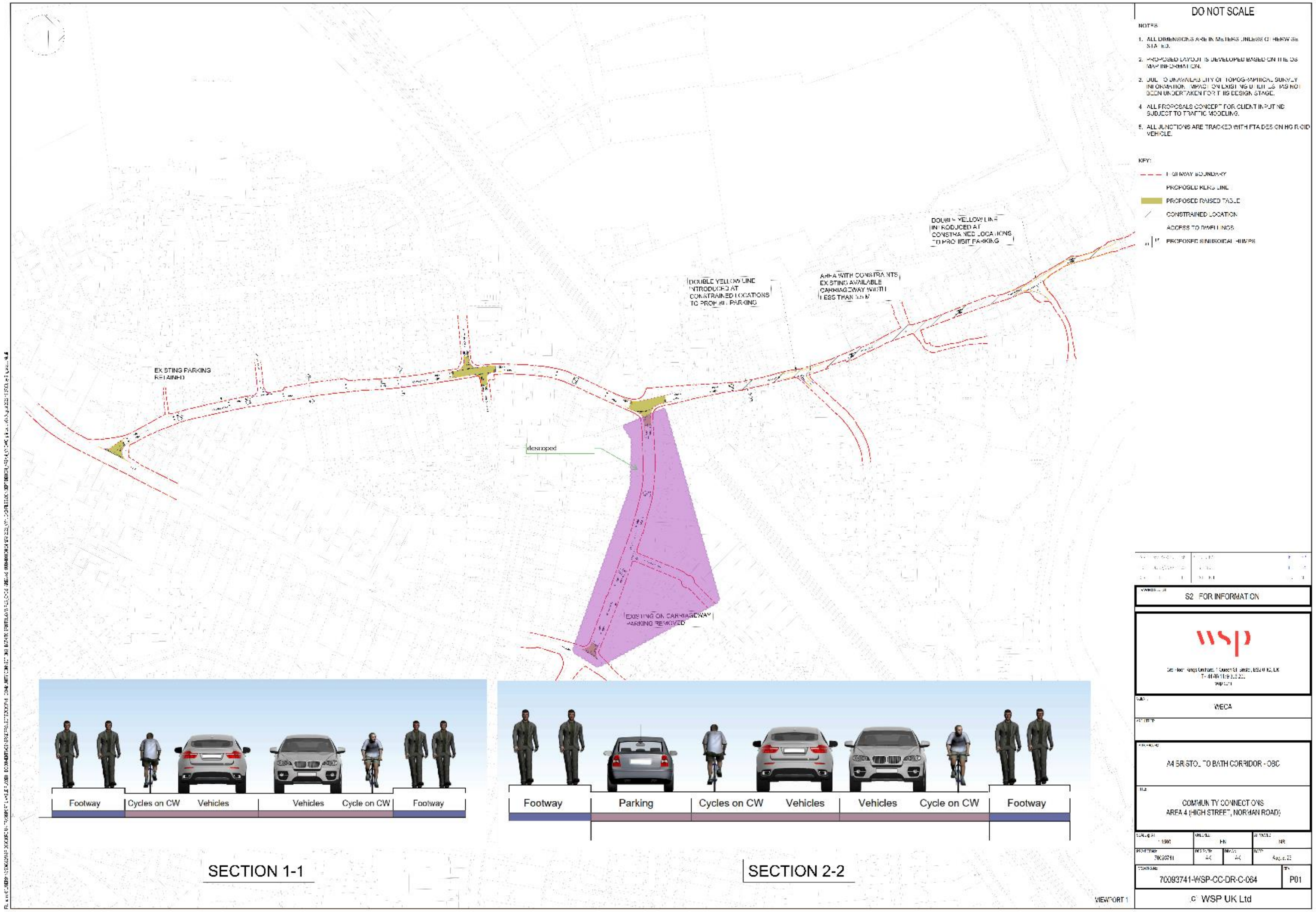


Figure 2-10 - 70093741-WSP-BBRP-XX-DL-LP-S1-01

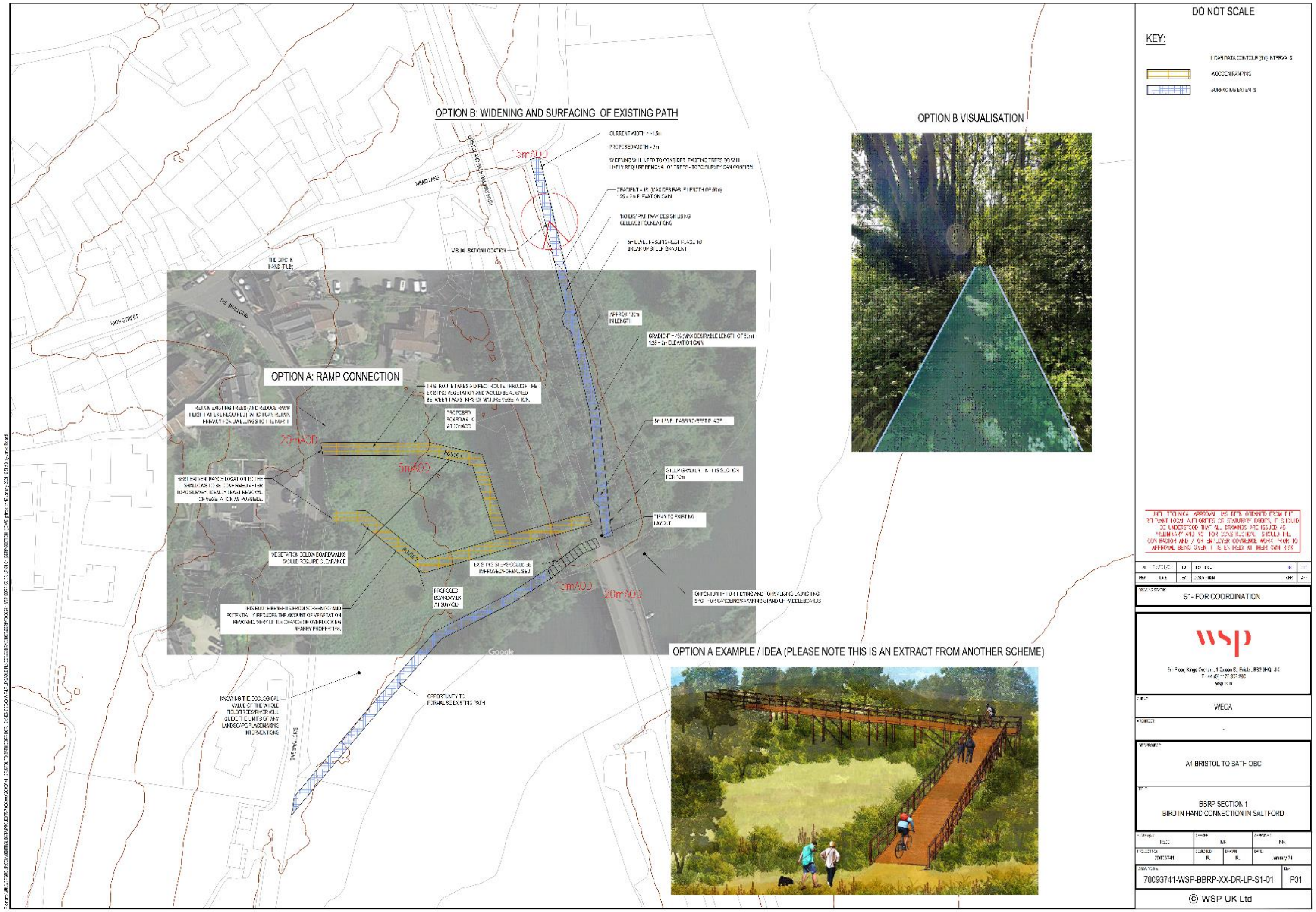


Figure 2-11 - 70093741-WSP-S5-XX-DR-LP-501-01

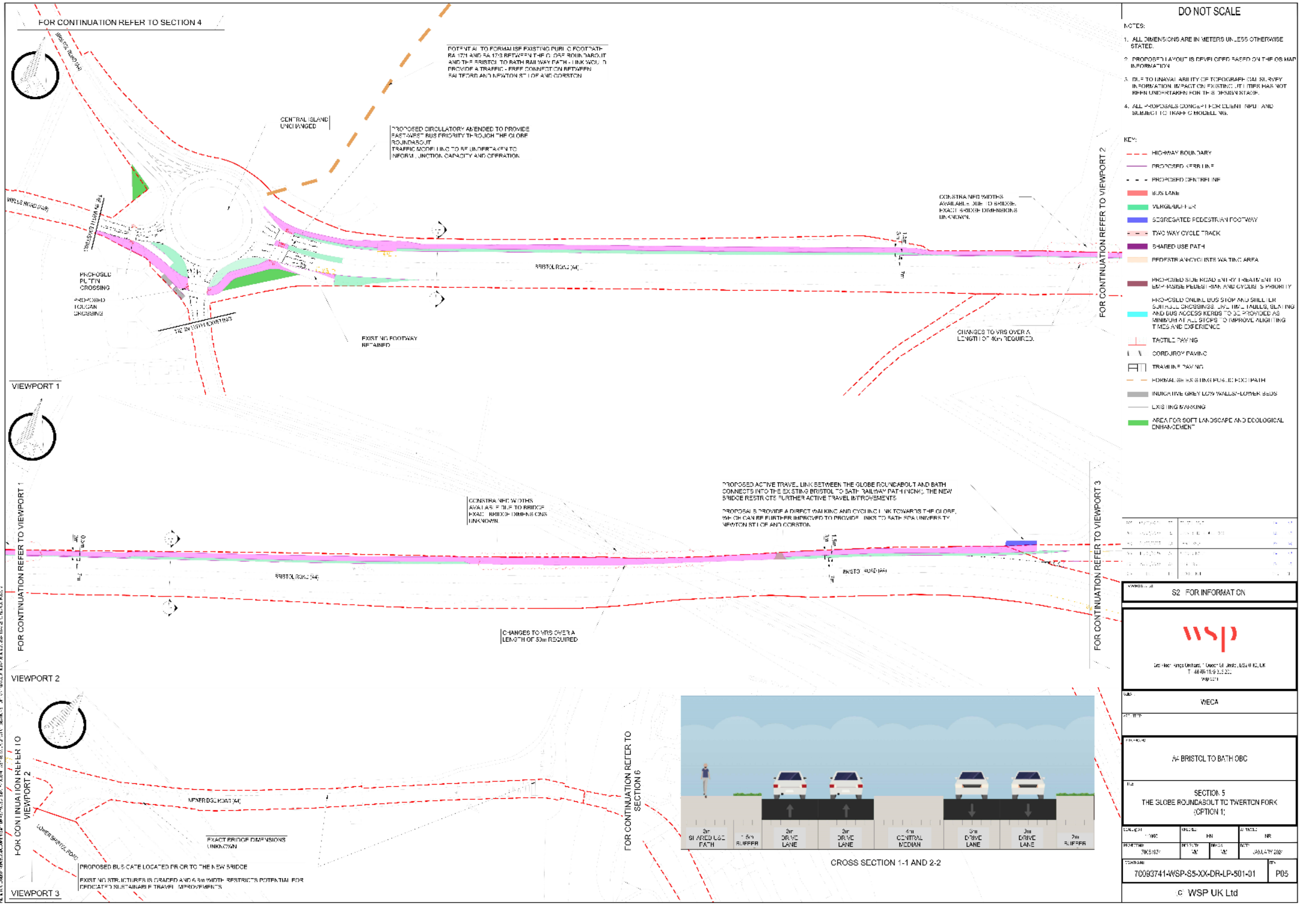
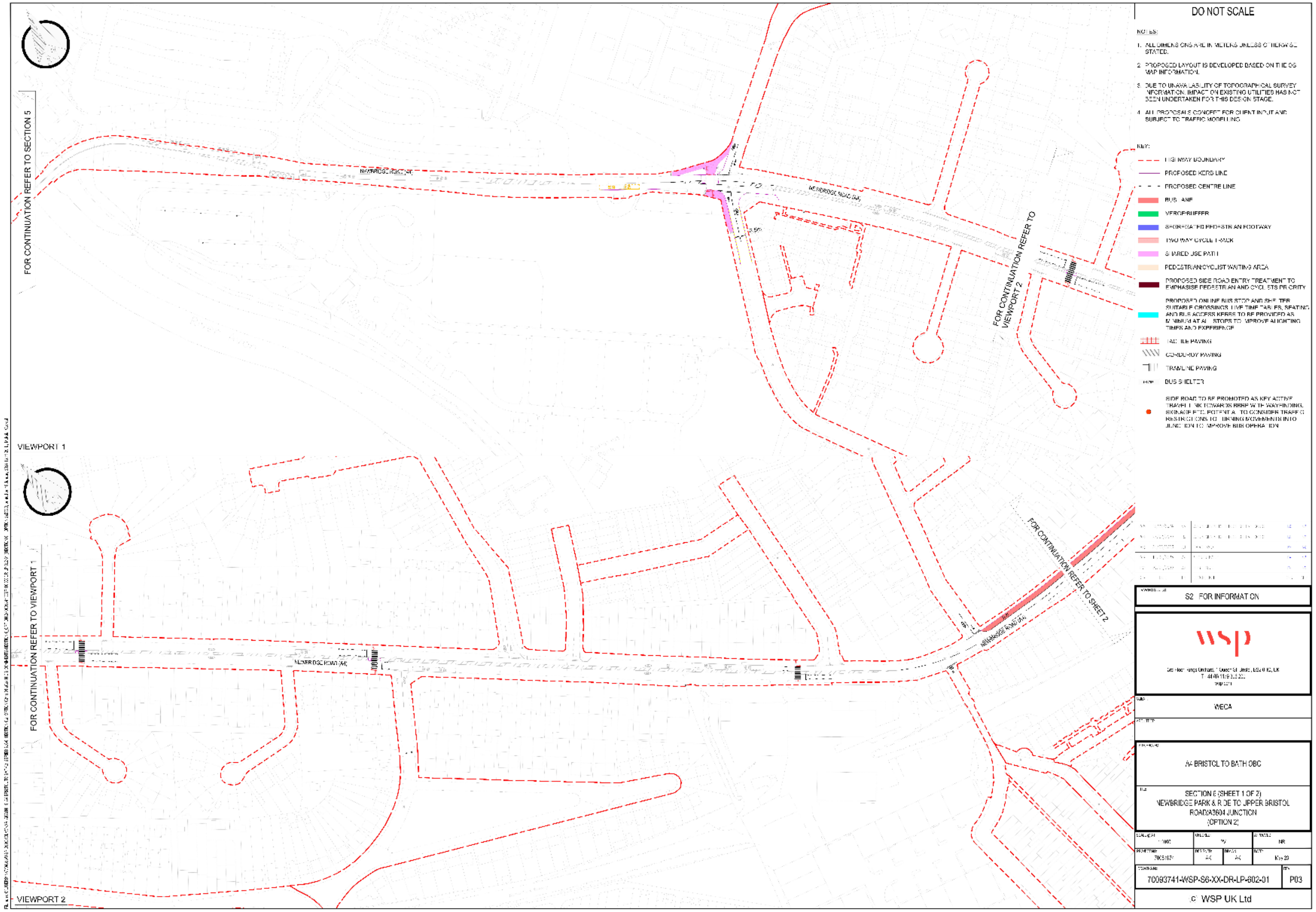


Figure 2-12 - 70093741-WSP-S6-XX-DR-LP-602-01



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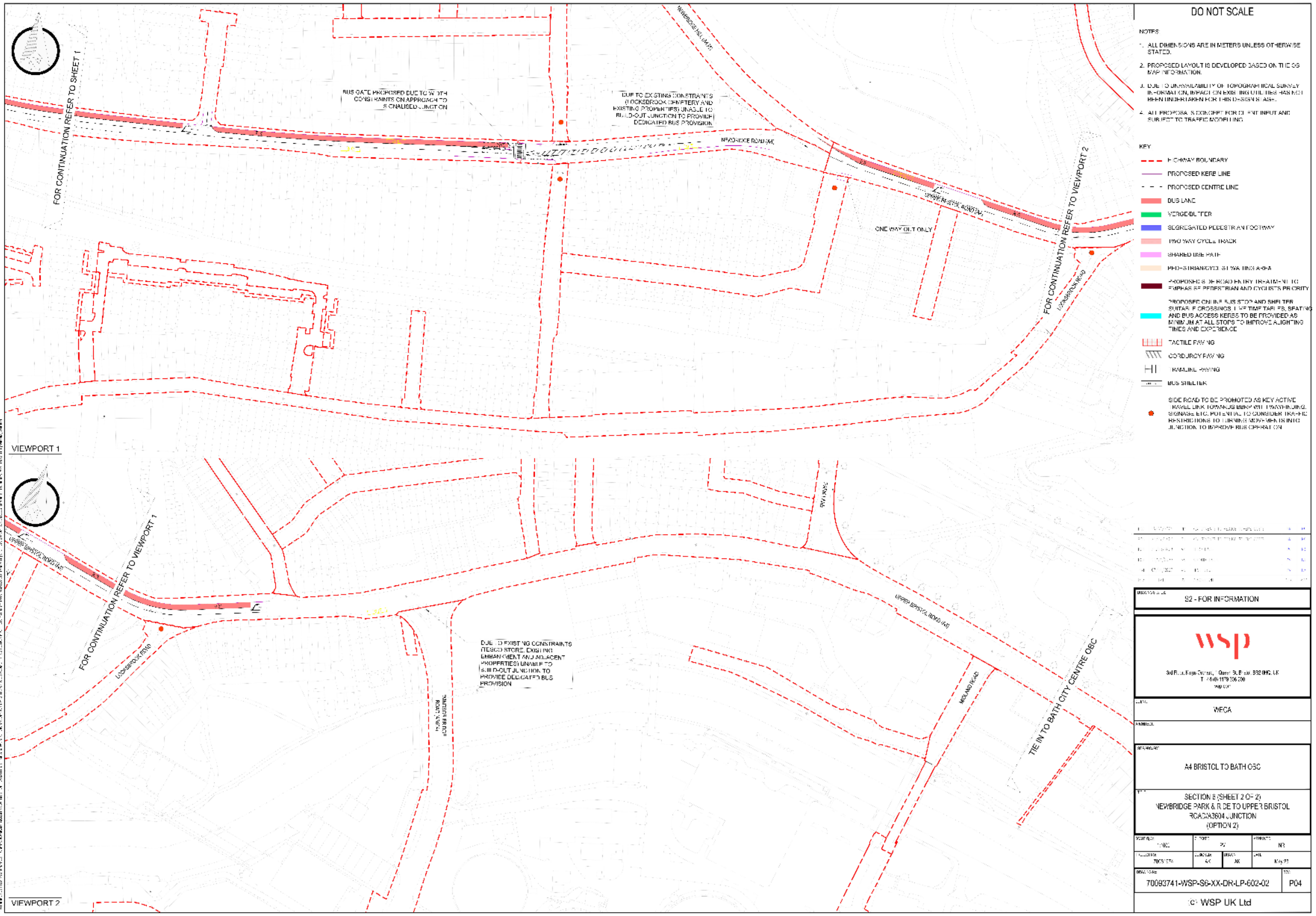
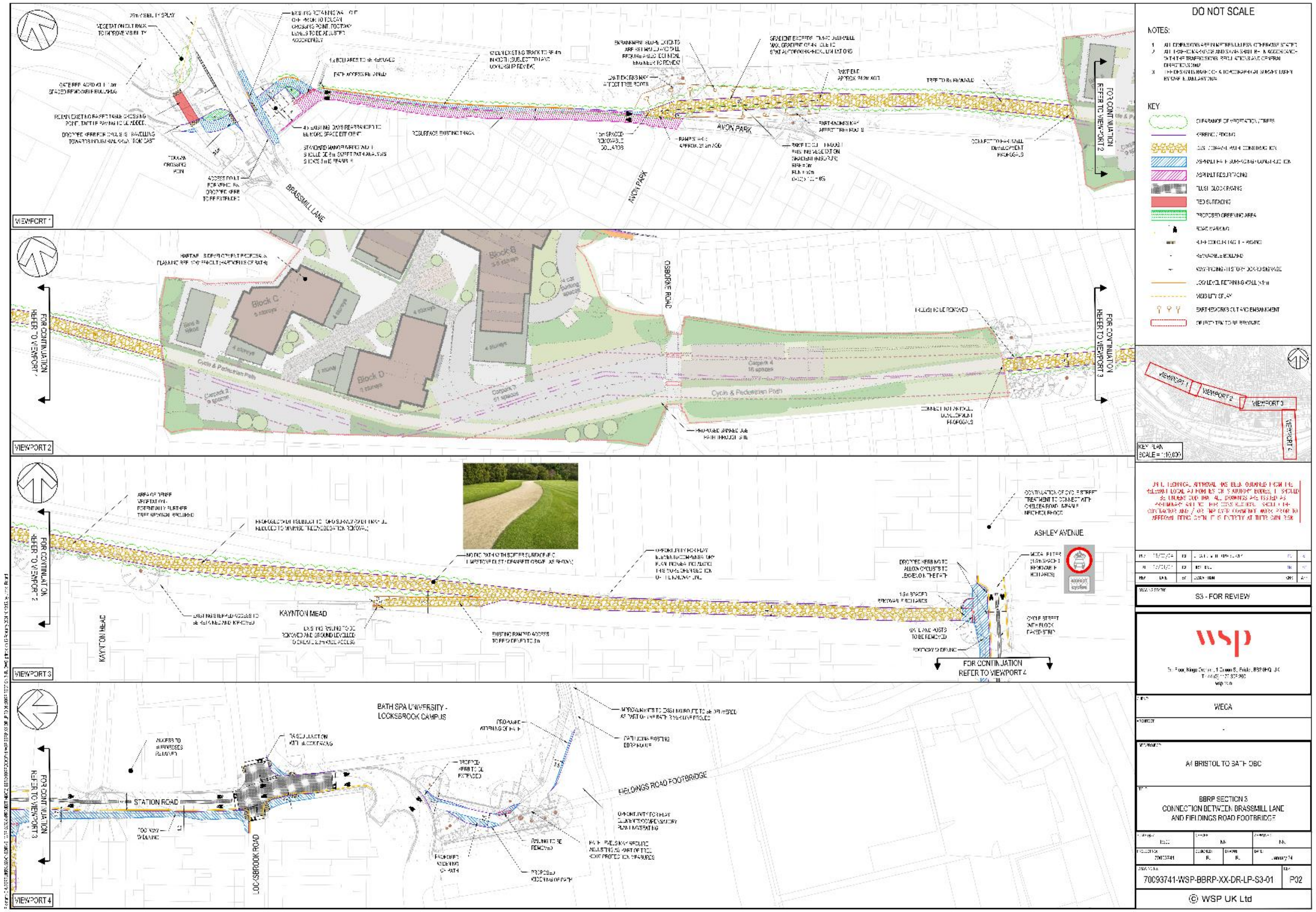


Figure 2-14 - 70093741-WSP-BBRP-XX-DR-LP-S3-01



West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix Q –Risk Register

70093741
February 2024

Public

West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix Q –Risk Register

Type of document (version) Public

Project no. 70093741

Our Ref. No. 70093741

Date: February 2024

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Contents

1 Introduction

1.1.1. This appendix contains the Risk Register that identified the key challenges and threats to the Scheme programme.

1.1.2. This document cannot be made fully accessible, therefore cannot be published. If you wish to request this document, please contact info@westofengland-ca.gov.uk

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West of England Combined Authority

Bath To Bristol Strategic Corridor Outline Business Case

Appendix S - Appraisal Specification Report

70093741
January 2024

West of England Combined Authority

Bath To Bristol Strategic Corridor Outline Business Case

Appendix S - Appraisal Specification Report

Type of document (version) Public

Project no. 70093741

Our Ref. No. 70093741

Date: January 2024

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Quality control

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Prepared by	SM	SM CS	LA CS
Checked by	LA	LA TM HW	LA
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Project number	70093741	70093741	70093741
Report number	70093741-ASR-001	70093741-ASR-002	70093741-ASR-V03

Contents

Tables

Figures

1 Introduction

1.1.1. This Appraisal Specification Report (ASR) details the proposed approach to assessing the impacts of the Bath and North East Somerset section of the Bristol to Bath Strategic Corridor programme (BBSC). The programme is being developed jointly by the West of England Combined Authority (the Combined Authority), Bristol City Council (BCC) and Bath and North East Somerset Council (B&NES) to provide a step-change in public transport and active travel provision along the Bristol to Bath corridor. This ASR details the proposed approach to the appraisal to inform the Outline Business Case (OBC), the Strategic Outline Case (SOC) was completed in 2021.

1.1.2. The BBSC has been separated out into two separate sections, based on local authority. The progression of the Bristol section towards OBC is behind that of the B&NES section. It is intended that each of the two local authority sections of the BBSC will deliver the required objectives in its own right.

1.1.3. Currently it is considered that only some of the proposed interventions identified for the Bristol section will be delivered in the same time period as the B&NES section. Discussions between the combined authority and Bristol City Council are currently underway to determine which of the identified elements in the Bristol section will be delivered by 2027.

1.2 Purpose of the appraisal specification report

1.2.1. This ASR sets out the methodology and scope for undertaking the appraisal of the options for the B&NES section of the BBSC programme for the forthcoming OBC. The proposed approach reflects the Combined Authority Transport Appraisal Guidance and the Department for Transport's (DfT's) Transport Analysis Guidance (TAG).

1.2.2. The ASR provides the opportunity to plan, programme and agree the approach prior to commencement, and produce a specification which meets assurance requirements in a proportionate manner.

1.2.3. This ASR sets out the context and objectives of the scheme and provides an overview of the proposed scope of options. It then further sets out the scope for assessment of the following elements structured under the sub-impacts within the Appraisal Summary Table (AST):

- Approach to Modelling and Forecasting
- Economic Appraisal
- Environmental Impact Assessment
- Social Impact Appraisal
- Public Accounts

1.2.4. The Appraisal Specification Summary Table (ASST) is provided in **Appendix V. Please refer to the stand alone document Appendix V – WERTM review** .

1.2.5. The ASR is a live document and will be updated at each of the business case stages to capture any changes in scheme specification and/or the approach to the appraisal based on the tools/modelling frameworks available.

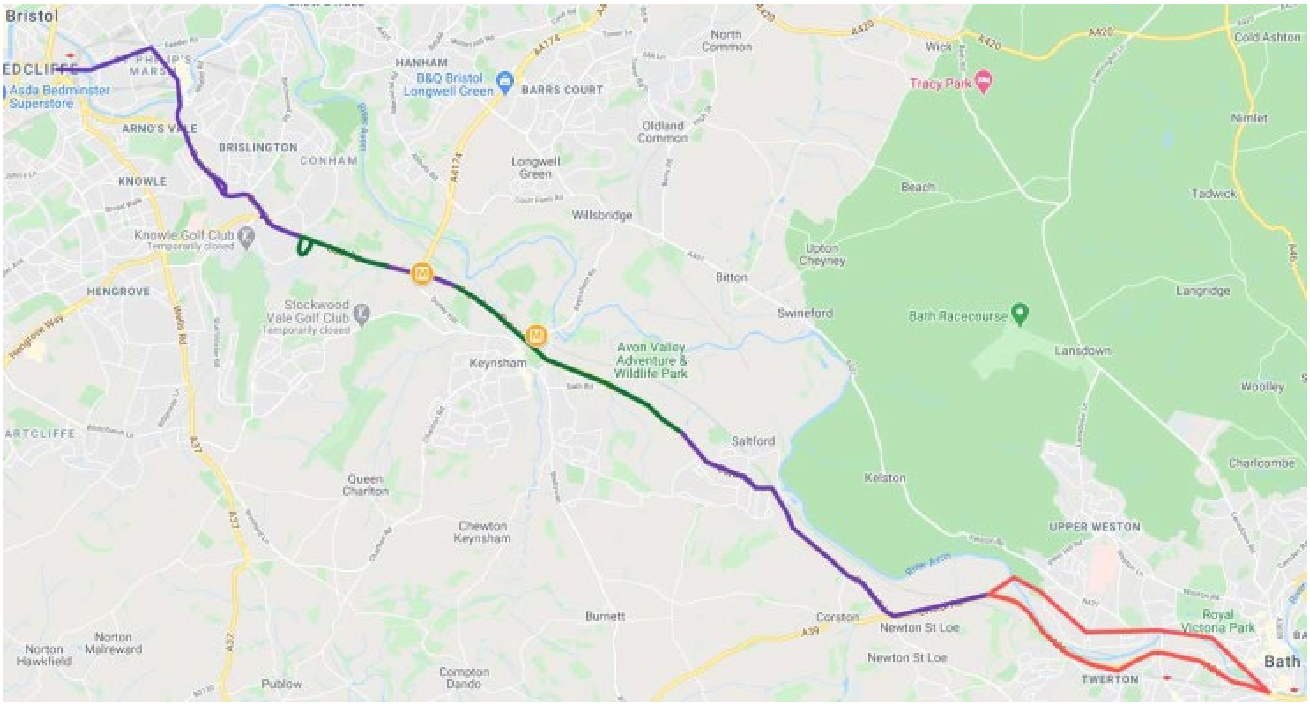
1.2.6. The ASR has been produced to set out the methodologies that respond to the Project Requirements note. A separate Appraisal Specification Report Requirements document has not been produced by the Combined Authority / B&NES.

2 Background to the programme

2.1 Overview of programme

2.1.1. As part of the DfT's City Regional Sustainable Transport Settlement (CRSTS), the West of England Combined Authority was awarded £540m to improve sustainable transport provision in the region. A key flagship project within this award was developing and delivering the BBSC. The overall objective of the programme is to deliver bus priority measures to the A4 from the Bristol City Centre to Bath City Centre (as shown in Figure 2-1), to improve existing services journey times.

Figure 2-1 - Map of BBSC route



2.1.2. This programme is needed because:

- There is a significant reliance upon car use for travel along the A4 and it is frequently heavily congested.
- 50% of the corridor has issues related to poor air quality.
- Frequent congestion on the corridor leads to extended bus journey times and bus reliability issues, impacting its perception as a viable mode of transport.
- Opportunities for walking and cycling are limited – most of the A4 has no safe, segregated and well-lit cycle infrastructure.
- Prior to the coronavirus pandemic, both the Brislington and Newbridge Park and Rides (P&R) were oversubscribed which limits the opportunity for further modal shift for travel to/from the region's key urban centres by sustainable modes.

- It can take over 30 mins to get to a bus stop (from the outskirts of Keynsham and Saltford) and then bus journeys into either city centre can take up to 50 minutes.
- Bus stop facilities in some locations along the corridor are poor, with no real time information, poor crossing facilities to access bus stops, no shelter, and poor lighting.

2.1.3. The improvements to the A4 corridor focus on improving access and reducing journey times and improving reliability for bus users, cyclists and pedestrians through the provision of:

- A high-quality, high frequency bus service between Bristol and Bath.
- Changes to the operations of bus services along the corridor.
- A continuous segregated cycling corridor between Bristol and Bath Cycling and walking connections between local communities along the A4 between Bristol and Bath and the new bus service and strategic cycling corridors.

2.1.4. The BBSC programme has been split into two parts with the section within Bristol being developed and assessed separately to the Bath and North East Somerset section. This ASR covers the section between Emery Road to the east of Bristol City Centre and Bath. The route follows the A4 until the outskirts of Bath where it could then follow the A36 to the south of the River Avon, or the A4 to the north of the river into the city centre.

2.1.5. The scheme to be delivered for the B&NES section of the BBSC consists of different elements which have been combined to form a package of measures. These elements include bus infrastructure improvements along the corridor, active travel infrastructure improvements along the corridor, transport hubs at both Hicks Gate and Keynsham, and active travel infrastructure improvements from the corridor into the neighbouring urban areas, providing better connections to the corridor itself. As the OBC is centred around the infrastructure requirements on the corridor the costs and benefits of this only will be included within the economic appraisal. Improvements to the operating model of the service(s) on this corridor are being considered as part of the BSIP and therefore the costs (and benefits) will be captured as part of this workstream as opposed to BBSC.

2.1.6. In parallel to the BBSC programme, the Combined Authority is developing the Mass Transit programme which also considers options for sustainable travel on the corridor between Bristol and Bath. Given the significant overlap the two programmes are being developed in close collaboration by the Combined Authority and unitary authorities (UAs). However, the BBSC is not dependent on Mass Transit progressing and is being developed (and appraised) as a stand-alone programme.

2.1.7. There are other projects being developed within the Bristol and Bath areas which, whilst not dependent on BBSC, will connect to the scheme to improve the overall connectivity, these include:

- B&NES Liveable Neighbourhoods which aims to improve residential streets and encourage safe, active and more sustainable forms of travel, such as walking, wheeling and cycling.

- CRSTS Bath Sustainable Walking & Cycling Links which will improve the infrastructure for pedestrians and cyclists travelling between residential areas to the east / west of Bath to the city centre.
- CRSTS Bath City Centre which will improve active travel infrastructure and provide greater bus priority in the vicinity of the bus station.
- Circulation Path for the City of Bath.

2.2 Scheme objectives

2.2.1. The vision for the BBSC is to deliver "*A high quality segregated and prioritised public transport and cycling corridor that will provide for reliable services to encourage people to use sustainable transport modes for short and mid-distance journeys and contribute to tackling the climate emergency through modal shift*."

2.2.2. In line with DfT guidance, the objectives for the BBSC have been established as a hierarchy across three tiers:

- High-level or strategic outcomes - the desired end state, which reflects the aims and ambition for the area. The scheme will contribute to these, though not always directly.
- Specific or intermediate objectives - these represent the direct effects of the scheme. They are SMART objectives, which become part of the monitoring and evaluation of the scheme at later stages.
- Operational objectives - those outputs necessary for the specific objectives to be achieved.

Strategic outcomes

2.2.3. The strategic outcomes for the BBSC are to deliver a public transport system that will:

- Tackle the climate emergency and poor air quality through mode shift to mass transport, walking and cycling, contributing to achieving the carbon net zero 2030 goal.
- Support sustainable and inclusive economic growth and enable regeneration, supporting neighbourhood renewal and regeneration of deprived areas.
- Improve local environmental conditions to achieve better health, wellbeing, safety and security for local communities.
- Enable equality and accessibility through better active travel and alignment with LTN 1/20, supporting the levelling up of local communities.
- Create better places and tackle the ecological emergency.
- Make sustainable transport the preferred option for short to mid-distance journeys.

Specific objectives

2.2.4. The specific objectives for the BBSC are set out in Table 2-1. These were agreed at the SOC stage and represent the direct effects of the scheme. They will be developed into SMART objectives, which become part of the monitoring and evaluation of the scheme at later stages.

Table 2-1 - BBSC specific objectives

Aspect	Objective	Measure
Public Transport	To increase bus patronage and contribute to the Bus Strategy ambition of doubling bus passenger numbers by 2036 To improve the user experience for communities accessing Bristol or Bath by bus along the corridor	Numbers of bus passengers making journeys on the BBSC Bus passenger satisfaction, the number of new formal interchange locations created, the number of journeys involving one or more interchanges, improved journey time reliability and journey times
Active Travel	To increase the number of, and diversify the composition of walking and cycling trips along the corridor through the creation of new and improved crossings and segregated cycle infrastructure in line with LTN 1/20 To improve access to bus stops and amenities for communities along the corridor To enhance streetscape, public spaces and urban environments along the A4 corridor	The number of walking and cycling journeys to/from and between local communities along the corridor, the number of walking and cycling journeys from local communities along the corridor to stops, between local communities along the corridor (including use of facilities to cross the A4). The number and quality of crossings, bus stops and waiting facilities along the BBSC route
Environmental	To improve air and noise quality along the BBSC route, particularly in Air Quality Management Areas (AQMAs) and Noise Important Areas (NIAs) To reduce the carbon footprint arising from transport movements along the corridor To increase the amount of green infrastructure along the BBSC route to contribute to biodiversity net gain	Noise and air quality emissions along the BBSC route The number of journeys made along the corridor by different modes, distinguishing between zero emission buses, diesel buses, electric cars and other modes. The amount of green infrastructure along the BBSC route

Operational objectives

2.2.5. The operational objectives, which identify the outputs necessary for the specific objectives to be achieved, were revised for the OBC to ensure that they aligned with the CRSTS objectives. The objectives apply to the whole BBSC and are:

- Improve public transport infrastructure in the study area to increase the number of people who have access to and use buses to contribute to growing patronage of the X39 (or similar/comparable services) by at least 24% by 2030:
  - To provide the infrastructure required to enable operators to deliver a fast, reliable, high-frequency bus service between Bristol City Centre (Three Lamps Junction) and Bath City Centre.
  - To deliver high-quality, safe and recognisable bus stops (comparable to the existing MetroBus service standards stops).
  - Provide the high-quality bus infrastructure necessary to sustain economic growth.
- Improve walking, wheeling, and cycling infrastructure in the study area to contribute to increasing the number of people using the corridor for active travel modes including to increase the number of people commuting by walking, cycling and wheeling modes to 25% of total modal share by 2036:
  - To enable continuous, safe and legible end-to-end active travel journeys along and to/from the corridor.
  - To improve access by active travel modes to public transport along the corridor.
  - To reduce severance for cyclists, walkers, wheelers and other active travel modes.

3 Scope of the BBSC and anticipated impacts

3.1 Introduction

3.1.1. This section sets out the scope of the BBSC. It summarises the previous work undertaken at the SOC stage to determine the longlist of options, the sifting and the final shortlist of options that have been taken forward to the OBC stage for further development and assessment.

3.2 Option development – OAR and SOC

3.2.1. As the corridor is being considered in two sections – BCC and B&NES – the option generation, development and assessment processes have been undertaken in parallel and documented in two Option Assessment Reports (OARs):

- Section 1 OAR (Bristol Temple Meads to Emery Road) – this section of the corridor is not covered within this ASR or the OBC it refers to.
- Sections 2 to 6 OAR (Emery Road to the point of interface with the Bath City Centre scheme).

3.2.2. A longlist of geographic route options was developed for sections 2 to 6 of the BBSC. These were identified based on the preceding review of existing and future local conditions and were influenced by inputs from stakeholders.

3.2.3. A Multi-Criteria Assessment Framework (MCAF) was developed and applied to support the assessment and sifting of geographic options. The results of this MCAF process, complemented by feedback through engagement with the Combined Authority and UAs, informed the identification of recommended shortlist of options:

- Bus priority infrastructure: 13 options.
- Hicks Gate P&R and Interchange Hub: 2 locations.
- Strategic cycling options: 9 options.
- Community connections: a range of potential interventions that can be filtered down by geography or funding status.

3.2.4. For the SOC these shortlisted options were grouped to form three shortlisted packages. These are summarised in Table 3-1.

Table 3-1 – SOC shortlist options

Option name	Description
Smaller intervention	For most of the route, this option makes use of existing bus priority and only adds in new bus priority where there is existing road space that can be reallocated. In locations where this provides no improvements to buses, 1 way traffic restrictions are added to the A4 to reduce general traffic and prioritise buses, and new routes are provided to compensate for the closed routes. Provides segregated cycle facilities along most of the corridor.
Medium intervention	This option provides bus priority in both directions if the land take impacts are not overly significant, or in one direction only. In locations where land take is not an option, alternative routes for buses are used and 2-way traffic restrictions are added to the A4 to reduce general traffic and prioritise buses. New routes are provided to compensate for the closed routes. Provides segregated cycle facilities along the length of the corridor.
Larger intervention	Provides full continuous bus priority in both directions along the length of the route. Provides segregated cycle facilities along the length of the corridor with additional ‘green’ routes (for less confident/leisure users) where possible.

3.2.5. Further details of the options and a full description of the optioneering process by which the interventions have been identified is included in the OAR which was submitted in support of the SOC.

3.3 Option development - OBC

3.3.1. For the OBC, two of the shortlisted packages identified at the SOC stage have been taken forward for further development, these are the Medium Intervention and the Smaller Intervention packages. The Larger Intervention was not taken forward for further development as it was considered that the costs and timelines for delivering the identified package of measures would be outside of the CRSTS window.

3.3.2. Both retained package options have been furthered developed to identify what can be delivered considering the existing constraints along the corridor, minimising land take and seeking to reduce the costs associated with changes to structures. The two final options will be made up of a combination of elements from both the Medium and Smaller Intervention packages to provide best value for the corridor.

3.3.3. The following sections provide more detail of the option development work being undertaken as part of the OBC, considering the bus infrastructure on the A4 followed by the strategic cycling infrastructure on the A4, and then the community connections.

A high-quality, high frequency bus service between Bristol and Bath

3.3.4. To facilitate a high-quality, high frequency service along the A4, there is a need to overcome the current impact of congestion and delays on bus operation along key parts of the corridor.

3.3.5. A further aspiration is to ensure that the new bus service is directly accessible by local communities along the corridor (e.g. Keynsham, Saltford).

Provision of bus priority along the length of the route

3.3.6. The further development work at the OBC stage is seeking to identify deliverable solutions to provide bus priority along the length of the route to reduce journey times and increase journey time reliability. At various locations along the corridor additional measures will be required to support bus priority, in particularly where existing constraints/built-up areas will limit the interventions.

3.3.7. The programme is also seeking to maximise the introduction of green infrastructure along the route and high-quality public realm at bus stops/waiting areas and interchanges.

3.3.8. The options under consideration for the OBC are set out as follows. This non-exhaustive list is organised by section of the corridor.

- Emery Road to Hicks Gate:
  - Relocation of the Brislington P&R to a location just south of the Hicks Gate junction. This P&R could potentially form a strategic interchange hub between local services, P&R and the BBSC services.
  - Changes to the layout and operation of Hicks Gate junction to support access to/from the P&R.
  - Carriageway reallocation from general traffic to bus for one lane.
- Hicks Gate to Broadmead Roundabout:
  - Reallocation of one lane per direction on the existing A4 Keynsham bypass (inbound and outbound) to a bus lane.
  - Introduction of bus stops in both directions along the bypass with links into Keynsham town centre and Keynsham rail station
- Broadmead Roundabout to Globe Roundabout:
  - Changes to Broadmead Roundabout to facilitate bus priority
  - Consolidation of local roads accessing the A4 within Saltford and potential introduction of right-turn pockets and/or signalised junctions to address congestion points
- Globe Roundabout to Twerton Fork:
  - Junction upgrades for bus priority
  - Reallocate carriageway from general traffic for bus lanes.

- Twerton Fork to Bath City Centre (Midland Road):
  - Reallocate carriageway for public transport provision, only achieved through removal of on road parking provision along A4.

A continuous segregated strategic cycling corridor between Bristol and Bath

3.3.9. The BBSC will develop options for the provision of a continuous segregated cycling route between Bristol and Bath.

3.3.10. The options for this provision include:

- Cycling facilities running alongside the A4 alignment (e.g. through expansion of the road cross-section to include cycle facilities).
- "Offline" routes wherein the cycle corridor may deviate from the A4 through existing or planned communities.

Cycling and walking connections between local communities and the A4 corridor

3.3.11. It is crucial to maximise the sustainable connectivity between the communities along the A4 between Bristol and Bath and the new BBSC service and the strategic cycle corridor.

3.3.12. The programme includes local walking and cycling improvements between local neighbourhoods directly adjacent or "nearby adjacent" from the A4.

3.4 Option packaging

3.4.1. The OBC will consider packages combining the interventions set out above into two scheme options:

- **Preferred Option** – the preferred scheme option, maximising the balance between benefits, costs and impacts on existing land and amenities, this is equivalent to the Medium Intervention identified in the SOC which has been further developed.
- **Low Cost Option** – this may include reduced road/bus lane/cycle lane widths or include sections with shared usage. This will be developed in line with the available budget for the project but will be future proofed to enable the delivery of the Preferred Option at a later date. This is based on the Smaller Intervention as set out in the SOC which has been further developed for the OBC. This option will target those areas of key congestion indicated by the available data.

3.4.2. Both package options will be subject to the same level of modelling and assessment to provide direct comparisons between costs and benefits.

3.5 Anticipated impacts of the BBSC

3.5.1. The BBSC programme will provide a step change in public transport, cycling and walking connectivity for local communities along the A4. It will make sustainable transport the preferred option for short to mid-distance journeys, increasing the level of bus patronage and active travel usage.

3.5.2. The main impacts of this are anticipated to be the following (which informs the appraisal and modelling approach set out in this ASR):

- Mode shift to bus, i.e. increases to the number of bus journeys.
- Mode shift to cycling, i.e. increases to the number of cycling journeys.
- Impacts on bus journey times along the A4 for all affected services.
- Impacts on bus journey time reliability along the A4.
- Impacts on bus operator costs and revenues.
- Impacts on cycling connectivity along the A4 and associated cycling journey times.
- Impacts on cycling and walking accessibility between communities along the A4, and from communities to the A4.
- Impacts on general traffic journey times along the A4.
- Impacts on public realm at bus stops and interchanges along the A4.
- Impacts on green infrastructure along the A4.
- Impacts on health and wellbeing for local residents.
- Impacts on air quality, noise and carbon emissions along the A4.
- Impacts on accidents along the A4.

3.6 Interdependencies

3.6.1. The development of the BBSC programme will need to recognise a number of adjacent programmes and projects, including:

- West of England Mass Transit programme.
- Bath Journey to Net Zero Plan.
- UA Local Plans (which are in development).
- West of England Future Transport Zones (FTZ).
- Bus Service Improvement Plan (BSIP).
- B&NES Liveable Neighbourhoods.
- CRSTS Bath City Centre.
- CRSTS Bath Sustainable Walking &Cycling Links.
- Bristol City Centre Development & Delivery Plan.
- Circulation Plan for the City of Bath.
- Bristol and Bath Railway Path (Brassmill Lane to Station Road, part of Bath Riverline)
- Keynsham-Willsbridge Active Travel Route (connecting to the Bristol and Bath Railway Path at Bitton Station.).
- WaterSpace Connected (Somerdale Bridge).

- Bath River Line (creating a level accessible active travel route from Newbridge to Batheaston).

3.6.2. Alongside these programmes and projects the OBC will also take consideration of emerging land use changes and potential development sites along the corridor.

3.6.3. A Dependencies Register is being developed which will be a live document recording other schemes, projects and developments which may impact, or be impacted by, the BBSC.

4 Scope of modelling

4.1 Introduction

4.1.1. This chapter considers the available modelling frameworks that could be used to capture the impacts of the BBSC scheme on public transport and highway users and considers which is most appropriate for use in the OBC.

4.2 Existing transport models

Overview

4.2.1. Work has been undertaken to identify available transport models which may be suitable for the assessment of the BBSC scheme. In brief, the candidate models are:

- Greater Bristol Area Transport Study (GBATS) model.
- Greater Bath Area Transport study (GBATH) model.
- BBSC SOC model – a combination of GBATS4 and GBATH highway assignment models, refined to improve validation around the scheme and with additional functionality introduced so that mode choice could be predicted.
- West of England Regional Transport Model (WERTM).

Greater Bristol Area Transport Study (GBATS) Model

4.2.2. The Greater Bristol Area Transport Study (GBATS) model covers a large area, predominantly covering the Greater Bristol area but also extending into North Somerset, South Gloucestershire and B&NES. On the A4, the simulation area extends to the Broad Mead roundabout (serving east Keynsham), with the rest of the A4 and Bath included only in the ‘buffer’. Keynsham and Saltford are represented by single zones in the model.

4.2.3. The current version of the model is called the GBATS4 Metro Model (GBATS4M). The GBATS4M model has the following features:

- Base year of 2013.
- Public Transport Assignment Model (PTAM) representing bus and rail-based movements for a typical 2013 morning peak period (07:00 – 10:00), an average inter-peak hour (10:00 – 16:00) and an evening peak period (16:00 – 19:00).
- Highway Assignment Model (HAM) representing vehicle-based movements for a weekday morning peak hour (08:00-09:00), an average inter-peak hour (10:00-16:00) and an evening peak hour (17:00-18:00).
- Three-stage multi-modal incremental Variable Demand Model (VDM) that forecasts changes in trip frequency, mode and destination choice, in response to changes in generalised costs across the 12-hour period (07:00 – 19:00).

4.2.4. The 2021 and 2036 forecast models developed from GBATS4M account for the interventions and developments considered as part of the West of England Joint Spatial Plan (JSP), based on an uncertainty log from 2015. The JSP was withdrawn in 2019 with constituent authorities now developing their own separate Local Plans. The planning assumptions underpinning the JSP are subject to change in line with these emerging documents and subsequently the spatial distribution of growth is subject to significant uncertainty. Additionally, forecasts are controlled to DfT NTEM v6.2 growth projections which are out of date (now NTEM v8.0).

Greater Bath Area Transport model

4.2.5. The GBATH model consists of a Public Transport Model, Highway Assignment Model and a three-stage multi-modal incremental Variable Demand Model (VDM). The GBATH model has a base year of 2014. It has detailed network coding from Bath City Centre out along the A4, A431 and A36 corridors. Simulation coding extends to the Globe roundabout, but neither Saltford nor Keynsham have any network coded.

4.2.6. Specifically, the GBATH model elements have the following features:

- Public transport model representing bus and rail-based movements across the same area for a typical 2014 morning peak period (07:00 – 10:00), an average inter-peak hour (10:00 – 16:00) and an evening peak period (16:00 – 19:00).
- Highway model representing vehicle-based movements across the Bath and surrounding area for a typical 2014 morning peak hour (08:00 – 09:00), an average inter-peak hour (10:00 – 16:00) and an evening peak hour (17:00 – 18:00).
- Three-stage multi-modal incremental demand model that considers the impact on frequency, main mode and destination choice in response to changes in generalised costs across the 24-hour period (07:00 – 07:00), similar to the one used in GBATS4M.

4.2.7. Similar limitations exist with respect to the GBATH forecast models to those in GBATS4M, in that they are based on an uncertainty log informed by the withdrawn JSP and on growth projections in NTEM v6.2.

BBSC SOC model

4.2.8. For work undertaken for the SOC, the GBATS and GBATH models were combined. The model coding along the A4 in between Bristol and Bath was refined to improve the fit with the existing network (as the A4 is in the buffer areas for both original models) and improve the validation of the model against observed flows and journey times.

4.2.9. The available public transport models were not used; instead, public transport costs were estimated using a bespoke model developed in the TRACC software.

4.2.10. Mode choice was implemented using the DIADEM software. The modal shift response was assumed to only include the shift from car to bus and not in the opposite direction as the nature of the scheme was considered unlikely to result in a decrease in journey times for highway trips (and hence no reduction in public transport trips in favour of car travel).

West of England regional transport model

4.2.11. The West of England Regional Transport Model (WERTM) is a strategic model with a detailed model area covering Bristol, North Somerset, South Gloucestershire, and B&NES. The model was developed in SATURN and VISUM and has a base year of 2019. The WERTM model consists of:

- Public Transport and Active Model (PTAM) representing active mode, bus and rail passenger movements in 2019 for a typical morning peak period (07:00 – 10:00), an average inter-peak hour (10:00 – 16:00) and an evening peak period (16:00 – 19:00).
- Highway Assignment Model (HAM) representing vehicle-based movements across the West of England for a typical 2019 morning peak hour (08:00 – 09:00), an average inter-peak hour (10:00 – 16:00) and an evening peak hour (17:00 – 18:00).
- Three-stage multi-modal absolute model (applied incrementally) Variable Demand Model (VDM) that forecasts change in trip ends, mode choice and distribution.

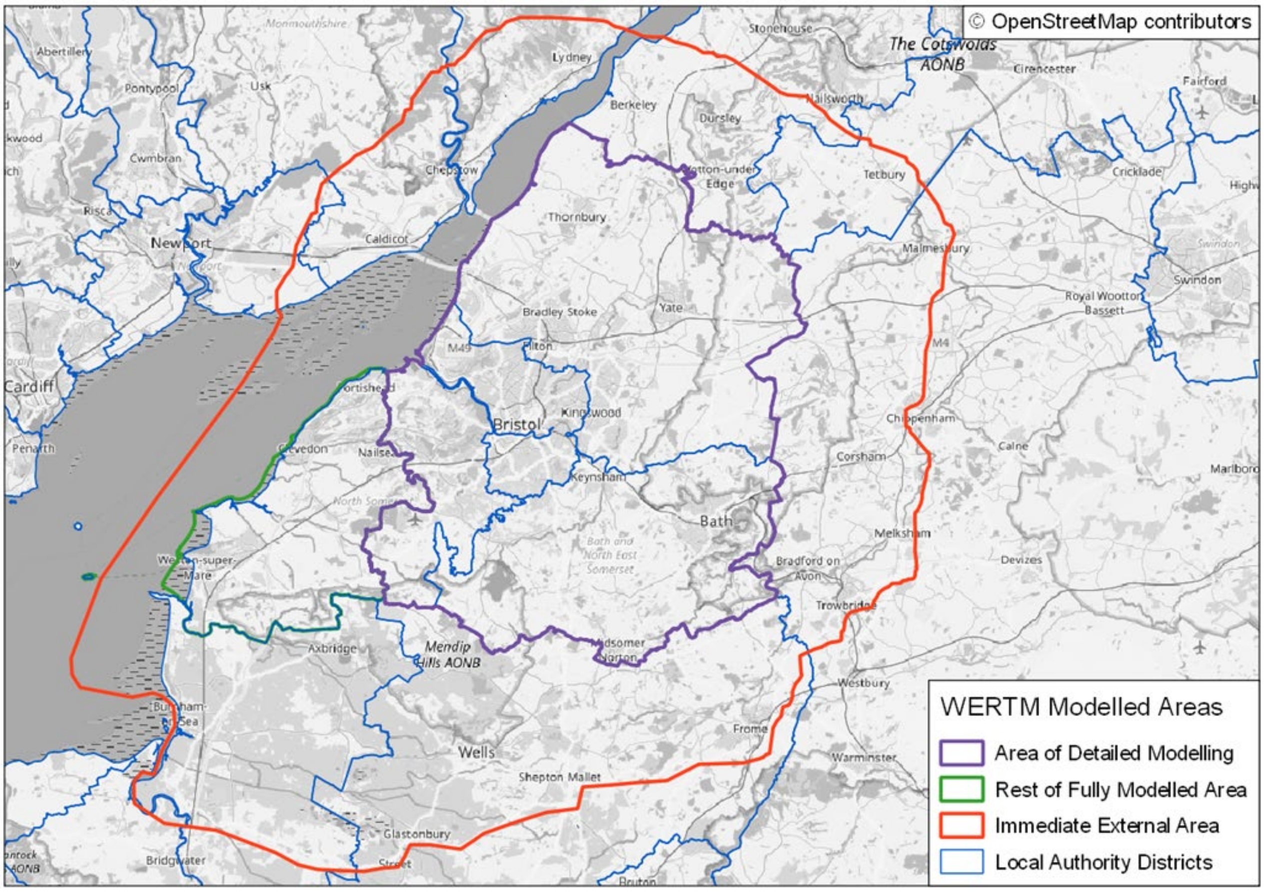
4.2.12. The model has been developed using 2019 mobile phone data (GBATS4M and GBATH are based on roadside interview data) and calibrated to 2019 (pre-coronavirus pandemic) flows.

4.2.13. The purpose of the model is to provide an evidence-based forecasting tool to assess the impacts of land use developments, transport schemes and policies on the local transport network at the strategic level. The model is intended to supersede all existing strategic models in the region (i.e. GBATS and GBATH), but documentation for the model notes that further development may be required in certain use cases and that a review should be undertaken before employing the model.

4.2.14. The coverage of the area of detailed modelling for WERTM is shown in Figure 4-1, and encompasses in simulation and with full trip representation, all highway and public transport trips across the three UAs in the West of England (Bristol, B&NES, and South Gloucestershire). The A4 between central Bristol and central Bath, together with all key competing routes are covered in detail.

4.2.15. As of June 2023, the Foundation Case forecasts and variant tests are complete with initial reporting undertaken. An independent review of WERTM is also ongoing. As such, whilst WERTM represents a significant upgrade to GBATS4M and GBATH, it still represents a work-in-progress solution.

Figure 4-1 – WERTM study area



4.3 Proposed model for OBC stage

4.3.1. After considering the relative strengths and weaknesses of the candidate models set out above, the following conclusions have been drawn:

- Except for the BBSC SOC model, all of the models considered have a similar structure, comprising a highway and public transport assignment model and a three-stage demand model handling trip end, mode and distribution choice (implementation varies).
- Neither GBATS4M nor GBATH assignment models extend far enough along the A4 to make representing the scheme in them a straightforward exercise. This was the main justification for developing the specific BBSC SOC model.
- The BBSC SOC model utilised only the highway assignment model elements of GBATS4M and GBATH. The TRACC model used to provide public transport costs, whilst built using current timetables, is unvalidated and is unable to represent cost changes in the public transport network fully. Demand model functionality introduced via DIADEM only covers mode choice. Overall the model would not meet the requirements of the OBC modelling without significant further development.
- Neither of the GBATS4M or GBATH models are actively maintained, and this is likely to present challenges if they were to be implemented for the BBSC OBC. Adding full

demand model functionality into the BBSC SOC model is unlikely to be practical and has significant cost and programme implications to the project.

- GBATS4M, GBATH and the BBSC SOC model are all subject to the same underlying weakness, being largely derived from 2013/14 (or older) data and the considerable uncertainty as a result of this.
- The base year and observed data underpinning the GBATS4M and GBATH are aged and unsuitable for use for the more detailed modelling and appraisal requirements at OBC.

4.3.2. WERTM addresses most of the above weaknesses. WERTM is the most recent model available and the extent of the simulation network includes the entire A4 corridor between Bristol and Bath. The network coverage is of a good standard considering the model is strategic in nature and all major route choices relevant to the scheme are captured within the modelled area.

4.3.3. Therefore, WERTM has been identified as the most appropriate model to use to underpin the appraisal of the scheme at OBC. It should be noted that the VDM will not capture the model shift to active modes, it will capture the change to public transport. Mode shift to active modes will be assessed through other tools discussed later in this ASR. It is however acknowledged that WERTM is still under development and that any model requires a detailed assessment of its strengths and weaknesses before being used. A detailed review is included in Appendix A and the conclusions of this review are summarised below:

- The level of network detail within the highway and public transport assignment models is sufficient for the purposes of testing changes to bus priority, highway capacity and new bus stops within the strategic corridor and does not need require any enhancement.
- The highway model data coverage is limited in areas around Saltford and Corston. However, the traffic count coverage is suitable to capture all the important traffic movements within the study area. The counts have been organised into suitable screen lines that have been shown to pass the TAG criteria.
- Public transport ticket data used in the public transport assignment model only provided trip origin and trip destination and has had to be synthesized. Lower confidence is assigned to the destination end of all bus trips in the PTAM.
- The highway model link calibration, where present, is satisfactory and requires no further changes to improve the comparison with the observed data.
- Journey time validation has shown that further amendments to the traffic model are required to enhance the representation of the travel times and delay along the strategic corridor, especially along the A4.
- Public transport model calibration is limited to monitoring of bus stop groups rather than individual bus stops due to constraints prescribed by TAG. However, the PTAM assignment recreates observed data in accordance with TAG thresholds.
- Distortions to the prior highway matrix bought about by matrix estimation is an area of concern, meaning that patterns in the observed data may have been lost.

- Being strategic in nature, the highway assignment model has not been validated against observed turning movements at junctions along the corridor, where robust representation may be required to adequately assess the impacts of the scheme.

4.3.4. WERTM is the principal tool that is proposed for use in the appraisal, but it is a strategic model and is not therefore considered to be robust for individual junction operation assessments. WERTM will provide an indication of broad junction performance, but any areas of specific concern would require further investigation using appropriate junction and/or microsimulation modelling tools. As part of the scheme development stand-alone junction models have been developed, outputs from these models will feed into the Do Something networks.

4.3.5. Due to the above observations, the following additional checks/controls will be put in place before the base model is finalised for the BBSC OBC and forecasting commences:

- **Confidence in public transport data:** travel patterns for bus users in WERTM are likely to be subject to a degree of uncertainty due to the quality of data used in the model. The biggest impacts arising due to the scheme are likely to be at the Brislington P&R, which could be relocated to a new hub close to the Hick's Gate roundabout. Therefore, a proportionate approach is proposed to deal with the apparent weakness in data where origin-destination data at the Brislington P&R will be replaced with new data via a passenger survey at the site.
- **Highway journey times:** work will be undertaken to address underperforming (in terms of calibration and validation criteria) journey times routes by revisiting highway model validation, bringing the model closer to TAG criteria.
- **Matrix estimation:** further analysis will be undertaken to i) understand the impacts of matrix estimation specifically in B&NES and ii) to assess the significance of these changes with respect to the uncertainties in the data used to build these matrices. As per TAG Unit M3.1, where the exceedances of thresholds are important and statistically significant, the development of the prior matrix will be reconsidered. Where changes are not considered to be significant, the reasons will be documented in an addendum to the Model Validation Report.
- **Comparison of observed turning movements with modelled turning movements:** at key junctions where data is available, to understand if further refinements are needed to improve routing along the corridor.

4.4 Operational modelling

4.4.1. As part of the OBC, the potential operational changes required to support the phased implementation of the key infrastructure elements will be explored. The potential delivery models will be outlined as well as their impact on operating costs and specific aspects which need to be considered by Combined Authority when developing future operational changes.

4.4.2. The operational objectives focus on providing zero emission services with improved quality, reliability, and efficiency. Combining these measures with consistent marketing and branding of a convenient off-board ticketing system can help provide a coherent bus network that encourages people to use sustainable transport for short and mid-distance journeys.

4.4.3. The development of the operational model for the BBSC focusses on the arrangement of services running mainly on the A4, such as service X39 which is the main service from Bristol to Bath. Detailed forecasting data on passenger demand is not currently available so commercial viability of the operational models cannot be established.

4.4.4. The operational models will not consider off-peak, night-time and weekend frequencies. The models will not explicitly take existing commercial arrangements into account at this stage but will acknowledge that future development options can have impact on existing commercial arrangements like the Park & Ride services from Brislington and Newbridge.

5 Future year forecasts

5.1 Introduction

5.1.1. This section details the proposed methodology for forecasting the impacts of the BBSC scheme. The forecasting will build upon currently available forecasting work produced during the development of WERTM and consider the DfT's Uncertainty Toolkit.

5.2 Forecast years

5.2.1. The available WERTM forecast years are 2029 and 2042. For the purposes of appraisal, it is considered that 2029 will align with the proposed scheme opening year (currently 2027). As it is within 2 years of the scheme opening year and the growth across this period is unlikely to be significant. The TUBA manual states that "If scheme opening is only 1 or 2 years after the first modelled year than the modelled year data can be used to represent the scheme opening year. A second forecast year of 2042 will also be used as it is considered that this falls far enough into the future for the impacts of longer-term growth to be understood.

5.2.2. Future year forecast scenarios will be prepared in line with the methodology set out in TAG Unit M4 and will align with the most recent version of the TAG Data Book.

5.3 Demand growth and uncertainty

5.3.1. All assumptions for developing forecasts will be based on the current WERTM uncertainty log which was developed using data provided by each of the UAs during the forecasting stage (c2022). This uncertainty log reflects all development sites and potential transport infrastructure schemes and assesses the level of certainty against the TAG levels. It also sets out the timeframe for developments and delivery of infrastructure schemes so that each site/scheme can be allocated to a suitable forecast year.

5.3.2. As per TAG, the core scenario reference case forecasts prepared for the BBSC OBC will only explicitly include developments that are rated as 'Near Certain' or 'More Than Likely' in the uncertainty log. These sites will be point loaded as new zones in the model. It is not intended that any further growth will be added to the demand matrices, however the overall growth for cars, private LGV and public transport users across the West of England region will be controlled to match the unadjusted growth rates in NTEM at the local authority level. Under the core scenario, goods vehicles will be uplifted in line with projections provided by DfT's 2022 National Road Traffic Projections.

5.3.3. In the interests of proportionality we would like to implement the TAG Unit M4 formulaic approach for both high and low growth. We consider that the high growth will give a reasonable upper bound at OBC stage with which to test operation of the corridor, whilst the low growth will be used to demonstrate that VfM of the scheme is robust.

5.4 Supply scenarios

5.4.1. The two Do Something scenarios described in Section 3.4 will be modelled.

5.4.2. Within the appraisal these scheme options will be compared to a Do Minimum scenario, i.e. the without scheme scenario. The Do Minimum scenario, prepared to reflect the network in each future year, will include schemes within the uncertainty log that are categorised as 'Near Certain' or 'More than Likely'.

5.4.3. As part of the development of the OBC the WERTM uncertainty log is currently being reviewed and the foundation case forecasts for 2027 and 2042 being updated. As part of this review specific consideration has been given to the Bristol section of BBSC corridor between Bristol City Centre and Emery Road.

5.4.4. Option testing is currently ongoing to agree a package of measures on the Bristol section of the corridor, with work yet to commence on the OBC. Given the current status of the schemes on the Bristol section of the corridor (Reasonably foreseeable on the uncertainty log), this will not form part of the core scenario of the OBC for the B&NES section. Therefore, no elements of the scheme on the Bristol section of the corridor will be included in the Do Minimum future year models. The status of the schemes on the Bristol section will be monitored closely during the development of the OBC and this assumption will be revised if necessary. Similar considerations will be made as part of the development of the Bristol section business case, ensuring the scheme on the B&NES section is appropriately reflected.

5.4.5. Therefore, our default position at this time is that no elements of the Bristol Interventions will be included in the Do Minimum future year models.

5.4.6. Only the Low Cost Option will be assessed under the high and low growth scenarios as it unlikely that the Preferred Option will be able to be fully funded within the allowance available as part of the CRSTS programme.

5.5 Dependent development

5.5.1. Given the current status of Local Plans it is not possible to identify development sites which are formally dependent on the delivery of BBSC as defined in TAG Unit A2.2, therefore tests for dependency will not be undertaken.

6 Appraisal

6.1 Introduction

6.1.1. The economic appraisal of potential options for BBSC will consider the quantitative, monetised impacts of the scheme, as well as the non-monetised impacts, which will feed into the overall VfM assessment of options.

6.1.2. The DfT's Value for Money Framework[1] sets out three levels of impacts of a transport proposal:

- Level 1 - Established Monetised Impacts - the impacts include user and non-user benefits of the scheme. These impacts form the initial Benefit Cost Ratio (BCR).
- Level 2 - Evolving Monetised Impacts - these impacts include reliability and wider economic impacts and form the adjusted BCR.
- Level 3 - Indicative Monetised Impacts & Non-Monetised Impacts - these impacts include induced investment and non-monetised environmental and social impacts. These impacts can be used as switching values for the change in VfM categorisation.

6.1.3. It is an 'in the round' consideration of these three levels of impact which inform the overall VfM assessment. Figure 6-1 shows an overview of the economic appraisal process that will be followed to determine the VfM.

6.1.4. The HM Treasury Green Book sets out the guidance applied by to appraise projects, programmes and policies.

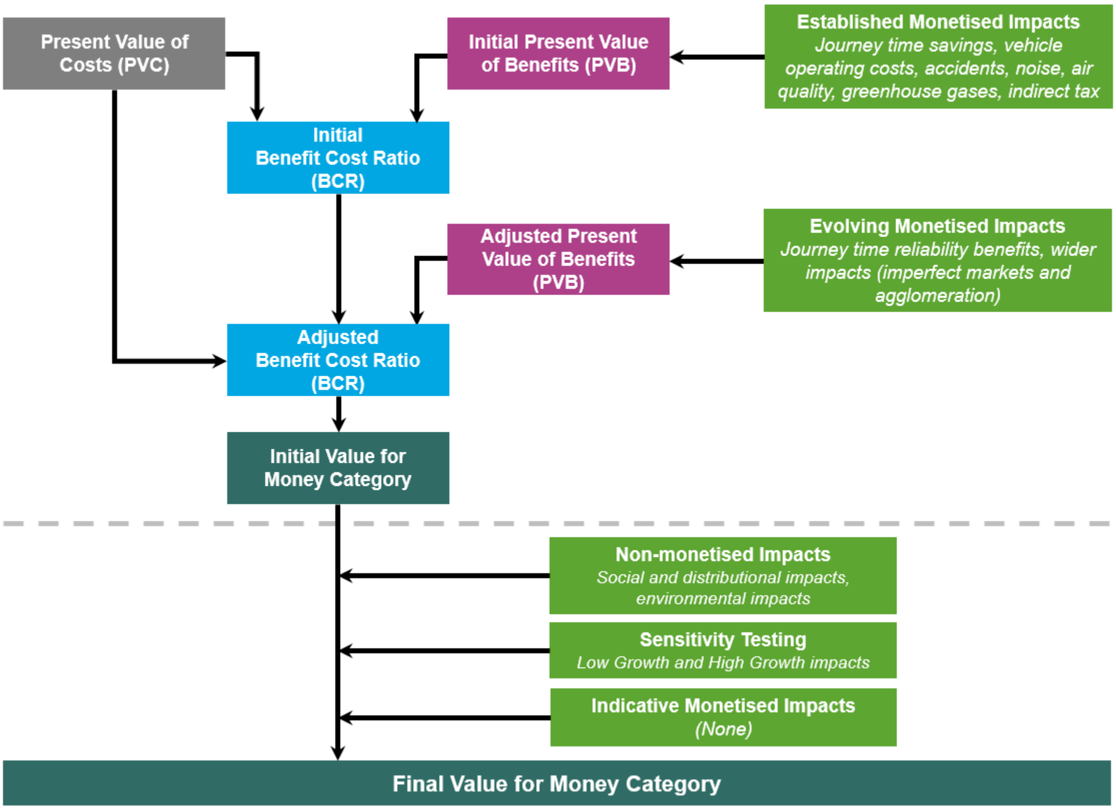
6.1.5. The recent updates include:

- A reduced emphasis on the benefit cost ratio (BCR) and corresponding increased emphasis on the Strategic Case in business cases with proposals needing to demonstrate strong fit with national policy priorities.
- Increased weight given to health impacts within appraisal with reduced discount rates being applied to physical activity, air quality, noise and accidents.
- The inclusion of place-based analysis, including the consideration of local impacts rather than solely national changes.
- Further detail of transformational schemes.

6.1.6. The OBC appraisal will reflect these changes in the Green Book, and the appraisal process will be reviewed to account for any further guidance from DfT as details are provided.

[1] Value for Money Framework, Department for Transport, 2015

Figure 6-1 - Calculation of BCR and VfM score – methodology



6.1.7. The appraisal will be undertaken for each of the packages of interventions defined by the Preferred Option and Low Cost Alternative, considering the impacts of the bus infrastructure and active mode infrastructure for each package.

6.1.8. As the OBC is centred around the infrastructure requirements on the corridor the benefits of this only will be included within the economic appraisal. Improvements to the operating model of the service(s) on this corridor are being considered as part of the BSIP and therefore the benefits (and costs) will be captured as part of this workstream as opposed to BBSC. The infrastructure improvements are likely to lead bus service improvements, however these will be implemented after the infrastructure improvements are in place and as such will not be included in the Do Minimum models.

6.1.9. Different tools will be used for different elements of the assessment. All these assessments will be combined together in an appraisal model with a consistent value.

6.1.10. To reflect the differing nature of infrastructure being delivered under the BBSC programme, within the appraisal, costs and benefits will be considered over different appraisal periods from the assumed opening year (2027) depending on the element of the scheme. The public transport and highway impacts of the scheme will be appraised over the standard 60-year appraisal period, while the walking and cycling appraisal will be over a shorter period of 40 years with sensitivity tests of 20 and 60 years.

6.1.11. All costs and benefits will be the presented in the DfT's base year (2010) present values (PV), market prices (TAG Unit A1-1). Monetised impacts will be rebased to 2010 prices using Gross Domestic Product (GDP) Deflator forecasts from the latest TAG Data Book. Impacts will be converted to PV using social or health discount rates as set out in the TAG Data Book. Where required, impacts will be adjusted to market prices from the factor unit of account using the adjustment factor within the TAG Data Book.

6.1.12. Given the range of interventions included within the BBSC programme, a range of tools and approaches will be utilised within the scheme appraisal. The following sections set out the approach to appraisal for each of the sub-impacts within the AST.

6.1.13. The Appraisal Specification Summary Table (ASST) in **Appendix A** summarises the appraisal approach and the information against each of the sub-impacts in the Appraisal Summary Table (AST).

6.2 Economic impacts

Business users and transport providers

6.2.1. The principles behind the valuation of transport user costs are based upon monetising the changes in:

- Travel time, disaggregated into public transport user and highway user impacts.
- User charges, including changes in fares, tariffs and tolls.
- Vehicle operating costs met by the user (applicable to highway journeys only).
- Transport operator revenues.

Travel times

6.2.2. WERTM will be used to capture journey time changes to public transport and highway users as a result of the scheme. The DfT's Transport User Benefit Appraisal (TUBA) software will be used to calculate and monetise the impacts. The appraisal will make use of the latest version of TUBA at the time when the modelling is undertaken. The outputs from TUBA will be in 2010 PV market prices.

6.2.3. Travel time benefits will be analysed to ensure that the level of benefit derived in each modelled year and time period is comparable and sensible. Travel time benefits will also be analysed using a suitable sector system to better understand where benefits are generated and to identify any anomalies. Impacts for trips fully outside of the study area, likely to be due to model noise, will be excluded from the appraisal.

6.2.4. As discussed previously the first forecast year for WERTM is 2029, however it is currently assumed that BBSC will open in 2027. For the purposes of the OBC appraisal, the 2029 forecast will be a proxy for the opening year as it only within 2 years of the opening year and the growth over this period is unlikely to be significant.

6.2.5. The following checks will be undertaken on the TUBA outputs:

- TUBA outputs will be reviewed and commentary provided on the split of benefits between mode, purpose, time period and modelled year will be provided.
- An analysis of sectoral benefits in the two modelled years will also be undertaken.
- Serious warnings will be reviewed and commentary provided on their realism
- Benefits for trips fully outside of the study area shown below will be excluded. A link based analysis in SATURN of proxy benefits (using rule of a half) will be used to identify significant areas of benefit outside the study area. Subject to the results of this analysis, the highway model may be cordoned before providing inputs into TUBA.

User charges

6.2.6. The scheme itself is focussed on the infrastructure required to provide more frequent services, not on the provision itself, therefore there will be no changes in fares on the existing or new services.

Vehicle operating costs

6.2.7. Similarly to the travel time impacts, for highway users the impact of the scheme on fuel and non-fuel vehicle operating costs will be estimated using WERTM. TUBA will then be used to calculate, and monetise, the vehicle operating cost impacts. The outputs from TUBA will be in 2010 PV market prices.

Transport operator revenues

6.2.8. The fare structure for the improved BBSC service is assumed to be similar to the existing structure. The impact on transport operator revenues will be estimated within WERTM and then extrapolated over the appraisal period within TUBA.

Construction and Maintenance Impacts

6.2.9. Until detailed design is underway and a contractor is appointed, the extent and duration of construction impacts are not yet fully known. Until the construction and traffic management plans are developed in more detail this will not be assessed. However, a high-level review will be undertaken which will highlight the main risk areas and areas for disruption during construction and maintenance works. This will be further investigated and appraised at the FBC stage.

Annualisation factors

6.2.10. Within TUBA, the outputs by modelled hour will be expanded to represent an annual value. The factors to expand from modelled hour to modelled time period will be derived using count data from the local area. B&NES have a number of count sites located on the A4; this data is currently being analysed to determine the factors to be used to expand from peak hour to peak period. These daily modelled periods will be annualised using a factor of 253 working days per year. This factor will be used for all assessments including, highway, public transport and active travel, the assessment will not account for any seasonal variation that may exist and impacts over the weekend will not be assessed as no models exist for this period.

Reliability

6.2.11. TAG Unit A1.3 states that it is not currently possible to estimate monetised reliability benefits for single carriageway roads outside urban areas (like the A4 corridor). An assessment of reliability could theoretically be undertaken based on changes in ‘stress’, the ratio of the Annual Average Daily Traffic flow to the Congestion Reference Flow. A qualitative assessment will be undertaken in line with the guidance.

6.2.12. For public transport reliability impacts an assessment in line with TAG will be undertaken which will use the lateness against the timetabled journey times for the service for each scenario and modelled period. It will compare the Do Minimum to the Do Something to identify what differences in reliability can be associated with the scheme.

Wider impacts

6.2.13. TAG Unit A2.1 sets out the guidance for considering whether a transport scheme may result in wider economic impacts and the approaches for estimating these. The impacts in secondary (non-transport) markets can be captured through changes in induced investment, through employment effects and agglomeration economies. TAG Unit A2.1 states that these are impacts “could occur in response to a reduction in transport costs” such as journey time savings as a result of the scheme proposals.

6.2.14. In accordance with TAG Unit A2.1, the impacts can be grouped into the following types of wider economic impacts associated with enhanced connectivity as a result of the scheme:

- Agglomeration - productivity benefits of businesses being clustered together.
- Labour supply impacts - the economically inactive due to high perceived transport costs or lack of transport links may now have better access to employment opportunities.
- Output change in imperfectly competitive markets - reducing businesses travel costs such that they can increase output, reduce prices and increase productivity.
- Land value uplift - the economic value of a development which is dependent on a transport intervention.

6.2.15. As discussed in Section 5.5, dependent development (and therefore land value uplift) will not be considered as part of the OBC due to the status of Local Plans. However, it is understood that delivery of BBSC, and provision of better sustainable transport infrastructure, will help to facilitate some sites in the pipeline. Although formal induced investment appraisal (in line with TAG Unit A2-2) will not be undertaken, consideration will be given to the potential benefits associated with this and these will be reported in the Economic Dimension but not included in the VfM assessment in line with the DfT framework.

6.2.16. However, there could be a case to consider the remaining wider economic impacts. The justification for including wider impacts will be outlined within the Economic Narrative which will be produced and appended to the Economic Dimension. Any supplementary appraisal and modelling of wider economic impacts that are found to be appropriate will be considered. The appraisal will be undertaken in alignment with TAG Units A2-1 - 2-4 and M5.3, and the wider economic impacts would be considered as part of the Adjusted BCR.

6.3 Environmental appraisal

6.3.1. The process followed for the OBC environmental appraisal will align with the guidance presented within the TAG Unit A3 Environmental Impact Appraisal and the Combined Authority Transport Appraisal Guidance.

6.3.2. The following impacts will be considered within the environmental appraisal:

- Noise.
- Air quality.
- Greenhouse gases.
- Landscape.
- Townscape.
- Historic environment.
- Biodiversity.
- Water environment.

6.3.3. A Preliminary Environmental Appraisal Report (PEAR) and sensitivities mapping have been prepared to support the design development and appraisal for the two shortlisted options. This includes the following:

- A summary of the existing baseline conditions, a commentary on the key environmental constraints and what they mean for the scheme.
- A summary of the current legislation and guidance coming forward.
- A qualitative assessment of each option based on a standard seven-point scale with an overall appraisal score for each. This scoring system and its description (e.g. “Moderate Adverse”) align with DfT’s standard approach.

6.3.4. Opportunities for delivering additional biodiversity benefits will also be considered for each of the two shortlisted options.

6.3.5. TAG worksheets will be prepared for each of the environmental indicators and the appraisal will be summarised in the Appraisal Summary Table (AST) that will be appended to the OBC.

6.3.6. The proposed assessment approach for each of the individual topic areas is detailed in the following sections.

Noise

6.3.7. A quantitative appraisal of the noise impacts of the scheme will be undertaken in accordance with TAG Unit A3, Section 3, and the appraisal will include:

- Scoping to determine the study area for assessment.
- Quantification of noise impacts.
- Appraisal of local noise impacts.
- Preparation of TAG Noise Workbook.

6.3.8. Noise sensitive receptors and potential significant noise impacts will be identified for both options. The location of NIAs for noise and main clusters of dwellings within 100m of the option routing will be identified.

6.3.9. To undertake the assessment, the annual average weekly traffic (AAWT) flows, average speed (kph) and percentage heavy goods vehicle data will be extracted from the highway model for the base year and future years under the Do Minimum and Do Something scenarios. Public transport vehicles will be accounted for within these model outputs as buses will be considered within HGV proportions.

6.3.10. As stated in Section 5.2, the future model years are 2029 and 2042. 2029 will act as a proxy for the 2027 opening year with the 2042 model year forming the 15 year post opening appraisal year.

6.3.11. A Speed Pivoting process as set out in DMRB LA111 will not be undertaken at this stage. This is proportionate to the current stage of the assessment.

Air quality

6.3.12. A quantitative appraisal of air quality impacts will be undertaken in accordance with TAG Unit A3, Section 3, and the appraisal will include:

- Scoping to determine the study area for assessment.
- Quantification of air quality impacts.
- Appraisal of local air quality impacts.
- Appraisal of regional air quality impacts.
- Monetary valuation of air quality impacts.
- Consideration of the distributional impacts of air quality changes.
- Completion of the TAG Air Quality Worksheet.

6.3.13. The appraisal will consider the effect of the scheme on the surrounding area during the construction and operational phases. It is expected that through modal shift and reduction in congestion there will be a potential overall beneficial impact on air quality. Given the potential offline nature of parts of the scheme route, there may be some areas where a negative impact occurs.

6.3.14. The air quality appraisal will use the highway model to determine the appraisal area, where traffic flows are predicted to undergo significant change due to the scheme. The traffic change criteria are any of the following:

- Annual average daily traffic (AADT) >=1,000.
- Heavy duty vehicle (HDV) AADT >=200.
- a change in speed band.
- a change in carriageway alignment by >=5m.

6.3.15. For both options, the study area over which air quality impacts will be considered will be limited to corridors extending 200m either side of the potential Affected Road Network (ARN). The ARN is defined in accordance with TAG Unit A3. The quantification of changes in concentrations at properties within the study area due to the scheme will be calculated.

6.3.16. The annual average daily traffic flows, average speed (kph) and percentage heavy goods vehicle data for the base year and future year models will be used under the Do Minimum and Do Something scenarios.

Greenhouse gas

6.3.17. Operational greenhouse gas emissions will be assessed quantitatively to inform the OBC appraisal. The assessment will be undertaken in line with TAG Unit A3, and IEMA's (2021) Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance.

6.3.18. It is not intended to use the greenhouse gas output from TUBA to estimate the change in carbon dioxide emissions as TUBA estimates fuel consumption based on the average speed for an entire journey. The proposed approach to estimating operational greenhouse gas emissions considers the model outputs on a link by link basis, rather than across the whole journey.

6.3.19. The proposed approach considers the proportions of the vehicle types, fuel type, forecast fuel consumption parameters and emission factors, sourced from the TAG Data Book. From this, emissions will be quantified for each year over the lifetime of the scheme and these emissions will be monetised using the greenhouse gas workbook. The greenhouse gas TAG tool output uses the 'central' net present value as default, we will report the low and high figures as well.

6.3.20. This assessment focusses on the quantification of operational emissions and does not consider whole lifecycle impacts (construction/embodied carbon). The project team are currently determining the best approach to considering embodied carbon for all projects within the Combined Authority area. It is proposed to undertake a whole life carbon assessment (to include construction and embodied carbon) and integration of carbon management (in the form of a Carbon Management Plan) at early design stages as suggested in the DfT Carbon Management Guidance for OBCs.

Landscape and townscape

6.3.21. Landscape and townscape will be appraised qualitatively based on the environmental resources that they each represent and their attributes such as character, distinctiveness, sensitivity and value in line with the TAG Unit A3, sections and 7.

6.3.22. The proposed methodology for qualitatively appraising the landscape and townscape effects are summarised below:

- **Scope and identify study area:** The assessment of potential impacts on the landscape and townscape will consider relevant features within 2km of each of the options. The study area for the appraisal will also include areas from which the proposed scheme could be visible and potentially have a significant visual effect.
- **Identify key landscape and townscape features:** The baseline will establish qualitatively, via desk study, the character of the landscape and townscape, its distinctive features and visual characteristics.
- **Describe anticipated impacts of the options (direct and indirect) on identified key landscape and townscape features and the likely effects:** The significance of effect on the local setting, visual amenity, pattern, tranquillity, and cultural or landcover elements of the existing landscape will vary between the different options. This is dependent on several factors, such as the proximity to a sensitive feature; extent (frequency, type) of recreational use; cultural value; landscape character and level of public enjoyment.
- **Define overall assessment score:** A score will be attributed based on the standard 7-point assessment scale.
- **Completion of TAG Landscape and Townscape Worksheets**

Historic environment

6.3.23. A qualitative assessment of the impact of the scheme on the historic environment will be made. Given the status of the City of Bath as a World Heritage Site this indicator is particularly important for the BBSC scheme.

6.3.24. The study area will initially consider 200m from each of the options for bus routes and 50m for cycle route options.

6.3.25. Based on the option designs there could be adverse impacts on the settings of multiple designated assets as a result of the scheme during the operational period. Depending on the location and nature of the scheme’s elements, there is also a risk of physical harm to designated heritage during the construction phase. It is usually not appropriate to consider environmental impacts during, or as a result, of construction. However, should these impacts be deemed relevant they will be taken into consideration.

6.3.26. The appraisal will be based on key data sources and information immediately available within the baseline study area for each corridor. This includes:

- Historic England National Heritage List for England (NHLE) - information on statutory designations including scheduled monuments and listed buildings.
- Unitary Authority Conservation Areas.

6.3.27. The proposed methodology for qualitatively appraising the Historic Environment effects is summarised below, it will be conducted in line with TAG Unit A3 section 8:

- **Scope and identify study area:** The assessment of potential impacts on the historic environment will consider relevant features within 200m of each of the options for bus routes and 50m for cycle route options. This could be reduced or further increased following closer scrutiny of the finalised route options and number and types of assets identified on baseline data collection.
- **Identify key historic features:** The baseline will establish qualitatively, via desk study, the character of the historic environment, its distinctive features and characteristics.
- **Describe anticipated impacts of the options on identified historic key features and the likely effects:** Appraisal against a set of judgemental indicators to establish the significance of each key historic environmental resource will be conducted. This will provide an assessment of the scale and seriousness of the impact. The extent to which the identified significance will be either compromised or enhanced will be identified, including any mitigating effects. All impacts on the key historic environmental resources, either adverse or beneficial, will be identified, along with their magnitude.
- **Define overall assessment score:** A score will be attributed based on the standard 7-point assessment scale.
- **Completion of TAG Historic Environment Appraisal Worksheets**

Biodiversity

6.3.28. The scheme area is connected via watercourses to several internationally designated ecological sites, including Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Ramsar sites. The corridor is also within 30km of a SAC designated for bats. The biodiversity appraisal will consider potential impacts on these sites and the requirement for a Habitats Regulation Assessment.

6.3.29. The baseline study area for the corridor contains local and national statutory and non-statutory designated sites including, Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Local Nature Reserves (LNR) and Sites of Nature Conservation Interest (SNCI). Potential impacts on these sites will be assessed within the biodiversity appraisal.

6.3.30. The corridor and associated study areas (as described in the Environmental Baseline Report) support areas of Important Open Space, Ancient Woodland Inventory (AWI) parcels and Habitats of Principal Importance (HPI). Granted European Protected Species (EPS) licences were also identified within each of the corridors and study areas for bats, great crested newts *Triturus cristatus* and hazel dormouse *Muscardinus avellanarius.*

6.3.31. Biodiversity Action Plans are in place for both species and habitats within the proposed corridor. This includes specific habitat action plans, species action plans and local priority species listed for each UA area that the corridors intersect. Further work to identify habitats of high ecological value and of local conservation importance will be included within the biodiversity work.

6.3.32. In line with TAG Unit A3, the methodology for qualitatively assessing biodiversity and potential impacts within the OBC is summarised:

- Scoping and identifying the study area.
- Identifying statutory and non-statutory designated sites, HPIs, AWI and Important Open Spaces.
- Identifying protected and/or notable species records, where available, including EPS licences.
- A high-level feasibility BNG assessment to capture likely habitat change within the study area.
- Assessment of the anticipated impacts, and opportunities, of the scheme on ecological receptors will be undertaken.
- Completion of TAG Biodiversity Worksheet.

6.3.33. The ‘biodiversity’ term used for the standard TAG assessment covers the conventional ecological work such as consideration of impacts on habitats, designated sites and protected and notable species, via survey, mitigation and licensing as required.

6.3.34. Biodiversity Net Gain (BNG) is a specific assessment term which relates to a new and emerging process by which biodiversity is given a proxy numerical value (biodiversity units) and a metric quantifies a percentage change in those units. A series of qualitative principles underpin the BNG process.

6.3.35. BNG will be mandatory for all Town and Country Planning Act and non-permitted development (with a couple of minor additional exclusions) from November 2023.

6.3.36. A high-level BNG assessment will be included as part of the OBC appraisal, this will outline potential impacts on broad habitats, likely BNG deficits and opportunities to enhance and create habitats to meet an overall BNG outcome.

Water environment

6.3.37. The impact on the water environment will be assessed qualitatively. In addition to the TAG Unit A3, the Design Manual for Road and Bridges (DMRB) LA 113 Road Drainage and the Water Environment guidance will also be referenced where appropriate. The following data sources will be used in informing the appraisal:

- Ordnance Survey Mapping.
- The Environment Agency's online indicative flood maps.
- Environment Agency catchment data explorer.
- The MAGIC geographical information portal.
- River Basin Management Plans (RBMP).
- The British Geological Survey (BGS) Geological Viewer.
- Wessex Water Sewer Plans (if available).

6.3.38. The assessment of potential environmental effects will include surface water features, such as watercourses and ponds up to 0.5km from each option, as well as groundwater features and groundwater abstractions up to a maximum of 1km from each option.

6.3.39. The study area for the assessment of flood risk will be defined by the extent to which flood risk may be influenced and the extent of the relevant Flood Zones. Although it is typical to consider risks up to a maximum distance of 1km from such schemes, the study area will also be driven by the wider consideration of the potential impact to people and property.

6.3.40. The potential receptors of high importance, such as large surface water or groundwater abstractions, source protection zones, downstream watercourses and Main Rivers will be included within the study area based upon their likely hydraulic connectivity.

6.3.41. A Flood Risk Assessment (FRA) will not be undertaken at the OBC stage but it is anticipated that a FRA will be required for some of the elements of the options to support subsequent design and future planning applications.

6.3.42. The assessment will consider attributes similar to those considered for Water Framework Directive (WFD) assessment i.e. ecological, hydromorphological, chemical and quantitative quality, but it is not proposed to undertake a WFD assessment at this stage.

6.4 Social and distributional impact appraisal

6.4.1. This section outlines the approach to the social and distributional impact appraisal that is proposed for the OBC. The approach follows the guidance set out by DfT in TAG Unit A4.1 Social Impact Appraisal and TAG Unit A4.2 Distributional Impact Assessment.

Social impacts

Commuting and other users; and reliability

6.4.2. The appraisal of commuting and other user benefits, and the impact of BBSC on journey time reliability, will be undertaken using the same process detailed for business users and transport providers. The model will be segmented to extract different trip purpose information.

Physical activity

6.4.3. The appraisal of physical activity impacts will be undertaken in accordance with TAG Unit A5.1 Active Travel Mode Appraisal.

Cycling

6.4.4. Benefits associated with the provision of dedicated cycling routes and facilities as part of the BBSC will be considered. Two elements of the BBSC will be appraised (refer to section 3.1):

- Benefits associated with the strategic cycling corridor between Bristol and Bath.
- Benefits associated with community connections, i.e. linking local communities along the A4 with the BBSC corridor through improved walking and cycling links.

6.4.5. The approach will be to calculate the benefits using the latest version of the DfT's Active Mode Appraisal Toolkit (AMAT).

6.4.6. By using the AMAT, the following benefits will be quantified:

- User benefits – journey quality improvements from changes in infrastructure.
- Business benefits - reduction in absenteeism.
- Health benefits - economic benefits of preventing early mortality through cycle exercise.
- Modal shift impacts– impacts associated with a reduction in car trips due to modal shift to cycling or walking (i.e. congestion, noise, air quality, greenhouse gases, accidents, infrastructure savings and indirect tax).
  - *NOTE: care will be taken to avoid double-counting of benefits between MECs and benefits appraised through TUBA*

6.4.7. The DfT guidance on using the AMAT provides a full explanation of these benefits, and the external sources from which they are derived.

AMAT Inputs

6.4.8. To calculate the scheme impacts, the AMAT requires the user to input several scheme-specific variables, including:

- Scheme opening year.
- Last year of funding.
- Type of area scheme is located (e.g. Bristol, conurbations, rural).
- Number of walking and cycle journeys per day without the proposed scheme.
- Number of walking and cycle journeys per day with the proposed scheme.
- The average proportion of a trip which uses the scheme infrastructure.
- Current walking and cycling infrastructure for the route.
- Proposed new walking and cycling infrastructure.
- Appraisal period.
- Annualisation factor that converts daily trips into annual trips.

6.4.9. The economic benefits of the walking and cycling improvements will be appraised over a 40-year period in the core scenario. As a sensitivity test the improvements will also be appraised over a 20-year and 60-year period.

Cycling trips

6.4.10. To calculate the baseline number of cycling trips that may use the proposed facilities, four data sources will be considered, in order of preference:

1. **BCC and B&NES count data** (currently being reviewed to determine available data).
2. **DfT Annual Average Daily Flow (AADF) counts** (currently being reviewed to determine available data).
3. **Additional Survey Data** (additional survey data may need to be collected to cover any gaps in coverage) this will be agreed with the Combined Authority.
4. **Propensity to Cycle tool (PCT) origin-destination flows**. The PCT is based on 2011 census journey to work data. In some cases (i.e. where there are any off-road sections), the road link which runs adjacent to the scheme will be used to understand the potential demand. As the PCT only accounts for commuting trips, which according to the National Travel Survey (NTS) (2017) account for 34.3%, the PCT value will be converted into all trips by multiplying by a factor of 2.92, it will then be doubled to account for two-way trips.

6.4.11. Growth factors obtained from NTEM v8.0 will be used to forecast the demand for the opening year using the baseline demand from the survey data.

For the sections that propose new or improved cycle infrastructure, benefits will be captured to account for the attraction of new cyclists shifting from other modes. The uplift is proposed to be based on the following for both the Strategic Cycling Corridor and the Community Connections elements:

- **Approach 1 - Comparative Study:** This requires researching other schemes that have been implemented elsewhere to see what level of impact they have had in terms of uplifts in walking and cycling trip numbers. This will involve analysis of the similarities and differences between the comparators and the schemes. Justification will be provided to highlight how the comparative studies are applicable; or
- **Approach 2 – Sketch Plan Method:** This technique employs the approximate elasticity estimate for the change in demand for cycling in a district, based on a change in the proportion of available routes that have facilities for cycle traffic. This method would be used for a network of routes across the area.

6.4.12. For both cycling and walking demand, the AMAT inputs will be based on the overall change in demand for walking and cycling for the scheme (accounting for any displacement of trips from other routes). A number of sensitivity tests will be undertaken to understand the impact that the assumed uplift in demand has on the appraisal outputs, including:

- Using the CRSTS target for modal shift/percentage increase of cycling.
- Using the DfT Active Travel Fund (ATF)4 Uplift Tool.

6.4.13. WERTM will not be used in active mode appraisal as this element of the model is uncalibrated. Modelling the walking and cycling elements of BBSC in WERTM to predict future changes in walking and cycling trips is not advisable. There is no clear guidance on how to update parameters in WERTM to reflect many of the proposed elements of the scheme.

6.4.14. It can:

- Forecast long term trends in the relative changes in walking and cycling demand.
- Forecast absolute changes in PT trips and therefore information re: the walk leg of these trips could be extracted.

6.4.15. Therefore, we will use WERTM to validate the AMAT assessments in terms of demand growth including growth related to PT.

Walking

6.4.16. Benefits for pedestrians as a result of the scheme will also be assessed in the AMAT. To establish the baseline demand, four data sources will be considered, in order of preference:

1. **BCC and B&NES count data** (if available and where there is sufficient coverage of routes).
2. **Strava Metro data** (if available and where there is sufficient coverage of routes).
3. **Additional Survey Data** (additional survey data may need to be collected to cover any gaps in coverage) this will be agreed with the Combined Authority.
4. **Propensity to Cycle tool (PCT) origin-destination flows**.

6.4.17. Given the uncertainty of what the demand for the scheme will be in the scheme opening year compared to the PCT's 2011 database, NTEM v8.0 will also be used to forecast the growth in demand between 2011 and the opening year.

6.4.18. There is limited guidance within TAG for estimating walk uplifts. Given the multi-faceted nature of the most appropriate approach is considered to be the use of comparative case studies which accord with the scheme proposals.

6.4.19. The Active Travel England Uplift Tool, as provided as part of the Tranche 4 of the Active Travel Fund (ATF4), will be used as a sensitivity test for uplift for both the walking and cycling interventions.

Assumptions

6.4.20. For both the cycling and walking appraisal, when calculating how much of an average trip will use the intervention, the scheme length will be divided by the average trip length for either walking or cycling (derived from NTS). As suggested by the ATF guidance, a cap of 50% should be used if using Manual Classified Counts for baseline trips.

6.4.21. Several other parameters are also included within the AMAT (e.g. the assumed average speed for walking and cycling). For these, the DfT has provided default values based on various DfT-defined sources and research; these default values will be retained unless specified elsewhere as part of the appraisal. The exception being annualisation factors.

6.4.22. There is the potential for benefits to be under-represented in the appraisal of active mode schemes, due to the application of an annualisation factor. Within the AMAT there is a default assumption of 253 days set for the “Number of days for which intervention data is applicable per year”. This is based on 365 days per year minus weekends and bank holidays. As such this assumes the scheme is applicable only on “workdays”. Therefore, any impacts for weekends and bank holidays will not be reflected.

6.4.23. Where possible average day counts will be sourced, these can be multiplied by 365 to annualise the counts.

Journey Quality

Bus Passenger Benefits – User Experience

6.4.24. As part of the BBSC programme, aligned with the emerging proposals from the Combined Authority BSIP, bus stop facilities serving the BBSC service will be improved and interchange points created.

6.4.25. To measure the benefits of the improved waiting environment, generalised minute values for a series of ‘soft factors’, displayed in Table 6-1 and taken from TAG Data Book section M3.2.1, will be applied to forecasted bus boarders at specific stop locations which are proposed to be upgraded. Only the appropriate measures will be included within the analysis where they align to the scheme proposals. The implied time savings will be fed back into the variable demand modelling to capture the demand uplifts and benefits of improved bus stops, waiting facilities and bus quality over a 60-year appraisal period.

Table 6-1 - Soft factors: generalised minute values

Soft measure	Bus users	Car users	Overall
CCTV at bus stops	3.70	2.49	2.91
Climate control	1.24	Not applicable	Not applicable
New bus shelters	1.08	Not applicable	Not applicable
New Bus with Low Floor	1.19	2.23	1.78
New interchange facilities	1.27	Not applicable	Not applicable
On-screen displays	1.90	0.89	1.29
RTPI (at bus stops)	1.47	1.74	1.69
Simplified ticketing	0.84	2.06	1.43

Urban realm improvements

6.4.26. Urban realm improvements are proposed as part of the scheme through the creation of interchange hubs along the corridor.

6.4.27. The benefits generated from these public realm improvements will be based on Transport for London's (TfL's) Ambience Benefits Calculator (ABC). The tool captures the monetised benefits of improvements to the public realm based on a change in state of infrastructure and a willingness to pay for this. The tool can capture impacts associated with new and improved crossing facilities, plants and public art. The value of using ABC is that it avoids the two-stage process of first having to do a Pedestrian Environment Review System (PERS) audit. It also looks at individual attributes and gives a value for each attribute, so it is clear what proportion of benefit each attribute is providing. The ABC tool has been used on a number of other projects which have been successful in receiving funding.

6.4.28. As the ABC is a TfL tool, the willingness to pay values are based on surveys undertaken in London. To adapt this tool to the local context of the scheme, the benefits output will be adjusted to reflect B&NES. A reduction factor will be applied to the London's willingness to pay figures, based on the relation between median hourly pay in London and B&NES, using official statistical data from the Annual Survey of Hours and Earnings (Office for National Statistics).

6.4.29. As the ABC produces outputs for a single year, a summary tool has been designed which allows appraisal periods to be set and the PVB to be returned in 2010 prices and values as per TAG.

6.4.30. As the AMAT includes journey quality/ambience benefits for pedestrians along the improved routes this will not be assessed with the ABC to avoid double counting. The ABC will focus on those aspects which are not included in the AMAT assessment, such as new or improved crossing facilities.

6.4.31. The same approach will be taken to count data as set out in the Physical Activity section.

Accidents

6.4.32. The scheme is likely to result in impacts on accidents from two perspectives:

- Changes in number of vehicle accidents through changes in use of the highway network.
- Changes in number of pedestrian and cyclist accidents through provision of improved infrastructure.

General traffic impacts

6.4.33. The impact of the scheme on accidents will be assessed by using COBA-LT software, in line with the methodology set out in TAG Unit A4.1. COBA-LT calculates the number of accidents within the assessment area for the Do Minimum and Do Something scenarios and can therefore determine accident reductions.

6.4.34. The assessment area to be included within the COBA-LT assessment will be determined and agreed by analysing traffic flows. Indicatively a +/-10% threshold in link flow change between the Do Minimum and Do Something scenarios will be used to determine the study area, but this is not fixed, especially where this appears to be 'noise' on minor links some distance from the scheme rather than a genuine effect. It is anticipated that modelling of the

A4 only will be required this will use observed accident rates, if screening suggests that other links should be considered then it is proposed to use default link and junction rates combined.

6.4.35. The change in vehicle accidents due to modal shift to active modes will be captured in the AMAT and this will be combined with the COBA-LT outputs to provide an overall accident impact for vehicles.

Cyclist/pedestrian impacts

6.4.36. As the AMAT does not account for reductions in accidents to cyclists or pedestrians as a result of the improved infrastructure, the suggested approach to capture this reduction involves monetising the accidents involving cyclists and pedestrians that may have been prevented if the improved walking and cycling infrastructure was already in place.

6.4.37. To undertake the analysis, detailed accident data (STATS19) will be used for the last full five years, excluding 2020 and 2021, (2016 to 2022 inclusively) to understand the accidents along the scheme extent that involved pedestrians and cyclists. TAG Data Book monetary values for the prevention of causalities will then be used to calculate the overall accident prevention benefit for pedestrians and cyclists. Care will be taken to reduce the risk of double counting of accidents involving cars. Only accidents involving cyclists/pedestrians and not cars will be included as part of this analysis.

Security

6.4.38. The delivery of transport schemes and interventions may affect the level of both real and perceived security for transport users. In line with TAG Unit A4.1, a qualitative assessment will be undertaken to consider the changes in security due to the scheme and the likely number of users affected. The impact will be reported on the standard 7-point scale.

Accessibility

6.4.39. As recommended in TAG Unit A4.1, to assess the impact a screening of accessibility impacts and a Distributional Impact Analysis (elaborated in Chapter 6.4) will be undertaken. The latter will identify the impacts on different groups of people considering different elements of a journey.

6.4.40. The qualitative assessment will be undertaken using the Strategic Accessibility Worksheet as recommended in the guidance. The impact will be reported on the standard 7-point scale.

Personal affordability

6.4.41. As recommended in TAG Unit A4.1, to assess the impact a screening of personal affordability impacts and a Distributional Impact Analysis (elaborated in Chapter 6.4) will be undertaken. The latter will identify the impacts on different groups of people considering different elements of a journey. The impact will be reported on the standard 7-point scale.

Severance

6.4.42. To assess the impact of the BBSC options on severance, a qualitative assessment of the difference in the level of severance in the Do Minimum and Do Something scenarios will be reviewed in line with TAG Unit A4.1. The assessment will consider the nature of any change in severance and the number of people potentially impacted, and the impact will be reported on the standard 7-point scale.

Option and non-use values

6.4.43. TAG Unit A4.1 states that option and non-use values should be 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). As the intention of the scheme is to provide the infrastructure to enable an *improved* service to run between Bath and Bristol, it is not considered that there will be any significant impact on option and non-use values. Therefore, no assessment will be undertaken as part of the OBC.

Distributional impacts

6.4.44. The assessment of Distributional Impacts (DIs) is designed to help understand the impacts of transport interventions on different groups of people, including those people that are potentially more vulnerable to the potential effects of transport schemes. The analysis of DIs is mandatory in the appraisal process and is a constituent of the Appraisal Summary Table (AST).

6.4.45. The DI analysis will be undertaken in line with TAG Unit A4.2 Distributional Impact Appraisal. The appraisal considers both beneficial and adverse impacts on the different social groups that might be affected, against the following indicators:

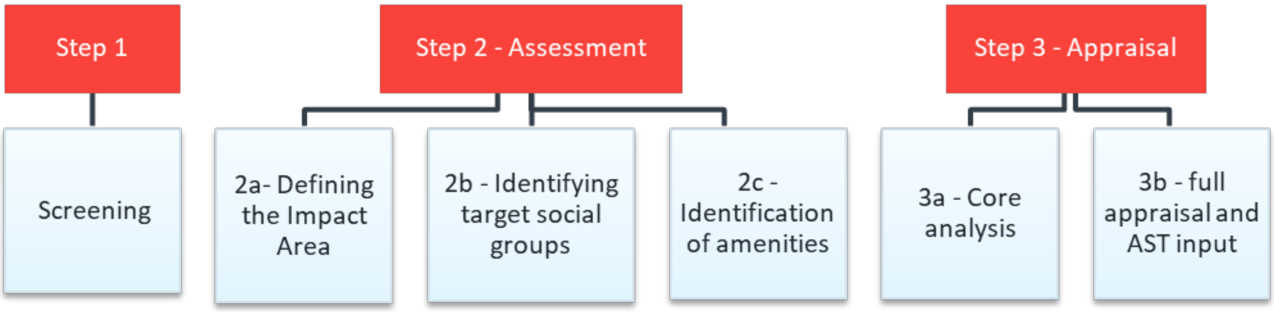
- Users Benefits.
- Noise.
- Air Quality.
- Accidents.
- Security.
- Severance.
- Accessibility.
- Affordability.

6.4.46. The appraisal process consists of 3 steps:

- Screening Process – identification of likely impacts for each indicator.
- Assessment – identification of impact area, social groups and amenities.
- Appraisal of impacts – analysis of impacts, full appraisal and input into AST.

6.4.47. The assessment and appraisal steps are split down further into separate sub-steps as shown in Figure 6-2.

Figure 6-2 –TAG Distributional Impact Process



6.4.48. The first step in the process involves undertaking initial screening to identify the likely impacts of the BBSC against the key indicators specified in TAG Unit A4.2.

Approach

6.4.49. Each indicator will be assessed individually using the TAG screening proforma. The output of this assessment will determine whether the intervention needs to be assessed further. Consideration will be given to:

- Whether there might be positive or negative impacts on different social groups.
- If changes to scheme design can mitigate any potential negative impacts.
- How dispersed the impact is likely to be.

6.4.50. At this stage, previously anticipated impacts (based on the SOC assessment) will be used to determine whether the indicator should be progressed to Step 2. The screening considers the extent and dispersion of the likely impact across social groups and geographical area.

6.4.51. Step 2 investigates the impacts that are carried forward from the screening step in more detail to confirm where both spatial impacts will be experienced, and where socio-economic, social and demographic characteristics need to be further considered.

6.4.52. The outputs for Step 2 will be summarised in the Output Summary table (TAG Unit A4.2 Table 4).

6.4.53. Step 3 will set out the assessment of the impact of the scheme on each indicator's social groups. This step covers the core analysis of impacts which will provide an assessment score for each indicator and each of the social groups. A qualitative assessment will also be undertaken for each relevant indicator which will be summarised in the DI appraisal matrix table and the AST entries.

Equality impact assessment

6.4.54. The Equality Impact Assessment (EQIA) will be undertaken using an evidence-based approach to assess the impact of the scheme proposals on specific groups and further analysing distribution impacts.

Place-based analysis

6.4.55. A place-based assessment will be conducted in line with TAG unit A4.3, this will be complementary to the Distributional Impacts assessment undertaken for the scheme. Place-Based Analysis consider how impacts are dispersed across spatial groups.

6.5 Public accounts

6.5.1. This section details the various costs associated with delivering and operating the BBSC scheme, and how these will be estimated and accounted for within the economic appraisal. The following cost lines will be considered for the OBC appraisal:

- Investment costs, including:
  - construction costs.
  - land and property costs.
  - preparation and administration.
- Operating, maintenance and renewal costs, to estimate the whole life costs for the scheme.

6.5.2. As the OBC is centred around the infrastructure requirements on the corridor the costs of this only will be included within the Financial Dimension and the economic appraisal. Improvements to the operating model of the service(s) on this corridor are being considered as part of the BSIP and therefore the costs (and benefits) will be captured as part of this workstream as opposed to BBSC.

Investment costs

6.5.3. For the OBC stage, the design of options will be at feasibility level, with cost estimation informed by a series of 2D General Arrangement (GA) drawings based on a Topographical background and C2 information. The costs will be developed using Bill of Quantity information taken from the design drawings, this will account for all itemised changes of the identified scheme including highway resurfacing, estimates of cut/fill and structural costs based on similar schemes.

6.5.4. Percentage uplifts will be applied for scheme development and further design, assurance and implementation stages based on similar schemes.

6.5.5. These costs will provide the base cost estimate. These base costs will be profiled over the delivery period and adjusted for inflation. For the Financial Dimension, the base costs will be adjusted for identifiable risk factors that may impact on scheme costs. As part of the OBC a Quantified Risk Assessment (QRA) will be undertaken to inform this risk allowance.

6.5.6. In November 2021 an update to TAG Unit A1.2 Scheme Costs was released, which included a revised approach to the treatment of risk and optimism bias within economic appraisal. Where previously optimism bias was applied to the risk-adjusted costs within the appraisal, the optimism bias rates have been re-estimated based on reference class forecasting techniques and guidance states they should be applied to the base cost. A comparison will be made between the base costs adjusted for optimism bias and the risk-adjusted scheme costs to ensure that the scale of costs under these two approaches are similar. In line with TAG Unit A1.2, the greater of the two costs will be used within the economic appraisal and a sensitivity test be undertaken using the other.

6.5.7. TAG Unit A1.2 provides guidance for the recommended level of optimism bias to be applied for different types of projects at different stages of the transport appraisal process. Currently for highway and active travel schemes the optimism bias level recommended is 23%.

6.5.8. Within the appraisal, costs will be adjusted to 2010 PV, market prices.

Operating, maintenance and renewal costs

6.5.9. In addition to the costs of delivering the scheme, the appraisal will also capture the costs associated with maintaining the two options over their life span. These costs will be considered for the 60-year appraisal period for highway and public transport infrastructure interventions and the maintenance and renewals costs for infrastructure and vehicles. A 40-year appraisal period for the walking and cycling interventions.,.

6.5.10. It is assumed that operating, maintenance and renewal costs will grow in line with general inflation forecasts over the appraisal period. For inclusion in the appraisal these costs will be rebased to 2010 prices, discounted to present values and converted to market prices, following the same approach as for investment costs. Comparing the operating costs to the revenue will provide an indication into the financial sustainability of the system.

Treatment of costs and revenue in economic appraisal

6.5.11. The treatment of costs in the economic appraisal and BCR calculation will be dependent on how the scheme will be funded and financed, and ultimately whether costs are attributed to the public or private sector. In line with guidance (TAG Unit A1.2), costs (both capital expenditure and whole life costs) incurred by the private sector will be subtracted from the Present Value of Benefits (PVB). Revenue attributed to the private sector will be removed from these costs incurred.

6.5.12. Costs to the public sector (both capital and whole life costs) are captured within the Present Value of Costs (PVC). Any revenues attributed to the public sector will be subtracted from these costs.

Indirect tax revenues

6.5.13. The change in indirect tax revenues to central Government will be captured within the appraisal. For the appraisal of BBSC, the change in tax revenues will consider:

- Changes in tax revenues generated through changes in fuel and non-fuel vehicle operating costs for highway users.
- Changes in tax revenues as a result of changes in spending on public transport fares (which are not taxed).

6.5.14. The changes in tax revenues associated with fuel and non-fuel vehicle operating costs will be captured within TUBA using outputs from WERTM and outputs from AMAT.

6.5.15. For public transport fares this will also be captured in WERTM and TUBA based on the change in transport operator revenue.

6.6 Stakeholder engagement

6.6.1. A Public Consultation for the scheme is planned for a 6 week period starting on 18th August 2023. Once the consultation is complete all feedback will be analysed and the results reported in the Consultation Report. The responses to the consultation will be reviewed and any changes to the proposed options put forward which may result in.

7 Appraisal outputs

7.1 Appraisal reporting

7.1.1. The reporting of the economic appraisal results will be detailed in the Economic Dimension of the OBC alongside the non-monetised impacts to form an overall view of the impacts and VfM category. The justification for the VfM category will be detailed in the Value for Money Statement. As noted previously, there is an increased emphasis on the strategic fit of schemes to local, regional and national policy objectives and how schemes which don't meet these cannot offer VfM.

7.1.2. The following standard output tables required by DfT will be populated and appended to the OBC:

- Transport Economic Efficiency (TEE).
- Public Accounts (PA).
- Analysis of Monetised Costs and Benefits (AMCB).
- Appraisal Summary Table (AST).

7.1.3. The sensitivity tests will be reported within the Economic Dimension as part of the Uncertainty Analysis section setting out how changes in different factors affect the VfM of the investment. This will also include switching value analysis which will show how much the scheme costs or impacts need to change by for the VfM category to change.

wsp

Appendix A - Appraisal specification summary table

Impacts	Sub-impacts	Proposed proportionate appraisal methodology	Reference to evidence and rationale in support of proposed methodology	Type of assessment output (Quantitative/ qualitative/ monetary/ distributional)
Economy	Business users & transport providers	AMAT, TUBA, ABC	TAG Unit A1.3	Qualitative & monetary
Economy	Regeneration	TAG guidance	TAG UNIT A2.2	Qualitative
Economy	Wider Impacts	TAG Guidance	TAG Unit A2.1	Qualitative
Environmental	Noise	TAG guidance	TAG Unit A3, Section 2	Qualitative & monetary
Environmental	Air Quality	TAG guidance	TAG Unit A3, Section 3	Qualitative & monetary
Environmental	Greenhouse gases	TAG guidance (using Marginal External Costs) & TUBA	TAG Unit A3, Section 4	Qualitative & monetary
Environmental	Landscape	TAG guidance	TAG Unit A3, Section 6	Qualitative
Environmental	Townscape	TAG guidance	TAG Unit A3, Section 7	Qualitative
Environmental	Historic Environment	TAG guidance	TAG Unit A3, Section 8	Qualitative
Environmental	Biodiversity	TAG guidance	TAG Unit A3, Section 9	Qualitative
Environmental	Water Environment	TAG guidance	TAG Unit A3, Section 10	Qualitative

Impacts	Sub-impacts	Proposed proportionate appraisal methodology	Reference to evidence and rationale in support of proposed methodology	Type of assessment output (Quantitative/ qualitative/ monetary/ distributional)
Social	Commuting and Other users	AMAT, TUBA & ABC	TAG Unit A1.3	Qualitative & monetary
Social	Physical activity	AMAT, TAG guidance	TAG Unit A4.1, Section 3	Qualitative & monetary
Social	Accidents	TAG guidance, COBALT	TAG Unit A4.1, Section 2	Qualitative & monetary
Social	Journey Quality	TAG Guidance	TAG Unit A4.1, Section 6	Qualitative
Social	Access to services	TAG guidance	TAG Unit A4.1, Section 8	Qualitative
Social	Affordability	TAG guidance	TAG Unit A4.1, Section 9	Qualitative
Social	Severance	TAG guidance	TAG Unit A4.1, Section 5	Qualitative
Social	Security	TAG guidance	TAG Unit A4.1, Section 4	Qualitative
Social	Option and non-use values	TAG guidance	TAG Unit A4.1, Section 7	Qualitative
Public Accounts	Cost to Broad Transport Budget	TAG guidance	TAG Unit A1.3	Monetary
Public Accounts	Indirect Tax Revenue	TAG guidance and TUBA	TAG Unit A1.3	Monetary

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West of England Combined Authority

BATH TO BRISTOL STRATEGIC CORRIDOR

Appendix T - Option Assessment Report Addendum

70093741
January 2024

West of England Combined Authority

BATH TO BRISTOL STRATEGIC CORRIDOR

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1 Introduction

1.1.1. The Bristol to Bath Strategic Corridor (BBSC) Option Assessment Report (OAR) was submitted to the West of England Combined Authority (the Combined Authority) in 2021. The Corridor name has since been changed to Bath to Bristol.

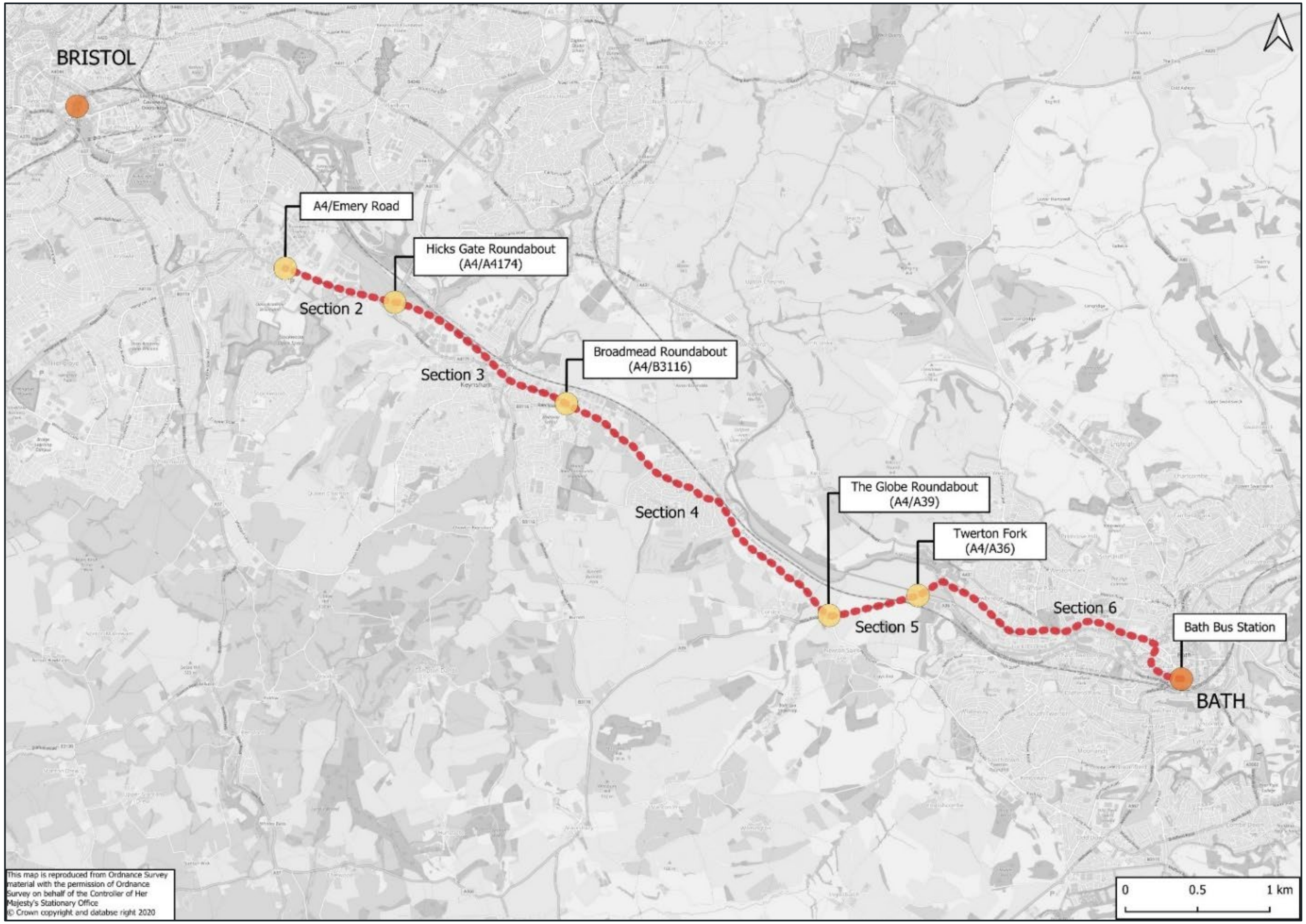
1.1.2. The OAR demonstrated that the project had been developed from a clear understanding of the policy context, transport challenges and clear objectives. It showed that a range of options had been considered, sifted and further developed so that the shortlist of solutions emerged from a transparent process with the intention to inform the SOC and future development stages. The OAR provided a robust foundation for decision-makers to determine the merit of the emerging options. It made the case for proceeding with the project, providing a clearly articulated rationale for the recommendation of a shortlist of options to be taken forward for further development and assessment.

1.1.3. This Addendum to the OAR documents the further development of these shortlisted solutions through the Strategic Outline Case (SOC) stage and through further development for the Outline Business Case (OBC), as well as the updates to the scheme vision and objectives since SOC.

1.1.4. As with the OAR, this report focuses on the section of the corridor between Emery Road and Bath Bus Station as shown in **Figure 1-1**. Whilst the original scope of the project covered the route all the way through to Bath Bus Station, the final 'leg' of the route has now been split into a separate project for delivery.

1.1.5. The Bristol and Bath Railway Path extension and improvements project has been absorbed within the scope of BBSC. This report summarises the option assessment work already undertaken, and which is reported in full in the Bristol to Bath Cycle Path Options Assessment Report.

Figure 1-1 - Scheme location



2 Strategic vision and objectives

2.1 SOC vision and objectives

2.1.1. As part of the development of the OAR and SOC, the Vision and Objectives for the scheme were identified. The vision was to provide:

A high-quality segregated and prioritised public transport and cycling corridor that will provide for reliable services to encourage people to use sustainable transport modes for short and mid-distance journeys and contribute to tackling the climate emergency through modal shift.

2.1.2. In line with DfT's Transport Analysis Guidance (TAG), the objectives were developed under three categories: strategic outcomes, specific objectives and operational objectives.

Strategic outcomes

2.1.3. TAG defines these as: *The desired central outcome, which reflects the aims and ambition for the area*. *The scheme will contribute to these, though not always directly*.

2.1.4. The strategic outcomes for the BBSC programme are to deliver a public transport system that will:

- Tackle the climate emergency and poor air quality through mode shift to public transport, walking and cycling, contributing to achieving the carbon net-zero 2030 goal set by both the West of England Combined Authority and Bath and Northeast Somerset Council.
- Support sustainable and inclusive economic growth and enable regeneration, supporting neighbourhood renewal and regeneration of deprived areas
- Improve local environmental conditions to achieve better health, well-being, safety and security for local communities
- Enable equality and accessibility through better active travel and alignment with LTN 1/20, supporting the levelling up of local communities
- Create better places and tackle the ecological emergency
- Make sustainable transport the preferred option for short to mid-distance journeys

Specific objectives

2.1.5. TAG defines these as: *The direct effects of the scheme. They are SMART objectives, which become part of the monitoring and evaluation of the scheme at later stages.*

2.1.6. The specific objectives for the BBSC programme have been developed separately from the perspectives of public transport, active travel and environmental.

Public Transport

- To increase bus patronage and contribute to the Bus Strategy ambition of doubling bus passenger numbers by 2036[1]
- To improve the user experience for communities accessing Bristol or Bath by bus along the corridor[2]

Active Travel

- To increase the number of, and diversify the composition of, active travel trips along the corridor through the creation of new and improved crossings and segregated cycle infrastructure in line with LTN 1/20 to improve access to bus stops and amenities for communities along the corridor[3]
- To enhance the streetscape, public spaces and urban environments along the A4 corridor[4]

Environmental

- To improve air and noise quality along the BBSC route, particularly in Air Quality Management Areas (AQMAs) and Noise Important Areas (NIAs)[5]
- To reduce the overall carbon footprint of the West of England by enabling modal shift on this corridor and the wider network[6]
- To increase the amount of green infrastructure along the BBSC route to contribute to Biodiversity Net Gain[7]

Operational objectives

2.1.7. TAG defines these as: *Outputs necessary for the specific objectives to be achieved.*

- A fast, at least five-minute frequency, reliable, high quality, zero-emission turn-up & go bus service between Bristol Temple Meads and Bath bus station
- A BBSC route with high-quality bus stops (in line with Combined Authority bus stop specifications), 24-hour bus priority (where appropriate) and good interchange opportunities with other modes, services and amenities
- A simple, fast and convenient off-board ticketing system for the BBSC metrobus service
- A simple, coherent and efficient bus network that links local communities along the A4 with consistent marketing and branding
- A continuous, direct, high-quality cycle route between Bristol and Bath which is segregated from general traffic and buses

---

[1] ***Measure:*** *numbers of bus passengers making journeys on the BBSC metrobus*
[2] ***Measure:*** *bus passenger satisfaction, the number of new formal interchange locations created, the number of journeys involving one or more interchanges, improved journey time reliability and journey times*
[3] ***Measure****: the number of walking and cycling journeys from and in between local communities along the corridor, and the number of walking and cycling journeys from local communities along the corridor to stops, and between local communities along the corridor (including use of facilities to cross the A4)*
[4] ***Measure****: the number and quality of crossings, bus stops and waiting facilities along the BBSC metrobus route*
[5] ***Measure****: noise and emissions along the BBSC metrobus route*
[6] ***Measure****: the number of journeys made along the corridor by different modes, distinguishing between zero emission buses, diesel buses, electric cars and other modes*
[7] ***Measure****: the amount of green infrastructure along the BBSC metrobus route current regional context*

2.2 Updated vision and objectives

2.2.1. As part of the development of the OBC both the vision and objectives from the SOC were reviewed and revised by the Combined Authority and Bath and North East Somerset (B&NES) Council to reflect the current regional context. These revised vision and objectives were approved by the Combined Authority in April 2023. Although the objectives have changed the key themes from the previous objectives remain.

2.2.2. The revised Vision is

To connect new and existing communities along the A4 via sustainable modes of transport to places of employment, study and key services to enhance the lives of existing and future residents and those travelling to and along the corridor. This will be achieved by increasing the access to, attractiveness and availability of sustainable and active transport modes for those living, working and travelling through the area.

Revised objectives

2.2.3. The objectives have been revised such that there are three overarching objectives identified for the whole corridor between Bath and Bristol with sub-objectives underpinning them.

- To facilitate economic growth along the corridor by improving the public and active travel opportunities. This includes delivering infrastructure which improves access for existing communities and also infrastructure that unlocks new opportunities for sustainable growth.
  - Support the delivery of new housing and job creation through the provision of high-quality public transport that serves existing and future housing. This should include safeguarding the potential for a mass transit solution along the corridor.
  - Unlocking housing growth and enhancing sustainable transport connectivity though the re-provision and enhancement of the Brislington Park and Ride to Hicks Gate.
- Improve public transport infrastructure in the study area to increase the number of people who have access to and use buses to contribute to growing patronage of the X39 (or increase in equivalent new service/bus rapid transit service along the corridor) by at least 24% by 2030
  - To provide the infrastructure required to enable operators to deliver a fast, reliable, high-frequency bus service between Three Lamps Junction and Bath City Centre.
  - To deliver high-quality, safe and recognisable bus stops (comparable to the existing metrobus service standards stops)
  - To provide the high-quality bus infrastructure necessary to sustain economic growth and improve the lives of residents of B&NES and BCC
- Improve walking, wheeling and cycling infrastructure in the study area to contribute to increasing the number of people using the corridor for active travel modes including to

increase the number of people commuting by walking, cycling and wheeling modes to 25% of total modal share by 2036.

- To enable continuous, safe and legible active travel journeys end-to-end and to the corridor for those living and working along the corridor.
- To improve access by active travel modes to public transport along the corridor
- To reduce severance for cyclist, walkers, wheelers and other active travel modes.

Operational objectives

2.2.4. The following operational objectives have been set for the BBSC project. The operational objectives are considered in two phases: Phase 1 elements are to be completed within the CRSTS phase of the programme (completed by March 2027), Phase 2 elements require additional funding and delivery time to be complete, which extend beyond the CRSTS programme and costs. The operational objectives include those of Phase 1 and 2 to show the scale of ambition for the corridor.

- A fully segregated, end to end bi-directional bus lane (from Three Lamps Junction to the boundary with the Bath City Centre Project) (Phase 1 & 2)
- An end-to-end LTN 1/20 walking and cycling route (from Three Lamps Junction to the boundary with the Bath City Centre Project) (Phase 1)
- Community Connections within the study area including within the towns, villages and suburbs of Brislington, Keynsham, Saltford and Bath (Phase 1)
- The relocation of the Bath Road, Brislington Park and Ride to Hicks Gate and the delivery of a new Transport Hub at Hicks Gate (Phase 2).
- A new Transport Hub at Keynsham (Phase1)
- Complementary measures required to make the project, or schemes within the project, deliverable. For example (but not limited to), biodiversity enhancements, tree planting, placemaking, transport hubs, cycle parking, signage etc. (Phase 1 & 2)
- Provide the infrastructure required to contribute towards achieving a 10% end to end (between Three Lamps Bristol and Bath City Centre) bus journey time reduction by 2030
- Provide the infrastructure required to contribute towards achieving 95% of services running on time, defined as being no more than 1 minute early or 5 minutes late, by 2030.

2.2.5. These objectives will be underpinned by the following design criteria:

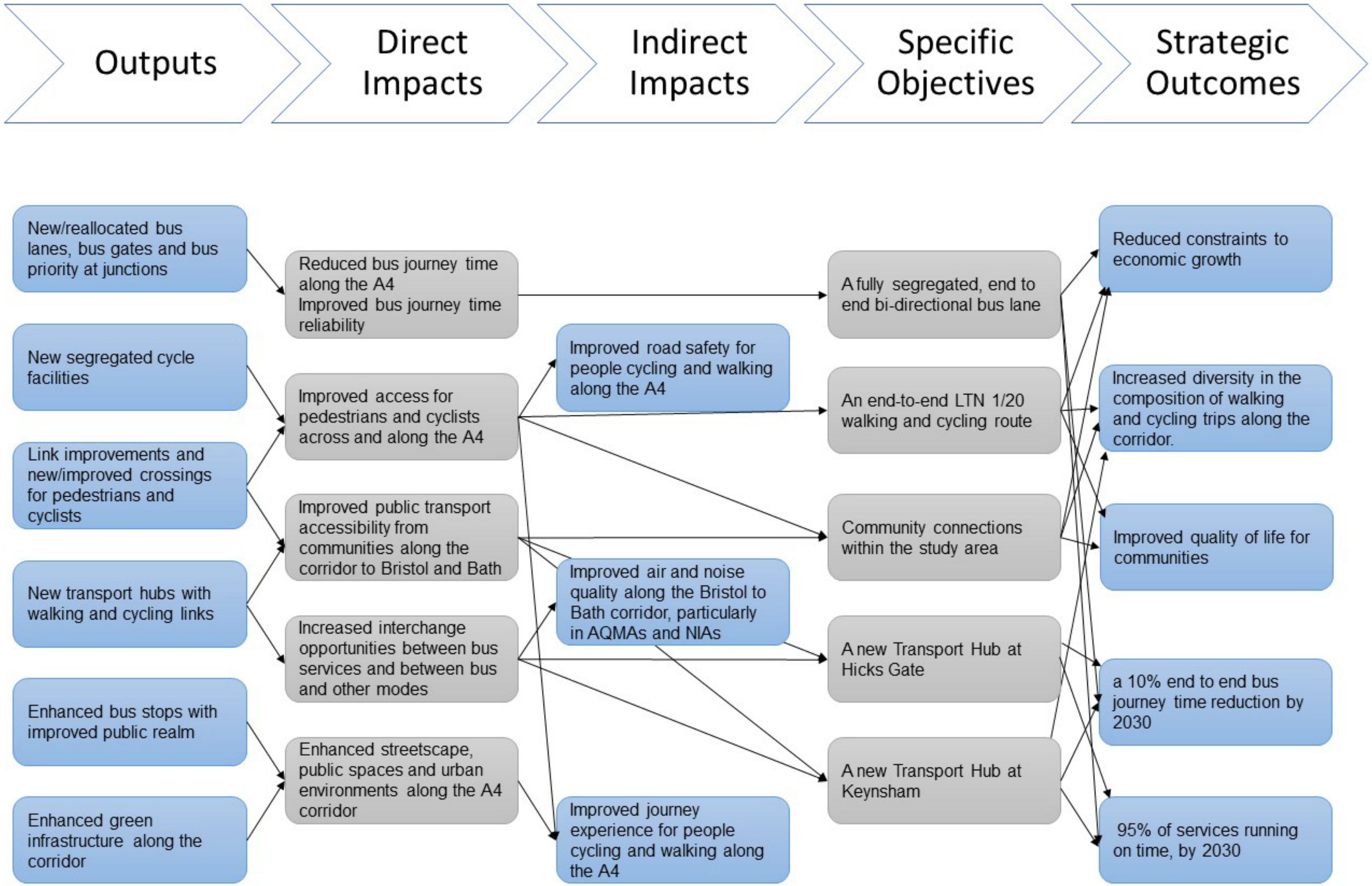
- The design scope includes routes linking main corridor to key adjacent destinations via active travel.
- A maximum of 400m between bus stops served by the X39 (or equivalent stopping service), apart from in circumstances where the population yield (and future population yield) is not sufficient to accommodate a bus stop.
- Bus stops adhere to the agreed design standard. This will include agreement on appropriate style of bus stop along the route.

- Walking and cycling routes must be improved to relevant standards, including LTN 1/20, particularly with regard to safe, and direct provision.
- That the intervention delivered in the study area provide a 10% uplift in biodiversity net gain with a development first approach. This should include no net loss of trees.
- That due regard of embodied carbon is considered at the option shortlisting and design process.
- To not inhibit and to contribute to the delivery of a future Mass Transit solution along the corridor.
- Practical completion of this phase of the project by March 2027.
- That the scheme falls within the available funding allocation, or that additional funding allocations can be secured.

2.3 Theory of change (Logic map)

2.3.1. A theory of change/logic map was developed for the SOC, this has been revised and updated to consider the revised objectives. This is shown in **Figure 2-1**.

Figure 2-1 – BBSC B&NES Section theory of change (Logic map)



3 OAR shortlisted options

3.1.1. As part of the development of the OAR a robust and extensive optioneering process was undertaken. As part of this the scheme was considered in terms of four ‘themes’:

- Bus Priority Infrastructure
- Strategic Cycling Infrastructure
- Community Connections
- Bus Operational Model

3.1.2. The OAR sets out the option generation and assessment process undertaken previously, and the following sections set out which options were shortlisted as a result of this process. Chapters 4 and 5 then provide an overview of the further option development and assessment work undertaken as part of the SOC and OBC.

3.2 Shortlisted options – Bus Priority Infrastructure

3.2.1. **Table 3-1** through to **Table 3-5** show the options considered within the OAR stage on each section of the corridor and details the rationale to support whether each option was shortlisted or discounted.

Table 3-1 – Bus Priority Infrastructure – shortlisted options – Section 2 Emery Road to Hicks Gate Roundabout

Option	Option name	Shortlisted	Rationale
2A	Reallocate road space for outbound bus lane	**Yes**	**Shortlisted as it supports continuous bus priority through this section through road space reallocation**
2B	New outbound bus lane	**Yes**	**Shortlisted as it supports continuous bus priority through this section building on existing inbound bus lane**

Table 3-2 – Bus Priority Infrastructure – shortlisted options – Section 3 Hicks Gate Roundabout to Broadmead Roundabout

Option	Option name	Shortlisted	Rationale
3A	Reallocate road space on Keynsham bypass for inbound and outbound bus lanes	No	Discounted as while it would improve bus journey times and reliability, without any additional interchange/bus stops, the route avoids most of the Keynsham catchment for the BBSC service.
3B	Reallocate road space on Keynsham bypass for bus lanes plus new at-grade transport interchange along bypass	**Yes**	**Shortlisted as it makes use of existing infrastructure to support bus priority (and future mass transit aspirations) on the most direct route along the A4 whilst connecting the BBSC service to Keynsham.**
3C	Reallocate road space on Keynsham bypass for bus lanes plus new grade-separated transport interchange at Station Road	No	Discounted due to the constrained space for on/off ramps to gain access to Station Road.

Option	Option name	Shortlisted	Rationale
3D	Reallocate road space on Keynsham bypass for bus lanes plus new grade-separated transport interchange in Memorial Park	No	Discounted due to the constrained space for on/off ramps to Memorial Park and the impact on Memorial Park itself from the required footprint of the slips and interchange hub.
3E	Route through Keynsham town centre	No	Discounted due to the significant highway constraints through town centre limiting bus priority in conjunction with longer journey distance and weight restrictions in the town centre.
3F	Route through Keynsham town centre and potential North Keynsham development site	No	Discounted due to the less direct alignment and resulting longer journey distance for the BBSC service.

Figure 3-1 – Shortlisted Bus Priority Infrastructure options (Sections 2 and 3)

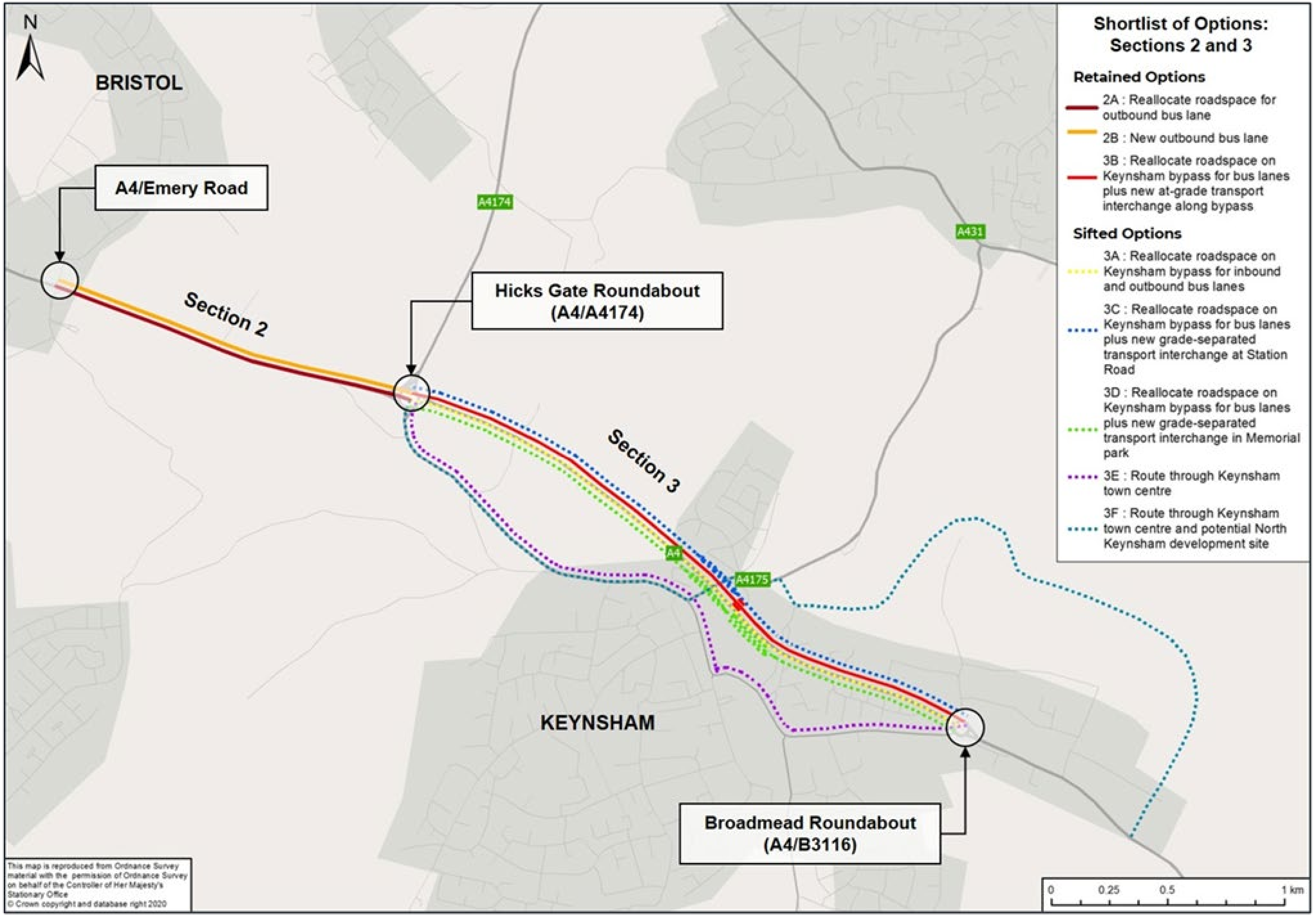


Table 3-3 – Bus Priority Infrastructure – shortlisted options – Section 4 Broadmead Roundabout to Globe Roundabout

Option	Option name	Shortlisted	Rationale
4A	Lining and signing along A4 only	No	Discounted as it would have negligible impact on bus journey times and reliability
4B	New bypass around Saltford	No	Discounted as enabling direct route for general traffic would risk mode shift away from bus. Anticipated local opposition to a bypass.
4C	Route bus services on local roads through south Saltford from Manor Road plus new link through golf course	No	Discounted due to the less direct alignment and resulting longer journey distance for the BBSC service. Impacts on local residential streets.
4D	Route bus services on local roads through south Saltford from Grange Road plus new link through golf course	No	Discounted due to the less direct alignment and resulting longer journey distance for the BBSC service. Impacts on local residential streets.
4E	New tunnel underneath Saltford	No	Discounted as it would have very high development and construction costs along with high timescales to develop and deliver the tunnel. Environmental impacts at tunnel entry/exit locations. Enabling direct route for general traffic would risk mode shift away from bus.
4F	Bus gates on entry to Saltford	**Yes**	**Shortlisted as part of phased package of proportional interventions that could address delays to buses through Saltford.**
4G	Bi-direction bus lane in Saltford	**Yes**	**Shortlisted as part of phased package of proportional interventions that could address delays to buses through Saltford.**
4H	Junction improvements and restrictions in Saltford	**Yes**	**Shortlisted as part of phased package of proportional interventions that could address delays to buses through Saltford.**
4I	Convert Bristol to Bath Railway Path to carry buses.	No	Discounted due to significant constraints in widening the Bristol to Bath Railway Path and anticipated opposition to its conversion from an active travel corridor.
4J	New bus lanes in both directions along section	**Yes**	**Shortlisted as it represents the most direct route along the A4 for bus priority and supports future mass transit aspirations.**

Table 3-4 – Bus Priority Infrastructure – shortlisted options – Section 5 Globe Roundabout to Twerton Fork

Option	Option name	Shortlisted	Rationale
5A	Reallocate road space to create bus lanes in both directions	**Yes**	**Shortlisted as provides dedicated bus priority through this section**
5B	New bus lanes in both directions along section	**Yes**	**Shortlisted as provides dedicated bus priority through this section**
5C	New bus lanes in both directions along section plus move Newbridge P&R	No	Discounted due to constraints to provision of access to the site underneath Great Western Mainline and flood risk affecting new P&R site.
5D	Retain existing carriageway layout. Introduce localised bus priority on approaches to Globe Roundabout	Yes	**Represents a lower cost option whilst still providing some bus priority.**

Figure 3-2 – Shortlisted Bus Priority Infrastructure options (Sections 4 and 5)

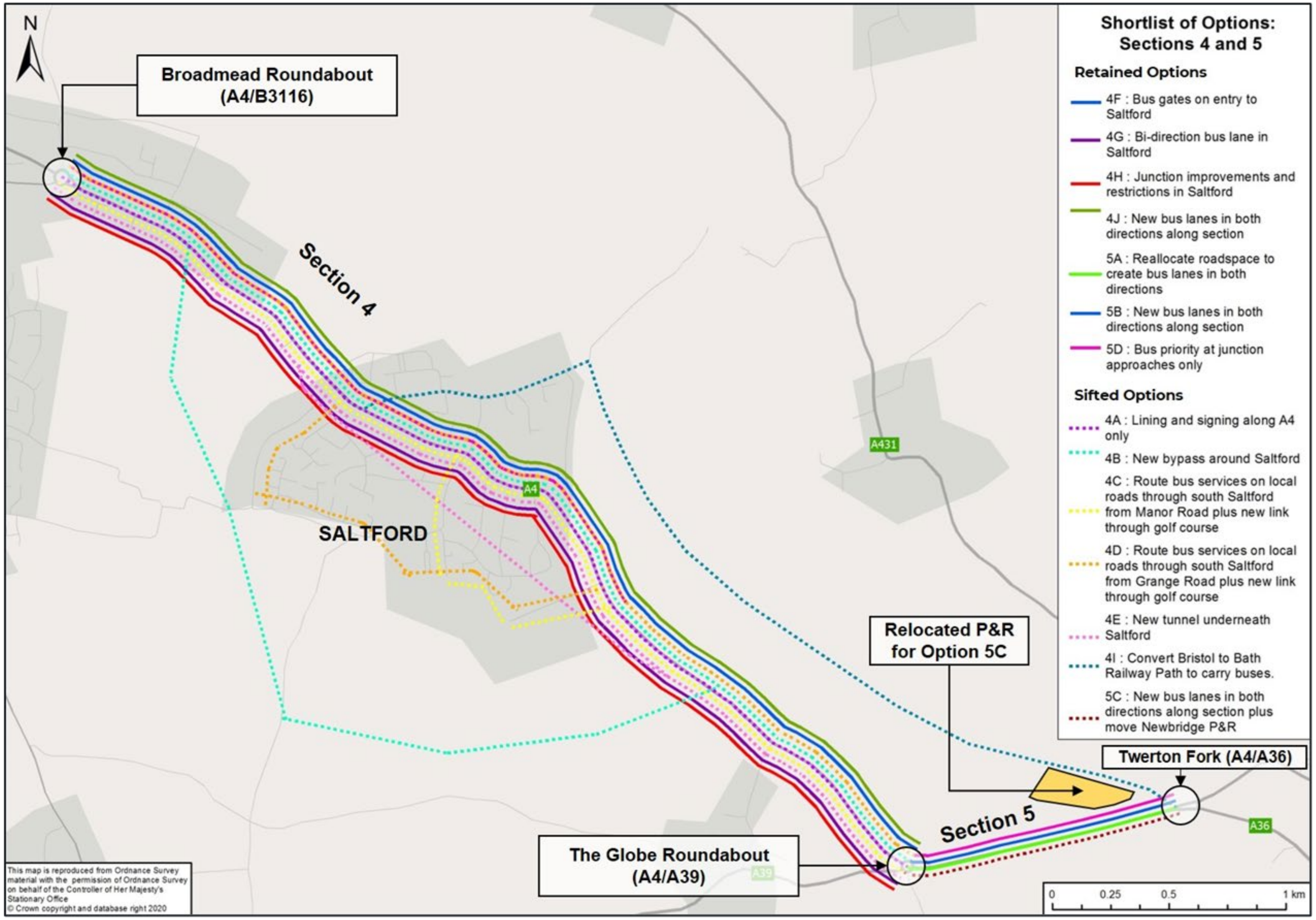
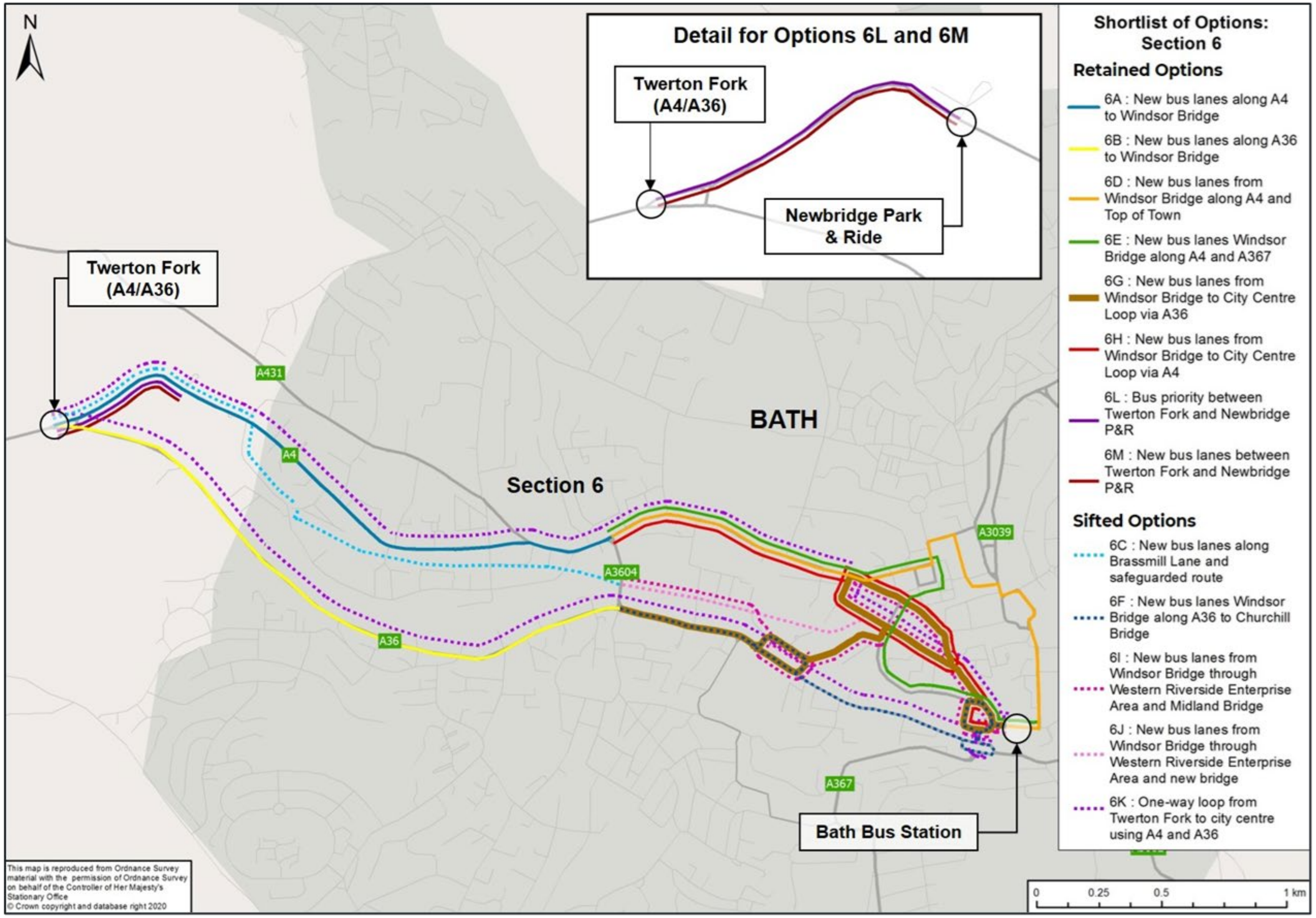


Table 3-5 – Bus Priority Infrastructure – shortlisted options – Section 6 Twerton Fork to Central Bath

Option	Option name	Shortlisted	Rationale
6A	New bus lanes along A4 to Windsor Bridge	**Yes**	**Shortlisted as option would provide priority direction bus priority (inbound) into central Bath. Serves bus stops/patronage served by existing services.**
6B	New bus lanes along A36 to Windsor Bridge	**Yes**	**Shortlisted as option would provide priority direction bus priority (inbound) into central Bath. Aligns with safeguarded section of the A36 under Local Plan policy ST3 for providing bus priority and active travel facilities along the A36.**
6C	New bus lanes along Brassmill Lane and safeguarded route	No	Discounted due to concerns about deliverability within 5-year timeframe that aligns with the BBSC Programme.
6D	New bus lanes from Windsor Bridge along A4 and Top of Town	**Yes**	**Shortlisted as option would provide priority direction bus priority (inbound) into central Bath. Serves bus stops/patronage served by existing services. This section of the BBSC is now covered under another project**
6E	New bus lanes Windsor Bridge along A4 and A367	**Yes**	**Shortlisted as option would provide priority direction bus priority (inbound) into central Bath. Serves bus stops/patronage served by existing services.**
6F	New bus lanes Windsor Bridge along A36 to Churchill Bridge	No	Discounted due to constraints to providing continuous inbound bus lane east of Pines Way along the A36 without impacting on heritage assets. Routing over A36 gyratory potentially increases bus journey length and time.
6G	New bus lanes from Windsor Bridge to City Centre Loop via A36	**Yes**	**Shortlisted as option would provide priority direction bus priority (inbound) into central Bath. Alignment is included within shortlisted options for Bath Mass Transit under the Journey to Net Zero Action Plan for Bath (formerly Transport Delivery Action Plan).**

Option	Option name	Shortlisted	Rationale
6H	New bus lanes from Windsor Bridge to City Centre Loop via A4	**Yes**	**Shortlisted as option would provide priority direction bus priority (inbound) into central Bath. Serves bus stops/patronage served by existing services and uses existing bus routes and infrastructure.**
6I	New bus lanes from Windsor Bridge through Western Riverside Enterprise Area and Midland Bridge	No	Discounted due to concerns about deliverability within 5-year timeframe that aligns with the BBSC Programme.
6J	New bus lanes from Windsor Bridge through Western Riverside Enterprise Area and new bridge	No	Discounted due to concerns about deliverability within 5-year timeframe that aligns with the BBSC Programme.
6K	One-way loop from Twerton Fork to city centre using A4 and A36	No	Discounted due to higher infrastructure costs (with investment required along both A4 and A36) balanced against reduced access for users with geographically separated locations to access and egress the service on opposite sides of the river.
6L	Bus priority between Twerton Fork and Newbridge P&R	**Yes**	**Shortlisted as supports bus priority through this pinch point**
6M	New bus lanes between Twerton Fork and Newbridge P&R	**Yes**	**Shortlisted as supports bus priority through this pinch point (further investigation required due to constraints and potential heritage impacts)**

Figure 3-3 – Shortlisted Bus Priority Infrastructure options (Section 6)



Further bus infrastructure improvements

3.2.2. As part of introducing the BBSC metrobus service and supporting bus priority infrastructure, all bus stops served by the BBSC metrobus service would be upgraded to a metrobus standard (aligning with the emerging West of England bus stop standards). The metrobus Quality Plan sets out the following requirements for bus stops:

- A platform of at least 18 metres length and 3 metres width to accommodate disabled access, boarding and alighting passengers and vehicles
- Conservation-style paving with a clearly defined boundary to distinguish the waiting area from the background pavement
- Distinctive, high-quality shelter of sufficient length (minimum 5 metres) and width to accommodate waiting passengers and passing pedestrians/cyclists
- Facilities to enable smart ticket purchasing
- Intelligent Transport Systems (ITS) equipment to be housed in a metrobus-branded free-standing `Monolith', at every stop
- CCTV and passenger emergency help points
- Clear timetable displays and RTI displays at stops as standard, as well as complementary passenger information
- Colour scheme for shelters and infrastructure consistent with the metrobus branding and vehicle livery
- Signing and lighting
- Cycle stands
- Red surfacing of bus stop 'cages' to minimise parking infringement in all cases
- Regular cleaning, repairs and updating of information by the advertising contractor and/or local authorities (or third parties where the stop is on private land)

3.2.3. In addition to the bus stop upgrades it is intended to provide improved public realm in the areas around the bus stops and along key walking and cycling approaches. This public realm will support the journey quality for passengers accessing the bus stops and waiting for services.

3.2.4. Improved public realm can be integrated with upgrading stops to mobility hubs which enable a wider range of transport options (e.g., e-cargo bikes) to support last mile journeys between the BBSC metrobus service and homes or destinations.

3.3 Shortlisted options – Hicks Gate Park & Ride and Transport Hub

3.3.1. The assessment of potential locations for the Hicks Gate Park & Ride (P&R) and Transport Hub is described in detail in the technical note included in **Appendix H3** of the OAR.

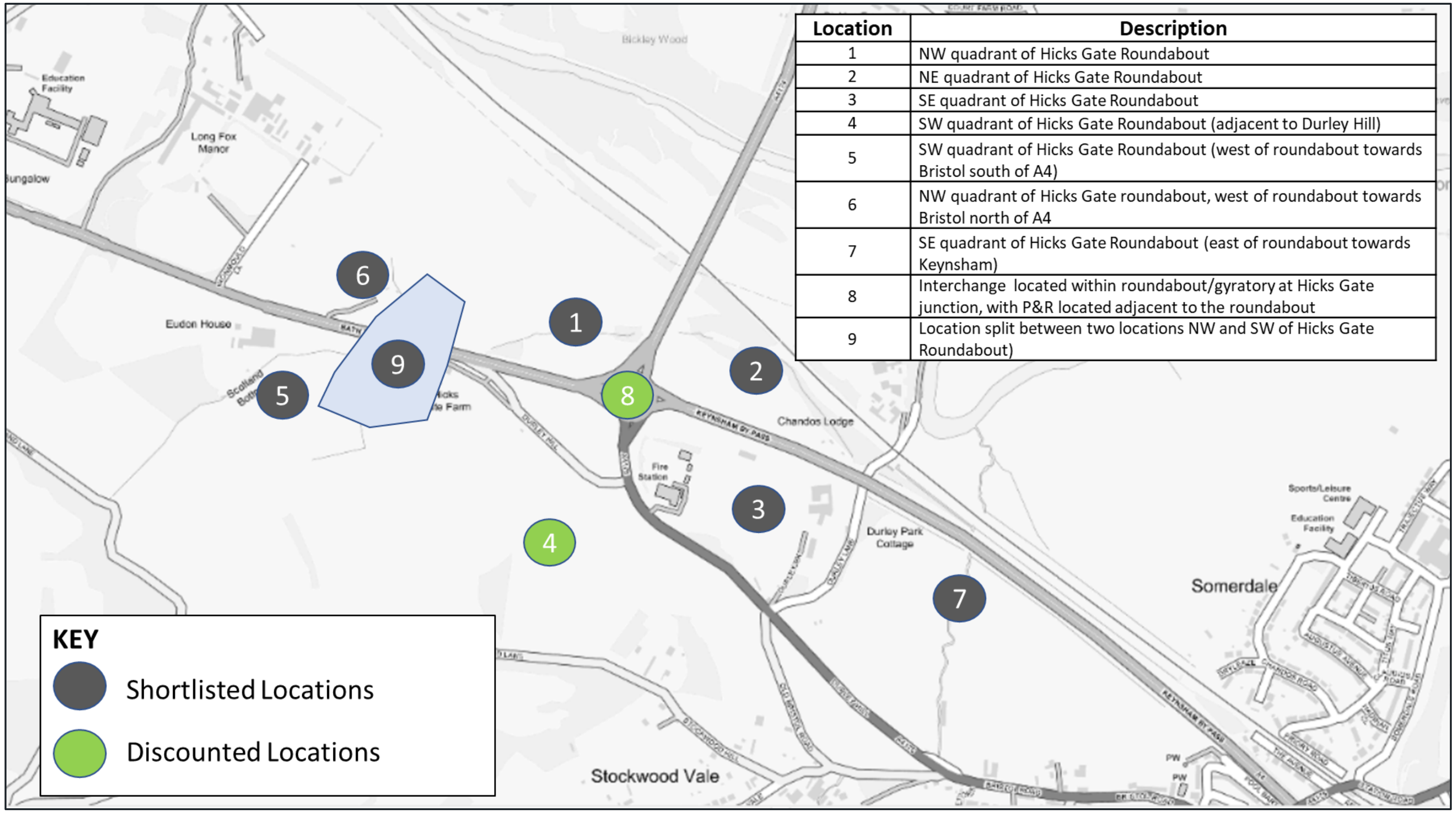
3.3.2. The options assessment considered a range of potential locations for the P&R and Transport Hub. The assessment was based on a notional requirement for 1,300 spaces (based on the existing Brislington P&R site).

3.3.3. **Table 3-6** shows the options considered within the OAR stage for the Hicks Gate P&R and Transport Hub and details the rationale to support whether each option was shortlisted or discounted. The shortlisted locations for the Hicks Gate P&R and transport hub are shown in **Figure 3-4**.

Table 3-6 – Hicks Gate P&R and Transport hub – MCAF assessment outcomes

Location number	Shortlisted (Yes/No)	Rationale
1	No	The environmental constraint of Flood Zone 3 (high risk of flooding) and the land requirement which may impact on the potential Hicks Gate development location may make this option unviable.
2	No	The constraints of the site (in that more than 1,300 spaces cannot be accommodated) means that this location is not resilient to adapt to future requirements.
3	No	The constraints of the site mean that there is limited scope for future expansion of the P&R, and there is not opportunity to provide connections to the potential Hicks Gate development location. Land take requirements would include impacts on built properties, and potentially on listed assets.
4	**Yes**	**Location provides an opportunity for reasonably efficient interchange with the BBSC and other local/orbital bus services. It has the least constraints in terms of land ownership/future allocation and environmental constraints. Deliverable during the 5-year timeframe.**
5	No	The interchange with services running along the A4174 would be complicated by the distance between the site and Hicks Gate roundabout (thereby not serving the aspirations of Bus Service Improvement Plan (BSIP)). Further, the land requirement may impact negatively on the potential Hicks Gate development location which may make this location unviable.
6	No	The interchange with services running along the A4174 would be complicated by the distance between the site and Hicks Gate roundabout (thereby not serving the aspirations of BSIP). Further, the land requirement may impact negatively on the potential Hicks Gate development location which may make this location unviable.
7	No	The environmental constraint of Flood Zone 3 (high risk of flooding) makes this option unviable. Further, the location would not serve orbital routes and meet the aspirations of BSIP.
8	**Yes***	**Location provides an opportunity for very efficient interchange with the BBSC and other local/orbital bus services. It has the least constraints in terms of land ownership/future allocation and environmental constraints.** ***Deliverability during the 5-year timeframe is a concern due to technical challenges and requirement to reconfigure Hicks Gate Roundabout.**
9	No	The interchange with services running along the A4174 would be complicated by the distance between the site and Hicks Gate roundabout (thereby not serving the aspirations of BSIP). Further, the land requirement may impact negatively on the potential Hicks Gate development location which may make this location unviable.

Figure 3-4 – Shortlist of locations for Hicks Gate P&R and Transport hub



Location	Description
1	NW quadrant of Hicks Gate Roundabout
2	NE quadrant of Hicks Gate Roundabout
3	SE quadrant of Hicks Gate Roundabout
4	SW quadrant of Hicks Gate Roundabout (adjacent to Durley Hill)
5	SW quadrant of Hicks Gate Roundabout (west of roundabout towards Bristol south of A4)
6	NW quadrant of Hicks Gate roundabout, west of roundabout towards Bristol north of A4
7	SE quadrant of Hicks Gate Roundabout (east of roundabout towards Keynsham)
8	Interchange located within roundabout/gyratory at Hicks Gate junction, with P&R located adjacent to the roundabout
9	Location split between two locations NW and SW of Hicks Gate Roundabout)

3.4 Shortlisted options – Strategic Cycling Corridor

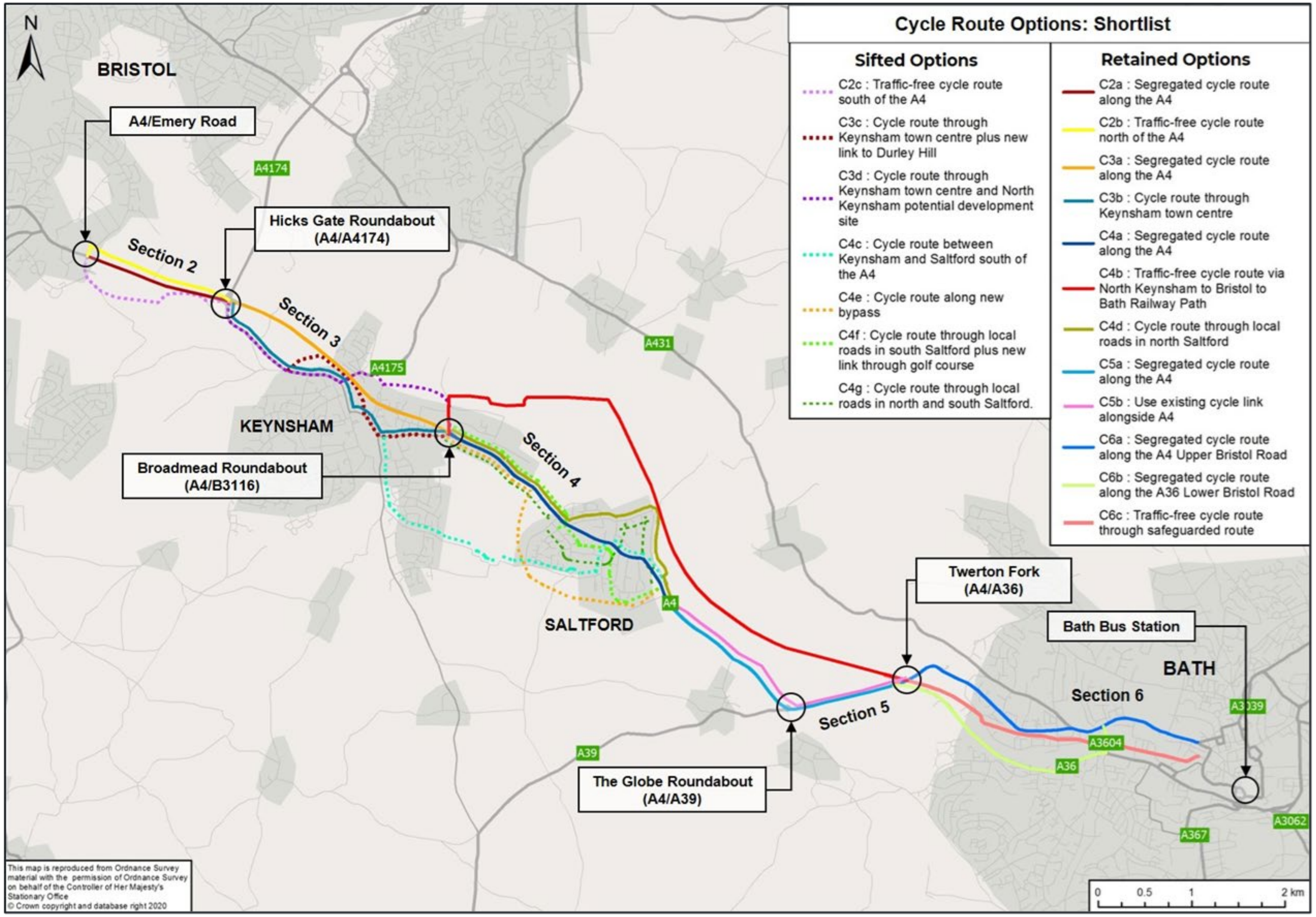
3.4.1. **Table 3-7** shows the shortlisted options for the cycling corridor options. The supporting information regarding these assessments is provided within the OAR and its appendices. The shortlisted options are illustrated in **Figure 3-5**.

Table 3-7 – Strategic Cycling Corridor – shortlisted options

Section	Option name	Option descriptions	Shortlisted	Rationale
Section 2	C2a	Segregated cycle route along the A4	Yes	Shortlisted as provides opportunity for the most direct route along the A4 as part of new cross-section with bus priority improvements.
Section 2	C2b	Traffic-free cycle route north of the A4	Yes	Shortlisted as it creates a potential route away from trafficked carriageway that would support less confident cyclists and can link to the traffic-free Regional Route 16 to A431 and NCN4. Route could be incorporated into the Hicks Gate potential development site.
Section 2	C2c	Traffic-free cycle route south of the A4	No	Discounted as route is less direct and longer than direct route along the A4.
Section 3	C3a	Segregated cycle route along the A4	Yes	Shortlisted as represents most direct route along the A4. Introduction of cycle links from town centre (through Memorial Park) to bypass would support connections to Keynsham from the bypass and bus/cycle interchange.
Section 3	C3b	Cycle route through Keynsham town centre	Yes	Shortlisted as it would provide more access to amenities and links to the community. It also links to shared-use path on Durley Hill.
Section 3	C3c	Cycle route through Keynsham town centre plus new link to Durley Hill	No	Discounted due to road width constraints and requirement for land take to support new facility.
Section 3	C3d	Cycle route through Keynsham town centre and North Keynsham potential development site	No	Discounted due to timeframes for build-out of possible North Keynsham development location. However, route is safeguarded through site in policy and hence could form a leisure link through the new site and/or to the Bristol to Bath Railway Path.
Section 4	C4a	Segregated cycle route along the A4	Yes	Shortlisted as current route between Broadmead Roundabout and Saltford West includes extensive sections of segregated shared walking/cycling facilities. Hence makes best use of existing infrastructure.
Section 4	C4b	Traffic-free cycle route via North Keynsham to Bristol to Bath Railway Path	Yes	Shortlisted as potential green/leisure route which maximises access to potential development site and uses existing Bristol to Bath Railway Path.
Section 4	C4c	Cycle route between Keynsham and Saltford south of the A4	No	Discounted as route is indirect and longer which may discourage users.
Section 4	C4d	Cycle route through local roads in north Saltford.	Yes	Shortlisted as it diverts cyclist around most constrained sections of Saltford and provides potential link to Bristol to Bath Railway Path.
Section 4	C4e	Cycle route along new bypass	No	Discounted as bypass route has been discounted for bus priority options. Route would be indirect and longer than along A4 which may discourage users.
Section 4	C4f	Cycle route through local roads in south Saltford plus new link through golf course	No	Discounted as new link across golf course to support bus priority has been discounted. Route would be indirect and longer than along A4 which may discourage users.
Section 4	C4g	Cycle route through local roads in north and south Saltford.	No	Discounted as route would be indirect and longer than along A4 which may discourage users. Takes users through busy A4/Manor Road/Beech Road junction which may impact on bus priority measures along the A4.
Section 5	C5a	Segregated cycle route along the A4	Yes	Shortlisted as supports a continuous segregated cycle route along this section.
Section 5	C5b	Use existing cycle link alongside A4	Yes	Shortlisted as the route maximises use of existing active travel assets.

Section	Option name	Option descriptions	Shortlisted	Rationale
Section 6	C6a	Segregated cycle route along the A4 Upper Bristol Road	Yes	Shortlisted as route maximises access along existing A4 route to communities and bus stops. Further investigation required to identify best solution in Bath as balanced with heritage impacts and bus priority.
Section 6	C6b	Segregated cycle route along the A36 Lower Bristol Road	Yes	Shortlisted as route maximises access along existing A36 route serving communities and bus stops. Further investigation required to identify best solution in Bath as balanced with heritage impacts and bus priority.
Section 6	C6c	Traffic-free cycle route through safeguarded route (Bath & North East Somerset Council Core Strategy & Placemaking Plan, Policy ST 2)	Yes	Shortlisted as route maximises current safeguarded route through with future integration into future active travel network.

Figure 3-5 – Strategic Cycling Corridor – shortlisted options



3.5 Shortlisted options – Community Connections

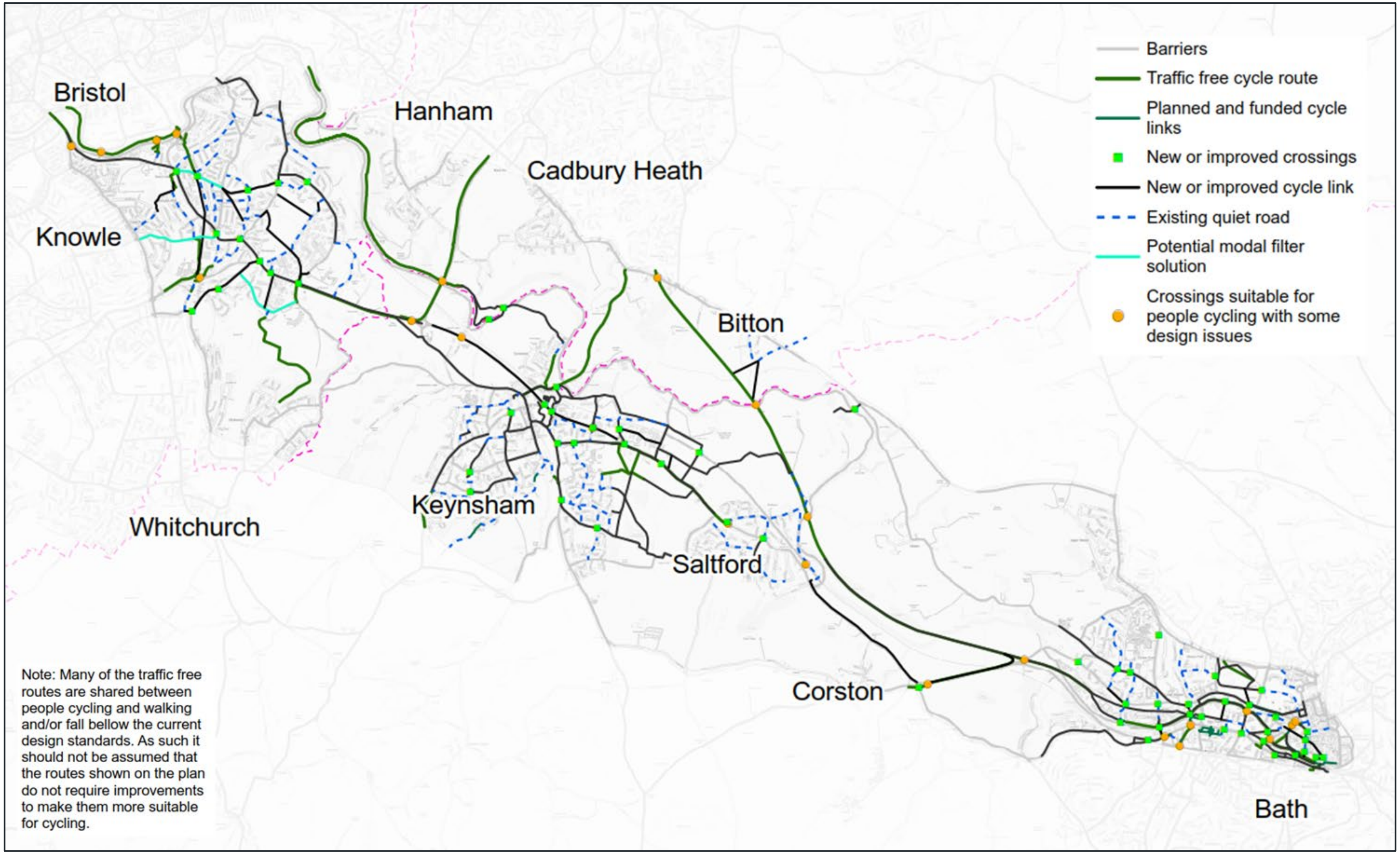
3.5.1. At the OAR stage the full list of community connections interventions was taken forward into the shortlist enabling flexibility in future design development to deliver the most effective infrastructure alongside other projects.

3.5.2. The identified interventions are illustrated in **Figure 3-6** and are summarised in **Table 3-8.**

Table 3-8 – Summary of shortlisted Community Connection interventions

Location	Number of new crossings - Total	Length of new cycle links - Total	Number of new crossings- identified by other projects/schemes	Length of new cycle links - identified by other projects/schemes	Number of new crossings - identified as part of the BBSC Programme	Length of new cycle links - identified as part of the BBSC Programme
On the A4	21	14.84km	Nil	7.01km	21	7.83km
Within 400m of the A4	19	31.95km	Nil	18.40km	19	13.56km
Within 400 to 800m of the A4	13	18.68km	Nil	11.42km	13	7.26km
More than 800m from the A4	8	6.34km	Nil	3.19km	8	3.15km
Total required to fully reach 'final stage porosity'	**61**	**71.83km**	**Nil**	**40.02km**	**61**	**31.81km**

Figure 3-6 – Community Connection – shortlist of interventions



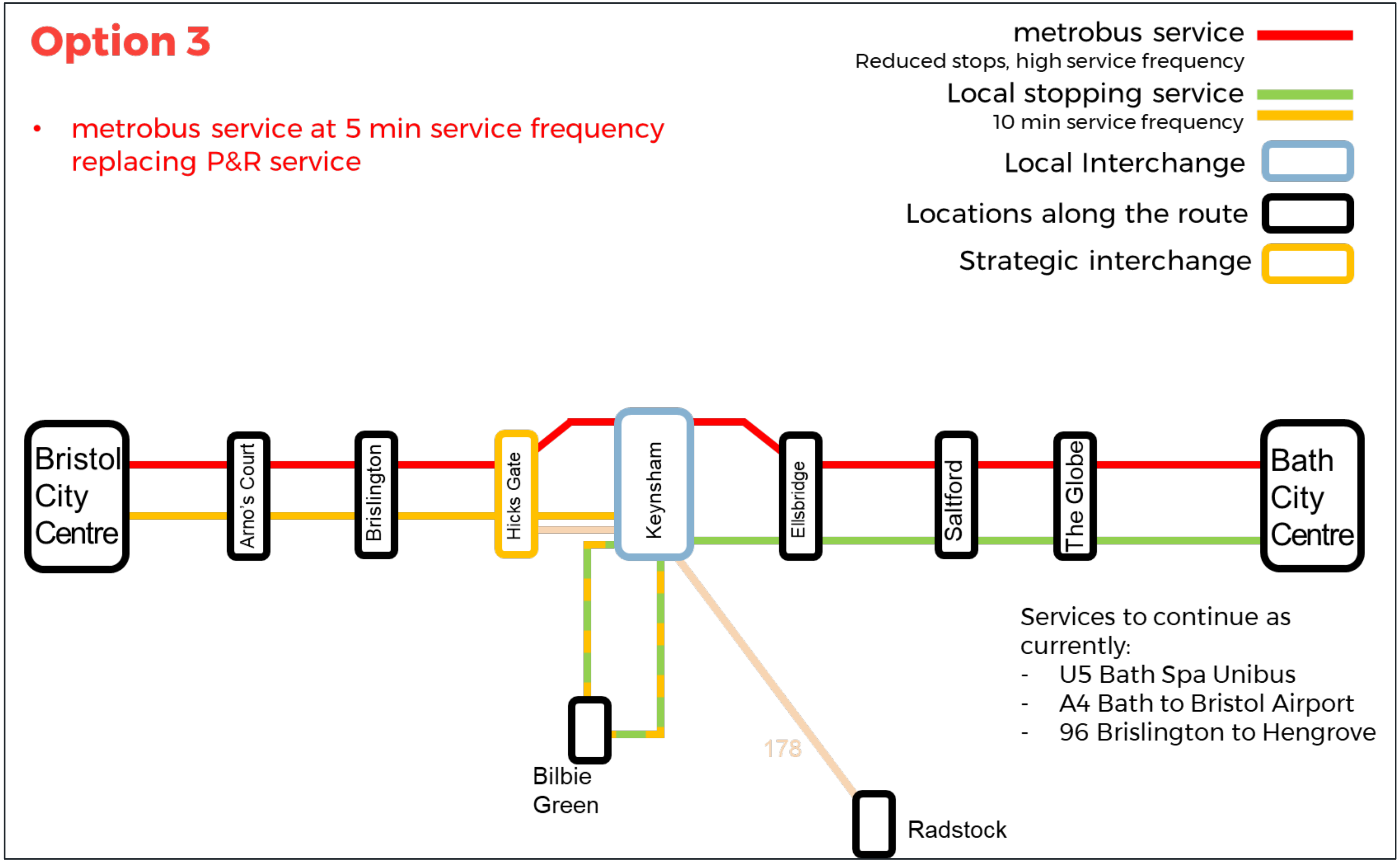
3.6 Shortlisted options – Bus Operational Model

3.6.1. Three options were considered for the Bus Operational Model:

- Option 1: Retain existing operations
- Option 2: introduce a new metrobus service running at a 10-minute headway with reduced stops, with the existing X39 amended to a 10-minute headway local stopping service
- Option 3: introduce a new metrobus service running at a 5-minute headway with reduced stops, with the existing X39 amended to a 10-minute headway local stopping service and the Hicks Gate P&R service replaced by the metrobus service

Option 1 was discounted as this option would not meet the operational objectives of the BBSC Programme as it would not provide an increased service frequency. Options 2 and 3 were taken forward into the shortlist. Of these options, Option 3 represents the option that best fits with the Operational Objectives of the BBSC Programme, and it is shown in **Figure 3-7**. Full details of the option development and assessment are included in **Appendix G7** of the OAR.

Figure 3-7 – Bus Operational Model – Option 3 (5-minute BBSC metrobus)



4 Strategic Outline Case option development

4.1.1. The shortlisted options identified in the previous chapter were further developed and assessed as part of the Strategic Outline Case. The options across the four themes were considered to determine four packages of measures that were assessed as part of the SOC.

4.2 Community Connections shortlist

4.2.1. As part of the SOC, the range of potential interventions to support Community Connections (i.e., linking communities served by the corridor to the proposed strategic bus and cycling infrastructure through active travel links and crossings) was identified as part of the OAR and allocated to the four packages as follows:

- Smaller Intervention: only includes interventions along the A4 (within 50m of A4)
- Medium 1 Intervention: only includes interventions within 400m of A4
- Medium 2 Intervention: only includes interventions within 400m of A4
- Larger Intervention: includes all proposed interventions

4.3 Bus Operational Model shortlist

4.3.1. The same Bus Operational Model was assumed across the four packages within the SOC. Based on the assessment undertaken as part of the OAR it was decided that Option 3 (the introduction of a new metrobus service running at a 5-minute headway with reduced stops, with the existing X39 amended to a 10-minute headway local stopping service and the existing Brislington P&R service replaced by the metrobus service) was the most suitable to use. This was chosen as it represents the option that best fits with the Operational Objectives of the BBSC Programme.

4.4 Bus and cycle infrastructure options – Sections 2 to 6 (Emery Road to Bath Station)

4.4.1. The options development process considered options across a range of measures to support the achievement of the objectives. A matrix approach was adopted to optioneering and for each section of the corridor options were developed for:

- **Bus Priority Infrastructure** (i.e., introducing bus priority measures to reduce bus journey times and increase bus journey time reliability)
- **Strategic Cycling Infrastructure** (i.e., introducing a continuous segregated cycling corridor between Bristol and Bath)

4.4.2. The resultant shortlist of options for bus priority and cycling infrastructure is set out in **Table 4.1** and **Table 4.2**.

Table 4-1 - Shortlist of bus priority infrastructure options (Sections 2 to 6)

Section	Option Nr	Option name	Option description
Section 2 – Emery Road to Hicks Gate	**Option 2A**	Reallocate road space for outbound bus lane	Reallocation of existing 2nd outbound highway lane to provide bus lane plus short section of widening to add outbound bus lane (where existing outbound single lane)
Section 2 – Emery Road to Hicks Gate	**Options 2B**	New outbound bus lane	Widen carriageway to add outbound bus lane, i.e., continuous bus lanes in both directions.
Section 3 – Hicks Gate to Broadmead Roundabout	**Option 3B**	Reallocate road space on Keynsham bypass for bus lanes plus new at-grade transport interchange along bypass	BBSC service running along A4 via Keynsham Bypass with transport interchange on Keynsham Bypass (at-grade). Reallocate one lane in each direction for bus lanes along the Keynsham bypass. Reduce Speed limit along Keynsham bypass. New bus stops/ interchange point along bypass connecting to active travel links through Memorial Park to serve the town centre and connect to the rest of Keynsham (including the rail station).
Section 4 – Broadmead Roundabout to Globe Roundabout	**Option 4F**	Bus gates on entry to Saltford	Bus gates / restrictions to general traffic on inbound approaches to Saltford facilitating bus priority. Restrict traffic flows (during peaks or permanently) to reduce congestion and delays to buses. No change to bus priority between Broadmead Roundabout and the bypass, and from the bypass to Globe Roundabout. Provide bus priority at Globe Roundabout on eastbound approach.
Section 4 – Broadmead Roundabout to Globe Roundabout	**Option 4G**	Bi-direction bus lane in Saltford	Bi-directional bus lane through short section (most constrained) of the A4 through the village. No change to bus priority between Broadmead Roundabout and the bypass, and from the bypass to Globe Roundabout. Provide bus priority at Globe Roundabout on eastbound approach.
Section 4 – Broadmead Roundabout to Globe Roundabout	**Option 4H**	Junction improvements and restrictions in Saltford	Rationalisation of junctions in Saltford (restricting turning movements to Left-in-left-out in some locations) to reduce friction to through-traffic. Introduction of right-turn pockets. Potential signalisation of junctions. No change to bus priority between Broadmead Roundabout and the bypass, and from the bypass to Globe Roundabout. Provide bus priority at Globe Roundabout on eastbound approach.
Section 4 – Broadmead Roundabout to Globe Roundabout	**Option 4J**	New bus lanes in both directions along section	Additional lanes inbound and outbound to provide continuous bus priority along A4 between the Broadmead Roundabout and the Globe Roundabout (including section through Saltford).
Section 5 - Globe Roundabout to Twerton Fork	**Option 5A**	Reallocate road space to create bus lanes in both directions	Reallocate one lane in each direction of dual carriageway to bus lane only (between Globe Roundabout and Twerton Fork). Provide bus priority at Globe Roundabout on eastbound approach.
Section 5 - Globe Roundabout to Twerton Fork	**Option 5B**	New bus lanes in both directions along section	Additional lanes inbound and outbound to provide continuous bus priority along A4 between the Globe Roundabout and Twerton Fork
Section 5 - Globe Roundabout to Twerton Fork	**Option 5D**	Bus priority at junction approaches only	Retain existing carriageway layout. Introduce localised bus priority on approaches to Globe Roundabout (A4/A39)
Section 6 - Twerton Fork to Bath Station	**Option 6A**	New bus lanes along A4 to Windsor Bridge	A4 Newbridge Road and Upper Bristol Road to Windsor Bridge - BBSC services continue along A4 past Newbridge P&R with additional bus lane to support priority.
Section 6 - Twerton Fork to Bath Station	**Option 6B**	New bus lanes along A36 to Windsor Bridge	A36 Lower Bristol Road to Windsor Bridge - BBSC services run from Twerton Fork along A36 to Windsor bridge with additional bus lane to support priority.
Section 6 - Twerton Fork to Bath Station	**Option 6D**	New bus lanes from Windsor Bridge along A4 and Top of Town	BBSC services continue along A4 from Windsor Bridge to junction of Monmouth Place / Charlotte Street with additional bus lane to support priority. Alternative northern and eastern route option to bus station.
Section 6 - Twerton Fork to Bath Station	**Option 6E**	New bus lanes Windsor Bridge along A4 and A367	BBSC services continue along A4 from Windsor Bridge following Upper Bristol Road, Queen Square and Green Park Road to junction of Monmouth Place / Charlotte Street with additional bus lane to support priority. Represents an alternative south-western route option to bus station supported by bus lanes/priority.

Section	Option Nr	Option name	Option description
Section 6 - Twerton Fork to Bath Station	**Option 6G**	New bus lanes from Windsor Bridge to City Centre Loop via A36	BBSC services run from Windsor Bridge following Lower Bristol Road with additional bus lane to support priority along the A36 up to Midland Bridge Road before routing along Bath city centre bus loop.
Section 6 - Twerton Fork to Bath Station	**Option 6H**	New bus lanes from Windsor Bridge to City Centre Loop via A4	BBSC services continue along A4 from Windsor Bridge to junction of Monmouth Place / Stanhope Place with additional bus lane to support priority. Service would then follow existing Bath city centre bus loop.
Section 6 - Twerton Fork to Bath Station	**Option 6L**	Bus priority between Twerton Fork and Newbridge P&R	Introduce linked bus priority at Twerton Fork Junction and Newbridge P&R access
Section 6 - Twerton Fork to Bath Station	**Option 6M**	New bus lanes between Twerton Fork and Newbridge P&R	Introduce new bus lane in each direction between Twerton Fork and Newbridge P&R, supported by new bridges/bridge widening.

Table 4-2 - Shortlist of Strategic Cycling Corridor infrastructure options (Sections 2 to 6)

Section	Option Nr	Option name	Option description
Section 2 – Emery Road to Hicks Gate	**Option C2a**	Segregated cycle route along the A4	Segregated cycle facility as part of revised A4 Bath Road cross section.
Section 2 – Emery Road to Hicks Gate	**Option C2b**	Traffic-free cycle route north of the A4	New traffic-free cycle link to the north of the A4 Bath Road carriageway.
Section 3 – Hicks Gate to Broadmead Roundabout	**Option C3a**	Segregated cycle route along the A4	Segregated cycle facility as part of revised A4 Keynsham Bypass. Includes cycle facilities across Hicks Gate Roundabout and cycle links from the town centre to Keynsham bypass.
Section 3 – Hicks Gate to Broadmead Roundabout	**Option C3b**	Cycle route through Keynsham town centre	Cycle route through Keynsham town centre (along High Street) making use of existing facilities (where appropriate) and introduced LTN1/20-compliant facilities where required (such as the route along Durley Hill)
Section 4 – Broadmead Roundabout to Globe Roundabout	**Option C4a**	Segregated cycle route along the A4	Segregated cycle facility as part of revised A4 Bath Road cross section (including bus priority) from Broadmead Roundabout to Globe Roundabout.
Section 4 – Broadmead Roundabout to Globe Roundabout	**Option C4b**	Traffic-free cycle route via North Keynsham to Bristol to Bath Railway Path	Route from Broadmead Roundabout through possible North Keynsham development area, with new cycle facility linking to the Bristol to Bath Railway Path (to Saltford and Bath)
Section 4 – Broadmead Roundabout to Globe Roundabout	**Option C4d**	Cycle route through local roads in north Saltford.	Quiet 20mph mixed traffic route from junction of A4/Norman Road along Norman Road and The Shallows to back A4 Bath Road. Rejoin the A4 just south of railway bridge. Follow route of C4Xa to western extent of Saltford. Follow C4Xa from eastern extent of Saltford to Globe Roundabout.
Section 5 - Globe Roundabout to Twerton Fork	**Option C5a**	Segregated cycle route along the A4	Segregated cycle facility as part of revised cross section from Globe Roundabout to Twerton Fork along the A4.
Section 5 - Globe Roundabout to Twerton Fork	**Option C5b**	Use existing cycle link alongside A4	Improve (as required) the existing segregated cycle facility from Globe Roundabout to Twerton Fork.
Section 6 - Twerton Fork to Bath Station	**Option C6a**	Segregated cycle route along the A4 Upper Bristol Road	Segregated cycle facility as part of revised cross section from Twerton Form to central Bath along Newbridge Road/ Upper Bristol Road.
Section 6 - Twerton Fork to Bath Station	**Option C6b**	Segregated cycle route along the A36 Lower Bristol Road	Segregated cycle facility as part of revised cross section from Twerton Fork to central Bath along A36 Lower Bristol Road
Section 6 - Twerton Fork to Bath Station	**Option C6c**	Traffic-free cycle route through safeguarded route	Follows Bristol to Bath Railway Path (NCN4) and then safeguarded active travel route to central Bath.

4.5 Hicks Gate Park and Ride and Transport hubs

4.5.1. Section 2 of the corridor includes the relocated and potentially expanded Hicks Gate P&R and Transport Hub. At the OAR stage two locations were shortlisted for the new P&R site:

- Option 4: To the south west of the Hicks Gate junction
- Option 8: Within the Hicks Gate Junction (with the Hub located within the roundabout)

4.5.2. In the SOC the Hicks Gate roundabout was assumed to be unchanged (with access to the P&R and Hub assumed to be from Durley Hill). However, it is anticipated that to better facilitate access for buses between the Hicks Gate and the P&R/Transport Hub that the configuration of the junction will need to be amended. The Hicks Gate P&R and Transport Hub was shortlisted for inclusion in all options regardless of location.

4.5.3. The Keynsham Hub is assumed to be a bus interchange with a building providing heated waiting facilities, toilets, ticketing machines, CCTV, cycle storage and opportunities for other mobility hub elements (such as e-cargo bikes). This transport hub was also shortlisted for inclusion.

4.6 Shortlist of options for the SOC

4.6.1. The four packages of options assessed as part of the SOC are summarised in **Table 4-3.**

Table 4-3 – Shortlist of options for the SOC

Option name	Option description
Smaller intervention	For the majority of the route, this option makes use of existing bus priority and only adds in new bus priority where there is existing road space that can be reallocated. In locations where this provides no improvements to buses, 1 way traffic restrictions are added to the A4 to reduce general traffic and prioritise buses, and new routes are provided to compensate for the closed routes. Provides segregated cycle facilities along the majority of the corridor.
Medium 1 intervention	This option provides bus priority in both directions if the land take impacts are not overly significant, or in one direction only. In locations where land take is not an option, alternative routes for buses are used and 2-way traffic restrictions are added to the A4 to reduce general traffic and prioritise buses. New routes are provided to compensate for the closed routes. Provides segregated cycle facilities along the length of the corridor.
Medium 2 intervention	The same as Medium 1 for the majority of the route. In locations where land take is not an option changes are made within the highway boundary. Provides segregated cycle facilities along the majority of the corridor.

Option name	Option description
Larger intervention	Provides full continuous bus priority in both directions along the length of the route. Provides segregated cycle facilities along the length of the corridor with additional ‘green’ routes (for less confident / leisure users) where possible.

4.6.2. For the B&NES section of the corridor there was no difference between Medium Intervention 1 and 2, therefore the three packages of interventions were considered within the SOC.

5 Outline Business Case option development

5.1.1. The makeup of the scheme has changed between the SOC and the OBC. At the SOC stage bus service improvements were included. It was decided as part of the OBC that the detailed consideration of the Bus Operational Model would be taken forward as part of the development and planning of the West of England Enhanced Partnership under the BSIP. Therefore, the OBC is focussed on the provision of infrastructure, any potential bus service changes that could be implemented because of these infrastructure improvements will be captured by the BSIP programme. The Phase 1 elements of the programme aligns with the objectives of the CRSTS, and this funding would be used for delivering the corridor.

5.1.2. Therefore, the option development for the OBC focuses on the Strategic Corridor including bus and cycle infrastructure along the A4 corridor, the Keynsham Hub, the Hicks Gate P&R and Transport Hub and the Community Connections interventions.

5.1.3. A public consultation exercise was undertaken (21st August until 1st October 2023) to provide feedback on the scheme and help inform the design.

5.2 Strategic Corridor including hubs

5.2.1. For the OBC, both the smaller intervention and the medium intervention packages identified at the SOC were taken forward for further design development. The larger intervention package was discounted at this point as it was considered that it was not deliverable in terms of timescales or funding within the existing CRSTS funding window.

5.2.2. The design work undertaken on the smaller and medium intervention packages was focused on the following factors:

- Deliverability within timescale and funding envelope
- Areas with greatest opportunity to improve public transport journey times
- Minimising the carbon impacts of the scheme

5.2.3. Option development and design focussed on those elements that could be completed with minimum land take (within the existing highway boundary) and within the programme timeframes. Any elements that required changes to existing structures, such as bridges and retaining walls, were discounted at this point as these would be unlikely to be deliverable within the existing delivery timeframes and would have an adverse effect on the scheme costs.

5.2.4. Automatic Vehicle Locator (AVL) 2019 data, along with Google traffic data, was interrogated to identify those areas of the route where the greatest delay occurred for public transport, and where the interventions would have the greatest impact on journey time for buses to ensure that the scheme met the 10% journey time reduction.

5.2.5. The OBC designs were developed considering the PAS 2080 carbon reduction hierarchy, which utilises the carbon reduction curve (Build nothing → Build less → Build clever → Build efficiently) and the IEMA Greenhouse Gas Management Hierarchy (Eliminate → Reduce →Substitute →Compensate).

5.2.6. In the first instance at least two designs were developed for each section in line with those set forward as the smaller and medium interventions within the SOC. However, as the designs developed certain aspects of these interventions were discounted as not being deliverable within the scheme timescale and funding window. This was either due to land take required, work to existing structures such as bridges and retaining walls and removal of existing established trees. **Table 5-1** summarises the initial options considered at the outset of the OBC option development.

Table 5-1 – Strategic Corridor initial options

Section	Option 1	Option 2
2 Emery Road to Hicks Gate	Continuous bus lane eastbound, continuous bus lane westbound except The Lodge to P&R junction. Continuous segregated two-way cycleway southern side of carriageway	Continuous bus lane westbound except The Lodge to P&R junction. Continuous segregated two-way cycleway southern side of carriageway
3 Hicks Gate to Broadmead roundabout	Continuous bus lane eastbound and westbound, continuous segregated cycleway.	Continuous bus lane eastbound and westbound, continuous segregated shared use path
4 Broadmead roundabout to Globe roundabout	Walking/Cycling only. Continuous segregated cycleway/shared use facility to south of carriageway	Continuous bus lane eastbound Broadmead to Grange Road, segregated cycleway/shared use facility to south of carriageway Broadmead to Grange Road
5 Globe roundabout to Twerton Fork (Newbridge)	Continuous bus lane eastbound and southbound and segregated cycle route to north of carriageway	Segregated cycle route to the north of the carriageway

Section	Option 1	Option 2
6 Twerton Fork (Newbridge) to Bath centre	Walking and cycling enhancements	Bus enhancements at various locations along the section, cyclists to use Bristol to Bath Railway Path (BBRP)
Hicks Gate	P&R and Hub and junction enhancements for bus, or Hub and junction enhancements for bus	Bus stop enhancement on corridor
Keynsham Hub	Only one Transport Hub option along A4 providing walking & cycling connections to Keynsham centre and the Train Station	Not applicable

5.2.7. A further review was then conducted on these designs to see which of the options could be delivered within the timescales and a more in-depth constraints review was undertaken. The review also looked at which options would be likely to deliver the 10% reduction in travel time as set out in the objectives and identifying those options offering the best value for money. Based on this review a preferred option was identified for each section. **Table 5-2** indicates the selected option and the reasoning behind discounting the alternative option.

Table 5-2 – Strategic Corridor selected options

Section	Option 1	Option 2
2 Emery Road to Hicks Gate	Selected	▪ Minimal difference in cost and so preferable to also include the eastbound bus lane
3 Hicks Gate to Broadmead roundabout	▪ Contains considerable structures work ▪ Unlikely to be deliverable in timescales and cost envelope ▪ Would have large carbon implications	Selected
4 Broadmead roundabout to Globe roundabout	▪ Prioritised the bus interventions and improve the cycle provision connecting to BBRP using less trafficked roads	Selected

Section	Option 1	Option 2
5 Globe roundabout to Twerton Fork (Newbridge)	Selected	▪ The potential journey time savings by provision of a bus lane were not considered to be significant
6 Twerton Fork (Newbridge)to Bath centre	Limited space, Cyclists can be redirected to use BBRP	Selected
Hicks Gate	▪ Hub and junction enhancements were not considered to be deliverable within the timescales	Selected
Keynsham Hub	Selected	Selected

5.2.8. The options were developed in collaboration with B&NES and the Combined Authority. These options were further reviewed in terms of value engineering to reduce the capital costs based on the initial costs' estimates, land take and minimise tree/habitat loss and embedded carbon. The revised designs were discussed with both the Combined Authority and B&NES throughout this process. The resultant shortlisted options which will form the scheme for OBC is summarised in **Table 5-3**, detailing the infrastructure delivered on each section. **Appendix A** includes the more detailed designs for each section of the corridor.

Table 5-3 – Strategic Corridor revised selected options

Section	Option description
2 Emery Road to Hicks Gate	Segregated bi-directional cycle lane to south of carriageway with crossing facilities, continuous bus lanes eastbound and southbound from P&R junction to Hicks Gate, not Emery Road due to tie into Bristol section proposals and traffic constraints.
3 Hicks Gate to Broadmead roundabout	Continuous bus lane eastbound and westbound along Keynsham Bypass, continuous segregated shared use path to south of carriageway
4 Broadmead roundabout to Globe roundabout	Eastbound bus lane Broadmead to Grange Road, shared use path/segregated cycleway provided to south of carriageway. Within Saltford there is limited room for provision of bus lanes or segregated cycling infrastructure.
5 Globe roundabout to Twerton Fork (Newbridge)	Shared use path provided to north of carriageway between Globe Roundabout and Newbridge Road ties into existing connection to BBRP. Constraints at bridges mean full segregated walking/cycling provision is unlikely to be achievable.

Section	Option description
6 Twerton Fork (Newbridge) to Bath centre	Eastbound bus lane between Newbridge P&R and Midland Road
Hicks Gate	Bus Stop Enhancement on Corridor and improved access to bus stops
Keynsham Hub	Transport Hub with on carriageway bus stops and at grade crossing of A4, bus shelters provided along with walking/cycling connections to Keynsham town centre and train station.

5.2.9. These options will be taken forward for further assessment in the OBC following the public consultation and any revision of designs following the feedback received.

5.3 Community Connections

5.3.1. For the longlist of options for the Community Connections, a sifting process took place using an MCAF, considering the option against a range of indicators including level of deprivation, proximity and connections to existing cycle network, access to public transport, education and employment, barriers to delivery and any permissions, approvals or legal powers required.

5.3.2. As the result of the MCAF process, a shortlist of eight schemes were identified to be taken forward for further design. A small number of the options identified in the longlist were along the Strategic Corridor and therefore have been included in the Strategic Corridor designs. The eight shortlisted options are summarised in **Table 5-4**.

Table 5-4 – Community Connections shortlisted options

Area of intervention	Option description
Bristol to Bath Railway Path (BBRP) Saltford Section	Upgrade of existing connections (Norman Road & High Street), potential walking/cycling crossing upgrades
Saltford	Manor Road, walking/cycling crossing upgrades
Keynsham Centre and connection to train station	Junction upgrades, connections to proposed Keynsham Transport Hub
South Western Keynsham	St. Frances Road, Keynsham: Connection to Broadlands Academy from A4. Also provides connection to residential areas to the south of A4 and town centre
Connecting directly to A4 sections (Keynsham Section)	Bath Road, Keynsham: Broadmead roundabout access to Wellsway sports centre and onward to the west

Area of intervention	Option description
Connecting directly to A4 sections (Saltford Section)	Junction improvements and cycleway at Grange Road off the A4 corridor
Connecting directly to A4 sections (Bath Section)	Osborne Road, Connecting A4 to BBRP, possible Modal Filter at this location
Globe Roundabout to Bath Spa Campus	Upgrade existing shared use facility along A39 Wells Road from Globe Roundabout to Corston Drive, facility is currently substandard

5.3.3. All of the options listed in **Table 5-4** have been taken forward for further design work and further assessment as part of the OBC process. As with the strategic corridor interventions the community connections interventions were designed in collaboration with the Combined Authority and B&NES and were included in the public consultation which took place between 21st August and 1st October 2023.

6 BBRP Improvements and extension

6.1.1. An Options Assessment Report for the Bristol to Bath Railway Path (BBRP) has been prepared for B&NES Council in February 2023.

6.1.2. The report has established that extending the BBRP is compatible with policy documentation at all levels. The aim of the report was to provide a feasible active travel route between Brassmill Lane and Locksbrook Bridge. These routes are expected in fit into the National Cycle Network. It looked into various options to provide a fully segregated cycle route connecting Bristol and Bath.

6.1.3. The existing cycle route between Brassmill Lane junction and Windsor Bridge Road comprises of an on-street, unprotected design that is not aligned to the latest LTN1/20 guidance. It runs along Brassmill Lane, before joining the River Avon towpath at Locksbrook Road. The towpath is narrow with several significant pinch points and a lack of lighting causing safety concerns.

6.1.4. Future planned and committed schemes for this part of Bath are set to create hundreds of new jobs and residential dwellings within the area, requiring a sustainable transport network than can support this increase.

6.1.5. The implementation of this BBRP scheme, as well as other upcoming active travel schemes such as the Bath River Line project will help to create a more comprehensive active travel network and enhance interconnectivity within the area.

6.1.6. An initial long list of 19 options was formed as a result of a site walkover, stakeholder meetings and study of the area. The long list options, many of which were minor variations of similar routes, were scored against three criteria; cost, deliverability, and alignment with the proposed objectives.

6.1.7. The long list was refined, and three options were put forward to form a short list, one of which had three sub-options, based on the future land ownership in the area. The short-listed options were put forward for stakeholder comment.

6.1.8. The first short listed option was a detailed improvement of the infrastructure along the existing route, with no physical realignment. Stakeholders suggested this option be discounted as the improved route wouldn’t meet LTN 1/20 standards or address a majority of the originally identified issues with the existing route. The Bath River Line project will also be delivering these improvements and therefore there was no need for further investment along this path.

6.1.9. Option 2 was put forward as a package of three sub-options, with the intention of a phased implementation from 2a to either 2b or 2c. This option aligned well with future developments, although land ownership barriers were acknowledged.

6.1.10. Option 3 was highlighted as the more ambitious option, with first-rate potential future active travel network connections, although some potential feasibility issues were raised, highlighting dense woodland and steep slopes. Due to land ownership issues, there were also concerns with delivering this option within the timeframes of the CRSTS funding.

6.1.11. Concept designs were developed for the four shortlisted options which were:

- Option 2a Disused Railway Alignment/Station Road/Existing BBRP
- Option 2b Disused Railway Alignment/Station Road/Locksbridge Road/Volkswagen Land
- Option 2c Disused Railway Alignment/Station Road/Locksbridge Road/Kelson's Field
- Option 3 Entire railway alignment

6.1.12. The options were assessed using the Options Assessment Framework set out in the DfT Transport Appraisal Process Guidance. They were assessed using a 3-point and 7-point scale depending on the impact.

6.1.13. Costs were also developed for the options, with a range of £0.88m to £2.29m.

6.1.14. An Active Mode Appraisal Tool (AMAT) Assessment was undertaken for each of the options. The assessment indicated that all of the options would deliver benefits which significantly outweigh the cost of delivery, with all options offering a high value for money.

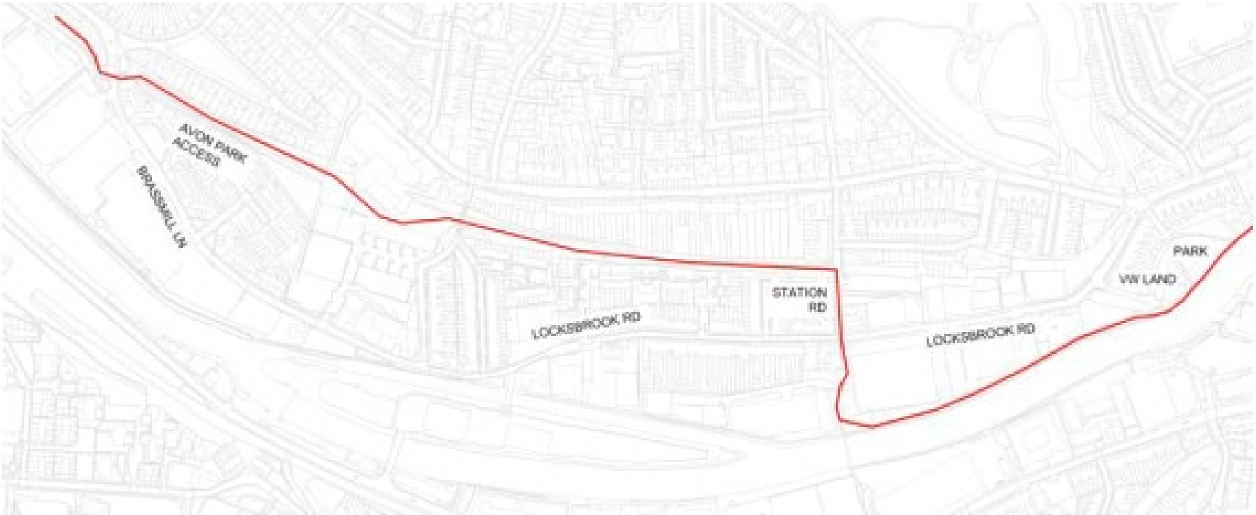
6.1.15. Overall, the results of the AMAT showed that Option 3 would offer the highest scale of benefits and quantified value for money, although the cost of this option is significantly higher than the alternatives. The cheapest, Option 2a, was the 2nd best scoring option as it delivers similar benefits to 2b and 2c, while costing less.

6.1.16. The report recommended that Option 2a be taken forward for further design and appraisal. Option 2a makes use of the disused railway alignment path to the east of Station Road and connects it to the existing shared use path alongside the river after reaching Station Road.

6.1.17. Option 2a, provides an off-road route along the western section between Brassmill Lane and Station Road, which will provide a safer route for cyclists and pedestrians which in turn will results in modal shift and encourage more pedestrians and cyclists to use the route due to improved journey quality.

6.1.18. The route travels along Station Road for a short stretch where on-street traffic calming measures are proposed such as replacing the centreline with a median strip to slow traffic. When reaching Station Road, the route then continues down the hill and re-joins the old BBRP.

Figure 6-1 - BBRP Extension alignment - preferred option



6.2 Summary

6.2.1. This OAR Addendum documents the further development of the shortlisted solutions from the OAR through the Strategic Outline Case (SOC) stage and through further development for the Outline Business Case (OBC), as well as the updates to the scheme vision and objectives since SOC.

6.2.2. As with the OAR, this report focuses on the section of the corridor between Emery Road and Bath Bus Station.

6.3 Vision and objectives

6.3.1. As part of the development of the OAR and SOC, the Vision and Objectives for the scheme were identified.

6.3.2. As part of the development of the OBC both the vision and objectives from the SOC were reviewed and revised by the Combined Authority and Bath and North East Somerset (B&NES) Council to reflect the current regional context. These revised vision and objectives were approved by the Combined Authority in April 2023. Although the objectives have changed the key themes from the previous objectives remain.

6.3.3. A theory of change/logic map was developed for the SOC, this has been revised and updated to consider the revised objectives.

6.4 Optioneering process

6.4.1. As part of the development of the OAR a robust and extensive optioneering process was undertaken. As part of this the scheme was considered in terms of four 'themes':

- Bus Priority Infrastructure
- Strategic Cycling Infrastructure
- Community Connections

- Bus Operational Model

6.4.2. The OAR sets out the option generation and assessment process undertaken previously, and the following sections set out which options were shortlisted as a result of this process. An overview of the further option development and assessment work undertaken as part of the SOC and OBC is provided in the subsequent paragraphs.

6.5 Strategic Outline Case option development

6.5.1. The shortlisted options identified in the OAR were further developed and assessed as part of the SOC. The options across the four themes were considered to determine four packages of measures that were assessed as part of the SOC.

Community Connections shortlist

6.5.2. As part of the SOC, the range of potential interventions to support Community Connections (i.e., linking communities served by the corridor to the proposed strategic bus and cycling infrastructure through active travel links and crossings) identified as part of the OAR considered and allocated to the four packages as follows:

- Smaller Intervention: only includes interventions along the A4 (within 50m of A4)
- Medium 1 Intervention: only includes interventions within 400m of A4
- Medium 2 Intervention: only includes interventions within 400m of A4
- Larger Intervention: includes all proposed interventions

Bus Operational Model shortlist

6.5.3. The same Bus Operational Model was assumed across the four packages within the SOC. Based on the assessment undertaken as part of the OAR it was decided that Option 3 (the introduction of a new metrobus service running at a 5-minute headway with reduced stops, with the existing X39 amended to a 10-minute headway local stopping service and the existing Brislington P&R service replaced by the metrobus service) was the most suitable to used. This was chosen as it represents the option that best fits with the Operational Objectives of the BBSC Programme.

Bus and cycle Infrastructure options – Sections 2 to 6 (Emery Road to Bath Station)

6.5.4. The options development process considered options across a range of measures to support the achievement of the objectives. A matrix approach was adopted to optioneering and for each section of the corridor options were developed for:

- **Bus Priority Infrastructure** (i.e., introducing bus priority measures to reduce bus journey times and increase bus journey time reliability)
- **Strategic Cycling Infrastructure** (i.e., introducing a continuous segregated cycling corridor between Bristol and Bath)

Hicks Gate Park and Ride and Transport hubs

6.5.5. Section 2 of the corridor includes the relocated and potentially expanded Hicks Gate P&R and Transport Hub. At the OAR stage two locations were shortlisted for the new P&R site:

- Option 4: To the south west of the Hicks Gate junction
- Option 8: Within the Hicks Gate Junction (with the Hub located within the roundabout)

6.5.6. In the SOC the Hicks Gate roundabout was assumed to be unchanged (with access to the P&R and Hub assumed to be from Durley Hill). However, it is anticipated that to better facilitate access for buses between the Hicks Gate and the P&R/Transport Hub that the configuration of the junction will need to be amended. The Hicks Gate P&R and Transport Hub was shortlisted for inclusion in all options regardless of location.

6.5.7. The Keynsham Hub is assumed to be a bus interchange with a building providing heated waiting facilities, toilets, ticketing machines, CCTV, cycle storage and opportunities for other mobility hub elements (such as e-cargo bikes). This transport hub was also shortlisted for inclusion.

Shortlist of options for the SOC

6.5.8. There were four packages of options assessed as part of the SOC, these are:

- Smaller intervention - For the majority of the route, this option makes use of existing bus priority and only adds in new bus priority where there is existing road space that can be reallocated. In locations where this provides no improvements to buses, 1 way traffic restrictions are added to the A4 to reduce general traffic and prioritise buses, and new routes are provided to compensate for the closed routes. Provides segregated cycle facilities along the majority of the corridor.
- Medium 1 Intervention - This option provides bus priority in both directions if the land take impacts are not overly significant, or in one direction only. In locations where land take is not an option, alternative routes for buses are used and 2-way traffic restrictions are added to the A4 to reduce general traffic and prioritise buses. New routes are provided to compensate for the closed routes. Provides segregated cycle facilities along the length of the corridor
- Medium 2 Intervention - The same as Medium 1 for the majority of the route. In locations where land take is not an option changes are made within the highway boundary. Provides segregated cycle facilities along the majority of the corridor.
- Larger Intervention - Provides full continuous bus priority in both directions along the length of the route. Provides segregated cycle facilities along the length of the corridor with additional ‘green’ routes (for less confident / leisure users) where possible.

6.5.9. For the B&NES section of the corridor there was no difference between Medium Intervention 1 and 2, therefore the three packages of interventions were considered within the SOC.

6.6 Outline Business Case option development

6.6.1. The makeup of the scheme has changed between the SOC and the OBC. At the SOC stage bus service improvements were included. It was decided as part of the OBC that the detailed consideration of the Bus Operational Model would be taken forward as part of the development and planning of the West of England Enhanced Partnership under the BSIP.

6.6.2. The option development for the OBC focuses on the Strategic Corridor including bus and cycle infrastructure along the A4 corridor, Keynsham Hub, the Hick’s Gate P&R and Transport Hub and the Community Connections interventions.

6.6.3. A public consultation exercise was conducted (21st August until 1st October 2023) to provide feedback on the scheme and help inform the design.

Strategic Corridor including hubs

6.6.4. For the OBC, both the smaller intervention and the medium intervention packages identified at the SOC were taken forward for further design development. The larger intervention package was discounted at this point as it was considered that it was not deliverable in terms of timescales or funding within the existing CRSTS funding window.

6.6.5. The design work undertaken on the smaller and medium intervention packages was focused on the following factors:

- Deliverability within timescale and funding envelope
- Areas with greatest opportunity to improve public realm, active travel and bus journey times
- Minimising the carbon impacts of the scheme

6.6.6. Option development and design focussed on those elements that could be completed with minimum land take (predominately within the existing highway boundary) and within the programme timeframes. Any elements that required changes to existing structures, such as bridges and retaining walls, were discounted at this point as these would be unlikely to be deliverable within the existing delivery timeframes and would have an adverse effect on the scheme costs.

6.6.7. Automatic Vehicle Locator (AVL) data, along with Google traffic data, was interrogated to identify those areas of the route where the greatest delay occurred for public transport, and where the interventions would have the greatest impact on journey time for buses to ensure that the scheme met the 10% journey time reduction.

6.6.8. The OBC designs were developed considering the PAS 2080 carbon reduction hierarchy, which utilises the carbon reduction curve (Build nothing → Build less → Build clever → Build efficiently) and the IEMA Greenhouse Gas Management Hierarchy (Eliminate → Reduce →Substitute →Compensate).

6.6.9. As the designs developed certain aspects of these interventions were discounted as not being deliverable within the scheme timescale and funding window. This was either due to land take required, work to existing structures such as bridges and retaining walls and removal of existing established trees.

6.6.10. A more in-depth constraints review was undertaken alongside identifying which options would be likely to deliver the 10% reduction in travel time as set out in the objectives and identifying those options likely to offer the best value for money. Based on this review a preferred option was identified for each section.

6.6.11. These options will be taken forward for further assessment in the OBC following the public consultation and any revision of designs following the feedback received.

Community Connections

6.6.12. For the longlist of options for the Community Connections, a sifting process took place using an MCAF, considering the option against a range of indicators including level of deprivation, proximity and connections to existing cycle network, access to public transport, education and employment, barriers to delivery and any permissions, approvals or legal powers required.

6.6.13. As the result of the MCAF process, a shortlist of eight schemes were identified to be taken forward for further design. A small number of the options identified in the longlist were along the Strategic Corridor and therefore have been included in the Strategic Corridor designs.

6.6.14. These options have been taken forward for further design work and further assessment as part of the OBC process. As with the strategic corridor interventions the community connections interventions were designed in collaboration with the Combined Authority and B&NES and were included in the public consultation which took place between 21st August and 1st October 2023

BBRP Improvements and extension

6.6.15. This project has been included in the BBSC Bath to Emery Road scheme.

6.6.16. A list of 19 options was identified and was sifted down to a final set of three options, which after stakeholder engagement was further sifted down to two final options; Options 2 and Option 3, of which Option 2 had three different sub routes to choose from, a, b and c.

6.6.17. Options 2A, B and C provide a largely traffic free route, making use of the disused railway path between Brassmill Lane and Station Road, which is currently informally used by local residents, with Option 2A tracking down Station Road and re-joining the current BBRP, Option 2B crossing Station Road and continuing along Locksbrook Road before joining the existing BBRP via land currently leased by B&NES to Volkswagen and Option 2C crossing station road and continuing along Locksbrook Road before joining the existing BBRP via Kelson's Field.

6.6.18. Option 3 provides a completely traffic-free route making use of the disused railway path between Brassmill Lane and Station Road, which is currently informally used by local residents, and continuing along the disused railway path to the east of Station Road.

6.6.19. High level concept plans have been developed for each of the short-listed options based on Ordnance Survey Mapping with constraints related to topography, existing land use and critical widths highlighted.

6.6.20. These concept design drawings were then used to create high level cost estimates for each of the short-listed options.

6.6.21. Each short-listed design has been individually assessed within an Options Assessment Framework (OAF). An Active Mode Appraisal Tool (AMAT) assessment was also undertaken for each of the short-listed options.

6.6.22. These assessments highlighted that all options are forecast to result in modal shift and a growth in walking and cycling, with Option 3 forecast to result in the largest increases, due to the route being completely off road. However, Option 3 is the most expensive option by approximately ~£1.2 million and also has the most complex delivery arrangements due to the requirement to acquire additional land and additional ecological issues associated with delivery of the eastern portion of the former railway alignment which could result in delivery falling outside of the CRSTS funding delivery timescales.

6.6.23. Option 2A was the second-best scoring option behind Option 3 and does not have the complex issues of land clearance and land purchase on the eastern side of Station Road. It is also a scheme that has the potential to be delivered within the CRSTS delivery timescales and therefore it was recommended that Option 2A is the scheme to take forward to the next stage with the option to potentially phase out to Option 2B or Option 2C in the future.

7 Summary

7.1.1. This OAR Addendum documents the further development of the shortlisted solutions from the OAR through the Strategic Outline Case (SOC) stage and through further development for the Outline Business Case (OBC), as well as the updates to the scheme vision and objectives since SOC.

7.1.2. As with the OAR, this report focuses on the section of the corridor between Emery Road and Bath Bus Station.

7.2 Vision and objectives

7.2.1. As part of the development of the OAR and SOC, the Vision and Objectives for the scheme were identified.

7.2.2. As part of the development of the OBC both the vision and objectives from the SOC were reviewed and revised by the Combined Authority and Bath and North East Somerset (B&NES) Council to reflect the current regional context. These revised vision and objectives were approved by the Combined Authority in April 2023. Although the objectives have changed the key themes from the previous objectives remain.

7.2.3. A theory of change/logic map was developed for the SOC, this has been revised and updated to consider the revised objectives.

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- Community Connections
- Bus Operational Model

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7.4 Strategic Outline Case option development

7.4.1. The shortlisted options identified in the OAR were further developed and assessed as part of the SOC. The options across the four themes were considered to determine four packages of measures that were assessed as part of the SOC.

Community Connections shortlist

7.4.2. As part of the SOC, the range of potential interventions to support Community Connections (i.e., linking communities served by the corridor to the proposed strategic bus and cycling infrastructure through active travel links and crossings) identified as part of the OAR considered and allocated to the four packages as follows:

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Bus Operational Model shortlist

7.4.3. The same Bus Operational Model was assumed across the four packages within the SOC. Based on the assessment undertaken as part of the OAR it was decided that Option 3 (the introduction of a new metrobus service running at a 5-minute headway with reduced stops, with the existing X39 amended to a 10-minute headway local stopping service and the existing Brislington P&R service replaced by the metrobus service) was the most suitable to used. This was chosen as it represents the option that best fits with the Operational Objectives of the BBSC Programme.

Bus and cycle Infrastructure Options – Sections 2 to 6 (Emery Road to Bath Station)

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7.5.3. A public consultation exercise was conducted (21st August until 1st October 2023) to provide feedback on the scheme and help inform the design.

Strategic Corridor including hubs

7.5.4. For the OBC, both the smaller intervention and the medium intervention packages identified at the SOC were taken forward for further design development. The larger intervention package was discounted at this point as it was considered that it was not deliverable in terms of timescales or funding within the existing CRSTS funding window.

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7.5.6. Option development and design focussed on those elements that could be completed with minimum land take (predominately within the existing highway boundary) and within the programme timeframes. Any elements that required changes to existing structures, such as bridges and retaining walls, were discounted at this point as these would be unlikely to be deliverable within the existing delivery timeframes and would have an adverse effect on the scheme costs.

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Community Connections

7.5.12. For the longlist of options for the Community Connections, a sifting process took place using an MCAF, considering the option against a range of indicators including level of deprivation, proximity and connections to existing cycle network, access to public transport, education and employment, barriers to delivery and any permissions, approvals or legal powers required.

7.5.13. As the result of the MCAF process, a shortlist of eight schemes were identified to be taken forward for further design. A small number of the options identified in the longlist were along the Strategic Corridor and therefore have been included in the Strategic Corridor designs.

7.5.14. These options have been taken forward for further design work and further assessment as part of the OBC process. As with the strategic corridor interventions the community connections interventions were designed in collaboration with the Combined Authority and B&NES and were included in the public consultation which took place between 21st August and 1st October 2023

BBRP Improvements and extension

7.5.15. This project has been included in the BBSC Bath to Emery Road scheme.

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7.5.18. Option 3 provides a completely traffic-free route making use of the disused railway path between Brassmill Lane and Station Road, which is currently informally used by local residents, and continuing along the disused railway path to the east of Station Road.

7.5.19. High level concept plans have been developed for each of the short-listed options based on Ordnance Survey Mapping with constraints related to topography, existing land use and critical widths highlighted.

7.5.20. These concept design drawings were then used to create high level cost estimates for each of the short-listed options.

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7.5.22. These assessments highlighted that all options are forecast to result in modal shift and a growth in walking and cycling, with Option 3 forecast to result in the largest increases, due to the route being completely off road. However, Option 3 is the most expensive option by approximately ~£1.2 million and also has the most complex delivery arrangements due to the requirement to acquire additional land and additional ecological issues associated with delivery of the eastern portion of the former railway alignment which could result in delivery falling outside of the CRSTS funding delivery timescales.

7.5.23. Option 2A was the second-best scoring option behind Option 3 and does not have the complex issues of land clearance and land purchase on the eastern side of Station Road. It is also a scheme that has the potential to be delivered within the CRSTS delivery timescales and therefore it was recommended that Option 2A is the scheme to take forward to the next stage with the option to potentially phase out to Option 2B or Option 2C in the future.

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix W - Economic Appraisal Report

70093741
January 2024

Public

West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix W - Economic Appraisal Report

Type of document (version) Public

Project no. 70093741

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Quality control

Issue/revision	First issue	Revision 1	Revision 2
Remarks	Draft for Comment	1st issue	2nd Issue
Date	November 2023	December 2023	February 2024
Prepared by	PS/DF/MH/MT	PS/DF/MH/MT	PS/DF/MH/MT
Checked by	CS	CS	CS
Authorised by	SG	SG	
Project number	70093741	70093741	70093741
Report number	70093741	70093741	70093741

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1 Introduction

1.1 Scope of Report

1.1.1. The West of England Combined Authority (Combined Authority) have commissioned WSP to develop a transport model as an evidence base for the A4 Bath to Bristol Strategic Corridor (BBSC) Outline Business Case (OBC).

1.1.2. The transport user appraisal of the scheme provides key inputs into the Economic Dimension section of the overall business case. This report will summarise the methodology behind the transport user appraisal and summarise the various tools used to calculate the overall benefits of the scheme.

1.2 Background

1.2.1. As part of the proposed traffic modelling methodology to appraise the preferred options, use of the West of England Regional Transport Model (WERTM) has been proposed. An initial review has been undertaken of WERTM and is summarised in a separate technical note (Base Model Update Report)[1]. This review provided an overview and recommendations for use of this model for the appraisal of the proposed schemes within the BBSC.

1.2.2. The base model has been updated for the purposes of this study and is based on the recommendations of the review and is summarised in the Base Model Update Report[2].

1.2.3. This base model has been the basis from which to apply the forecast assumptions to the network and matrices to create the forecast model scenarios and is summarised in the forecasting report[3]. This is the evidence base for the economic appraisal and is set out in this EAR.

1.2.4. Many of the changes to the infrastructure proposed as part of the A4 BBSC scheme are aimed towards promoting sustainability and reducing carbon emissions by limiting the number of private vehicles accessing the network. One of the most significant modifications forming part of the scheme involves reallocating road space to buses in the form of bus lanes. Additionally, the scheme includes a speed reduction from 70mph to 50mph on the Keynsham Bypass to facilitate the crossing of the A4 to reach the new Keynsham Mobility Hub. Moreover, the scheme introduces signal-controlled pedestrian crossings at various points along the corridor, spanning from Broadmead to Globe Roundabout, as well as within the Keynsham Mobility Hub region.

[1] **BBSC - WERTM Review**
[2] **BBSC – Base Model Update Report**
[3] **BBSC – Forecasting Report**

1.3 Transport Model

1.3.1. The WERTM suite of models has a 2019 base year. The purpose of the model is to provide an evidence-based forecasting tool to assess the impacts of land use developments, transport schemes and policies on the local transport network. The model is intended to build upon and supersede all existing strategic models in the region (i.e., Greater Bristol Area Transport Study Model and Greater Bath Area Transport study model).

Highway Assignment Model

1.3.2. The highway assignment model (HAM) has undergone a local calibration to enhance the performance of the 'standard WERTM HAM' in the BBSC study area. The review of the model identified the following key problems within the highway assignment model:

- Matrix estimation was distorting the matrix significantly, beyond the suggested tolerances set out in TAG Unit M3-1.
  - R squared values of internal trips being between 0.3 – 0.5.
- Journey time validation on A4 needs improvement.
  - Failed to meet TAG Unit M3-1 criteria in the AM and PM peak along two sections on the A4.
- Side roads within area of focus to be re-validated.
  - Identified unrealistic use of Scotland Lane with traffic rat-running from Keynsham to Bristol.
  - Underestimate traffic using Hicks Gate roundabout to access the A4 from Durley Hill.
  - Some A4 side roads were not included within WERTM.

1.3.3. The base model refinement has focussed on addressing these key problems, making the model suitable to appraise the BBSC scheme. The model has been developed to improve adherence with Transport Appraisal Guidance (TAG) across several different metrics for the purposes of use within an Outline Business Case. This update is summarised in the Base Model Update Report.

1.3.4. In addition, the generalised cost parameters applied in the highway assignment model were updated to reflect the values in the Department for Transport's (DfT's) May 2023 TAG Databook (v1.21).

Public Transport Assignment Model

1.3.5. Alongside the updates to the base year WERTM HAM, the base year WERTM public transport assignment model (PTAM) was also subject to minor refinements. The updates to the PTAM focused on the representation of trip making and travel patterns at the Brislington Park & Ride (P&R) site.

1.3.6. Origin-destination (OD) and car park occupancy count surveys were undertaken at the site between 24 January 2023 and 26 January 2023 inclusive. The survey data was used to enhance the base year demand travelling on bus to and from the P&R site zone in the PTAM.

1.3.7. In addition, the generalised cost parameters applied in the public transport assignments were updated to reflect the values in the Department for Transport's (DfT's) May 2023 TAG Databook (v1.21).

1.3.8. The updated model has retained the 2019 base year of the WERTM. Forecasts were produced for 2029 and 2042. The model, and its forecasts, have provided the information to underpin the public transport user economic assessment of the scheme.

1.3.9. The performance of the base year PTAM against observed data is reported in the 'BBSC OBC WERTM 2019 Base Model Update' report. The forecasts developed from the 2019 base year model are described in the 'BBSC OBC Forecasting Report (OBC 2023)'.

Variable Demand Model

1.3.10. The WERTM variable demand model (VDM) was updated to reflect the use of the May 2023 TAG Databook (v1.21) in the refined HAM and PTAM. The values of time, and fuel and non-fuel operating costs applied in the VDM were updated to align to the values in the May 2023 TAG Databook (v1.21). No other updates were made to the VDM.

1.3.11. The performance of the VDM, in replicating the observed base demand patterns and in responding to changes in travel costs, is reported in the 'BBSC OBC WERTM 2019 Base Model Update' report.

1.3.12. The forecasts developed for this study include a variable demand response, reflecting changes in travel cost between the base and forecast year brought about by economic, demand, and network changes. The demand response is modelled separately for scenarios with and without the BBSC scheme included. The impact of the variable demand model on the forecasts is described in the 'BBSC OBC Forecasting Report (OBC 2023)'.

1.4 Purpose of the Economic Appraisal

1.4.1. The DfT requires that an economic appraisal of a proposed scheme is undertaken in accordance with TAG.

1.4.2. The assessment determines whether the proposed scheme produces a satisfactory cost benefit ratio in economic terms, taking account of costs incurred by government and benefits and disbenefits accruing to both users and the wider community.

2 Approach to Economic Appraisal

2.1 Scope of the Appraisal

2.1.1. The appraisal of the proposed scheme included monetised benefits as well as impacts that cannot be quantified in monetary values.

2.1.2. The DfT's Value for Money (VfM) Framework identifies three categories of monetised impacts:

- Established: where the method for estimating the impact and the monetary value is tried-and-tested.
- Evolving: where some evidence exists to support the estimation of a monetary value but is less widely accepted and researched; and
- Indicative: where monetary valuation methods are not considered widely accepted or researched to be definitive, with a high degree of uncertainty in terms of the magnitude of the impact.

2.1.3. The economic appraisal covered by this report encompass the following 'established' monetised impacts:

- Economic benefits to transport users, including time savings and vehicle operating costs; and
- Accident savings and associated economic benefits.

2.2 Methodology and Assumptions

2.2.1. This section describes the processes and sets out the assumptions that underpin both the economic benefits to transport users and economic appraisal of accident savings resulting from the Scheme.

Monetised Benefits

2.2.2. The calculation of economic benefits to road users (excluding accident benefits) was undertaken using the DfT's TUBA V.1.9.17 (Transport Users Benefit Appraisal) program, released in December 2021 and using economic inputs as issued in TAG Databook v1.21 released in May 2023 (versions applicable at the time of the assessment).

2.2.3. TUBA compares the costs for the Do-Minimum against the cost for the Do-Something to establish the value of the savings in road user travel time and vehicle operating costs.

2.2.4. Benefits arising from changes in accidents with the Scheme were assessed using the DfT's COBALT V2.5 (Cost and Benefit to Accidents – Light Touch) software, released in May 2023.

2.3 User Classes and Area of Assessment

Highway Assignment User Classes

2.3.1. There were 5 user classes in the HAM (Commute, Employers Business, Other, LGV and HGV). They were converted to 7 user classes as required in TUBA.

2.3.2. The LGV in the traffic model were split into work and non-work according to the proportions set out in TAG Unit A1.3 (User and Provider Impacts). The HGV were split into OGV1 and OGV2 based on the traffic counts. LGV work / non-work proportions have been taken from the TAG data (May 2023); HGV proportions have been taken from traffic counts. The disaggregation factors are shown in Table 2-1.

Table 2-1 - Disaggregation of LGVs and HGVs

Time Period	LGVs Non-work	LGVs Work (Freight)	HGVs OGV1	HGVs OGV2
AM	12%	88%	53%	47%
IP	12%	88%	53%	47%
PM	12%	88%	53%	47%

2.3.3. The TUBA benefits, including the user time and operating costs, were assessed over the whole of the model area (subject to masking to remove spurious model results arising from model 'noise').

2.4 Annualisation Factors

Highway Assignment Model

2.4.1. Annualisation factors were used to expand the benefits identified for each model time period over a whole year. Annualisation factors for the three modelled time periods were based on values obtained from local traffic survey data.

2.4.2. These factors were derived through analysis of long-term Automatic Traffic Counters (ATC) and Manual Classified Counts (MCC) data from 2018 and 2019 and were located within the study area.

Table 2-2 – ATC site locations for annualisation factors

Description	Data Considered - Year
A4 London Road - W of Beaufort West	2018
A3064 Windsor Bridge Road - N of Stable Yard	2019
A4 Newbridge Road - E of A36 Lower Bristol Rd	2019
A36 Lower Bristol Road - E of A4 Newbridge Rd	2019
A39 Corston - W of Village	2018

Description	Data Considered - Year
B3116 Bath Road Keynsham - E of Unity Rd	2019
A4 Bath Road - E of Keynsham By-Pass	2018
A4175 Durley Hill - W of Durley Lane	2019
A36 Bathwick Street S of St Johns Road	2018

2.4.3. The annualisation factors is set out in Table 2-3 below. The calculation requires expansion of peak hour demand up to AM, Inter, and PM peak periods which, when summed, represent an average 12-hour weekday (5-days).

Table 2-3 - Annualisation factors

Number	Calculation Stages	AM	IP	PM
1	Model Period	AM (0800 - 0900)	IP (average 1000 - 1600)	PM (1700 - 1800)
2	Expanded Period	AM (0700 - 1000)	IP (1000 - 1600)	PM (1600 - 1900)
3	Number of Days	253	253	253
4	Number of Hours per day	3	6	3
5	Total Number of Hours	759	1,518	759
6	Average Hour Factor	0.933	1.000	0.966
7	Annualisation Factor by period	708	1,518	733

Public Transport

2.4.4. The PTAM assigns full period demand to the network in comparison to the peak hour and average hour assignments employed by the HAM. However, TUBA expects demand matrices to be input for hourly time slices. Therefore, the full period PTAM demand matrices were converted to average hour demand matrices by dividing by the number of hours in each period, which was three, six, and three for the AM, inter-peak, and PM respectively.

2.4.5. The annualisation factors applied in the appraisal were then based on the standard assumptions of there being 253 weekdays in a year multiplied by the number of hours in each period. The demand and annualisation factors applied in the public transport (PT) user appraisal are shown in Table 2-4.

2.4.6. It should be noted that there was no annualisation of modelled time periods to cover non-modelled periods, such as the weekend, bank holidays or off-peak. Therefore, no PT user impacts have been estimated for the non-modelled periods, which is likely to result in a conservative estimate of impacts of the present value of benefits.

Table 2-4 - Public transport user appraisal annualisation factors

Time Period	Number of Days	Number of Hours	Period to Average Hour Demand Factor	Annualisation Factor
AM	253	3	One third	759
IP	253	6	One sixth	1,518
PM	253	3	One third	759
Other	Not applicable	Not applicable	Not applicable	Not applicable

2.4.7. The public transport annualisation factors, shown in Table 2-3, are only used for the appraisal of public transport user impacts. Bus driver impacts are assessed using the highway assignment forecast results and make use of the highway annualisation factors, shown in Table 2-4.

2.5 Sectoring of User Benefits

Highway and Public Transport Assignment Models

2.5.1. In the analysis aimed at determining user benefits along the A4 corridor from Bristol to Bath, zones are organised into sectors, based on the location of the modelled zones and its influence on the scheme. The categories of sectors that are masked are listed below:

- **Low-Impact Sectors:** These sectors do not significantly contribute to the total volume of trips in the Bristol to Bath Corridor along A4. Their influence on the overall analysis is limited and the expected impact of the schemes in this area is also expected to be weak/negligible.
- **Critical Study Area Sectors:** These sectors are situated in the central regions of Bristol and Bath where the impacts of the scheme are expected to be material.
- **Noise Sectors:** These sectors are classified as 'noise' in the analysis, indicating that their impact on the assessment of user benefits should be negligible.

2.5.2. Figure 6-1 in Appendix A contains a matrix that clearly differentiates between masked sectors (those excluded from the analysis) and non-masked sectors (those included in the analysis). This categorisation streamlines the analysis process, allowing a focused evaluation of sectors that are most relevant in understanding user benefits along the A4 corridor.

2.5.3. The sectors within and surrounding the study area are shown in Figure 2-1 and a comprehensive overview of the sectors that partition the larger area can be found in Figure 2-2. Table 6-1 in Appendix A provides the details of all the sectors.

Figure 2-1 - BBSC TUBA Sectors within the Study Area

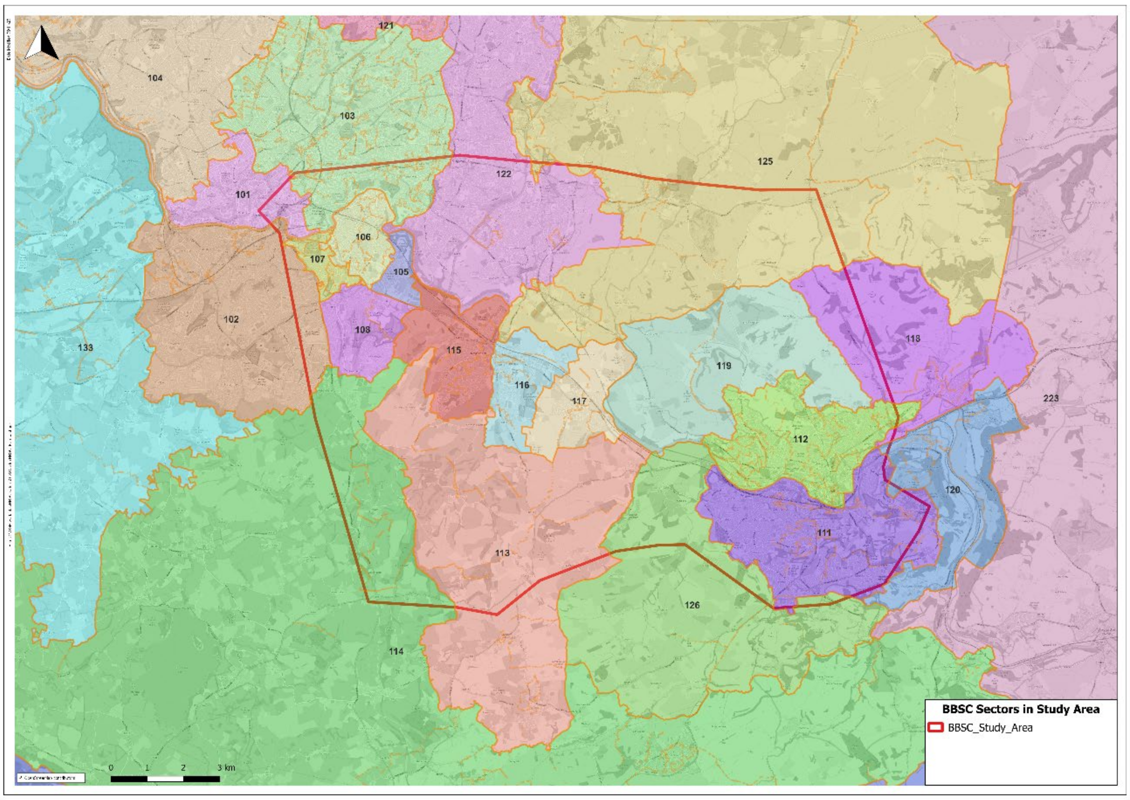
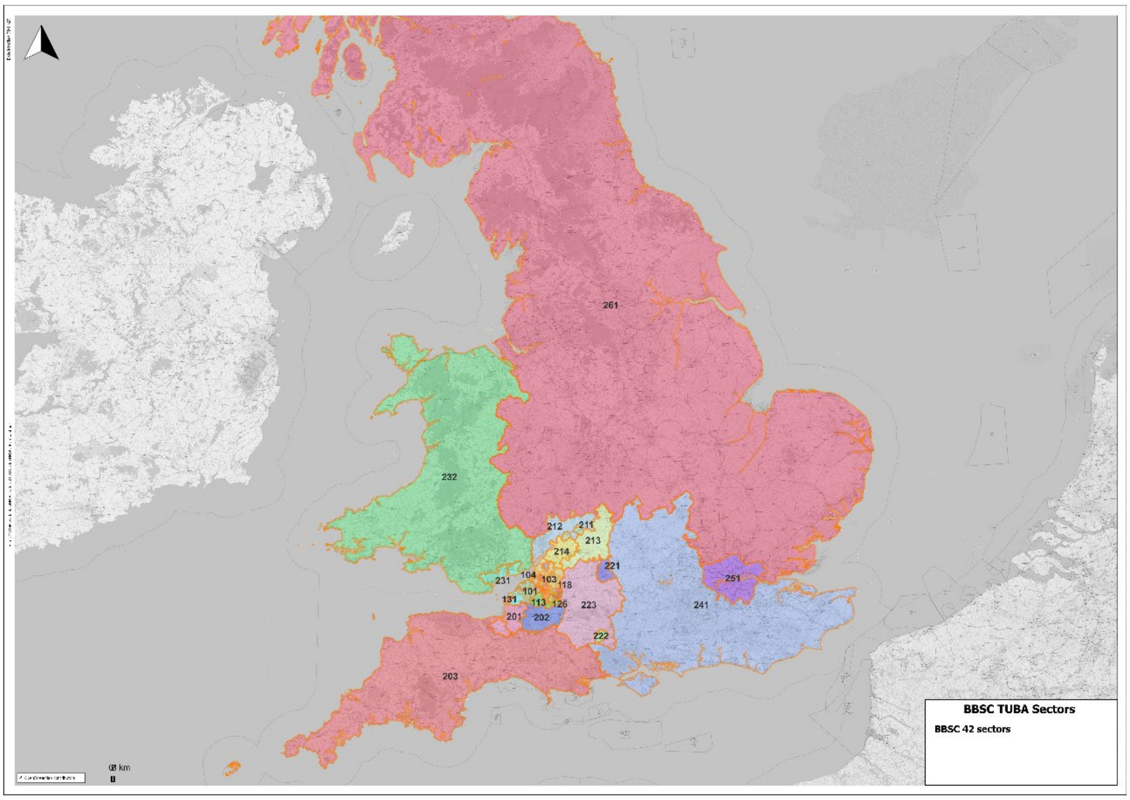


Figure 2-2 - BBSC TUBA All Sectors



2.6 Assessment Period

2.6.1. TUBA and COBALT, used to assess transport user benefits and accident savings, calculate benefits on a year-by-year basis for an appraisal period of 60 years from scheme opening as required by TAG Unit A1.1 (Cost-Benefit Analysis).

2.6.2. The appraisal period for the full scheme was based on a 60-year period from the opening of the first phase of the scheme with benefits accruing from 2026 (aligned with an early version of the project programme). The final year of the evaluation period was therefore 2085. The traffic forecasts beyond the last modelled year (i.e., from 2042 to 2085) were taken to remain constant with no further growth applied. To derive inputs to the TUBA model for 2026, the 2029 model was used as a proxy. Subsequently it has been identified that the scheme opening year is likely to be 2027, therefore benefits have been marginally overestimated.

3 Transport User Benefit Appraisal

3.1 Introduction

3.1.1. This chapter describes and presents the results of the economic appraisal.

3.1.2. It covers the assessment of transport user costs and scheme investment costs. Costs are determined for the Do Something scenario.

3.1.3. The appraisal period for the full scheme was based on a 60-year period from the opening of the first phase of the scheme with benefits accruing from 2026. The final year of the evaluation period was therefore 2085. The traffic forecasts beyond the last modelled year (i.e., from 2042 to 2085) were taken to remain constant with no further growth applied.

3.2 Transport Users Benefit Appraisal (TUBA) - HAM

3.2.1. TUBA takes, as its principal input, zone to zone matrices of trip numbers, times taken, and distances travelled. Values of time and operating cost are applied, and a 60-year stream of benefits calculated that is discounted to the present value year (defined by the DfT as 2010) and expresses the benefits in 2010 market prices. Zones are combined into sectors and certain sectors are masked for analysis which is described in section 2.5.

3.2.2. The Highway User benefits of the proposed scheme, after masking of certain sectors calculated by TUBA, are presented in Table 3-1 below. User benefits are sub divided into user travel time, fuel and non-fuel costs, and indirect tax revenue and are tabulated based on the purpose of road users. The introduction of the scheme results in a positive consumer user benefit for commuting purposes. However, for other users and business users, the scheme provides disbenefits, ultimately resulting in an overall reduction in transport user benefits for highway trips of the scheme.

Table 3-1 - Transport user benefits in (£000s)

Road User	User Time	Fuel	Non-fuel	Indirect Tax Revenue	Total (Including Indirect Tax Revenue)
Consumer Commuting	1,386	-38	-154	106	1,300
Consumer Other	-4,927	-893	-12	-70	-5,903
Net Consumer User Benefits	-3,541	-931	-167	35	-4,603
Business Personal	-1,212	-33	-69	20	-1,294
Business Freight	-259	30	14	-13	-227
Net Business User Impact	-1,472	-3	-55	7	-1,522

Road User	User Time	Fuel	Non-fuel	Indirect Tax Revenue	Total (Including Indirect Tax Revenue)
Present Value of Transport Economic Efficiency Benefits (PVB)	-5,013	-934	-222	42	-6,125

3.2.3. The scale of impacts is relatively small. This result derives from the fact that the scheme seeks to reallocate capacity to sustainable modes, where it can be afforded and where it would not have significant detrimental impact. The slight positive impacts for commuting arises due to the tidality of flows into Bristol and the shift away from car (and hence lower) demand along the A4 corridor.

3.2.4. The majority of the disbenefits are travel time (82% of total) and the fuel vehicle operating costs (18% of total). This suggests that this has been caused by longer journeys within the model with more travel time and fuel being used.

3.3 Transport Users Benefit Appraisal (TUBA) - PT

Public Transport Passengers

3.3.1. Travel time and user charge impacts on public transport passengers have been estimated from the future year Do Minimum and Do Something PTAM forecasts. Public transport passenger demand, perceived journey time, and total journey distance matrices were extracted from the final, post-VDM PTAM for each modelled mode (bus and rail) and time period (AM, inter-peak, and PM).

3.3.2. It should be noted that, in-line with guidance in TAG to assess changes in perceived transport costs, the journey times extracted from the PTAM were weighted to reflect the perceived time on different legs of the journey. The weightings applied were the same as those applied in the VDM, as follows:

- in-vehicle time was multiplied by 1.0;
- access, egress, and transfer walking time was multiplied by 2.0; and
- waiting time, either at the first stop or at transfer stops, was multiplied by 2.0.

Travel Time Impacts

3.3.3. By implementing the B&NES section of the BBSC scheme, bus travel times along the A4 corridor, between Emery Road and Bath city centre, are forecast to reduce. In addition, the scheme introduces a new ‘Hub’ stop in the Keynsham Bypass, which improves accessibility to the bus network for travellers within Keynsham.

3.3.4. The majority of the travel time impacts of the scheme are expected to accrue to users of the X39 bus service, which travels along the A4 corridor between Bristol and Bath, but other smaller benefits will be experienced by other bus services using sections of the corridor, e.g. the 39, 349, 522, A4. There are also expected to be impacts due to mode shift, particularly between rail and bus, due to the bus travel time improvements along the A4 corridor and the introduction of the Keynsham Hub stop.

3.3.5. It is likely that there will also be some indirect impacts of the scheme where the changes in travel times on services travelling along the A4 corridor impact inter-connectivity with other services by reducing or increasing interchange times. There was no detailed timetable analysis undertaken as part of this study to optimise schedules on other services to the updated travel times on the services using the A4.

3.3.6. The travel time impacts of the scheme, to bus and rail users, are shown in Table 3-2. The monetary values are presented in 2010 market prices, discounted to a 2010 present value year. The overall monetary value of the travel time impacts of the scheme is around £6.5 million in 2010 prices and values.

Table 3-2 - PT passenger travel time impacts by time period (£000s)

Mode	User	AM	IP	PM	Total
Bus	Commuting	939	394	1,113	158
Bus	Other	965	1,300	890	570
Bus	Business	120	83	229	10
Rail	Commuting	75	6	2	1
Rail	Other	88	27	44	14
Rail	Business	10	- 1	- 1	- 0
Both	Total	2,246	2,198	1,810	2,277

3.3.7. The majority (96%) of the public transport user travel time impacts accrue to bus users. Of this, 38% of impacts accrue to commute users whilst 62% of impacts accrue to users travelling for purposes other than work or business. The rail travel time impacts are a very small element of the overall travel time impacts and arise due to improved access to rail, via bus, along the A4 corridor.

User Charge Impacts

3.3.8. There were no changes to the fares charged for public transport in the Do Something scenario compared to the Do Minimum scenario. Therefore, the only impacts which will arise due to changes in public transport user charges will be where the access or egress stops have changed sufficiently to cause a change in the fare paid. This would arise due to a bus passenger boarding or alighting a bus service in a different fare zone or a rail passenger boarding or alighting a train at a different station. These impacts are expected to be immaterial.

3.3.9. Table 3-3 shows the public transport user charge impacts of the scheme, to bus and rail users, in 2010 market prices, discounted to a 2010 present value year. The overall monetary value of the user charge impacts of the scheme is around £19,000 in 2010 prices and values. This represents less than 0.5% of the public transport user travel time and charge impacts.

Table 3-3 - PT passenger user charge impacts (£000s)

Mode	User	AM	IP	PM	Total
Bus	Commuting	-1	-2	-4	-1
Bus	Other	-1	-12	-6	-5
Bus	Business	0	-1	-2	0
Rail	Commuting	6	2	12	1
Rail	Other	-3	5	23	2
Rail	Business	2	1	2	1
Both	Total	4	4	-6	24

Public Transport Operators

3.3.10. Impacts of the scheme on bus driver travel times, and fuel and non-fuel vehicle operating costs, which will be presented as changes in bus operator costs, have been estimated using the future year Do Minimum and Do Something HAM forecasts. The use of the HAM to estimate bus driver time impacts is in-line with guidance in the TUBA manual. The scheme has no impact on train driver travel times.

3.3.11. Changes in fare revenue accrued by bus and train operators has been estimated using the future year Do Minimum and Do Something PTAM forecasts. These changes will be presented in the Transport Economic Efficiency (TEE) table as changes in private operator revenue.

Bus Driver Time and Operating Cost Impacts

3.3.12. By implementing the B&NES section of the BBSC scheme, bus travel times along the A4 corridor, between Emery Road and Bath city centre, are forecast to reduce. This reduction in travel time is experienced by both the passengers travelling on buses on the corridor, as estimated in the previous section, and the drivers of those buses.

3.3.13. The scheme does not impact the length of the A4 corridor between Bristol and Bath but changes in bus travel times, and therefore speeds, do also impact the fuel and non-fuel costs of journeys.

3.3.14. Both the bus driver travel time and operating cost impacts accrue to the bus operators and are presented in the TEE table. The impacts were estimated in TUBA by using the bus route information extracted from the future year HAM SATURN assignments, as set out in the TUBA guidance.

3.3.15. Table 3-4 shows the bus driver time and operating cost impacts of the scheme in 2010 market prices, discounted to a 2010 present value year. The overall monetary value of the bus driver impacts of the scheme is around £800,000 in 2010 prices and values.

Table 3-4 - Bus driver impacts (£000s)

Element	AM	IP	PM	Total
Travel time	345	206	6	557
Operating cost	133	92	5	231
Total	478	298	11	787

Operator Revenue Impacts

3.3.16. Whilst there are negligible impacts on the public transport charges perceived by passengers (presented in Table 3-4), operators of public transport services are expected to see changes in their revenues due to mode shift, especially from rail to bus, as a result of the scheme.

3.3.17. Faster travel times will lead to increases in bus use, and therefore bus fare revenues, whereas travellers choosing to use buses along the A4 rather than the competing rail line will lead to reductions in train fare revenues.

3.3.18. Table 3-5 shows the estimated operator revenue impacts of the scheme. It should be noted that these have been estimated through TUBA using data from the future-year PTAM forecasts at an appropriate level of detail for economic appraisal at OBC. They are not detailed operational revenue forecasts and should not be relied upon as such.

3.3.19. Overall, there is a fall in operator revenue over the appraisal period, amounting to just over £750,000 in 2010 prices and values. This is made up of an increase in bus operator revenue and a decrease in rail operator revenue. The decrease in rail operator revenue is larger than the increase in bus operator revenue due to the price differential between rail and bus tickets, where bus fares are, generally, lower than rail fares.

Table 3-5 - Public transport operator revenue impacts (£000s)

Mode	AM	IP	PM	Total
Bus	1,093	1,952	1,438	801
Rail	-1,804	-1,055	-2,309	-455
Total	-711	896	-871	345

Indirect Tax Revenues

3.3.20. Indirect tax revenues accrue to the government and are impacted directly by changes in bus operator (or driver) fuel and non-fuel costs. Similarly, whilst public transport fares are not subject to Value Added Tax (VAT), the calculation for change in indirect tax revenues within TUBA assumes that, for consumer trips, an increase in expenditure on transport is offset by a decrease in expenditure elsewhere in the economy (and vice versa). This also impacts the indirect tax revenue that the government receives. The impacts on indirect tax are presented as part of the Public Accounts (PA) table.

3.3.21. Impacts of the scheme on indirect tax revenues were estimated as part of the appraisal of the public transport user and bus driver impacts. The total monetary value of the change in indirect tax revenues is shown in Table 3-6, in 2010 market prices, discounted to a 2010 present value year.

3.3.22. It should be noted that the values in Table 3-6 reflect the change in revenue as they would be presented in the Analysis of Monetised Costs and Benefits (AMCB) table. Therefore, positive numbers are benefits (or increases in revenue) to the government, whilst negative numbers are costs (or decreases in revenue). Within the PA table within the Outline Business Case, costs are always represented as positive values.

Table 3-6 – Public transport indirect tax revenue impacts (£000s)

Element	Bus Passenger	Bus Driver	Rail Passenger	Total
Indirect tax revenue	-610	-36	872	226

Summary

3.3.23. The total TEE impacts of the scheme attributable to public transport users and bus drivers is approximately £6.7 million over the 60-year appraisal period, in 2010 market prices discounted to 2010 values. This value is made up of positive and negative impacts.

3.3.24. Approximately £7 million, the majority of the monetary impacts of the scheme to public transport users and operators, is attributable to changes in public transport user and bus driver travel times. However, there is a disbenefit of around £340,000 due to changes in bus and train operator revenues.

3.3.25. The impacts were assessed at an aggregated sector-to-sector level, as shown in Table 3-7. The largest impacts are within Bath (approximately £1.3 million) and between the centre of Bristol and Keynsham (approximately £2 million). There are also benefits for longer distance travel along the A4 corridor, with approximately £1 million of benefits accrued by users travelling between Bristol and Bath.

Table 3-7 – Public transport sector-to-sector TEE impacts

Sectors	Bristol-Centre and North	Bristol-South West	Bristol-South East	Bath-City	Rest of BandNES	Keynsham	Saltford	Bath-E and NE	Bath-NW	South Gloucestershire	North Somerset	South West	North	East	West	Total
Bristol-Centre and North	209	4	-6	64	115	1,351	148	2	0	209	-332	0	0	0	0	1,764
Bristol-South West	126	80	-34	-3	10	160	10	1	0	5	-26	0	0	0	0	330
Bristol-South East	-307	-67	-25	922	38	373	16	7	1	23	-1	0	0	0	0	979
Bath-City	-680	-73	477	1,257	-225	300	65	-41	-321	69	-20	0	0	0	0	807
Rest of BandNES	52	6	17	-40	17	22	-1	-1	-0	-2	2	0	0	0	0	71
Keynsham	828	156	306	1,001	16	18	53	18	1	58	50	0	0	0	0	2,505
Saltford	52	3	4	106	-1	28	0	-0	0	13	11	0	0	0	0	217
Bath-E and NE	2	-0	4	-4	-2	8	-0	0	-0	0	1	0	0	0	0	8
Bath-NW	0	0	1	-457	-0	0	0	0	0	-0	-0	0	0	0	0	-456
South Glos.	242	4	4	110	4	28	17	0	-0	92	10	0	0	0	0	510
North Somerset	-171	-16	5	22	8	60	15	2	0	-94	150	0	0	0	0	-17
South West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
East	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	354	96	752	2,980	-19	2,348	321	-12	-320	373	-156	0	0	0	0	6,718

3.3.26. There is also a change in indirect tax revenues accrued by the government as a result of the scheme, estimated to total around £225,000 in 2010 market prices, discounted to a 2010 present value.

Accident Appraisal

3.3.27. The assessment of the benefits associated with the reduction in accidents associated with the provision of the total scheme was undertaken using COBALT, the DfT's program for calculating the cost benefit analysis from savings in accidents. The appraisal used COBALT version 2.5 and the parameter file associated with version 1.21 of the TAG Databook (released in May 2023).

3.3.28. COBALT assesses the safety aspects of road schemes by calculating the number of accidents on each link in each year of the evaluation period with and without the Scheme. COBALT can either calculate accidents for road links and road junctions separately or combined. For the appraisal for the Proposed Scheme the combined link and junction accidents were assessed using assignment results from the traffic model as inputs.

3.3.29. Average Annual Daily Traffic (AADT) flows were taken from the WERTM HAM assignment for the forecast years.

3.3.30. The COBALT program was run for the A4 only. Modelled flow changes away from the A4 are relatively dispersed meaning widening the assessment beyond the A4 was not appropriate. In line with the proposed opening date of the scheme, the accident benefits were calculated for the appraisal period between 2026 and 2085. The network was represented using link and junction accidents combined.

3.3.31. The projected changes in the numbers of accidents, over the appraisal period for the proposed scheme are presented in Table 3-8 below. The COBALT analysis estimates that 71.2 accidents would be saved because of the proposed Scheme during the 60-year appraisal period (2026-2085).

Table 3-8 – Accident savings over 60 years

Year	'Without' Scheme Accidents	'With' Scheme Accidents	Reduction in accidents
Total for all Years	2,439.7	2,368.5	71.2
2026	46.3	45.9	0.4
2041	40.1	38.9	1.2

3.3.32. COBALT also provides a summary of the predicted number of casualties saved as a result of the scheme. This is presented in Table 3-9 below. The data indicates a significant reduction in Slight and Serious Casualties, with a slight increase of 0.3 in fatal casualties over a 60-year period following the implementation of the scheme.

Table 3-9 – Casualty Summary Over 60 Years

Year	WOS Fatal	WOS Serious	WOS Slight	WS Fatal	WS Serious	WS Slight	Total Fatal	Total Serious	Total Slight
Total for all Years	20.1	282.5	2983.0	20.5	278.4	2898.8	-0.3	4.2	84.2
2026	0.4	5.4	56.6	0.4	5.3	56.1	0.0	0.0	0.5
2041	0.3	4.6	49.0	0.3	4.6	47.6	0.0	0.1	1.4

3.3.33. The economic benefit of the accident savings was calculated by comparing the cost of accidents over the 60-year appraisal period, with and without the scheme, at 2010 prices, discounted to 2010. The benefits arising from the accident savings are summarised in Table 3-10 below.

Table 3-10 – Present value of accident savings over 60 years

Year	Accident Costs Without-Scheme (£000s)	Accident Costs With-Scheme (£000s)	Benefit of Scheme (£000s)
Total for all Years	92,656.1	90,879.3	1,776.8
2026	2,709.9	2,686.0	24.0
2041	1,816.2	1,779.7	36.4

3.3.34. The total predicted accident benefits are approximately £1,776,800.

4 Sensitivity Testing

4.1 Introduction

4.1.1. The forecasts and economic benefits reported in the earlier Chapter is based on the Core scenario. This is based on the most unbiased and realistic set of assumptions to form the central case.

4.1.2. TAG Unit M4 requires that tests be carried out to assess the sensitivity of the results of the appraisal to uncertainty in the forecasts. This chapter describes the approach to sensitivity testing and presents the results of the assessment.

4.1.3. For the purposes of sensitivity testing the assessment was undertaken for the whole scheme. It should be noted that sensitivity testing was not carried out for each of the individual construction phases.

4.2 Low and High Growth Assessment

4.2.1. TAG Unit M4 (Forecasting and Uncertainty) advises that an effective way to test the uncertainty of national trends such as population and GDP growth and fuel price trends is by using high and low growth scenarios.

4.2.2. In accordance with advice in TAG Unit M4, low and high growth forecasts were prepared by increasing the forecast demand matrix by a proportion of the base year matrix which for highway demand is defined as:

$$\pm\,\mathbf{2.5} * \sqrt{\boldsymbol{N}}\,\%$$

where N represents the number of years into the future with respect to the base year.

4.2.3. The transport user and accident benefits for the low and high growth scenarios were assessed using TUBA and COBALT, respectively.

4.2.4. The results of the sensitivity tests for the Highway user low and high growth scenario sensitivity are presented in Table 4-1 below. Low growth scenario demonstrates a positive benefit, whereas core and high growth scenarios shows a disbenefit. The benefits of the low growth scenario are attributed to relatively higher benefits in user-time and non-fuel costs. In contrast, the majority of the disbenefits in high and low growth are associated with travel time and fuel vehicle operating costs. This suggests that longer journeys within the model result in increased travel time and fuel usage in these scenarios, whereas in the low growth scenario, travel time may be relatively reduced.

4.2.5. The benefits arising from the accident savings are summarised in Table 4-1 below.

Table 4-1 – High, core and low growth scenario TUBA benefit sensitivity tests (£M)

Growth Scenario	User Time	Fuel	Non-fuel	Indirect Tax Revenue	Total (Including Indirect Tax Revenue)
Low Growth	101	-488	375	-311	-323
High Growth	-3,225	-575	23	-190	-3,966
Core	-5,013	-933	-221	43	-6,125

4.2.6. The results of the sensitivity tests for the Public Transport low and high growth scenario sensitivity are presented in Table 4-2 below. The results show that the low growth scenario sensitivity has experienced a reduction in benefits, when compared to the core growth scenario, which is as expected due to total benefits being proportional to the level of demand for public transport. However, the high growth sensitivity test has shown a reduced level of benefits when compared to the core growth scenario. The rail operator revenue impacts account for this change and suggests that demand for rail is lower, due to a shift from rail to bus in the higher demand scenario.

Table 4-2 – High, core and low growth scenario public transport TUBA benefit sensitivity tests (£M)

Purpose	Core	High	Low
Consumer: Commuting	2,701	3,442	2,060
Consumer: Other	3,904	4,636	3,323
Business: Users & Providers	113	-2,597	-2,428
Total	6,718	5,482	2,955

5 Summary and Conclusions

5.1 Summary

5.1.1. This report has summarised the transport user appraisal of the BBSC scheme. The report has summarised the impact of the scheme on highway users using the HAM and public transport users from the PTAM.

5.1.2. It should be noted that this report only includes the following benefits:

- Highway Transport User benefits;
- Public Transport User benefits;
- Accident saving benefit.

5.1.3. These benefits have been included as part of the overall value for money assessment within the economic case.

5.2 Conclusions

5.2.1. The total benefits from each appraisal is summarised below in Table 5-1 below. The overall impact shows a benefit of £2,535k and has been included in the overall BCR.

Table 5-1 – Benefits summary

Appraisal	**Benefits (£k)**
HAM TEE	-6,167
HAM Indirect Tax Revenues	43
PT TEE	6,718
PT Indirect Tax Revenues	*164*
Accident Benefit Analysis	1,777
Overall Impact	*2,535*

Appendix A – Masking of Sectors

The figure below shows a matrix that clearly differentiates between masked sectors (those excluded from the analysis) and non-masked sectors (those included in the analysis).

Figure A-1 – Masking of Sectors

1 = not masked
0 = masked

Red cells indicate reverse sector pair is not masked. Consider whether this is correct.

Yellow cells indicate masked cells.

		Central Bristol	South Bristol	NE Bristol	NW Bristol	Brislington Trading Estate	St Anne's	Upper Knowle	Stockwood	South Bath	North Bath	Corston, Compton Dando and South	Rest of B&NES	Keynsham West	Keynsham East	Saltford	Batheaston	Kelston	Bathampton	Filton & Bradley Stoke	SG: East Urban	Yate	Thornbury	Rest of South Glos	Newton St Loe, Enlishcombe, Dunkerton	Weston-super-Mare	Clevedon, Nailsea & Portishead	Rest of North Somerset	Sedgemoor	Mendip	South West	Cheltenham & Gloucester	North Glos	Cotswold	Stroud	Swindon	Salisbury	Wiltshire	Cardiff & Newport	Wales & NI	South East	London	Midlands, East, North & Scotland
		101	102	103	104	105	106	107	108	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	131	132	133	201	202	203	211	212	213	214	221	222	223	231	232	241	251	261
Central Bristol	101	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Bristol	102	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NE Bristol	103	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NW Bristol	104	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brislington Trading Estate	105	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
St Anne's	106	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Knowle	107	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stockwood	108	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Bath	111	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North Bath	112	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corston, Compton Dando and South	113	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rest of B&NES	114	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Keynsham West	115	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Keynsham East	116	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Saltford	117	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Batheaston	118	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kelston	119	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bathampton	120	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Filton & Bradley Stoke	121	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SG: East Urban	122	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yate	123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thornbury	124	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rest of South Glos	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newton St Loe, Enlishcombe, Dunkerton	126	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weston-super-Mare	131	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clevedon, Nailsea & Portishead	132	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rest of North Somerset	133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sedgemoor	201	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mendip	202	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South West	203	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheltenham & Gloucester	211	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North Glos	212	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cotswold	213	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stroud	214	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Swindon	221	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salisbury	222	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wiltshire	223	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cardiff & Newport	231	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wales & NI	232	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South East	241	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
London	251	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Midlands, East, North & Scotland	261	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A-2 – Sector details

Sector Name	Sector Number
Central Bristol	101
South Bristol	102
NE Bristol	103
NW Bristol	104
Brislington Trading Estate	105
St Anne's	106
Upper Knowle	107
Stockwood	108
South Bath	111
North Bath	112
Corston, Compton Dando and South	113
Rest of B&NES	114
Keynsham West	115
Keynsham East	116
Saltford	117
Batheaston	118
Kelston	119
Bathampton	120
Filton & Bradley Stoke	121
SG: East Urban	122
Yate	123
Thornbury	124
Rest of South Glos	125
Newton St Loe, Enlishcombe, Dunkerton	126
Weston-super-Mare	131
Clevedon, Nailsea & Portishead	132
Rest of North Somerset	133
Sedgemoor	201
Mendip	202
South West	203
Cheltenham & Gloucester	211

Sector Name	Sector Number
North Gloucester	212
Cotswold	213
Stroud	214
Swindon	221
Salisbury	222
Wiltshire	223
Cardiff & Newport	231
Wales & NI	232
South East	241
London	251
Midlands, East, North & Scotland	261

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix X - Bus Operational Model

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West of England Combined Authority

Bath to Bristol Strategic Corridor Outline Business Case

Appendix X - Bus Operational Model

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Quality control

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Contents

Tables

Figures

1 Introduction

1.1 Introduction

1.1.1. This document has been developed alongside the Outline Business Case (OBC) for the Bath to Bristol Strategic Corridor (BBSC) Programme and explores options for improving the current bus network from an operational standpoint.

1.1.2. This report outlines the potential delivery models and resulting impacts on operating costs and sets out aspects that should be considered by the Combined Authority as part of the further development of any operational changes as part of future development of the BBSC Programme.

1.1.3. This document has been developed during the OBC stage of the BBSC Programme and builds upon the operational modelling work that was undertaken at Strategic Outline Case (SOC) stage.

1.2 Overview of the BBSC programme

Scheme background

1.2.1. The BBSC Programme has been developed jointly by the West of England Combined Authority (the CA), Bristol City Council (BCC) and Bath and North East Somerset Council (B&NES).

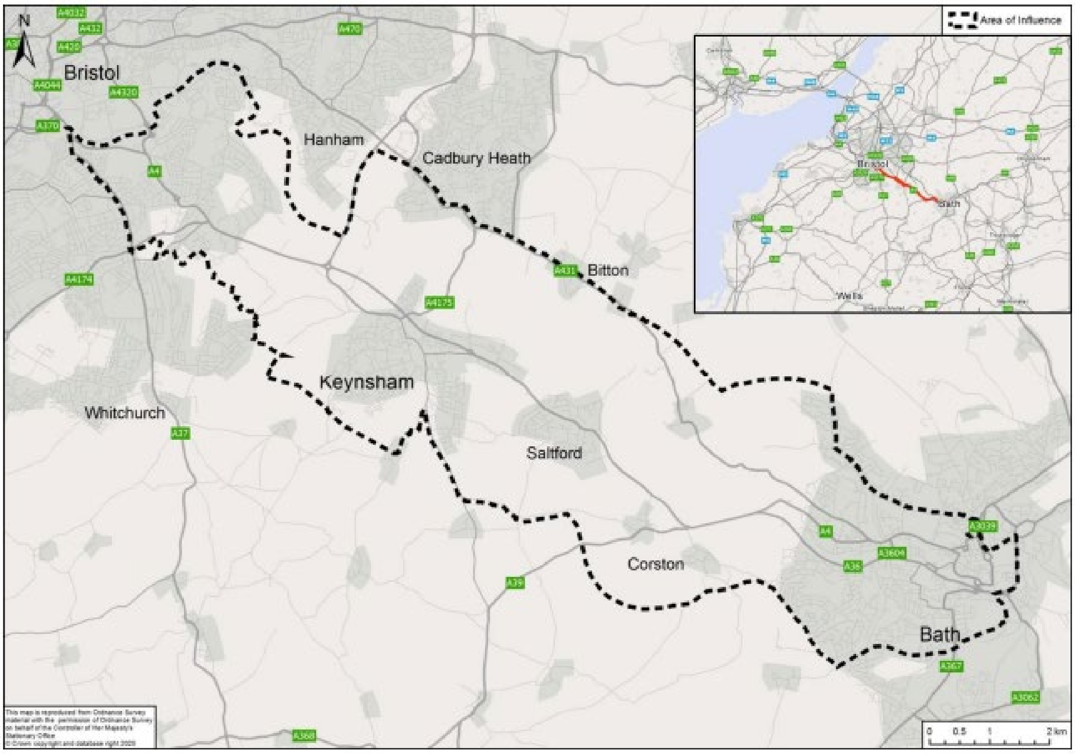
1.2.2. The primary aim of the BBSC Programme is to connect communities along the A4 via sustainable modes of transport to places of employment, study, and key services to enhance the lives of existing and future residents and those travelling to, and along, the corridor.

1.2.3. This overall aim will be achieved through the successful accomplishment of three smaller-scale, quantifiable objectives:

- To facilitate economic growth along the corridor by improving the public and active travel opportunities. This includes delivering infrastructure which improves access for existing communities and also infrastructure that unlocks new opportunities for sustainable growth.
- To improve public transport infrastructure in the study area to increase the number of people who have access to and use buses to contribute to growing bus patronage along the corridor by at least 24% by 2030.
- To improve walking, wheeling, and cycling infrastructure in the study area to increase the number of people using the corridor for active travel modes, including increasing the number of people commuting by walking, cycling, and wheeling modes to 25% of total modal share by 2036.

1.2.4. An overview of the BBSC study area is illustrated in Figure 1-1 whilst Figure 1-2 shows how the study area has been divided into three broad areas and six work packages.

Figure 1-1 – Bath - Bristol Strategic Corridor (BBSC) study area



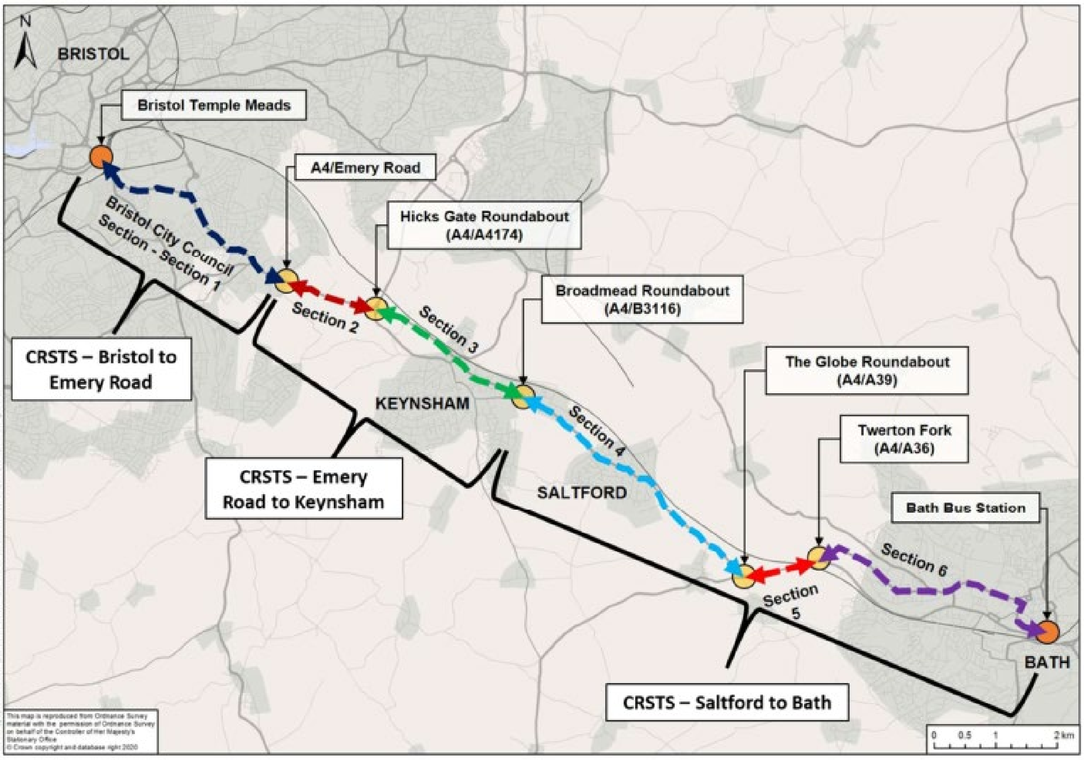
1.2.5. In March 2022 the project was allocated funding through the City Region Sustainable Transport Settlement (CRSTS). This funding provides a significant opportunity to progress the BBSC corridor work by dividing the route into three deliverable sections. This approach can be seen in Figure 1-2.

1.2.6. The CRSTS funding is capital only, available for infrastructure improvements, and therefore the operational options outlined in this report may require separate funding and engagement with the local operators through an Enhanced Partnership (EP), or similar.

1.2.7. The infrastructure improvements enabled by the CRSTS funding will unlock opportunities to restructure the current bus network and maximise the benefits for bus passengers, by reducing journey times and variability, increasing reliability and providing higher frequency services. As discussed in later sections, the additional funding required for these bus service changes is significantly lower following the efficiencies generated by the infrastructure improvements.

1.2.8. The OBC stage of the BBSC programme focuses on infrastructure interventions along sections 2 to 6, i.e. between Emery Road and Bath City Centre.

Figure 1-2 - CRSTS Funding - BBSC route sectioning



1.3 Report structure

1.3.1. This report has been broken down into the following chapters:

- Chapter 2 – Review of Previous Work.
- Chapter 3 – Bus Network Review.
- Chapter 4 – Journey Time Analysis.
- Chapter 5 – Operational Modelling.
- Chapter 6 – Bus Operator Engagement.
- Chapter 7 – Recommendations and Next Steps.

2 Review of previous project operational modelling

2.1.1. The bus operational work that was undertaken at the SOC stage of the BBSC project has been reviewed and summarised throughout this chapter. The review acknowledges that the baseline bus network has changed since 2021 and looks to consider the principles of the options previously considered but in the context of the current network.

2.2 Operational model options

2.2.1. Bus operational model options for the BBSC Programme were developed for the 'end state' i.e., with the full BBSC Programme implemented and as such the full set of predicted operational costs and benefits outlined in the SOC (and now in the OBC) are only likely with the full scheme implementation. As the OBC is looking at infrastructure improvements on the B&NES sections only, the option generation and assessment will be reconsidered in later sections of this report.

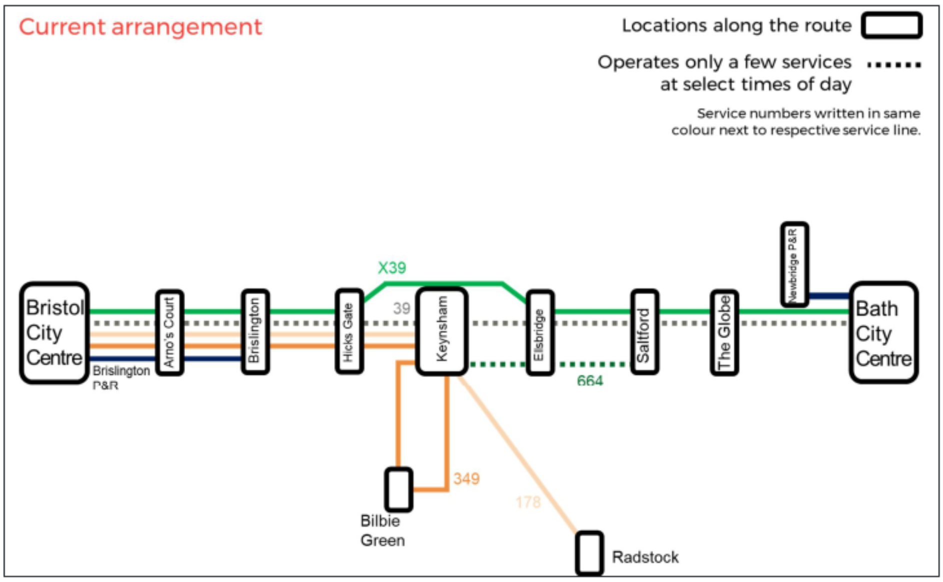
2.2.2. The operational models at the SOC stage considered focus on the services in the list below – these are known for the purposes of the OBC work as the 'critical service group' (CSG). These are also illustrated in Figure 2-1 for reference.

- X39 (39) Bristol to Bath.
- Brislington Park and Ride (P&R).
- 349 Bristol to Keynsham.
- 178 Bristol to Radstock.
- 664 – operates only three times daily and will be absorbed into a frequent service in all proposed operational models.

2.2.3. The operational modelling at SOC stage also acknowledges services like the U5 and the A4 Air Decker that will benefit for journey time savings following the BBSC programme, due to running partly or mostly along the A4 corridor. These were not included in the in operational model focus due to the very specific customer base the services would likely have, which was deemed out of scope at the time. Furthermore, no changes to the operation of those services would be proposed, unlike the services in the CSG.

2.2.4. The BBSC Programme Options Appraisal Report (OAR) sets out the longlist of options considered and the reasoning behind the shortlisting process. The shortlisted operational models are detailed below with only two (OAR Option 2 and Option 3) being carried forward to the SOC stage.

Figure 2-1 - Operational model focus

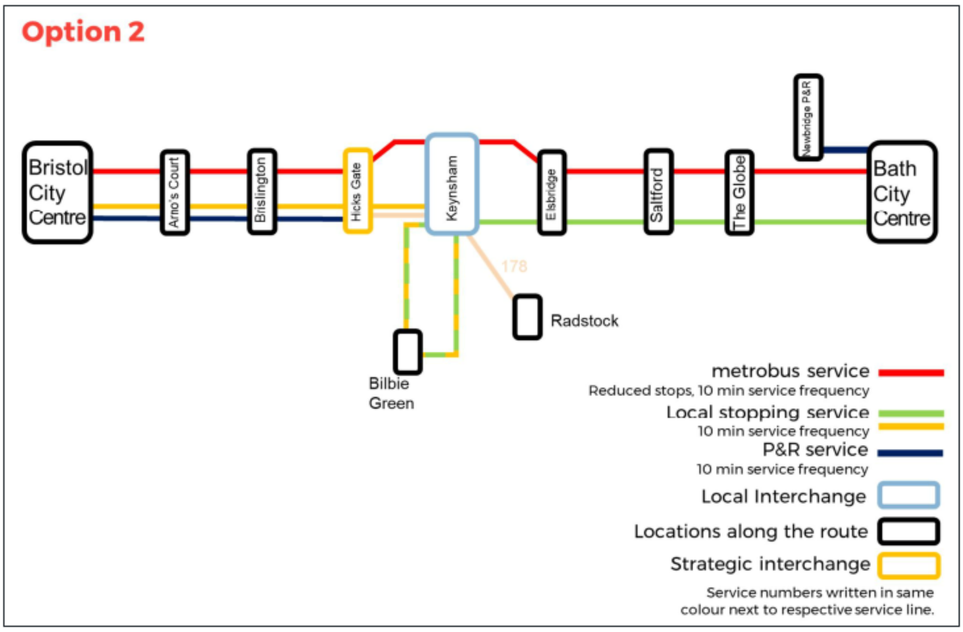


Operational model – option 2

2.2.5. Option 2 introduced a new BBSC metrobus style service running at a 10-minute headway on a limited stop basis. The existing X39 would be amended to a 10-minute headway (from a 15-minute headway) and split between two local stopping services with an additional loop through Keynsham and Bilbie Green. This provided a notional combined 5-minute end to end headway but retained the P&R service which supplemented the short section between Brislington and Bristol city centre and was itself extended back to the proposed Hicks Gate Interchange. The 178 service in operation at the time would be reduced to run only between the new Hicks Gate transport hub and Radstock.

2.2.6. The proposed service arrangement for Option 2 is set out in Figure 2-2.

Figure 2-2 - Operational model - Option 2



2.2.7. Option 2 would significantly improve the quantity of local buses operating along the corridor and between the cities of Bath and Bristol. However, operational complications are likely to arise when the two principal services (both 10-minute headways) are coordinated as the metrobus style services are limited stop and, by default, will run end to end faster than the local stopping services created by the changes planned to the current X39 service.

2.2.8. Further coordination issues will also occur between Brislington P&R and Bristol city centre when a further 10-minute headway service (likely metrobus style and limited stop) is coordinated with the two proposed 10-minute headway services, themselves challenged by the different stopping patterns each would adopt. At best the combined services on this corridor section would create a 2.5/2.5/5.0 pattern within each 10-minute period.

2.2.9. Option 2 notionally creates an average wait time of 5 minute (or less at some points between Brislington P&R and Bristol) but only realistically from each termini leading some passengers further down the line in each direction seeing a less coordinated arrival pattern and possibly service bunching. For example, if the core metrobus style service is 4-minutes faster between Bath and Saltford then a departing pattern between the red and green services of a coordinate 5-minutes at Bath will become a 1-minute gap by Saltford with the red line catching the green line bus up and then likely overtaking it before Keynsham. In this scenario the waiting pattern would move from a 5/5 at Bath to a 1/9 at Saltford.

OBC stage opinion – option 2

- Option 2 has significant merit regarding the general increase in bus service resource, but the different stopping patterns of the planned service groups will limit the benefits of coordination to service termini, leading to a more fragmented service being seen en-route and potentially a re-set required at common stops close to Keynsham – adding further operational complexity.
- However, the proposed 10-minute frequency of the red line (city to city) is an improvement on the existing X39 service, running every 15-minutes currently. Therefore, this option will likely see a segmented market with travellers between the cities unlikely to consider green or yellow lines in favour of the improved X39 (red line) service. However, promoting and marketing the corridor as a coordinated 5-minute headway would be unrealistic.

Operational model – option 3

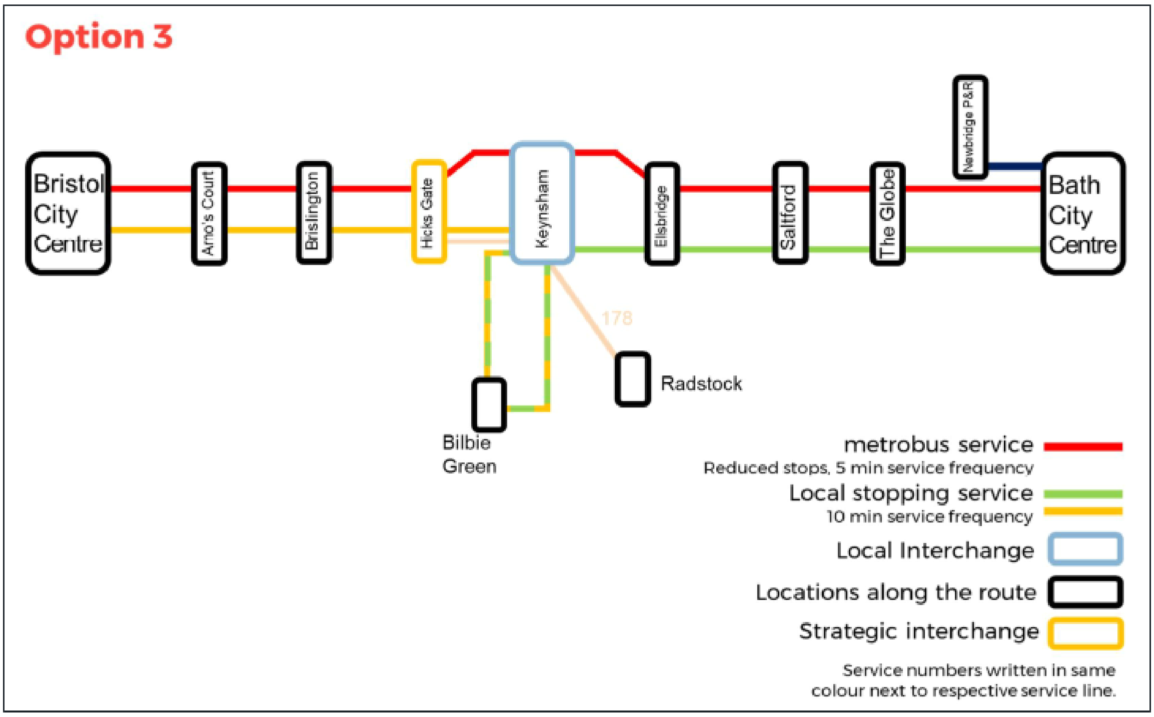
2.2.10. Option 3 differed to the earlier Option 2 by introducing a new BBSC metrobus service running at a significantly increased 5-minute headway with reduced stops. The existing X39 was amended to a 10-minute headway (from a 15-minute headway) and split in two local stopping services with an additional loop through Keynsham and Bilbie Green (as in Option 2).

2.2.11. In this option the Brislington P&R service is replaced by the metrobus service due to the increased frequency of trips on the proposed red line.

2.2.12. This approach effectively segments the market (as with Option 2) as city-to-city travellers are unlikely to consider use of either yellow or green lines as they would have the option to use a 5-minute headway red line. It significantly improves the current offer but in combination with other services may over-bus some segments.

2.2.13. The proposed service arrangement for Option 3 is set out in Figure 2-3.

Figure 2-3 - Operational Model - Option 3



2.2.14. Option 3 potentially provides over-resource when considering the current commercial market. Moving the local stopping service options to a 10-minute headway in addition to the core 5-minute headway service does represent an improvement for all passengers. However, SOC data suggested a strong end to end market for services which would likely transfer in its entirety to the red line. This would leave a smaller residual level of passenger use from all intermediate stops that may not support a 10-minute headway service between Keynsham and each city centre at the outset.

2.2.15. To resolve this, further options based on Option 3 (and in part Option 2) could consider reduction of the green and yellow lines to a 15-minute or 20-minute headway each with a coordinated pattern around Keynsham and Bilbie Green to link to/from the interchange before travel to each city as shown. This would allow existing demand between Keynsham and Bristol to be met at current service levels (if 15-minute headway) and the market for increased services to Bath to be tested.

2.2.16. Where passenger numbers grow consideration could then be given to paralleling the 5-minute headway 'red-line' with the proposed 10-minute headway blue line either end to end (Bristol to Bath) or in part (to/from Keynsham only) or with a mixed 10/20-minute headway either side of Keynsham utilising alternate short and long route buses.

2.2.17. Alternatively, consideration could be given to terminating each local service at a notable interchange point with the red line (e.g., Hicks Gate for the yellow line and Saltford for the green line), limiting duplication in the urban areas of each city and potentially supporting a 10-minute headway for connectional purposes to the red line. To compensate for a loss of intermediate urban stops the red line could see minor stop additions between respective city centres and local interchanges.

2.2.18. Variations to the currently proposed SOC stage options discussed in this section are outlined further below.

OBC stage opinion – option 3

- Option 3 provides a significantly improved metrobus style service, operating limited stop between the two cities of Bath and Bristol. However, this may be over provision were the additional 10-minute frequency stopping services also overlaid across the corridor.
- The ability to coordinate is made more difficult when these operate at differing frequency levels, as is the case with Option 3. As with Option 2, the ability to effectively coordinate all services is further impeded by the mix of limited stop and stopping service.
- The removal of a dedicated P&R service and absorption of this into the longer distance city to city routes makes sense at a resource level. However, if delays occur prior to buses reaching the P&R location there is potential for the pattern to vary, with bunching of buses occurring. P&R works best when people do not perceive P&R to be a delay to their journey and as such a bespoke service ensuring a bus is always boarding at the P&R terminal (leaving only when the next arrives) is seen as the most effective delivery of this mode.

2.3 Phased delivery scenarios considered at SOC

2.3.1. The Bus Operational Report at SOC stage considered a phased implementation of the preferred operational model, in line with likely scenarios for the order of delivery of the infrastructure improvements.

2.3.2. The phased implementation scenarios are set out in Table 2-1.

Table 2-1 - Delivery scenarios considered

Scenario	Summary	Link to CRSTS schemes
A	Section 1 (Bristol Three Lamps Junction to Emery Road) is completed	Bristol to Emery Road
B	Sections 1 and 2 (Emery Road to Hicks Gate, including Hicks Gate Transport Hub) are completed	Bristol to Emery Road & Emery Road to Keynsham (partial)
C	Sections 1 to 3 (Bristol Three Lamps Junction to Broadmead Roundabout) are completed	Bristol to Emery Road & Emery Road to Keynsham (full)

Scenario	Summary	Link to CRSTS schemes
D	Sections 3 to 6 (Hicks Gate to Bath City Centre) and the new Hicks Gate Transport Hub are completed	Emery Road to Keynsham (partial) Keynsham to Bath
E	Hicks Gate Transport Hub only	Emery Road to Keynsham (partial)

2.3.3. The intermediary operational options proposed for each phased delivery scenario effectively each split the preferred operational model option into deliverable sections. For example, for scenario B, services west of the Hicks Gate Transport Hub would be adjusted to match the final operational arrangement, but most would terminate at Hicks Gate and interchange to the remaining unchanged services. This enabled journey time savings to be taken advantage of as soon as delivered, working towards the full corridor operational model in phases.

2.3.4. The commercial modelling indicates that the delivery phases on the western end of the corridor (Scenarios A, B, and C) require a lower increase in operating cost due to the relatively shorter length of the sections and the existing higher frequency provision.

2.3.5. The introduction of the Hicks Gate Transport Hub would support the BBSC by providing opportunities for multi-modal interchange with orbital services and supporting potential expansion of P&R capacity.

2.3.6. Therefore, the recommended approach to phasing (at SOC stage) was to prioritise the introduction of the Hicks Gate Transport Hub, followed by bus priority infrastructure on the western section of the corridor (Scenarios A, B, and C).

2.3.7. The analysis at SOC stage however also highlighted that journey time savings on the B&NES section, particularly in Bath, would enable lower increases in operational costs.

OBC Update

2.3.8. At this stage, the scope of the OBC itself presents a different phased delivery scenario, where sections 2 to 6, i.e., from Emery Road to Bath are intended to be delivered first, followed by Hicks Gate Transport Hub and section 1 in the longer term.

2.3.9. This means that the phased delivery scenarios will be revisited later in this report, but will follow largely the same principles:

- Develop intermediate operational models to benefit from journey time savings as soon as they are enabled by the infrastructure improvements.
- If corridor segments are delivered at different times, identify a natural point or hub for services to interchange if required.

2.4 Further considerations

2.4.1. As part of the BBSC Programme development following the SOC, further consideration must be given to several aspects of the proposed operational model:

- The implications of splitting services between Bath and Bristol as part of interim models, i.e., removing direct end-to-end services. Introducing an interchange and the implied interchange penalty risks losing patronage and may not enjoy operator support for a range of commercial and strategic reason.
- Some options have included assumptions that combined headways can be achieved through the mix of limited stop (metrobus style) services alongside all-stop services across the corridor. This requires re-examination as such operations may create even headways departing each end of the corridor but will likely see bus bunching at some intermediate stops mixed with excessive gaps at other stops as faster (limited-stop) buses catch and overtake slower (all-stop) buses along the corridor.

2.4.2. To achieve the vision for BBSC metrobus services the Combined Authority should prepare a detailed vehicle specification, learning lessons as applicable from the development of the existing metrobus services:

- This should include, but not be limited to, fare collection systems, seating capacities, number of vehicle entry/exist points, application of all-door boarding/alighting, passenger counting technology, AVL systems, propulsion options, ventilation and heating systems, rigid or articulated options, single and double deck options, on-board systems and passenger information, driver assistance and safety monitoring equipment.

OBC stage opinion – overall view

- Agree that the higher existing levels of public bus service provision on the western end of the corridor make delivery of service improvements easier to deliver in cost and coordination terms.
- However, to be competitive with private modes across the whole study area the complete package is important as this provides a holistic approach to all service provision and allows greater benefits in resource reallocation and visual appearance of the unified corridor approach.

3 Bus network review

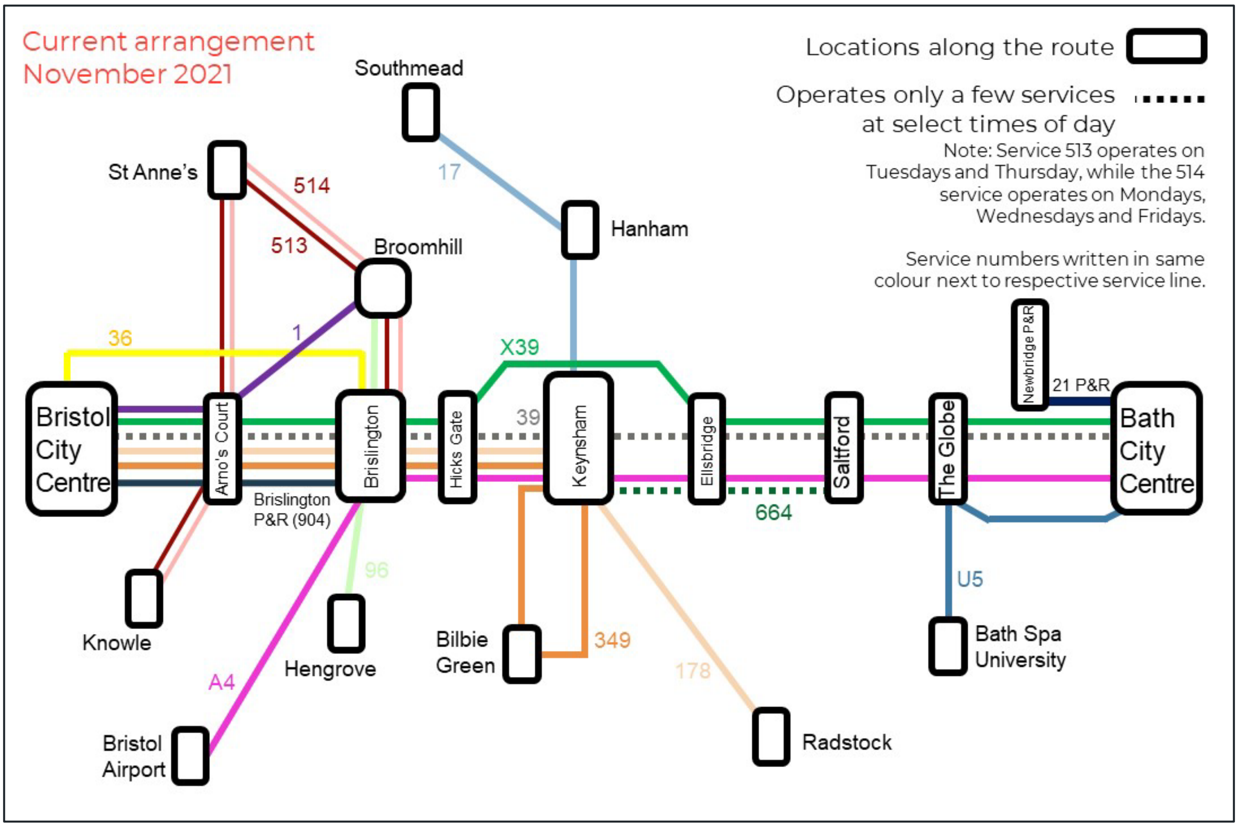
3.1.1. A review of the current bus service provision throughout the Bath - Bristol corridor has been undertaken and compared to the bus network as of November 2021 (the period in which the previous SOC bus operational work was undertaken).

3.2 November 2021 bus service provision

Service arrangement

3.2.1. Bus services operating across the BBSC corridor in November 2021 are illustrated in Figure 3-1.

Figure 3-1 - BBSC service provision (as of November 2021)



3.2.2. During November 2021, the spine of the Bristol to Bath corridor comprised the X39(39) service, with additional services running on parts of the A4 and connecting adjacent areas to the corridor. Other services running along the corridor included:

- A4 Air Decker between Bath and Bristol Airport via Keynsham and Brislington;
- 349 between Bristol and Keynsham via Brislington;
- 178 between Bristol and Radstock via Brislington and Keynsham; and
- 904 P&R between Brislington P&R and Bristol.

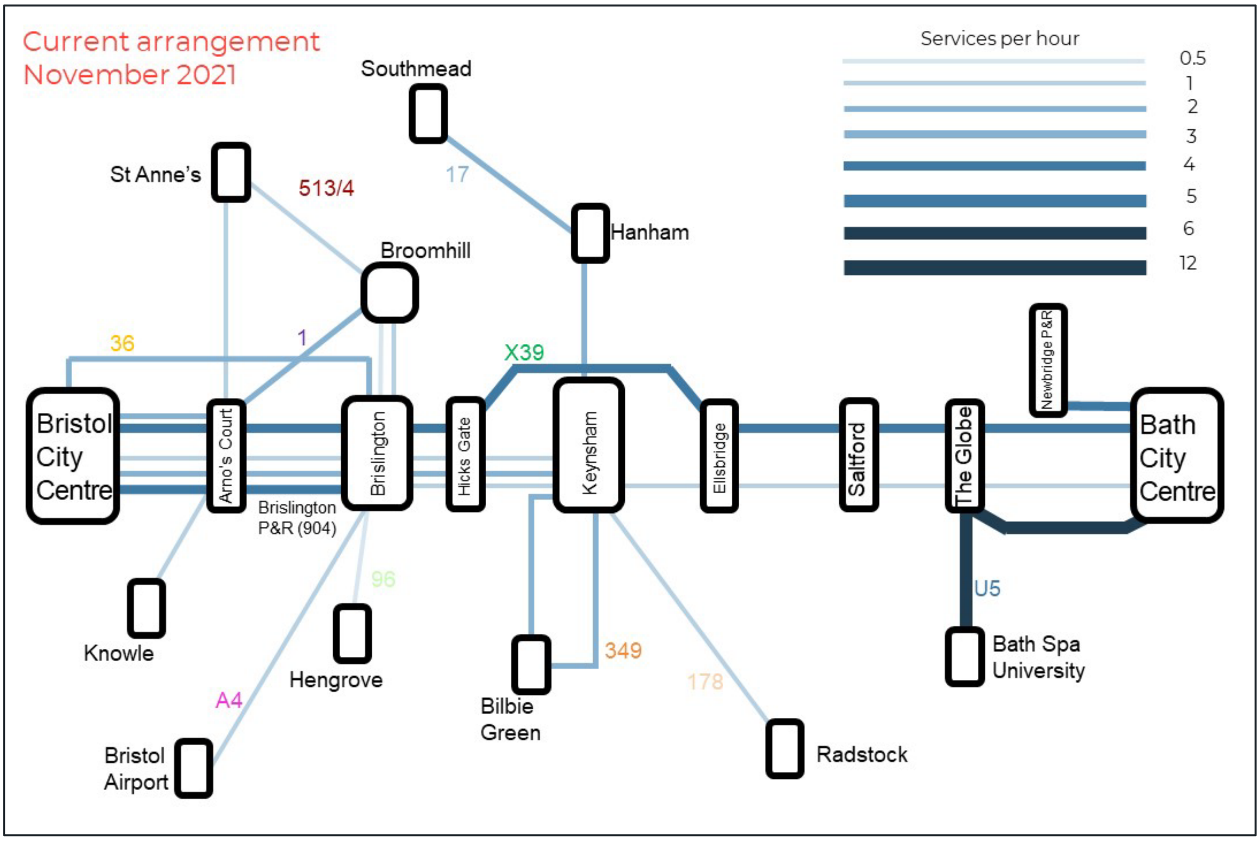
3.2.3. There were several other services operating in Bristol and Bath, including as a minimum:

- 96 between Broomhill to Hengrove;
- 17 between Southmead to Keynsham; and
- 1 between Bristol to Cribbs Causeway via Broomhill.

Average service frequencies

3.2.4. Figure 3-2 highlights Average Weekday Frequencies of bus services operating throughout the BBSC study area in November 2021.

Figure 3-2 - BBSC average weekday frequencies (as of November 2021)



3.2.5. Figure 3-2 highlights that the most frequent service operating on the corridor was the U5 Bath Spa University service, followed closely by the X39 (39), and the Brislington and Newbridge P&R services:

- Table 3-1 tabulates this data and provides further information regarding the service's funding status, defining each as either:
- Commercial where the operator retains revenue and runs the service at its own financial risk having full control over the resources used and times operated, or,
- Subsidy (Supported by a Local or Combined Authority) where the operator runs under contract to the Local or Combined Authority who will likely set the timetable and fare structure. There are two types:
  - Gross cost contract - the tendering authority pays an operator a fixed sum to provide services, retaining the passenger revenue and often setting the routes and specifying the types of vehicles.
  - Net cost contract - the operator takes on both the income risk and the cost risk but retains all passenger revenue.

Table 3-1 - Bristol - Bath Bus service provision (as of November 2021)

Bus service route	Bus operator	Service number	Average service frequency per hour (November 2021)	Supported or commercial?
Bristol City Centre - Broomhill	First Bus	1	2	Commercial
Keynsham - Southmead	First Bus	17	2	Subsidy (the CA)
Bath City Centre – Newbridge P&R	First Bus	21	4	Subsidy (Gross Cost)
Bristol City Centre - Brislington	First Bus	36	3	Commercial
Broomhill - Hengrove	First Bus	96	0.5	Subsidy
Bristol City Centre - Radstock	First Bus	178	1	Subsidy
Bristol City Centre - Keynsham	First Bus	349	2	Commercial
Knowle - Brislington	Stagecoach	513	1	Subsidy (the CA)
Knowle - Brislington	Stagecoach	514	1	Subsidy (the CA)
Keynsham - Saltford	Stagecoach	664	0.5	Subsidy (the CA)
Bristol City Centre - Brislington (P&R)	First Bus	904	6	Subsidy (the CA)
Bristol City Centre - Bath City Centre	First Bus	X39 (39)	4	Commercial
Bristol Airport – Bath City Centre	Bath Bus Company	A4	1	Commercial
Bath Spa University – Bath City Centre	First Bus	U5	6	Commercial

3.2.6. Summary of 2021 Network in Table 3-1 highlights that during November 2021, most services throughout the Bristol – Bath corridor were operated by First Bus.

3.2.7. Stagecoach operated three services in the South Bristol and Keynsham area.

3.2.8. The Bath Bus Company operated the Bristol Airport – Bath City Centre A4 ‘AirDecker’ service, running on an hourly basis.

3.2.9. Across the wider BSCC study area, several services were operated commercially. This is important, particularly for those services identified as playing a critical role in the creation of a metrobus style corridor across the BBSC study area, as this potentially makes these services more difficult to integrate into a unified solution as ownership lies with private operating companies. In these scenarios a partnership approach to service amendment would be required (and facilitated through the Enhanced Partnership process).

3.2.10. A summary of the CSG routes and their funding status is provided below.

- X39 (39) Bristol to Bath – commercial;
- 349 Bristol to Keynsham – commercial;
- 904 Brislington P&R – subsidy;
- 178 Bristol to Radstock – subsidy; and
- 664 Keynsham to Saltford- subsidy.

3.2.11. Where services are wholly subsidised, it will be easier for the Local and Combined Authority partners delivering the BBSC to redefine service patterns and routes to realise the benefits of a unified corridor approach and the benefits brought by improved bus priority measures.

3.2.12. The November 2021 network also comprised several local routes (e.g., services 1, 17, and 96) that are likely to combine at key sections of the BBSC area, particularly close to the principal cities of Bath and Bristol. The way in which these services are considered in the delivery of the metrobus style improvements will be important as they should be seen as additional parts of the solution and not detached from the overall corridor approach.

3.2.13. The average frequency of the services throughout BBSC area ranges widely from one bus every two hours (service 664) to six services per hour (service U5).

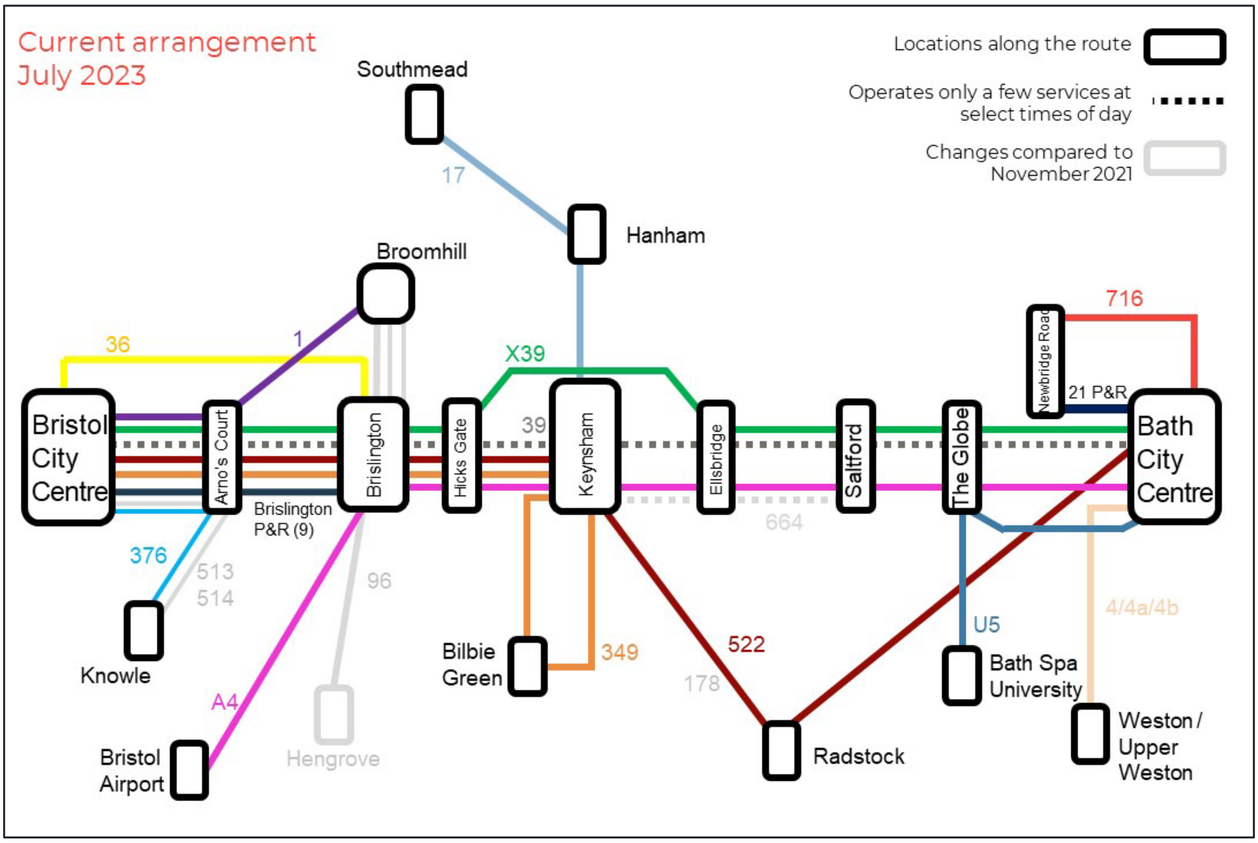
3.3 July 2023 bus service provision

3.3.1. In moving from the SOC to OBC stages it is important to update the SOC stage network analysis. This has two important outcomes. Firstly, it helps to understand any substantive (or otherwise) changes to services along the BBSC area which may impact on the proposed SOC shortlisted options, and secondly it both validates (or otherwise) these options and allows creation of additional options that may be further advantageous in terms for financial and operational delivery.

Service arrangement

3.3.2. Figure 3-3 illustrates the updated Bus Service Provision for services operating throughout BBSC in July 2023.

Figure 3-3 - BBSC Bus Service Provision (as of July 2023)

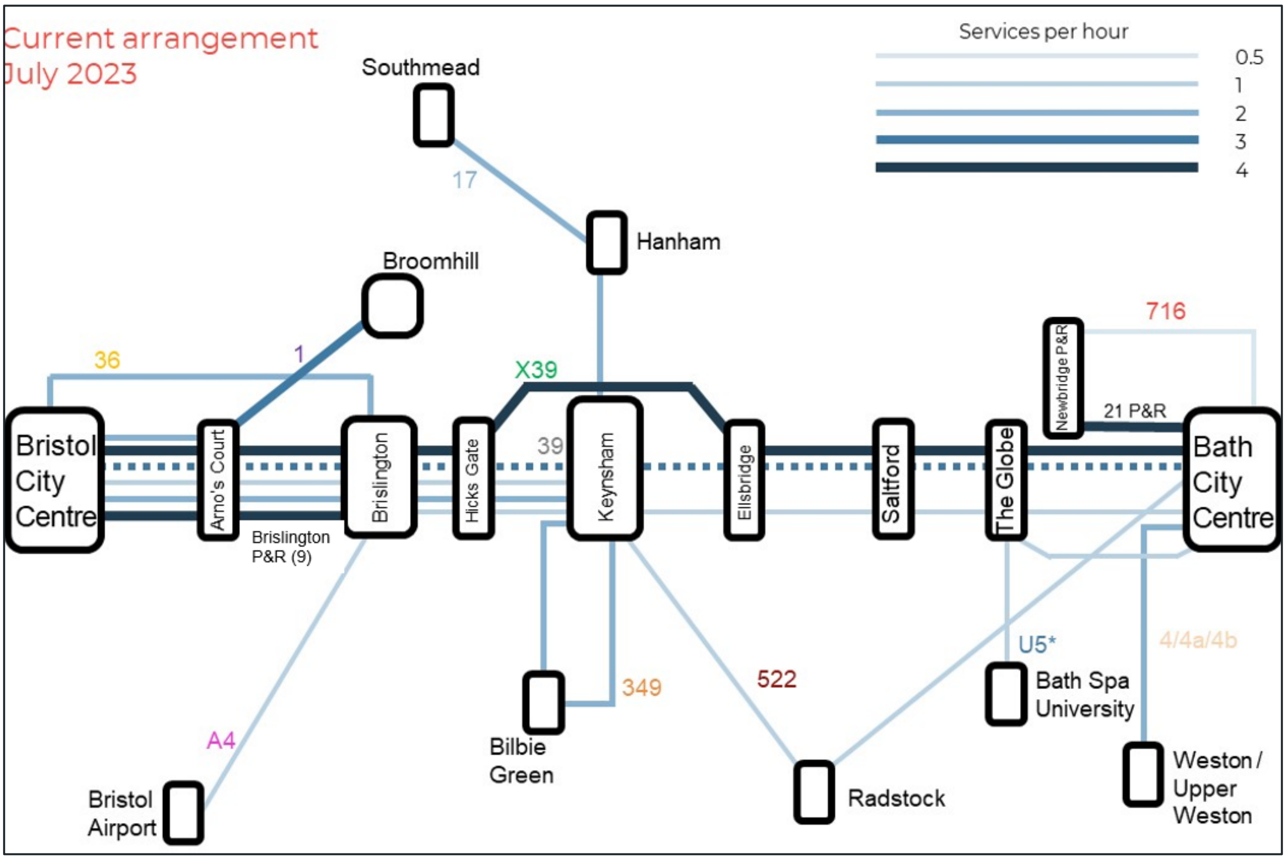


3.3.3. Figure 3-3 highlights the changes in service operation between November 2021 and July 2023. Services 513/514 to Knowle and service 96 to Hengrove have been stopped, whilst the 178 service has been replaced by the 522 service, extending back to Bath.

Average service frequencies

3.3.4. Figure 3-4 highlights Average Weekday Frequencies of bus services operating throughout the Bristol – Bath corridor during July 2023.

Figure 3-4 - Bristol - Bath average weekday frequencies (as of July 2023)



3.3.5. Figure 3-4 highlights the service frequency in July 2023. The average frequency of the key service along the corridor, the X39 is unchanged, but service 1 has increased from two buses an hour to three (every 30-mins to every 20-mins) whilst service 36 has reduced from three buses an hour to two (every 20-mins to every 30-mins).

3.3.6. The average frequencies of P&R services between Bristol and Brislington to the west of the corridor and Newbridge Road and Bath to the east have remained the same.

3.3.7. There is some coordination between the overlapping 349 (Keynsham-Bristol) and new 522 (Bath-Radstock-Keynsham-Bristol) services with both the short and long options for the 522 being uncoordinated between the common locations of Keynsham and Bristol. However, when the 349 is overlaid across the section an analysis of the departures from Keynsham (Church Stop B) between 0928 and 1227 shows the following service interval pattern 16/14/13/16/15/13/13/17/17/15/11/19. This suggests that a small movement of the 349 service onto a 00 / 30 pattern (c+2 to +5 minutes for most trips from Keynsham) and the 522 service onto a 15 / 45 pattern (c+1 to +7 minutes for most trips from Keynsham) would redistribute resources to an even 15-minute headway (4 buses per hour) across the corridor. The 349 is commercially operated and this smaller proposed move in service timings sits well with a commercial operation. Where the 522 is supported by a subsidy more substantive changes in service times are possible as these are in the gift of the Local Transport Authority.

3.3.8. Engagement with the operator however has identified that trying this previously this has caused difficulties in terms of coordination between the 522 and other services in Bath, as well as requiring problematic layovers to ensure the coordination works. Further engagement with operators once the journey time savings will materialise will help identify further opportunities for coordination.

3.3.9. Service 39 is a variant of the X39. The 39 service operates only at the extremities of the day and provides late evening and night time services via Keynsham town centre, serving the town when existing day time services 349 and 522 stop operating. The 39 also performs some limited early morning services through Keynsham before 0600 which are Bristol bound. The X39 operates for most of each daily period providing four buses per hour but does not serve Keynsham town centre and instead operates along the Keynsham bypass. Keynsham residents can use the service if they board and alight at Ellsbridge House, however this is a 25-minute walk from central Keynsham, rendering this option unviable for the majority of residents.

3.3.10. Bath to Keynsham town centre is provided either as a link via Radstock on the new service 522, this being a long diversion in comparison to the other option, the A4 'Air Decker' service which operates hourly. Bath to Keynsham town centre by service 522 takes 98 minutes and by A4 'Air Decker' the same journey takes 38 minutes. While evidence from the engagement suggests that Keynsham residents would use the bus if available, the current lower general intensity of bus services between Bath and Keynsham suggests that operators do not feed demand is sufficient to sustain a service commercially.

3.3.11. The former Brislington P&R service 904 is now numbered 9. Compared to 2021, the frequency has now dropped from six buses per hour (10-minute headway) to only four buses per hour (15-minute headway) off peak and five buses per hour (12-minute headway) in the morning and evening peaks with the service running as a through journey from Brislington P&R to Shirehampton (Portway) P&R via Bristol city centre. An analysis of the timetable suggests the buses depart Brislington P&R off-peak at 08 / 23 / 38 / 53 minutes past each hour with buses arriving at 03 / 18 / 33 / 48, suggesting a dwell time for boarding of five minutes and a period of ten minutes between each departing and arriving bus where no bus is present at the P&R stop for waiting passengers. Were timetable and resource changes implemented, a scenario could be achieved where there is always a bus present at each P&R terminal, providing added confidence to users of this mode (who by nature have a higher propensity to switch between P&R and more central parking locations).

3.3.12. Were the 349 and 522 to be coordinated to a 15-minute headway there is potential to coordinate additionally with service 9 between Brislington and Bristol city centre to create a 07 / 08 service pattern and headway. Both the 349 / 522 combination and the 9 are further supplemented from Arnos Vale (Arno's Court) by the 1 service operating every 20-minutes, though meaningful coordination will be difficult to achieve with the differing headways available.

3.3.13. Services 4/4a/4b, 21 (Newbridge P&R), 36, 716, 19 and U5 operate for only short common sections across the corridor and coordination of these services with the CSG is out of scope at this stage. Similarly, service 17 operates to the corridor from Southmead and Hanham and would likely be amended to serve the proposed Keynsham Interchange before the town centre to provide connectivity to the core services between Bath and Bristol for those within 400-800 metres of the corridor.

3.3.14. Table 3-2 tabulates this updated data and provides further information regarding whether the service is commercial or subsidy (supported by a Local or Combined Authority) in the same ways as described in Section 3.2.6.

Table 3-2 - Bristol - Bath Bus Service Provision (as of July 2023)

Bus service route	Bus operator	Service number	Average service frequency per hour (July 2023)	Supported or commercial?
Bristol City Centre - Broomhill	First Bus	1	3	Commercial
Weston - Odd Down via Royal United Hospital, Bear Flat	First Bus	4/4a/4b	2	Commercial
Portway (P&R) - Bristol City Centre - Brislington (P&R)	Stagecoach West	9	4 (5 at peak)	Subsidy (the CA)
Keynsham - Southmead	First Bus	17	2	Subsidy (the CA)
Bath City Centre – Newbridge P&R	First Bus	21	4	Subsidy (B&NES)
Bristol City Centre - Brislington	First Bus	36	2	Commercial
Bristol City Centre - Bath City Centre	First Bus	39 / X39	4	Commercial
Bristol City Centre - Keynsham	First Bus	349	2	Commercial
Bristol City Centre – Radstock - Bath	First Bus	522	1	Subsidy (the CA)
Bath Bus Station - Newbridge Road	CT Coaches	716	0.5	Subsidy (B&NES)
Bristol Airport – Bath City Centre	Bath Bus Company	A4	1	Commercial
Bath Spa University – Bath City Centre	First Bus	U5	1* (usually 4 term time)	Commercial

Summary of 2023 network

3.3.15. Table 3-2 highlights that during July 2023, most services throughout the Bath – Bristol corridor were operated by First Bus.

3.3.16. Stagecoach have reduced their role in service operation from three service to just operating one service, the 9 (which is a replacement for the 904 Bristol to Brislington P&R). As a result, they become a key provider as they operate a service in the CSG.

3.3.17. The Bath Bus Company operates the Bristol Airport – Bath City Centre A4 'Air Decker' service as before to an hourly timetable via Keynsham town centre.

3.3.18. CT Coaches provide the 716 (a B&NES contracted service) at a low frequency from Newbridge Road to Bath city centre. This service was also in operation in November 2021 but was omitted from the network maps for the SOC stage work.

3.3.19. Across the wider BBSC study area, most services were operated commercially. As with the case in the November 2021 review, this is important, particularly for those services identified as playing a critical role in the creation of a metrobus style corridor across the BBSC study area, as this potentially makes these services more difficult to integrate into a unified solution as ownership lies with private operating companies. In these scenarios a partnership approach to service amendment would be required (and facilitated through the Enhanced Partnership process which is now in place following adoption of the West of England Combined Authority Bus Service Improvement Plan (BSIP) and creation of the associated Enhanced Partnership).

3.3.20. A summary of the CSG routes and their funding status is provided below. Some services have changed from the November 2021 network and these changes are noted below.

- X39 (39) Bristol to Bath – commercial;
- 349 Bristol to Keynsham – commercial;
- 904 Brislington P&R – subsidy (now service 9); and
- 178 Bristol to Radstock – subsidy (now service 522 and extended to Bath).

3.3.21. It remains the case that where services are subsidised, it is likely to be easier for the Unitary and Combined Authority partners delivering the BBSC to redefine service patterns and routes to realise the benefits of a unified corridor approach and the benefits brought by improved bus priority measures. Of the services within the CSG the 9 provides significant capacity on the BBSC, as do the combined long / short workings on the 522 between Keynsham (Church) and Bristol.

3.3.22. The July 2023 network continues to comprise several local routes (e.g., services 1, and 17) that are likely to combine at key sections of the BBSC area, particularly close to the principal cities of Bath and Bristol. The way in which these services are considered in the delivery of the metrobus style improvements will be important as they should be seen as additional parts of the solution and not detached from the overall corridor approach.

3.3.23. The average frequency of the services throughout BBSC area still ranges widely when compared to the November 2021 scenario, however on an improved basis at the lower end of the scale but with less frequent services at the higher end. The former two hourly 664 service has ceased, and the lowest frequency is now provided by the A4 (hourly) and 522 (hourly, which replaces the former 178 service), however, the higher frequency services now only see a maximum of four services per hour, this being on all P&R services and the U5.

3.4 Average service frequency comparison

3.4.1. To better track the changes in network provision between the SOC and OBC stages, analysis has been undertaken to provide a comparison of the average service frequencies between November 2021 and July 2023.

3.4.2. The detailed outputs of this analysis are summarised in Table 3-3. This highlights that there has been some service provision change throughout the BBSC area between November 2021 and July 2023.

3.4.3. In total, five services that operated during November 2021 were no longer operational in July 2023 (service numbers 96, 178, 513, 514 and 664). Conversely, there are three new services that operate along the BBSC that were not operational during November 2021 (service numbers 4, 522 and 716).

3.4.4. The frequencies of most of the services that operated during both time periods have remained the same. However, service number 36 has seen a slight decrease in frequency whilst service number 1 has increased its frequency.

3.4.5. During the period between the SOC and the OBC the UK local bus market has experienced significant cost and staffing pressures. This has been created due to the slow recovery period following the Covid-19 Pandemic and additional financial and supply pressures placed on vehicle operations caused by wider global events.

3.4.6. As a result, local bus operators are having to review service levels and, in many cases, reduce service levels to better link supply and demand. Peak travel patterns have changed due to increased working from home and a level of increase in more sustainable travel modes for local trips where people have continued to adopt these in the post Covid-19 pandemic world.

3.4.7. The review of the BBSC area suggests the situation is similar for the local bus service network between the cities of Bath and Bristol. Several services have been cancelled and other have seen a subtle decrease in typical hourly frequencies with only service 1 between Bristol and Broomhill seeing a modest increase.

3.4.8. This potentially causes some issues when looking to coordinate local bus services, particularly those within the CSG into a unified corridor offer to match the aspirations of the BBSC approach. To continue to deliver improvements to the magnitude suggested in Options 2 and 3 at SOC stage it is likely that an increased investment in operational support will be needs and this will be explored in the next sections.

Table 3-3 – Average frequency comparison

Bus service route	Service number	Buses per hour (Nov 2021 average)	Buses per hour (July 2023 average)
Bristol City Centre - Broomhill	1	2	3
Weston - Odd Down via RUH, Bear Flat	4/a/b	4	2
Portway (P&R) - Bristol City Centre - Brislington (P&R)	904 / 9	6 (as 904)	4 (or 5 at peak) (as 9)
Keynsham - Southmead	17	2	2
Bath City Centre – Newbridge P&R	21	4	4
Bristol City Centre - Brislington	36	3	2
Bristol City Centre - Bath City Centre	39 / X39	4	4
Bristol City Centre - Keynsham	349	2	2
Bristol City Centre – Radstock - Bath	522	1 (when 178 service)	1 (now 522 extended to Bath)
Bath Bus Station - Newbridge Road	716	Service not operational in Nov 2021	0.5
Bristol Airport – Bath City Centre	A4	1	1
Bath Spa University – Bath City Centre	U5	6	1* (usually 4 term time)
Broomhill - Hengrove	96	0.5	Service no longer operational
Knowle - Brislington	513	1	Service no longer operational
Knowle - Brislington	514	1	Service no longer operational
Keynsham - Saltford	664	0.5	Service no longer operational

4 Journey time analysis

4.1.1. A key part of assessing proposed operational arrangements is understanding the impact different options will have on cost. To do this, an updated understanding on the resulting journey time (JT) savings from the wider scheme is required.

4.2 Methodology summary

4.2.1. Automated Vehicle Location (AVL) data was analysed for three months from April to June 2023 for the current X39 service. This period was chosen as it is neutral in that traffic figures are not disrupted by holidays, thereby giving a more accurate reflection of average daily traffic.

4.2.2. Using a bespoke spreadsheet tool, the journey time between stops was analysed and plotted for each direction. The tool then uses estimated delay reduction for each stop pair to calculate the reduction in journey time across the corridor.

4.2.3. In order to quantify the delay reduction, a detailed understanding of the bus priority proposed between each stop pair is required. Unlike the SOC, the OBC stage of the project looks at infrastructure improvements delivered on the B&NES sections of the corridors only.

4.2.4. Table 4-1 summarises the proposed interventions in each direction along the A4 corridor.

Table 4-1 - Summary of bus priority improvements proposed along the A4

Stop pair	Current eastbound bus priority provision	Proposals on Eastbound direction	Current Westbound bus priority provision	Proposals on Westbound direction
Bristol Bus Station – Emery Road	*No changes proposed as part of OBC*	*No changes proposed as part of OBC*	*No changes proposed as part of OBC*	*No changes proposed as part of OBC*
Emery Road - Brislington House	No bus lane	50% bus lane	60% bus lane	100% bus lane
Brislington House - Hicks Gate	No bus lane	100% bus lane	No bus lane	100% bus lane
Hicks Gate - Ellsbridge House	No bus lane	100% bus lane excluding Hicks Gate Roundabout	No bus lane	100% bus lane excluding Hicks Gate Roundabout
Ellsbridge House - Pixash Lane	No bus lane	100% bus lane	No bus lane	No bus lane
Pixash Lane - Copse Road	No bus lane	100% bus lane	No bus lane	No bus lane
Copse Road - Norman Road	No bus lane	60% bus lane (until entry to Saltford)	No bus lane	No bus lane
Norman Road - Tyning Road	No bus lane	No bus lane	No bus lane	No bus lane
Tyning Road - The Shallows	No bus lane	No bus lane	No bus lane	No bus lane
The Shallows - Dryleaze	No bus lane	No bus lane	No bus lane	No bus lane
Dryleaze - Corston Lane	No bus lane	No bus lane	No bus lane	No bus lane
Corston Lane - The Globe	No bus lane	Bus lane on approach to The Globe Roundabout	No bus lane	No bus lane
The Globe - Twerton Fork	No bus lane	No bus lane	No bus lane	No bus lane
Twerton Fork - Newbridge Gardens	No bus lane	Bus lane between Old Newbridge Hill and Newbridge Garden (10%)	No bus lane	No bus lane

Stop pair	Current eastbound bus priority provision	Proposals on Eastbound direction	Current Westbound bus priority provision	Proposals on Westbound direction
Newbridge Gardens - Rudmore Park	No bus lane	100% bus lane	No bus lane	No bus lane
Rudmore Park - Charmouth Road	No bus lane	100% bus lane	No bus lane	No bus lane
Charmouth Road - Horstmann Close	No bus lane	100% bus lane	No bus lane	No bus lane
Horstmann Close - The Weston	No bus lane	20% bus lane, except between Staton Rd and Ashley Avenue	No bus lane	No bus lane
The Weston - Windsor Villas	No bus lane	100% bus lane	No bus lane	No bus lane
Windsor Villas – Bath Bus Station	*No changes proposed as part of OBC. Tie in to Bath City Centre project*	*No changes proposed as part of OBC. Tie in to Bath City Centre project*	*No changes proposed as part of OBC. Tie in to Bath City Centre project*	*No changes proposed as part of OBC. Tie in to Bath City Centre project*

4.2.5. The inter-stop JT provided by the tool is then combined with the average dwell time at each stop to give the overall JT savings for the corridor. The results of this analysis are summarized in Table 4-2.

4.2.6. The main corridor service (Red Service) will operate on a limited stop basis, as outlined in the SOC report. While removing some stops from the current stopping pattern would lead to some dwell time savings, the desired increase in patronage at the remaining stops may increase dwell times, therefore negating some of the dwell time savings. At this time, dwell time savings are not quantified as part of the overall JT savings.

4.2.7. In the eastbound direction, a 4.8% JT saving would be achieved overall, with the current proposed infrastructure outlined in Table 4-1. However, when considering only the sections with improvements in the scope of this project, i.e., between Emery Road and Windsor Villas, it equates to a 12% JT saving. If similar JT reductions can be obtained on the remaining sections of the corridor, this will make a significant difference to the overall RRT and resources needed to operate.

Table 4-2 – Estimated JT savings

Section	Current average Eastbound JT	Improved Eastbound JT	Current average Westbound JT	Improved Westbound JT
Section 1: Bristol to Emery Road	00:28:23	00:28:23	00:26:04	00:26:04
Section 2: Emery Road to Hicks Gate	00:01:52	00:01:30	00:01:57	00:01:41
Section 3: Hicks Gate to Ellsbridge House	00:05:43	00:04:46	00:04:40	00:03:59
Section 4: Ellsbridge House to The Globe	00:10:34	00:09:47	00:10:18	00:10:18
Section 5: The Globe to Twerton Fork	00:01:21	00:01:21	00:01:35	00:01:35
Section 6: Twerton Fork to Bath	00:15:13	00:14:13	00:18:40	00:18:40
Total Corridor JT	**01:03:07**	**01:00:00**	**01:03:15**	**01:02:18**

4.2.8. This tool, and the stop-by-stop approach, has enabled this journey time saving analysis to evolve from that at SOC stage, providing a more realistic reflection of JT savings. Further significant JT savings would be enabled by priority infrastructure that will be considered as part of the Bath City centre OBC, however these cannot be quantified as part of this report.

4.2.9. These time savings, enabled by the infrastructure improvements, unlock potential changes to the existing bus network. These are discussed in the next section.

5 Operational modelling

5.1 Overview

5.1.1. This section uses the updated understanding of the 2023 BBSC network to consider if the amendments made affect the potential to deliver the SOC shortlisted operational model options, those being Option 2 and Option 3 as summarised earlier.

5.1.2. This section will first review the current CSG in the study area and form a baseline position for current operational resources across this route group. This will be followed briefly by a ‘do nothing’ scenario that suggests how existing resources may be redeployed to create coordinated service patterns between main centres and a ‘do something’ (low) that suggests minimal resource additions to fill any identified gaps or opportunities.

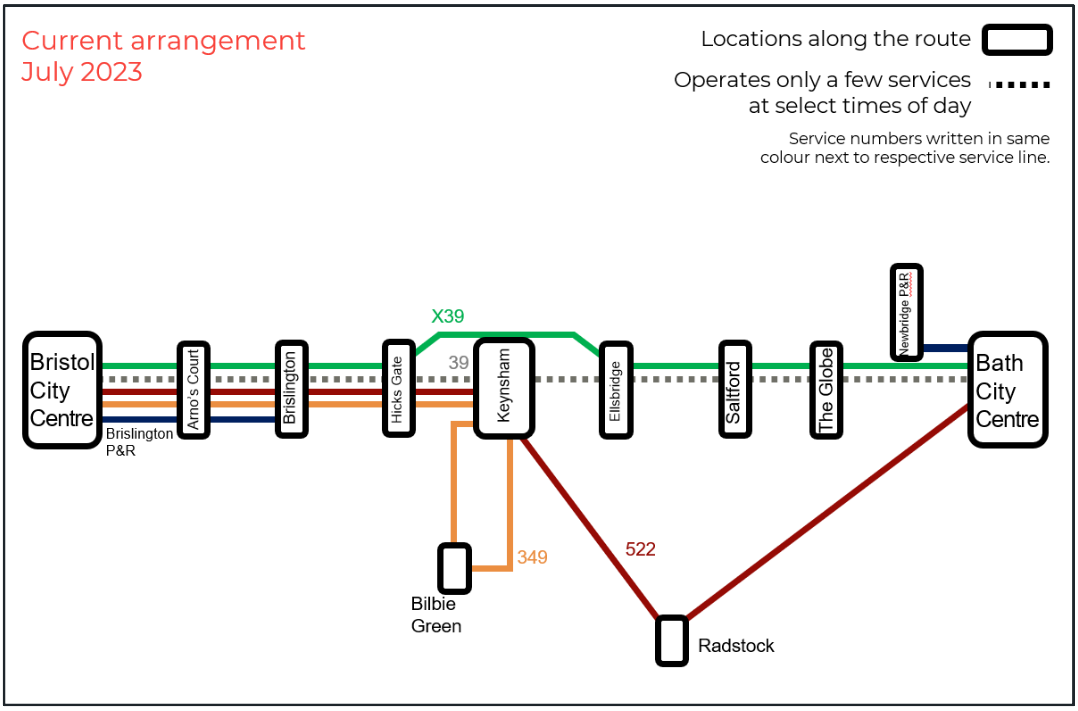
5.1.3. The section will then re-assess SOC Options 2 and 3 and consider resource impacts of these against the baseline / ‘do nothing’ as a do something (high) scenario.

5.2 Operational model focus

5.2.1. As already outlined, the operational model analysis focuses on the CSG outlined below. These are also illustrated again in Figure 5-1 for reference.

- X39 (39) Bristol to Bath;
- 9 Bristol to Brislington P&R;
- 349 Bristol to Keynsham; and
- 522 Bristol to Bath via Radstock.

Figure 5-1 - Operational Model Focus



5.2.2. Other services operating along sections of the corridor will also benefit from journey time savings, namely services like the A4 and 19. While consideration will need to be given to their interworking with the CSG, they are not included in the CSG as no changes to their operation is proposed as part of this report. While the A4 service for example is used for trips along the corridor, its primary route is to serve the airport, which is not proposed to be changed as part of this project.

5.3 Baseline network – 'do nothing'

5.3.1. Based on the current CSG of routes operated across the BBSC there is potential to realign some service patterns to create greater coordination. This has already been highlighted in 3.3.7 for example but is set out in a little more detail in the section below.

5.3.2. The aspiration for the BBSC is a high frequency core service connecting the two principal cities of Bath and Bristol and communities between them. This service would operate a direct route which would minimise end to end journey time and be attractive to current and new passengers. This form of route would maximise the opportunities available through interchange between itself and feeder services and would rely on high quality interchange locations en-route.

5.3.3. With proposals in place for two new interchange locations on the BBSC at Keynsham and Hicks Gate and already existing facilities at Brislington P&R the current CSG routes may maximise the benefits created by these with potentially minimal intervention at a resource level – this case being strengthened by the already direct routing of the X39 which omits Keynsham town centre.

5.3.4. The core X39 service operates every 15-minutes but does not use the same minutes past each hour across the operational day save for the period between 17:57 and 19:27 from Bath. This is largely due to the unpredictable levels of traffic and congestion along the corridor but does make trip planning and spontaneous use of the service more difficult, particularly for new / less frequent users.

5.3.5. The levels of service either side of Keynsham differ markedly.

- East of Keynsham sees only the X39 and A4 services operate to Bath – this equates to five buses per hour, four of which operate every 15 minutes. This makes coordination difficult and only the A4 serves Keynsham town centre.
- West of Keynsham, several services link the town to Bristol including the X39 (does not serve the town centre), 349, 522, Brislington P&R (service 9 from Brislington), and 1 (from Arnos Vale). From the Keynsham town area, a total of eight buses per hour operate (including X39) and from Brislington this increases to 12 buses per hour.

5.3.6. Suggested changes outlined in Section 3 show that routes 349 and 522 have the potential to be better coordinated to provide a bus every 15-minutes between Keynsham town centre and Bristol. This may then be further supplemented by coordination with the 9 (Brislington P&R) from Brislington to a 7/8 headway by coordinating two 15-minute headway corridors.

5.3.7. Due to proximity to the city centre, differing headways, and unique passenger markets, it is likely that the 1 (every 20-minutes) would simply overlay any coordinated approach for the 9 (P&R), 349, and 522 services, providing a further three buses per hour on this short section to the city centre.

5.3.8. An example of the potential corridor timetable inbound is shown in Figure 5-2. This shows a revised pattern for 349 (00/30) and 522 (15/45) services from Keynsham.

Figure 5-2 - Proposed 349 and 522 Pattern

	349	522	349	522	349	522	349	522	349	522	349	522	349	522	349
Keynsham Church (Stop B)	08:00	08:15	08:30	08:45	09:00	09:15	09:30	09:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30
Brislington Emery Road	08:09	08:23	08:38	08:54	09:08	09:25	09:38	09:51	10:08	10:23	10:38	10:51	11:08	11:25	11:39
Brislington Square (W-bound)	08:12	08:26	08:41	08:57	09:11	09:28	09:41	09:54	10:11	10:26	10:41	10:54	11:11	11:28	11:42
Bristol Bus Station (Bay 15)	08:32	08:48	09:02	09:22	09:31	09:49	10:01	10:15	10:31	10:47	11:01	11:15	11:31	11:49	12:02

5.3.9. From Brislington the 9 (Brislington P&R) would need to sit within the currently proposed coordinated headway for the 349 and 522. It is estimated that buses on these services will reach Brislington Emery Road at a similar time to current P&R departures at the following pattern 08/23/38/53 (off-peak). As a result, the P&R service would need to move by +7 or +8 minutes to fall in between 349 and 522 services on a consistent 7/8 headway. To make this coordination meaningful, P&R services would need to serve additional stops between Brislington and the city centre (e.g., Brislington Square) to allow a mix of users to benefit from the coordination and 7/8 headway (as on Bath P&R). A sample inbound timetable pattern is shown in Figure 5-3.

Figure 5-3 - Proposed 349/522 Pattern and Amended 9 (P&R)

	349	9	522	9	349	9	522	9	349	9	522	9	349	9	522	9	349
Keynsham Church (Stop B)	08:00		08:15		08:30		08:45		09:00		09:15		09:30		09:45		10:00
Brislington Emery Road	08:08		08:23		08:38		08:53		09:08		09:23		09:39		09:53		10:08
Brislington P&R		08:15		08:30		08:45		09:00		09:15		09:30		09:45		10:00	
Brislington Square (W-bound)	08:12	08:19	08:27	08:34	08:42	08:49	08:57	09:04	09:12	09:19	09:27	09:34	09:43	09:49	09:57	10:04	10:12
Broadmead, The Haymarket		08:40		08:55		09:10		09:25		09:40		09:55		10:10		10:25	
Bristol Bus Station (Bay 15)	08:33		08:48		09:03		09:22		09:32		09:47		10:03		10:17		10:32

5.3.10. Analysis of return timetables ex Bristol for services 349 and 522 show that changes inbound can be replicated outbound with a likely pattern for 349 being 00/30 ex Bristol Bus Station and 522 being 15/45 ex Bristol. Similarly, service 9 (Brislington P&R) would need to advance by +7 or +8 minutes but this would be achieved through the inbound changes causing a consequential change to outbound times from Portway P&R on this circular route.

5.3.11. The changes outlined in the 'do nothing' scenario for services west of Keynsham so far provide a coordinated 15-minute headway, which builds to a coordinated 7/8-minute headway from Brislington, towards Bristol. However, the X39 service (15-minute headway) is yet to be considered.

5.3.12. If effectively coordinated, the addition of the X39 from the first common stop west of Keynsham on the X39, 349 and 522 services (Brislington Hicks Gate) would then provide a

7/8-minute headway as far as Brislington, then building to a 3/4-minute headway onwards to the city centre.

5.3.13. The current X39 timetable, although not a regular 15-minutes past each hour, tend to serve Hicks Gate inbound at 06/21/36/51 past each hour though this can vary by up to +/- 3mins. The proposed coordinated patter of 349/522 services inbound in Figure 5-4 would reach Hicks Gate after leaving Keynsham (Church) at circa 06/21/36/51, therefore the same approximate pattern as the X39 and suggesting that one or other 15-minute headway service set would need to move by +7 or +8 minutes to achieve the 7/8 offset coordinated headway.

5.3.14. Earlier it has been suggested that for 349/522 to maintain the suggested times in Figure 5-4 all services would need to advance by +7 or +8 minutes. With this also the case for the X39 (see above), one solution would be to maintain the end to end X39 times (making these a consistent pattern during each hour) and move back by +7 or +8 minutes the proposed coordinated times for the 349 and 522 to create a 7/8 headway from Hicks Gate and then only advance the 9 (Brislington P&R) by +3 or +4 minutes to ensure a 3/4/8 headway from Brislington (Emery Road area) and through common stops such as Brislington Square and Temple Meads to the city centre. This may result in Figure 5-4 below. Where further services exist from Brislington to Bristol they could be re-timed to fully (or partially) fill the 8-minute gap each 15-minute period.

Figure 5-4 - Amended 349/522 Pattern and inclusion of X39 and amended 9 (P&R)

	349	9	X39	522	9	X39	349	9	X39	522	9	X39
Keynsham Church (Stop B)	07:53			08:08			08:23			08:38		
Brislington, Hicks Gate	07:59		08:06	08:14		08:21	08:29		08:36	08:44		08:51
Brislington Emery Road	08:01		08:08	08:16		08:23	08:31		08:38	08:46		08:53
Brislington P&R		08:04			08:19			08:34			08:49	
Brislington Square (W-bound)		08:08	08:12		08:23	08:27		08:38	08:42		08:53	08:57
Broadmead, The Haymarket		08:29			08:44			08:59			09:14	
Bristol Bus Station (Bay 15)			08:33			08:48			09:03			09:22
Brislington Pattern		3	4	8	3	4	8	3	4	8	3	4

	349	9	X39	522	9	X39	349	9	X39	522	9	X39	349	9	X39
Keynsham Church (Stop B)	08:53			09:08			09:23			09:38			09:53		
Brislington, Hicks Gate	08:59		09:06	09:14		09:21	09:29		09:36	09:44		09:51	09:59		10:06
Brislington Emery Road	09:01		09:08	09:16		09:23	09:31		09:38	09:46		09:53	10:01		10:08
Brislington P&R		09:04			09:19			09:34			09:49			10:04	
Brislington Square (W-bound)		09:08	09:12		09:23	09:27		09:38	09:43		09:53	09:57		10:08	10:12
Broadmead, The Haymarket		09:29			09:44			09:59			10:14			10:29	
Bristol Bus Station (Bay 15)			09:32			09:47			10:03			10:17			10:32
Brislington Pattern	8	3	4	8	3	4	8	3	4	8	3	4	8	3	4

5.3.15. Conclusions that can be drawn from this work are as follows for a ‘do nothing’ scenario:

- Services east of Keynsham to Bath see a maximum of four coordinated buses per hour through the X39 service with the A4 timetabled to cut one 15-minute period into a coordinated 7/8 headway. Based on the X39 only this would provide an average passenger waiting time of 7.5 minutes but due to its stopping nature may feel a slow alternative to rail or private car.
- Services west of Keynsham towards Bristol have significant opportunity to be coordinated to achieve very attractive headways, both from Keynsham town centre every 15 minutes, along the A4 corridor to Brislington to a 7/8 pattern and from Brislington onwards to a 3/4 pattern. These options provide very low average wait times ranging from 3.75 minutes to as low as 1.75 minutes and over the shorter distances would be attractive to existing and new passengers if well-advertised and ideally singularly branded.

- In achieving this coordination, it is anticipated that no additional resources are required unless the operator proposes further buses to maintain existing running times due to increased congestion.
- It is likely that buses operating routes 349 and 522 may interwork with other services at the Bristol end – if so, the consequential effects on these paired timetables will need to be understood if departure and arrival times are moved on the 349 and 522 services.

5.3.16. Whilst no resource costs regarding additional vehicles are foreseen in the 'do nothing' scenario, it is anticipated that some sunk costs would be required for marketing, branding, and monitoring to ensure all improvements were seen as a single, cohesive network and through monitoring service gaps were managed and maintained.

5.4 Baseline network – 'do something (low)'

5.4.1. The 'do nothing' scenario has highlighted significant potential for coordination between Keynsham and Bristol but less opportunity to increase service frequency between Keynsham and Bath. Whilst end to end there would remain four buses per hour, the overall corridor would be unbalanced unless treated as two distinct halves.

5.4.2. Frequency and reliability in addition to low cost are often cited as the main drivers for mode shift towards public transport, and particularly bus. A 'do something (low)' scenario will examine how current provision and resources could be adapted at a low level with zero to minimal resource added to affect a more balanced corridor approach and stimulate demand through frequency improvements.

5.4.3. Based on current baseline estimates and linked round trip times (RTT), the X39 requires 10 peak vehicle requirement (PVR) on a 150-minute RTT to meet the timetabled 15-minute headway. If this were to be increased to a 10-minute headway a further 5 PVR (minimum) would be required. Whilst this would make the service more attractive with average wait times decreased to 5 minutes, this may see service bunching unless fully monitored and would fail to coordinate neatly with the 349/522 services beyond Brislington. As a result, it may be considered sensible at this frequency to make the X39 limited stop, reducing journey times by the removal of some bus stop dwell time and negating the need to fully coordinate with common corridor services.

5.4.4. If the X39 was amended to limited stop it may be able to operate to a shorter end to end journey time between Bath and Bristol. Were this the case, to save 1 PVR a journey time reduction of 10 minutes in RTT (5-minutes each way) would be needed.

5.4.5. Typical dwell times per stop can range from 20-40 seconds leading to a potential reduction in stops of between 8 and 15 stops. Tables 3-1 and 3-2 in the BBSC SOC stage report highlighted the stopping patterns (as at 2021) for the X39 in both directions:

- From Bristol 61.1% of passengers board at Bristol Bus Station, Temple Meads and Brislington combined with 63.9% alighting at Brislington and Bath city centre; and

- From Bath 59.2% of passengers board at Bath city centre and Brislington (with Arnos Vale also being a reasonable boarding stage with an additional 11.3% of passengers) combined with 65.5% alighting at Brislington, Bristol City Centre and Bristol Bus Station.

5.4.6. As a result of the SOC stage boarding analysis, it is reasonable to assume few changes by June 2023 and as a result consideration could be given to reducing the number of intermediate timetabled stops on the X39 service. However, with all remaining stops outside of those noted above spreading the remaining passenger base, often at very low percentage levels, the actual dwell time saving per stop may struggle to be above 20-seconds and in many cases may be closer to 12 seconds suggesting that removing some stops may not provide the full journey time savings required to save 1 PVR.

5.4.7. However, whilst there seems to be a case to move the X39 into a limited stop service based on typical boarding and alighting distributions, any increase in frequency will incur at least +4 PVR and potentially 5 PVR unless further journey time savings can be found by reducing layover at each route end and/or introducing bus priority measures that will increase the average operational speed of the service. If the service were to remain at a 15-minute headway, the RTT saving needed to save 1 PVR would be 15-minutes (7.5 minutes each way).

5.4.8. Regarding service layover at each end, the 150-minute RTT includes around 17-minutes at Bristol between arrival and next departure and around 11 minutes at Bath. The usual rule for layover is c.10% of RTT time so the indicated layover appears excessive at 19% but is likely symptomatic of unpredictable congestion levels and a high level of journey time variance at any time of the day when attempting to leave either city centre bus station.

5.4.9. With total layover for service X39 assumed to be in the region of 28 minutes and an idealised level nearer 15-minutes there appears to be some scope to reduce layover through a combination of bus stop removal at some locations (the X39 becoming limited stop) and bus priority measures allowing more reliable and shorter end to end journey times.

5.4.10. Were layover to be reduced to 15-minutes, it would be expected that up to 13-minutes could be removed from the RTT. This coupled with some bus stops being removed may allow the existing service to operate with 1 less PVR. In this instance bus priorities would be needed to maintain existing journey times to a highly stable level as opposed to creating any additional journey time saving benefit. Where additional journey time was saved, this would serve to make the timetable even more robust unless time savings accumulated to levels of 14+ minutes in RTT where a further 1 PVR may be saved.

5.4.11. Based on this analysis, the 'do something (low)' scenario suggests that leaving the X39 as a 15-minute headway (stopping) service would provide a better spread of benefits across the BBSC when it is used in conjunction with changes to services 349 and 522 to coordinate headways at common sections. This therefore leaves the Bath to Keynsham section potentially under-bussed and solutions here would likely focus on:

a) The A4 Air Decker service increasing to 2 buses per hour and a headway of every 30-minutes and complemented with a short version running every 30-minutes between Bath and Keynsham town centre.

b) A straight 15-minute stopping service operating between Bath and Keynsham town centre and coordinating with the current X39 service but requiring the X39 to remain as a stopping service on this section in addition to that between Hicks Gate and Bristol city centre.

c) Seek to extend the U5 service every 15-minutes to Keynsham, providing a link from Keynsham town centre to the Bath Spa University campus in addition to Bath city centre.

d) Seek to extend the 21 (Newbridge P&R) from the P&R site to Keynsham via Saltford. This operates already as a 15-minute headway so would complement the X39 in frequency coordination terms.

5.4.12. Based on current timetable information a stopping service between Bath city centre and Keynsham town centre requires 38-minutes in the outbound direction and 33-minutes inbound leading to a RTT of c80 minutes when layover at each end is considered. In consideration of each option above Table 5-1 below suggests the potential PVR implications of providing a 15-minute headway service between Bath and Keynsham that would coordinate with the existing X39 to create a 7/8 pattern between the two locations.

Table 5-1 Comparison of Bath / Keynsham Option PVR

Option	Option description and Calculations	Expected PRV (Rounded)
a	The A4 Air Decker uses an estimated 3 PVR, doubling the frequency based on a current RTT of 180 minutes would require an additional 3 PVR. Providing a supplementary short working between Bath and Keynsham every 30-minutes based on an estimated RTT of 80-minutes would require an additional 2.7 PVR.	**6**
b	Providing a straight 15-minute headway service operating opposite to the X39 but only between Bath and Keynsham with an extension into Keynsham town centre based on an estimated RTT of 80-minutes would require an additional 5.3 PVR	**6**

Option	Option description and Calculations	Expected PRV (Rounded)
c	Extending the U5 would incur an additional 19 minutes in each direction between the Bath Spa Campus and Keynsham with a further period required for layover. Current U5 RTT is 50-minutes (excluding layover at Bath Spa in lieu of Keynsham in this solution) leading to a revised RTT of c88-minutes and at a 15-minute headway requires 5.9 buses. At a term time four buses per hour the U5 normally requires 4 PVR.	**2** (In addition to 4 PVR deployed in term time but required to operate year-round)
d	Extending the 21 (Newbridge P&R) service would incur an additional 18 minutes in each direction with a further period required for layover. Current 21 RTT is 24-minutes (excluding layover at Bath Spa in lieu of Keynsham in this solution) leading to a revised RTT of c65 minutes requiring a total 4.3 PVR.	**3** (In addition to 2 PVR deployed already on the P&R service)

5.4.13. It is notable that Option ‘c’ requires the lowest PVR addition. However, to achieve a 7/8 headway between the X39 and an amended / extended U5 the latter service would need to operate year-round as it currently has a decrease in frequency to 1 bus per hour during student holidays. Further, the U5 would need to extend back from St James Parade to Bath Bus Station adding a small amount of additional time. Finally, the diversion in/out of the Bath Spa Campus would cause a loss of coordination between the X39 and an extended U5 from the Globe through Saltford to Keynsham

5.4.14. The diversion in/out of Bath Spa University is the most significant blocker to successfully using Option ‘c’. However, this could be resolved by considering Option ‘d’ – an extended Newbridge P&R service in the same way.

5.4.15. Option ‘d’ sees the extension of the 21 (Newbridge P&R). Calculations include the 5-minute dwell time already indicated at the P&R site and extends the service to Keynsham town centre. This creates a 4.3 raw PVR outcome suggesting that some tweaks may allow this to be a 4 PVR solution. However, it is recommended to round this up to 5 PVR as to deliver this solution the 21 would need to terminate at Bath Bus Station (and not Westgate Buildings) and observe some additional stops between Newbridge and the city centre.

5.4.16. Using P&R in this way would require capacity to be available on the buses used which may be an issue at certain times of the year (e.g., Christmas) and on match day weekends when Bath Rugby Football Club play home games. Further, extending the branded service / mode to Keynsham may dilute the P&R concept for many and introduce some reliability issues.

5.4.17. Regarding the operation of P&R, it is also considered reasonable at the ‘do something (low)’ scenario to consider improvements to Brislington P&R to ensure a bus is always present at the site (both Brislington and Portway) to ensure a higher quality level of service. Using the existing timetable this approach notionally increases PVR from 7 to 9 PVR.

5.4.18. Conclusions that can be drawn from this work are as follows for a 'do something (low)' scenario:

- Services east of Keynsham remain as in the 'do nothing' scenario, benefiting from significantly more effective coordination using no additional resources and providing a 15-minute headway from Keynsham town centre to Bristol, increasing to a 7/8 pattern from Hicks Gate and increasing further to a 3/4 pattern from Brislington (Emery Road area).
- Services west of Keynsham can be improved based on several approaches that see additional resources required range from 2 PVR to 6 PVR. In all scenarios an additional 15-minute service is put in place to work alongside the X39 and provide a 7/8 pattern that matches the provision to the east of Keynsham. However, based on a lack of current options over and above the X39 and A4 services, the commercial viability of such a high coordinated headway must be questioned and considered against the substantive issue that Bath and Keynsham town centre are only currently linked once per hour through the A4 service.
- It is likely that a progressive solution for the Bath – Keynsham link would be most appropriate, perhaps seeing an initial increase on the A4 service to every 30-minutes providing additional spin off effects for the BBSC and Bristol Airport or operating a short Bath – Keynsham service every 30 minutes off-set against the X39 to create a 7/8/15/7/8/15 pattern. Were this to be further coordinated with the hourly A4 service a 7/8/7/8/7/8/15 pattern could be achieved at a PVR increase for the new, 'short' service of 3 buses.

5.5 SOC stage options feasibility – 'Do Something (high)'

5.5.1. The following section moves on further from the simplistic adaptation of the baseline network currently in operation and instead considers a more significant change to the local bus network within the BBSC study area. The approaches developed for this purpose at SOC stage are validated against the current network to ensure they are still relevant and where possible (or required) further option variations are set out and evaluated.

5.5.2. Firstly, to understand if SOC stage options 2 and 3 remain feasible at the OBC stage given the current local bus network in the BBSC area we have reviewed the two options against the criteria detailed below:

- Is the option still based on the routes that are in operation for the 2023 Network?
- Does the option still allow connections between key stops within the BBSC study area?
- Does the option allow to us to still achieve the frequency between key stops that is not less than is being achieved within existing network and which can match those frequencies in the Option?

Operational model – option 2

5.5.3. The feasibility test for each proposed measure within SOC stage Option 2 is outlined in Table 5-2 below.

Table 5-2 – Feasibility check for Option 2

Measure	Feasibility	Comment
Introduction of a metrobus service operating the length of the entire corridor, via Keynsham Bypass (serving Keynsham via new bus stops along the Bypass), at a 10-minute headway.	Yes	The proposed measure is not influenced by 2023 Network amendments
Introduction of two new local services (amendment of the existing X39), a Yellow Line and Green Line, operating at a 10-minute headway. The two local lines are adapted from the X39 and 349 services, to act as local stopping services between Keynsham (looping through Keynsham) and Bristol (Yellow) and Bath (Green). An inner local Keynsham loop can be part of the local Green line or shared between the two local lines.	Yes	The proposed measure is not influenced by 2023 Network amendments
The P&R service would be retained at a 10-minute headway and run alternately with the metrobus service to provide an average 5-minute headway at the terminus points. P&R service to be run as a metrobus service to ensure consistency of branding etc.	Yes	The proposed measure is not influenced by 2023 Network amendments
Hicks Gate P&R would be a strategic transport hub (including the relocated and potentially expanded Brislington P&R site)	Yes	The proposed measure is not influenced by 2023 Network amendments
Service 178 to Radstock would terminate at the new Hicks Gate Transport Hub, with the option of interchanging onto any of the main spine services.	No	Further investigation needed as service 178 has ceased. Replaced by service 522 within the 2023 Network

5.5.4. Four out of five feasibility tests conducted for Option 2 are passed and Option 2 can still be considered as an acceptable approach based on the current local bus network. The proposed reduction of service 178 to Hicks Gate Transport Hub will be investigated further as this service has been replaced by new service 522.

5.5.5. To address the amendments in the network the new 522 service has been further analysed across the criteria described earlier.

5.5.6. Service 522 connects Bristol to Bath via Keynsham and Radstock:

- Connection of key stops:
  - Service connects Bristol and Keynsham following the same route as service X39 (39).
  - Service connects Radstock and Bath following the same route as three other services 172, 173, and 174.
- Monday to Friday average frequency:
  - The 522 between Bristol and Keynsham operates as two services per hour while overall there are eight services per hour connecting these stops when the X39 (39) (4/hour) and 349 (2/hour) services are considered.
  - The 522 between Radstock and Bath operates as one service per hour while overall there are five services per hour connecting these stops when the 172, 173, and 174 (combined 4/hour) services are considered.
  - The operation through to Bath is a new extension to this B&NES subsidised service as formerly the 178 terminated at Radstock, providing only a link to Keynsham and beyond to Bristol hourly.
  - The section between Radstock and Bath now reconnects local communities en-route that were recently left without a bus service after service rationalisations on the 172, 173, and 174 saw some stops removed from the services.
  - The 522 is heavily duplicated between Keynsham and Bristol. However, the 522 across this section operates twice an hour using a short working that runs between Bristol city centre and Keynsham, but in an uncoordinated pattern with the long working 522 service.

5.5.7. Based on further consideration, there are two options to amend 522 service that could be proposed within the approach to delivering SOC Option 2:

- Option 2a – service would terminate at the new Hicks Gate Transport Hub, with the option of interchanging onto any of the main metrobus style services.
- Option 2b – service would run between the new Hicks Gate Transport Hub and Radstock.

5.5.8. Each of proposed option enables rationalisation of the services running between Bristol and Bath via Keynsham and allows resources to be consolidated.

5.5.9. This can involve either running a higher frequency 522 service at the same operational cost or transferring some of the freed-up resources to another branch of the network as each of the proposed options decreases existing peak vehicle requirements (PVR) on service 522.

5.5.10. It is estimated that service 522 in its current format uses a total of seven buses. Two of these operate the short working between Bristol and Keynsham, with a further five buses deployed across the longer end to end route between Bristol and Bath via Keynsham and Radstock. However, it is unclear if the 522 interworks with any other bus services at the Bristol end.

5.5.11. The proposed service arrangements for Option 2a is shown in **Figure 5-5.**

Figure 5-5 - Operational Model - Option 2a

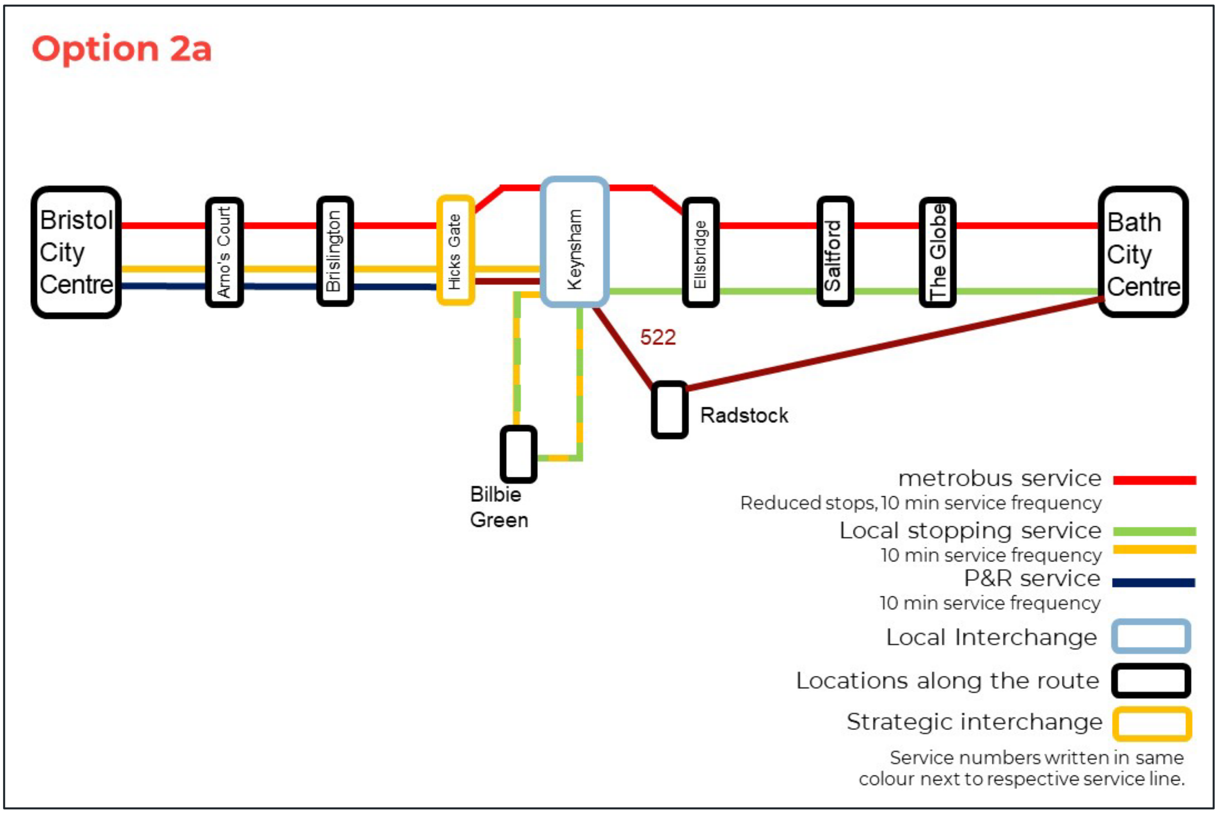
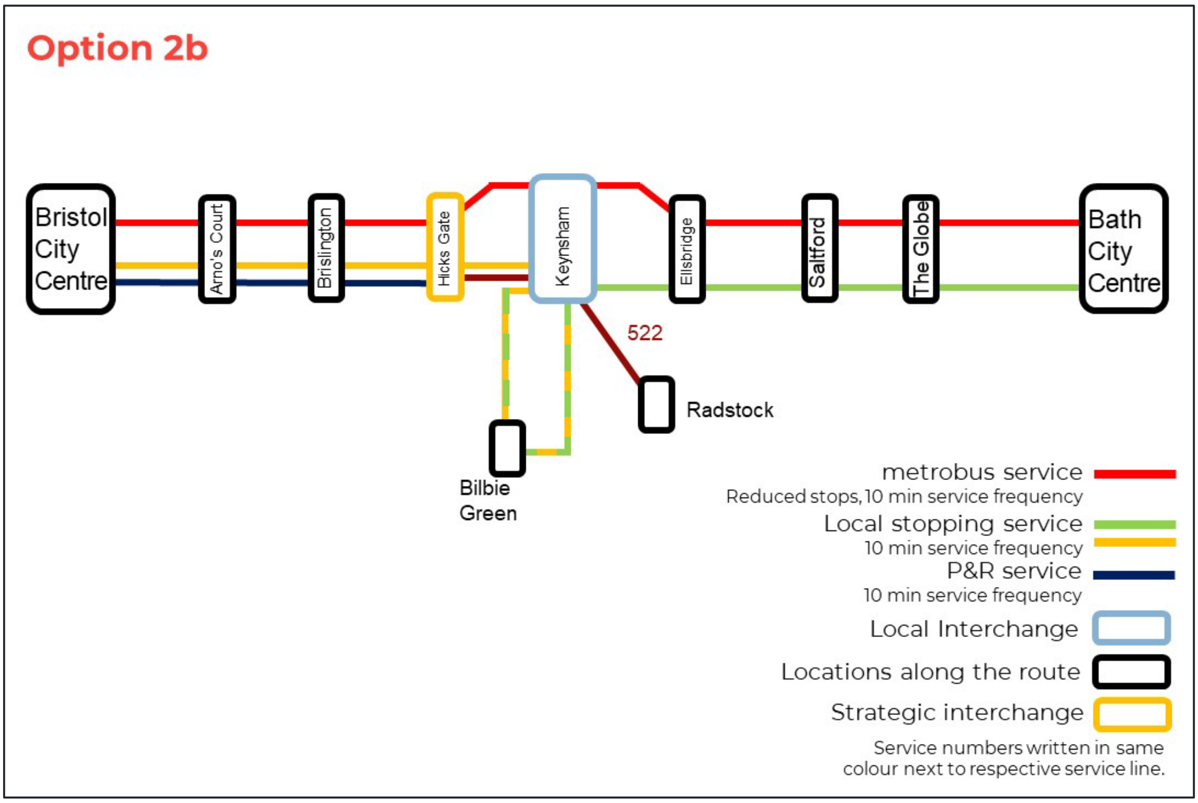


Figure 5-6 - Operational Model - Option 2b



5.5.12. On this basis we have validated the SOC stage Option 2 approach which we confirm would entail:

- Introduction of a metrobus service operating the length of the entire corridor, via Keynsham Bypass (serving Keynsham via new bus stops along the Bypass), at a 10-minute headway.
- Introduction of two new local services (amendment of the existing X39), a Yellow Line and Green Line, operating at a 10-minute headway. The two local lines are adapted from the X39 and 349 services, to act as local stopping services between Keynsham (looping through Keynsham) and Bristol (Yellow) and Bath (Green). An inner local Keynsham loop can be part of the local Green line or shared between the two local lines.
- The P&R service would see a reinstated 10-minute headway and run alternately with the metrobus service to provide an average 5-minute headway at the terminus points. P&R service to be run as a metrobus service to ensure consistency of branding etc.
- Hick's Gate P&R would be a strategic transport hub (including the relocated and potentially expanded Brislington P&R site).
- Service 522 in Option 2a - would terminate at the new Hicks Gate Transport Hub, or in the Option 2b scenario the service would run between the new Hicks Gate Transport Hub and Radstock only.
- However, Option 2b would remove the ability for the 522 to serve the unique locations between Radstock and Bath removed from services 172, 173, and 174 meaning that a further localised solution would be required on this section of route.

Operational Model – Option 3

5.5.13. The feasibility test for each proposed measure within SOC stage Option 3 is outlined in Table 5-2 below.

Table 5-3 - Feasibility check for Option 3

Measure	Feasibility	Comment
Introduction of a metrobus service operating the length of the entire corridor, via Keynsham Bypass (serving Keynsham via new bus stops along the Bypass), at a 5-minute headway.	Yes	The proposed measure is not influenced by 2023 Network amendments
Introduction of two new local services (amendment of the existing X39), a Yellow Line and Green Line, operating at a 10-minute headway. The two local lines are adapted from the X39 and 349 services to act as local stopping services between Keynsham (looping through Keynsham) and Bristol (Yellow) and Bath (Green). An inner local Keynsham loop can be part of the local Green line or shared between the two local lines.	Yes	The proposed measure is not influenced by 2023 Network amendments
The P&R service would be replaced by the metrobus service.	Yes	The proposed measure is not influenced by 2023 Network amendments
Hick's Gate P&R would be a strategic transport hub.	Yes	The proposed measure is not influenced by 2023 Network amendments

Measure	Feasibility	Comment
Service 178 to Radstock would terminate at the new Hicks Gate Transport Hub, with the option of interchanging onto any of the main spine services. This enables rationalisation of the services running between Bristol and Keynsham and allows resources to be consolidated. This can involve either running a higher frequency 178 service at the same operational cost or transferring some of the freed-up resources to another branch of the network.	No	Further investigation needed as service 178 has ceased. Replaced by service 522 within the 2023 Network

5.5.14. Four out of five feasibility tests conducted for Option 2 are passed and Option 2 can still be considered as an acceptable approach. The proposed reduction of service 178 to Hicks Gate Transport Hub will be investigated further as this service has been replaced by new service 522.

5.5.15. To address the amendments in the network, two proposed options for a revised 522 service have been proposed earlier in 5.2.6. Both revisions are applicable to SOC stage Option 3 implying the same resource consolidation as was defined for Option 2.

- Option 3a – service would terminate at the new Hicks Gate Transport Hub, with the option of interchanging onto any of the main metrobus style services.
- Option 3b – service would run between the new Hicks Gate Transport Hub and Radstock.

5.5.16. The proposed service arrangement for Option 3a is shown in Figure 5-7 and that for Option 3a is shown in Figure 5-8.

Figure 5-7 - Operational Model - Option 3a

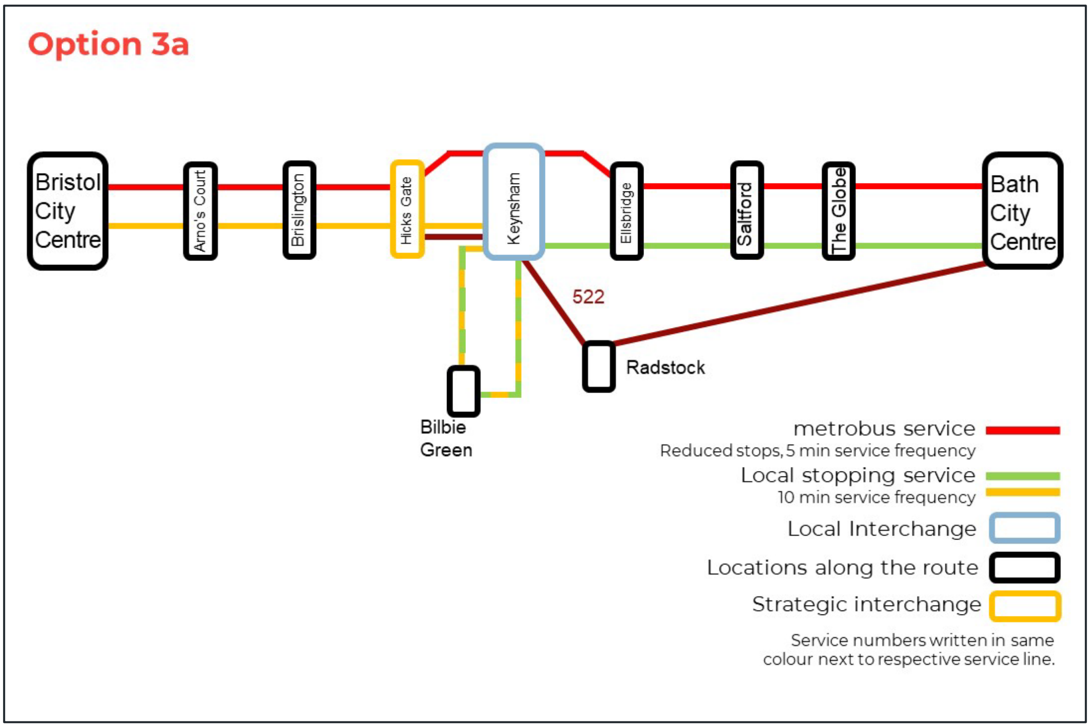
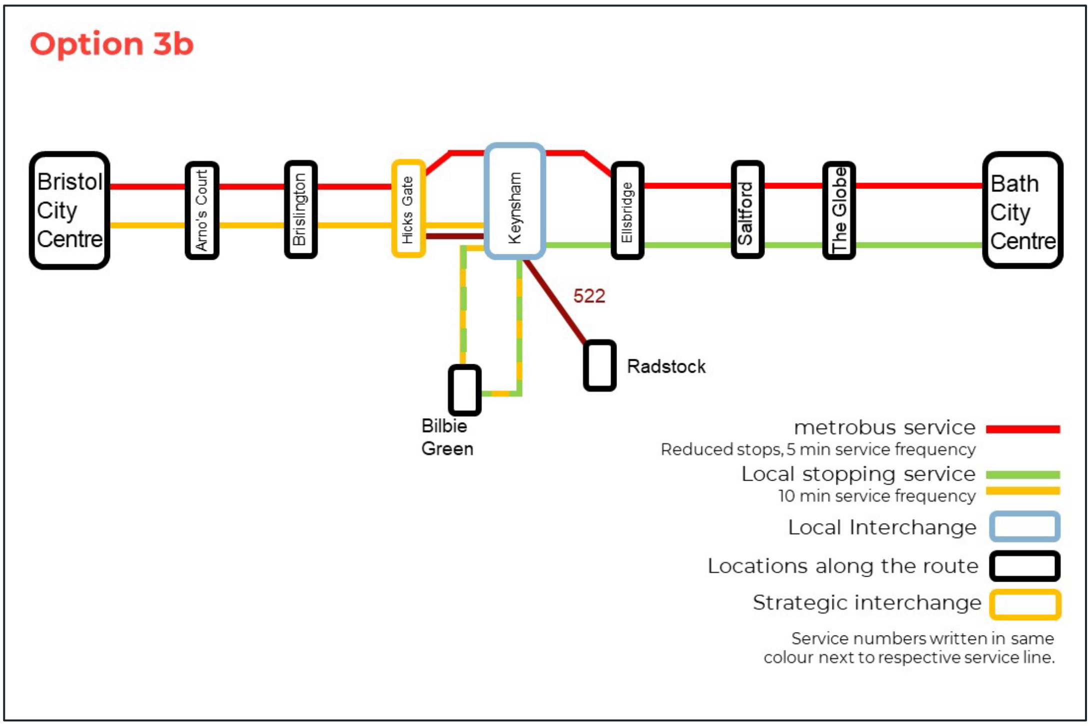


Figure 5-8 - Operational Model Option 3b



5.5.17. On this basis we have validated the SOC stage Option 3 approach which we confirm would entail:

- Introduction of a metrobus service operating the length of the entire corridor, via Keynsham Bypass (serving Keynsham via new bus stops along the Bypass), at a 5-minute headway.
- Introduction of two new local services (amendment of the existing X39), a Yellow Line and Green Line, operating at a 10-minute headway. The two local lines are adapted from the X39 and 349 services, to act as local stopping services between Keynsham (looping through Keynsham) and Bristol (Yellow) and Bath (Green). An inner local Keynsham loop can be part of the local Green line or shared between the two local lines.
- The P&R service would be replaced by the metrobus service.
- Hick's Gate P&R would be a strategic transport hub.
- Service 522 in Option 3a - would terminate at the new Hicks Gate Transport Hub, in Option 3b – service would run between the new Hicks Gate Transport Hub and Radstock.

5.5.18. However, Option 3b would remove the ability for the 522 to serve the unique locations between Radstock and Bath removed from services 172, 173, and 174 meaning that a further solution would be required on this section of route.

5.6 Option 4

5.6.1. A further option, informed by early public consultation comments, is to support a high frequency metrobus style service with a feeder service in Keynsham. This feeder service would link the residents of Keynsham and the high street to the new mobility hub proposed on Keynsham bypass, therefore increasing the accessibility of the new service for the Keynsham patronage.

5.6.2. While this would require an interchange at the mobility hub, a high-frequency feeder service with the correct branding could encourage uptake of the corridor service and also provide a local service within Keynsham.

5.6.3. The other benefit of this option is reducing overlap between an end-to-end service and local services that would loop through Keynsham (See Options 2 and 3).

5.6.4. In order to maximise the catchment of the proposed feeder service, a potential route arrangement is illustrated in Figure 5-9. The western area of the loop is the same as the one operated by the current 349 service, and a new loop was added through the eastern half of Keynsham to maximise catchment. The service would then connect to the mobility hub on the bypass via the two roundabouts.

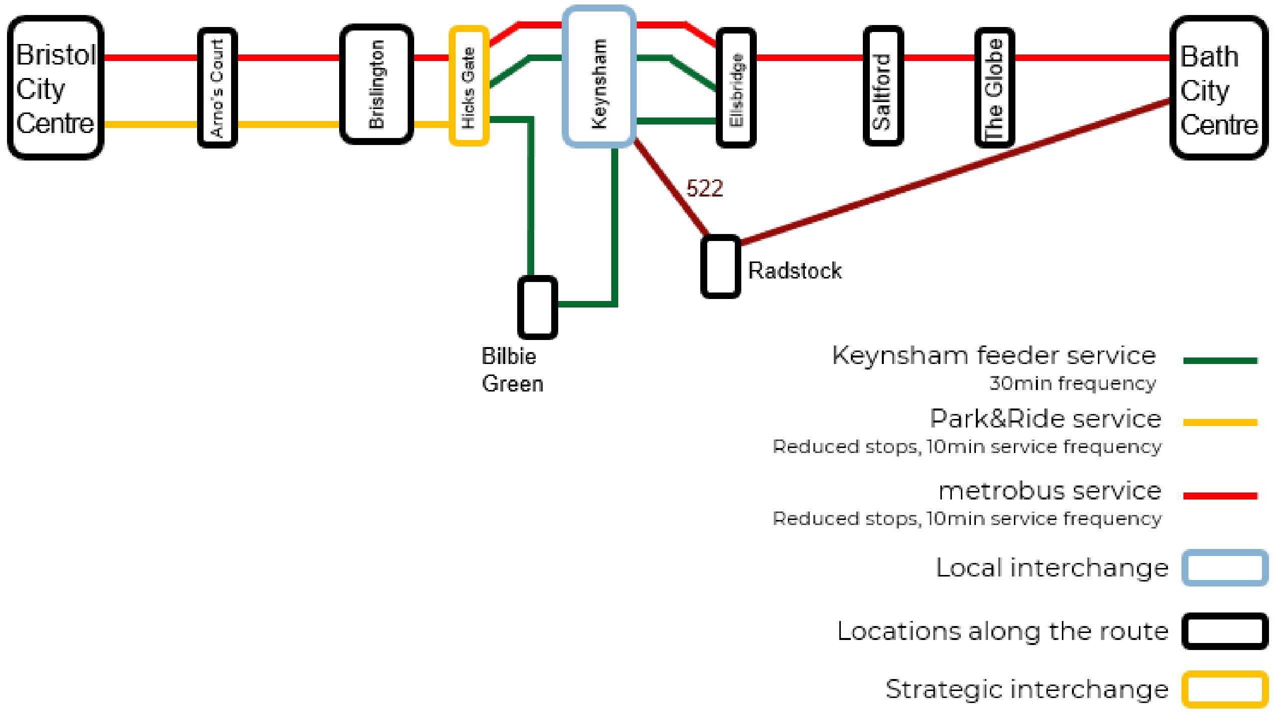
5.6.5. The service loop shown would take approximately 45 minutes to complete, and it can be operated in one direction only or it can be run both clockwise and anticlockwise. The benefit of operating the loop in both directions is that passengers from Keynsham could be dropped off at the mobility hub both on the Bristol-bound side of the bypass and on the Bath-bound side of the bypass, however this would come with additional resource requirements.

Figure 5-9 - Proposed route alignment of feeder service in Keynsham with walk radius to bus stops (Podaris Software extract)

5.6.6. Along the wider corridor, the end-to-end service would operate every 10 minutes, complemented by a Park & Ride service on the bath side and a reduced 522 service.

5.6.7. Figure 5-10 schematically illustrates this option.

Figure 5-9 - Option 4 diagram



6 Option assessment

6.1.1. A series of options have been outlined through the earlier sections. These have set the current baseline for CSG routes regarding resources and operational parameters considering a ‘do nothing’ approach before building through ‘do something’ options ranging from low to high impact across the BBSC area.

6.1.2. Each option suggests changes that could be made to the BBSC local bus service network either as part of an independent network review seeking to improve and consolidate services or as a response to a range of infrastructure measures that could be implemented (in full or in part) to improve the progression of buses across the corridor, raising levels of reliability and punctuality whilst reducing journey times and increasing service frequencies.

6.2 Summary of options

6.2.1. The baseline ‘do nothing’ scenario has assessed the level of current service and resource provision, providing ideas to better coordinated existing resources and provide some very attractive headways west of Keynsham between the town and Bristol city centre. No additional resources are seen as necessary to deliver the ‘do nothing’ scenario. However, the network is unbalanced with Keynsham town centre only seeing an hourly service to/from Bath via the A4 (the alternative being an hourly service via Radstock with a long journey time). This could be mitigated with one of the four X39 services per hour (ideally one opposite the current A4 Ai Decker service) diverting via Keynsham town centre to create a coordinated 30-minute headway service to/from Bath. This would have a minimal impact on resources with the diversion being only 5-7 minutes in length and should only have a minimal impact on the perception of service speed for end-to-end users of the X39 service.

6.2.2. Building on the baseline network, the proposed ‘do something (low)’ approach seeks to formally provide an improved link between Keynsham and Bath following work to coordinate services between Keynsham and Bristol. A few options are evaluated that include potential service extensions to the 21 (Newbridge P&R) service or the U5 as well as a potential doubling of headway to every 30-minutes on the A4 Air Decker service. However, it is recommended that a cleaner approach would be the delivery of a bespoke service, running every hour initially and set opposite to the A4 Air Decker. This would require a level of joint marketing and common ticketing to attract users to the effectively doubled service frequency from Keynsham town centre to Bath city centre and on common route areas with the X39 timings of the two hourly services should be set to offer a 7/8 split between X39 services in the affected 15-minute periods. Frequency increases have been noted to have a demand elastic effect ranging from +0.4 to +0.7 and demand may increase by up to 70% of current use based on a doubling of service frequency on this corridor. A dedicated service would see an increase of 3 PVR in the BBSC area which would likely require initial funding support to establish potentiality longer-term self-sustaining demand.

6.2.3. Taking a fresh approach often works well when significant parallel improvements are made across a corridor regarding supporting infrastructure for bus services and increases in the level of bus priority measures. The wider OBC for the BBSC area outlines a range of bus priority measures that are being designed to reduce end to end bus journey times, increase reliability and punctuality, stimulate new demand as part of a virtuous cycle of service frequency improvements and make ‘bus’ a more attractive proposition to new markets. As part of this approach the ‘do something (high)’ considers two options shortlisted from a long list of options at the SOC stage that may deliver these network attributes and capture the feel of a BRT ‘light’ approach that has been already successfully deployed across Bristol as part of the metrobus scheme. Both options evaluated propose ambitions levels of service frequency and, when compared to baseline levels of service and resource deployment, do require significantly higher PVR to deliver the proposed service levels. In each option evaluation, AVL data has been used to understand current journey times between BBSC study sections (already highlighted in Figure 1-2) both at a typical ‘average’ level and at a minimum level with the latter being considered a proxy for journey times were all proposed bus priority measures across the BBSC to be introduced.

6.3 Operational costs

6.3.1. In order to understand the relative financial requirements for operating each of the options outlined in this report, a cost model has been developed, comparing the baseline (i.e., current network estimated operating costs) to each of the options. The operational costs have been calculated for two scenarios, without the infrastructure improvements and with the infrastructure improvements.

6.3.2. Table 6-1 below summarises the results of this costing exercise. The full breakdown of costs against individual services can be found in Table 6-1.

Table 6-1 – Operational costs summary

Option	Cost per year with no infrastructure improvements	Additional cost per year with no infrastructure improvements	Cost per year with infrastructure improvements	Additional cost per year with infrastructure improvements
Baseline	£7,281,977	Not applicable	£7,142,212	Not applicable
Do Something (Low)	£7,716,203	£434,226	£7,576,437	£434,226
2a	£13,089,437	£5,807,459	£12,949,671	£5,807,459
2b	£12,808,860	£5,526,883	£12,669,095	£5,526,883
3a	£15,059,919	£7,777,941	£14,780,387	£7,638,176
3b	£14,779,343	£7,497,365	£14,499,811	£7,357,600
4	£7,752,517	£470,540	£7,752,517	£610,306

6.3.3. The operational costs are based on the following assumptions:

- Costs are built up from: vehicle costs (Euro VI Double Decker), fuel costs, driver costs and maintenance costs. These are all calculated as a function of time or distance in operation as well as Peak Vehicle Requirement
- The time and PVR are calculated based on:

  a) Current average timetabled JT for any segments not on the BBSC.
  b) Current average JT based on AVL data for segments along the BBSC corridor.
  c) Potential improved JT based on methodology outline in Chapter 4 for segments along the BBSC.

- Uniform service frequency between 7am and 7pm Monday to Friday and 8 am to 6pm Saturday. Outside of those times, i.e., 5am-7am and 7pm-midnight Monday-Friday, 5am-8am, 6pm-midnight Saturday and between 6am-midnight on Sunday, a service frequency half of the main one has been assumed. For example, for Option 2a, the main corridor service will be every 10 minutes during the day Monday to Saturday and every 20 minutes outside of those times.
- A layover of 10% has been applied to all services.
- Where changes are proposed to the current P&R service 9, an indicative cost for the service operating between Portway Park and Ride and Bristol has been maintained in the total cost to enable like-to-like comparison.

6.3.4. Table 6-2 below outlines the costs for the main corridor service (Red service) at different frequencies. The currently proposed infrastructure improvements would enable savings of 6% when operating every 15mins, and of approx. 2% when operating every 5 minutes. When operating every 10 mins, the JT savings as outlined in Chapter 314, i.e., 4 minutes off the RTT, is not sufficient to save a PVR. A saving of 9 minutes would however see a PVR saved and a cost with infrastructure improvements of £3,396,563.

Table 6-2 – Yearly Operational Costs for Red Service

Service Headway	Cost per year with no infrastructure improvements	Cost per year with no infrastructure improvements
15 min	£2,468,395 (baseline cost)	£2,328,630
10 min	£3,536,328	£3,536,328
5 min	£7,072,657	£6,932,891

6.3.5. When considering the Keynsham loop service, the costs for these vary depending on service frequency and loops operated as shown in Table 6-3:

Table 6-3 – Yearly Operational Costs for Keynsham Feeder Service

Service Headway	Cost per year
30 min	£ 353,621
15 min	£ 588,985
10 min	£ 942,606

6.3.6. Patronage for this service is likely to include not just those accessing the mobility hub, but those doing other trips within Keynsham.

6.4 Option Assessment

6.4.1. In order to inform future development of the options and further operator engagement, is it important to consider the relative benefits of each option over another.

6.4.2. To enable this, a high-level assessment against a multi-criteria assessment framework (MCAF) has been undertaken as outlined in Table 6-4, using the following criteria:

- Cost – how much more expensive, when compared to the baseline, is each option. Scored on a scale of 1-3, where 3 is least expensive and 1 is most expensive
- Accessibility – in each option, how many people have access, within a 15-min walk, to a stop with a CSG service at least every 10 minutes. Scored on a scale of 1-3, where 3 is the most people and 1 is the least people with access to a high frequency service
- Interchanges required – when considering locations in the South of Keynsham, how many interchanges would be required to reach key locations such as Bath or Bristol. Scored on a scale of 1-3, where 3 is least interchanges required and 1 is most interchanges required

Table 6-4 – MCAF assessment of proposed operational options

Option	Cost	Accessibility	Interchanges required	Total score
Do Something (Low)	3	1	2	6
2a	2	2	3	7
2b	2	2	3	7
3a	1	2	3	6
3b	1	2	3	6
4	3	3	1	7

6.4.3. The results in Table 6-4 show that Options 2 and 4 score highest against the three chosen criteria. These options will form the basis of further engagement with operators at Full Business Case Stage.

6.5 Phased approach

6.5.1. The operational cost modelling shows that significant investment is required to reach the aspirational level of service in Options 2 and 3. In order to minimise the revenue gap when implementing service improvements, a phased approach can be considered, to gradually increase the patronage while increasing the level of service.

Initial improvements

6.5.2. Considering the BBSC CSG routes, one way forward to allocating resources most effectively on either side of Keynsham could be to make the X39 semi-fast across its end-to-end route. To improve journey times and reliability the X39 could operate between the proposed Keynsham Interchange and Bristol as a limited stop service at the baseline stage and could be further improved if bus priorities are installed as planned along the BBSC. Removing some stops and consequently dwell-time requirements in the timetable would put more resilience into the RTT and would require less of a time saving impact provided by priorities. This approach would need to be supported by services 349 and 522 being formerly coordinated to a 15-minute headway from Keynsham (30 mins from Bilbie Green) to Bristol. This would increase to a 7/8 pattern if the Brislington P&R service was interworked and saw a small number of additional stops.

6.5.3. Where this is applied at the baseline level one of the four buses per hour in the X39 service could run as a 39 via Keynsham town centre at the opposite time to the A4 Air Decker service, providing a 30-minute headway between Keynsham and Bath. Applying this operational approach with bus priorities will allow the X39 to run up to every 10-minutes. However, to provide a significantly increased Keynsham to Bath link it might be more efficient to remove the Brislington P&R service (saving c4-5 PVR) and to operate more services as ‘39’.

6.5.4. To allow 39s to catch up and fall into pattern before the Keynsham Bristol limited stop section all non-Keynsham town centre buses could dwell at the proposed Keynsham Interchange (and or P&R) for 3-5 minutes. Since the difference going via Keynsham town, or not, is 4-5 mins in each direction (this would be lower with BBSC priority measures in place) a 3-min dwell at the proposed Keynsham Interchange for direct X39s would see service 39(s) fall back into pattern by Hicks Gate.

6.5.5. Bus route renumbering on common sections could be implemented to provide a better perception of the service improvements. Following the National Bus Strategy approach (DfT March 2021) a common route number could be used for the coordination of two routes into a combined frequency so that passengers do not further percept it as two separate 30-minute services (e.g., 349 and 522 services).

6.5.6. Further strengthening the network, Do Something (Low) could be implemented next, with a service between Keynsham and Bath introduced.

6.5.7. Following initial infrastructure improvements, Option 2a or 2b would be implemented next. Depending on scheme progression along Section 1, the new Keynsham mobility hub would act as the main interchange point ahead of delivery of Hicks Gate mobility hub.

7 Bus operator engagement

7.1.1. Operator engagement has been undertaken with the relevant bus service providers that operate services across the BBSC, including:

- First Bus (First West of England).
- Bath Bus Company (part of RATP Group).
- Stagecoach (West of England).

7.1.2. Discussions with operators took place at the beginning of the project to provide a high-level overview of the proposed bus priority measures and gain their initial feedback, and throughout the report development to understand any interworking arrangements while developing the options.

7.1.3. Operator feedback has been collated and summarised in Table 7-1.

7.1.4. The feedback given by bus service providers outlines higher demand for bus priority to be arranged on sections approaching both ends of the corridor:

- Sections 2-3: Bristol bound.
- Sections 4-5: Bath bound.

7.1.5. It is suggested to move proposed bus lanes to the side of the carriageway that approaches the indicated city if the opposite has been proposed in the draft earlier. It is expected that bus lanes will benefit commuters heading into both city centres in peak hours.

7.1.6. On the contrary section 6 that covers Bath City Centre requires bus priority to be arranged westbound. Due to central location and high congestion this section needs particular attention as it contributes to growing unpredictability of the journey times the most. The Bath City Centre project will look to address these issues. To improve the traffic for buses it is suggested to amend the proposed bus lanes:

- Move bus lane on Newbridge Road to the other side Bristol bound.
- Move bus lane between the Twerton Fork and Tuckers Meadow Roots Allotment site to the other side Bristol bound.

7.1.7. Particular attention was attracted by junctions and roundabouts as they restrict the capacity of the corridor the most. Following junctions and roundabouts are asked to be considered in terms of provision additional priority measures:

- P&R junction (bus priority signalling is required in both directions).
- Broadmead Roundabout (need for bus lane Bristol bound that starts at the roundabout).
- The Globe Roundabout (bus priority signalling is required Bath bound).

Table 7-1 –Operator engagement feedback

Corridor	Corridor location	Operator feedback
Section 2	Brislington Road – Hicks Gate Roundabout	Operator believes bus priority is more valuable in inbound (Bristol) direction than outbound (Bath).
Section 2	Brislington Road – Hicks Gate Roundabout	The bus lane is partially shared with cars in the Bristol bound direction - is there any way to achieve better segregation?
Section 2	Brislington Road – Hicks Gate Roundabout	Can the P&R junction have bus priority signalling to allow a green phase for approaching buses in either direction?
Section 3	Hicks Gate Roundabout	No existing capacity issues approaching Hicks Gate from the Bristol direction towards Bath.
Section 3	Hicks Gate Roundabout	Bus lane towards Bristol approaching the Hicks Gate roundabout is great news and welcomed.
Section 3	Keynsham Bypass	More information is required about the specifics of the Keynsham interchange on the Keynsham Bypass.
Section 3	Broadmead Roundabout	Operator believes this area should be prioritised - queueing during AM peak stretches back as far as the bridge / River Chew.
Section 3	Broadmead Roundabout	Bus lane finishes before approaching roundabout so cars will cut in front of the bus and create congestion – instead could the bus lane be extended up to the roundabout entrance?
Section 3	Broadmead Roundabout	A bus lane approaching the roundabout from the eastbound direction would be more helpful than the current short section of bus lane shown on the exit of the roundabout towards Bath – this would allow for easier access Keynsham town centre
Section 4	Saltford	Operator believes that congestion is more significant in eastbound (Bath) direction than westbound (Bristol) direction
Section 4	Saltford	What's the reasoning behind the intermittent bus lanes at Corston Lane – what does the modelling suggest?
Section 5	The Globe Roundabout	Bus lanes approaching the Globe (towards Bath) and their continuation around the roundabout are very much welcomed.
Section 5	The Globe Roundabout	On either side of The Globe Roundabout there are bus stops that are frequently used – this needs to be taken into consideration.
Section 5	The Globe Roundabout	The removal of the westbound layby (before the roundabout) is useful as it allows the bus to progress directly into traffic – could there be peak time pre-signals?
Section 6	Bath City Centre / Approach	Queueing worse exiting Bath (westbound) (due to Bath P&R traffic) rather than entering Bath (eastbound), however bus lane is currently eastbound only. Would suggest swapping bus lane on Newbridge Road to the other side.
Section 6	Bath City Centre / Approach	It is suggested to move the bus lane shown towards Bath (between the Twerton Fork and Tuckers Meadow Roots Allotment site) to the other side (Bristol direction)
Section 6	Bath City Centre / Approach	This project also requires tackling of Bath inner city congestion (Southgate Street / A367) – this can take significant time to negotiate and effectively negates any proposed journey time improvements created at other sections.

8 Conclusions and future actions

8.1.1. This report has reviewed the previous work completed at SOC stage and considers any further options for improving the bus network along the BBSC corridor. The merits and potential issues with each of the options were considered, looking at potential passenger perception, issues with coordination of services and overall level of service.

8.1.2. Journey time savings for sections along the corridor were estimated based on the OBC stage bus priority proposals along the BBSC sections in scope. Using the same methodology, this estimate can be updated in line with revised bus priority proposals at later stages of the project.

8.1.3. Using the JT savings obtained, operational costs for the CSG have been calculated for the baseline and the proposed options, looking at costs for implementation currently and after the introduction of the bus priority improvements along the BBSC. This has highlighted the investment required to reach the aspirational level of service along the corridor, i.e. Option 3a.

8.1.4. As the OBC stage looks at improvements on the BBSC corridor only in the B&NES section, this report has put forward intermediate options for improving the bus network, proportional to the bus priority improvements proposed. This focused on improvements that could be achieved with minimal or no increases in PVR, by better coordinating existing services and introducing unified branding. Engagement with operators so far has highlighted complexities around such coordination, particularly with service 522 which is further coordinated with other Radstock services.

8.1.5. While improvements such as those in the Do Something (Low) option may not provide the most even or consistent service frequency throughout, they enable a phased approach which could gradually increase demand, therefore lowering the need for immediate subsidies.

8.1.6. Through the EP, further engagement with operators should seek to identify opportunities for better coordination along the corridor, particularly in Keynsham town centre and from this location to/from Bristol, as an initial step to improving the bus service level along the BBSC.

8.1.7. The next stages of the operator engagement can look to discuss in detail the operational options proposed, consider any hybrid options suggested by the operator and develop a detailed service change implementation plan, based on the bus network at the time and any interworking that the operator will have in place closer to the time of construction. This process would also rank the potential operational options using a Multi-Criteria Assessment Tool (MCAT) leading to a preferred operational option to take forward to Full Business Case (FBC) stage.

8.1.8. Both the JT analysis completed as part of this report and the operator engagement have highlighted the need for improvements in Bath, to unlock JT savings and address reliability issues. This further reduction in JT would further reduce the operational costs required for the desired service level. It is therefore recommended that this analysis be at least partly revisited when further details on the Bath City Centre project are available.

Appendix A - Operational costs

Option	Services	Headway	Total JT (mins)	Total Improved JT (mins)	Cost Per Year	*Cost Per year with improved infrastructure*
Baseline / Do Nothing	X39/39	15	139	135	£2,468,395.45	£2,328,629.78
Baseline / Do Nothing	522 (to Keynsham)	60	82	81	£418,580.21	£418,580.21
Baseline / Do Nothing	522 (to Bath)	60	290	289	£1,393,617.48	£1,393,617.48
Baseline / Do Nothing	Brislington P& R (9)	15	108	107	£2,112,397.63	£2,112,397.63
Baseline / Do Nothing	349	30	106	105	£888,986.47	£888,986.47
Do Something Low	X39/39	15	139	135	£2,468,395.45	£2,328,629.78
Do Something Low	522 (to Keynsham)	60	82	81	£418,580.21	£418,580.21
Do Something Low	522 (to Bath)	60	290	289	£1,393,617.48	£1,393,617.48
Do Something Low	Brislington P& R (9)	15	108	107	£2,112,397.63	£2,112,397.63
Do Something Low	Bath-Keynsham	60	80	79	£434,225.81	£434,225.81
Do Something Low	349	30	106	105	£888,986.47	£888,986.47
2a	Red	10	139	135	£3,536,328.46	£3,536,328.46
2a	522	60	226	226	£998,505.67	£998,505.67
2a	P&R	10	64	63	£1,565,846.38	£1,565,846.38
2a	Portway P&R (remaining from service 9)	15	44	44	£1,057,243.55	£1,057,243.55
2a	Yellow	10	130	129	£3,015,201.30	£3,015,201.30
2a	Green	10	112	110	£2,916,311.15	£2,776,545.49
2b	Red	10	139	135	£3,536,328.46	£3,536,328.46
2b	522	60	157	157	£717,929.61	£717,929.61
2b	P&R	10	64	63	£1,565,846.38	£1,565,846.38
2b	Portway P&R (remaining from service 9)	15	44	44	£1,057,243.55	£1,057,243.55
2b	Yellow	10	130	129	£3,015,201.30	£3,015,201.30

Option	Services	Headway	Total JT (mins)	Total Improved JT (mins)	Cost Per Year	*Cost Per year with improved infrastructure*
2b	Green	10	112	110	£2,916,311.15	£2,776,545.49
3a	Red	5	139	135	£7,072,656.92	£6,932,891.26
3a	522	60	226	226	£998,505.67	£998,505.67
3a	Portway P&R (remaining from service 9	15	44	44	£1,057,243.55	£1,057,243.55
3a	Yellow	10	130	129	£3,015,201.30	£3,015,201.30
3a	Green	10	112	110	£2,916,311.15	£2,776,545.49
3b	Red	5	139	135	£7,072,656.92	£6,932,891.26
3b	522	60	157	157	£717,929.61	£717,929.61
3b	Portway P&R (remaining from service 9)	15	44	44	£1,057,243.55	£1,057,243.55
3b	Yellow	10	130	129	£3,015,201.30	£3,015,201.30
3b	Green	10	112	110	£2,916,311.15	£2,776,545.49
4	Red	10	139	135	£3,536,328.46	£3,536,328.46
4	522	60	157	157	£717,929.61	£717,929.61
4	9	10	108	107	£3,028,830.79	£3,028,830.79
4	Feeder	30	45	45	£469,428.41	£469,428.41

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