West of England Combined Authority

Mass Transit (Future4WEST)

Strategic Outline Case

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Executive summary

This Strategic Outline Case (SOC) for the West of England Mass Transit programme (the scheme) has been prepared on behalf of the West of England Combined Authority (the Combined Authority). It explores the viability of a fully segregated mass transit solution meeting highest aspirations for the West of England, the condition for success, and the next steps for progressing to Outline Business Case (OBC).

Background

The ambition for a mass transit system in the West of England was outlined in the 2017 *Joint Transport Study* (JTS), which aimed to establish a clear direction for the long-term development of transport in the region. Looking to 2036 and beyond, the JTS targeted not only current challenges, but also aimed to accommodate future growth.

Following on from the JTS, the Combined Authority published the *Joint Local Transport Plan* (JLTP4) in 2020. JLTP4 recognised the challenges faced by the region in terms of growth in travel demand and the increased need to improve the offer of more sustainable modes of transport in the context of climate considerations. It built on the vision established in the JTS, placing a mass transit solution at the centre of its strategy to create:

"A well-connected public transport network, focused around mass and rapid transit, supported by a comprehensive walking, cycling, local bus and rail network."

In consulting with the public as part of JLTP4, the *West of England Bus Strategy*, and the 2020 *Future of the Region* survey, public transport was shown to be a key priority, with 65% of respondents agreeing with the vision identified within JLTP4, and 82% of respondents feeling that transport solutions other than a conventional bus service should be explored to serve communities.

In 2019, a *Mass Transit Feasibility Study Early Phase Options Report* (EPOR) was commissioned. The EPOR considered the feasibility and viability of a mass transit system in the Greater Bristol area, building on an *Underground Metro Pre-Feasibility Study* carried out in 2017. The EPOR considered the need for intervention as well as potential routes on the four corridors, which were established as part of JLTP4.

The work undertaken to 2020 demonstrated that a mass transit system would provide major opportunities for unlocking housing growth and stimulating the economy in the wider West of England area. Enhanced public transport connectivity and fully connected interchange facilities would be transformational for how people live and travel around the region.

From 2020, work began on the production of an Options Assessment Report (OAR), and subsequently an SOC for the Mass Transit scheme. These documents were supported by a number of reports underscoring the rationale for decision-making and ultimately the scheme.

The Need for Mass Transit

The West of England region has large-scale ambitions for the next decade. With a climate emergency declared by each UA in the region in 2019, *the West of England Climate and Ecological Strategy and Action Plan* has committed the region to meeting net zero carbon by 2030, well ahead of the national agenda.

Over the same period, the region's aspirations for growth target the creation of an additional 65,000 jobs, spread across its cities, development zones, and across the region. In addition, the *West of England Housing Delivery Strategy* has demonstrated a need for over 6,000 new houses a year to 2036, made increasingly urgent by its rapidly accelerating population growth.

This level of growth will put pressure on the transport network, currently dominated by private car use, and is likely to exacerbate the ongoing climate emergency.

Private vehicles are the primary mode of transport within the West of England region. This has contributed to severe congestion within all four corridors and comes at an estimated cost of over £300m in lost time each year. It was estimated in JLTP4 that without intervention, this is likely to increase to £800m by 2036. With transport as the highest contributor of carbon emissions in the West of England – at 32% compared to 26% nationally, standing and slow-moving traffic is hampering the region's progress towards net zero.

Congestion has also resulted in a poor perception of public transport within the region. Low bus reliability and frequency limitations result in only 1 in 11 journeys being made via public transport. This attitude extends to active travel, with consultation on the region's Walking and Cycling strategy reporting a perceived lack of safe walking and cycling options due to the number of cars on the roads.

Access to high-quality, frequent, reliable public transport is important for all the region's residents, businesses and visitors, but absolutely critical in the region's pockets of deprivation, where a lack of high-quality alternatives to private car ownership currently limits access to opportunities. To link up existing and planned housing and employment areas in a sustainable way, a solution must be put in place that shifts people away from private car use, and onto a combination of public transport and active travel modes that enable end-to-end journeys.

As such, the mass transit scheme seeks to address:

- **Climate emergency** – reducing transport-related emissions in the region by reducing the number of private car journeys
- **Low public transport use** – creating a public transport system with increased connectivity that improves public perception of unreliable, infrequent, and expensive services, thereby shifting trips away from private car use

- **Barriers to walking and cycling** – making active travel a preferred choice by reducing conflicting traffic on direct routes and linking public transport with walking and cycling for end-to-end journeys
- **Congestion and delay** – addressing current and predicted congestion and delay on the region's radial routes, which results in poor associated environmental externalities
- **Safety** – reducing accidents, particularly with regard to vulnerable road users, where the number of collisions is higher in highly congested areas
- **Regional inequality and deprivation** – addressing the transport challenges experienced by deprived communities without access to private vehicles, and linking current and future housing and employment opportunity sites
- **Enabling regeneration and economic growth** – enhancing recovery efforts and increasing regional labour mobility to unlock clean and inclusive economic growth

A transformational mass transit system, integrated with first-mile last-mile solutions and existing public transport, is closely aligned with national, regional and local policies and plans. It targets a step change in public transport connectivity, changing the way people travel, and enabling the region to push forward with its vision for regeneration and growth. In doing so it will not only contribute to shared goals of decarbonisation, but reinforce the West of England's unique regional identity, while ensuring that all of its residents, visitors, and businesses are able to access housing and employment opportunities in a green, sustainable manner.

Conditions for Success

Successful mass transit systems across the UK have uniformly responded to a need within the region, often driven by growth, regeneration, or planned development. Based on the review of case studies, the following conditions for success are considered beneficial:

- Strategic planning that both identifies and incorporates the need for intervention
- Phased planning and construction, staged in response to a need (e.g. development, funding, regeneration, impact on the highway network)
- Extensive stakeholder engagement and public participation, ensuring a strong understanding of local needs
- Use of ready-made corridors and/or space, where possible
- Integrated transport, using feeder services and first-mile last-mile solutions to expand catchment areas
- Policy measures to support demand for the scheme, as well as financing
- Careful consideration of funding and financing solutions

It is recognised that not all of these conditions are immediately available within the study area. This does not mean that a mass transit solution is unachievable; where challenges do exist, these are either expected to be addressed as the scheme progresses, or it may strengthen the need for other success conditions.

Development of the Scheme

The proposed Mass Transit scheme is expected to be a phased programme of works to deliver a transformational public transport network across four corridors in the West of England, which are linked within Bristol City Centre:

- North Corridor (Bristol City Centre – Proposed Almondsbury Transport Hub)
- East Corridor (Bristol City Centre – Bristol & Bath Science Park)
- Bristol – Bath Corridor (Bristol City Centre – Bath Spa railway station)
- South-West Corridor (Bristol City Centre – Bristol Airport)

It is expected that the corridors will be phased into a number of work packages, each of which will contribute to the improvement of the network as a whole. As these packages are broken down into discrete Outline Business Cases, they will be accompanied by first-mile-last-mile solutions to increase access to the network and encourage mode shift.

This SOC assesses the possibility of a fully segregated scheme, with 3.2m-wide corridors in each direction that allows the proposed mass transit system to run separated from general traffic, frequently, and reliably.

A robust optioneering process has been followed for the Mass Transit scheme, considering both overground route options and those with significant stretches of tunnelling for each corridor and within the city centre. Four possible modes have been explored across two broad categories:

- **Rubber-wheeled solutions**: Bus Rapid Transit, Trackless Light Transit
- **Steel-wheeled solutions**: Very Light Rail, Light Rail Transit

As part of the SOC process, the appraisal considers each corridor option, as well as transport improvements to Bristol's City Centre, forming three illustrative networks that provide connectivity across the four corridors. These networks are not intended as a final shortlist of options, nor remove any further routes from consideration.

Value for Money

The Value for Money of the shortlisted options has been assessed in line with DfT's *TAG and Value for Money Framework*, considering both quantified and qualitative impacts from an economic, environmental and social perspective in the round to provide an overall assessment.

At this stage a solution has been considered that seeks to achieve full segregation for the extent of the route in order to maximise potential system user benefit, but with a corresponding impact on both costs and non-user impacts.

The appraisal at this point is based on the tools available and is reflective of the early stage of scheme development. It is recognised that the modelling framework used is based on inputs from the GBATS / G-BATH models, which both have dated base years, and modal shift is not fully reflected within the approach used. This is a known constraint and once

WERTM becomes available for use there is an opportunity to revisit the modelling assessment of the Mass Transit options, and assess potential variances in demand prior to the designation of work packages.

Sensitivity testing shows that there is the **potential for an overground Mass Transit** network to deliver **medium value for money** based on only the monetised impacts. This is achieved under a scenario where there is high demand and the impacts on remaining highway users are not considered in the monetised appraisal. This test is suggestive of the changes in travel patterns likely to develop in the coming years. Further policy measures to reduce the use of private car and increase sustainable travel modes would form part of wider demand management strategies across the region, and must be considered at future stages of the project.

As part of an exercise to understand the impact a potential mass transit solution might have for the region, an analysis of wider economic opportunities was done. This showed that should a viable solution for both public transport and highway users be agreed and implemented, sizeable productivity and land value benefits could arise from the delivery of a mass transit system. As an illustration, were these benefits to be realised, the **value for money of an overground solution could increase to high**. Due to the costs associated with delivering a largely tunnelled network, there is limited change in the associated value for money category, even with a substantial increase in the benefits generated. At this stage these impacts have not been estimated following the detailed approaches outlined in TAG, more detailed analysis is required as the scheme develops to understand the level of benefits attributable to the specific scope of the West of England scheme.

Based on its current scope and the available modelling framework, it is suggested that a fully segregated version of the scheme with current demand offers **very poor to poor value for money,** based on a comparison of costs and benefits. The appraisal of the scheme demonstrates the challenges associated with delivering a fully segregated solution in a constrained urban area. Although all options deliver against the objective of journey time benefits for public transport users, for the options that are predominantly overground the level of impact on the highway network is substantial. For options with a tunnelling component, there are significant associated capital costs and generating benefits of the same magnitude is difficult.

A comparison of high-level operating, maintenance and renewal costs and farebox revenue shows that for some corridors and networks the revenue generated could sustain the ongoing operation of the system. As the programme develops, affordability and strategies for funding and financing will be considered in more detail as approaches to phasing are better understood, there is more detail of the options in terms of costs and revenues and the economic landscape becomes clearer in terms of potential inflation in the short to medium term.

Developing a Path to OBC

The sensitivity testing carried out as part of the SOC process suggests that while there are challenges to be addressed in developing this ambitious system, there remains the case for a successful mass transit intervention.

The SOC has set out the strategic need for significant investment in a mass transit intervention in the West of England. Consideration of the potential wider economic benefits – both as part of EPOR and work done to support this SOC – demonstrates that, should a viable solution for both public transport and highway users be established, a mass transit solution could bring extensive benefits to the region.

This presents the opportunity to explore measures to reduce costs, increase ridership and reduce the level of private car use, and identify potential strands of induced investment as the region's various Local Plans progress. The SOC provides the foundations to take forward these further pieces of more detailed work to consider how and where mass transit can offer the strongest benefits to the region.

An Addendum to the SOC has been prepared in order to explore the potential impact of changes in cost and benefits as a result of a value engineering exercise. Sections of overground options that resulted in significant highway disbenefits during the SOC appraisal were identified and adjusted to run underground.

This work is expected to evolve as the scheme progresses towards and into OBC. The core purpose of the OBC is to undertake detailed assessment of those options shortlisted at SOC stage and find an optimum solution for the region.

Consideration will be given to the exploring the scope, packaging, and phasing of the programme, as well as addressing the limitations of GBATS and G-BATH through the integration of WERTM. A multi-staged value engineering exercise will be undertaken to better understand the scale of potential cost savings, and as part of the OBC process, further consideration will be given to first-mile, last-mile solutions, to increase the area of influence a mass transit system could have.

Acronyms

Acronym	In Full
AADT	Average Annual Daily Traffic
ALB	Arm's Length Body
AMCB	Analysis of Monetised Costs and Benefits
AONB	Area of Outstanding Natural Beauty
AQMA	Air Quality Management Areas
ASR	Appraisal Specification Report
AST	Appraisal Summary Table
AURN	Automatic Urban and Rural Network
AVTM	Ashton Vale to Temple Meads
B&NES	Bath & North East Somerset Council
BAME	Black, Asian and Minority Ethnic
BBC	Bristol – Bath Corridor
BBRP	Bristol to Bath Railway Path
BBSC	Bristol to Bath Sustainable Transport Corridor
BBSP	Bristol and Bath Science Park
BCC	Bristol City Council
BCR	Benefit Cost Ratio
BIM	Building Information Modelling
BRI	Bristol Royal Infirmary
BRT	Bus Rapid Transit
BSIP	Bus Service Improvement Plan
BTQEZ	Bristol Temple Quarter Enterprise Zone
CAZ	Clean Air Zone
CDE	Common Data Environment
CPI	Consumer Price Index
CPO	Compulsory Purchase Order
CPZ	Controlled Parking Zone
CRSTS	City Region Sustainable Transport Settlement
D&A	Development and Assessment
DBFM	Design, Build, Finance and Maintain Contract
DBFOM	Design, Build, Finance, Operate and Maintain Contract

Acronym	In Full
DBO	Design, Build and Operate Contract
DBOM	Design, Build, Operate, Maintain
DECA	Delivery Environment and Complexity Analytic
DfT	Department for Transport
DI	Distributional Impacts
DPA	Data Protection Act
EAR	Economic Assessment Report
EC	East Corridor
ECC	Engineering and Construction Contract
ECS	Engineering and Construction Subcontract
ECSC	Engineering and Construction Short Contract
ECSS	Engineering and Construction Short Subcontract
EN	Economic Narrative
EPOR	Early Phase Options Report
EqIA	Equality Impact Assessment
FBC	Full Business Case
FEA	Filton Enterprise Area
FMLM	First Mile / Last Mile
FTZ	Future Transport Zone
G-BATH	Greater Bath Strategic Model
GBATS	Greater Bristol Area Transport Study Model
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
GHG	Greenhouse Gas
GLT	Guided Light Transit
GVA	Gross Value Added
HGV	Heavy Goods Vehicle
ICC	Infrastructure Conditions of Contract
ICE	Institute of Civil Engineers
IMD	Indices of Multiple Deprivation
IPA	Infrastructure and Projects Authority
ISP	Integrated Service Plan
ITS	Intelligent Transportation System

Acronym	In Full
JLTP4	Joint Local Transport Plan
JTS	Join Transport Study
KPI	Key Performance Indicator
KRN	Key Road Network
LA	Large Adverse
LB	Large Beneficial
LCWIP	Local Cycling and Walking Infrastructure Plan
LEP	Local Enterprise Partnership
LGV	Large Goods Vehicle
LIS	Local Industrial Strategy
LNR	Local Nature Reserve
LRT	Light Rail Transit
LSOA	Lower Layer Super Output Area
LTA	Local Transport Authority
LTN	Local Transport Note
LULUCF	Land Use Change and Forestry
M&E	Monitoring & Evaluation
MA	Moderate Adverse
MB	Moderate Beneficial
MCAF	Multi-Criteria Assessment Framework
MEC	Marginal External Cost
MoD	Ministry of Defence
MT	Mass Transit
N	Neutral
NAO	National Audit Office
NC	North Corridor
NCP	National Car Park
NEC4	New Engineering and Construction 4
NEET	Not in Education, Employment or Training
NFHP	North Fringe to Hengrove Package
NIA	Noise Important Area
NO2	Nitrogen Dioxide
NPPF	National Planning Policy Framework

Acronym	In Full
NPV	Net Present Value
NSC	North Somerset Council
OAR	Options Assessment Report
OBC	Outline Business Case
OD	Origin and Destination
OJEU	Official Journal of the European Union
OLE	Overhead Line Electrification
OMR	Operating, Maintenance and Renewals
ONS	Office of National Statistics
Opex	Operating Expenditure
ORR	Office of Rail and Road
ORS	Options Refinement Strategy
OSR	Objectives Setting Report
P&R	Park and Ride
PA	Public Accounts
PCR	Public Contract Regulations
PFI	Private Finance Initiative
PHE	Public Health England
PM	Particulate Matter
PPP	Public-Private Partnerships
PRT	Personal Rapid Transit
PSF	Professional Services Framework
PT	Public Transport
PV	Present Values
PVB	Present Value of Benefits
PVC	Present Value of Costs
QRA	Quantified Risk Assessment
RPS	Resident Parking Scheme
RUH	Royal United Hospital
S151	Section 151
SA	Slight Adverse
SAC	Special Area of Conservation
SB	Slight Beneficial

Acronym	In Full
SBL	South Bristol Link
SDS	Spatial Development Strategy
SEP	Strategic Economic Plan
SGC	South Gloucestershire Council
SMART	Specific, Measurable, Achievable, Relevant, Time-bound
SMEs	Small-to-Medium Enterprises
SOC	Strategic Outline Case
SPA	Special Protection Area
SPV	Special Purpose Vehicle
SPZ	Source Protection Zone
SRN	Strategic Route Network
SRO	Senior Responsible Officer
SSSI	Site of Special Scientific Interest
STB	Sub National Transport Body
SWC	South-West Corridor
TAG	Transport Analysis Guidance
TDP	Transport Decarbonisation Plan
TEE	Transport Economic Efficiency
TIS	Transport Investment Strategy
TLT	Trackless Light Transit
TPO	Tree Preservation Order
TQEZ	Temple Quarter Enterprise Zone
TUBA	Transport User Benefit Appraisal
TUPE	Transfer of Undertakings (Protection of Employment)
UA	Unitary Authority
ULR	Ultra Light Rail
UWE	University of the West of England
VCSEs	Voluntary, Community and Social Enterprise
VfM	Value for Money
VLR	Very Light Rail
VOC	Vehicle Operating Cost
VP VfM	Very Poor Value for Money
WBS	Work Breakdown Structure

Acronym	In Full
WERTM	West of England Regional Transport Model
WLC	Whole Life Carbon
WHS	World Heritage Site

Associated Document References

Report	Reference Number
Appraisal Specification Report	70069287-WSP-BCA-0009
Baseline Environment Report	70069287-WSP-ENV-0002
Biodiversity Net Gain Strategy	70069287-WSP-ENV-0001
Demand Forecasting Report	70069287-WSP-TPM-008
Mass Transit and Decarbonisation Technical Note	70069287-WSP-BCA-0024
Development and Assessment Report	70069287-WSP-TPM-014
Economic Assessment Report	70069287-WSP-BCA-0013
Economic Narrative	70069287-WSP-BCA-0012
Engagement Outcomes Report	70069287-WSP-BCA-0017
Equality Impact Assessment Strategy	70069287-WSP-TPM-005
Feasibility Design Summary Report	70069287-WSP-HWY-0003
Funding and Financing Strategy	70069287-WSP-BCA-0003
Green Infrastructure Strategy	70069287-WSP-HWY-0005
Integrated Service Plan	70069287-WSP-TPM-006
Land Acquisition Strategy	70069287-PMS-BCA-0002
Mass Transit Case Studies Note	70069287-WSP-TPM-009
Objective Development Report	70069287-WSP-BCA-0008
Option Assessment Report	70069287-WSP-BCA-0010
Phasing Strategy	70069287-WSP-HWY-0004
Planning and Consents Strategy	70069287-PMS-BCA-0001
Technology Options Refinement Report	70069287-WSP-TPM-012
Traffic Forecasting Report	70069287-WSP-TPM-007
Carbon Management Strategy	70069287-WSP-CBN-0001
Strategic Outline Case Addendum	70069287-WSP-BCA-0025

1 Introduction

1.1 Overview

1.1.1. This Strategic Outline Case (SOC) for the Mass Transit programme has been prepared on behalf of the West of England Combined Authority (the Combined Authority).

1.1.2. The content and preparation of the business case adheres to published Department for Transport (DfT) guidance, including the most up to date transport analysis guidance (TAG), Transport Business Case Guidance for both projects and programmes, and Value for Money (VfM) framework. As it is expected that Mass Transit will be delivered as a programme of projects, this business case also adheres to the HM Treasury's *Guide to Developing the Programme Business Case*.

1.1.3. This SOC builds on information in the *Option Assessment Report* (OAR). It demonstrates that the proposed scheme is based on analysis of the current situation, a clear vision of how things should be in the future, a careful consideration of the options (as presented in the OAR), a robust appraisal of costs and benefits, and a clear plan for delivering the scheme.

1.1.4. Within the West of England region, Mass Transit is part of a long-term ambition to inform and deliver multi-modal transport options under the banner of Future4WEST. Throughout this business case and supporting documents, the proposed scheme will be referred to as the Mass Transit programme or 'the proposed scheme'.

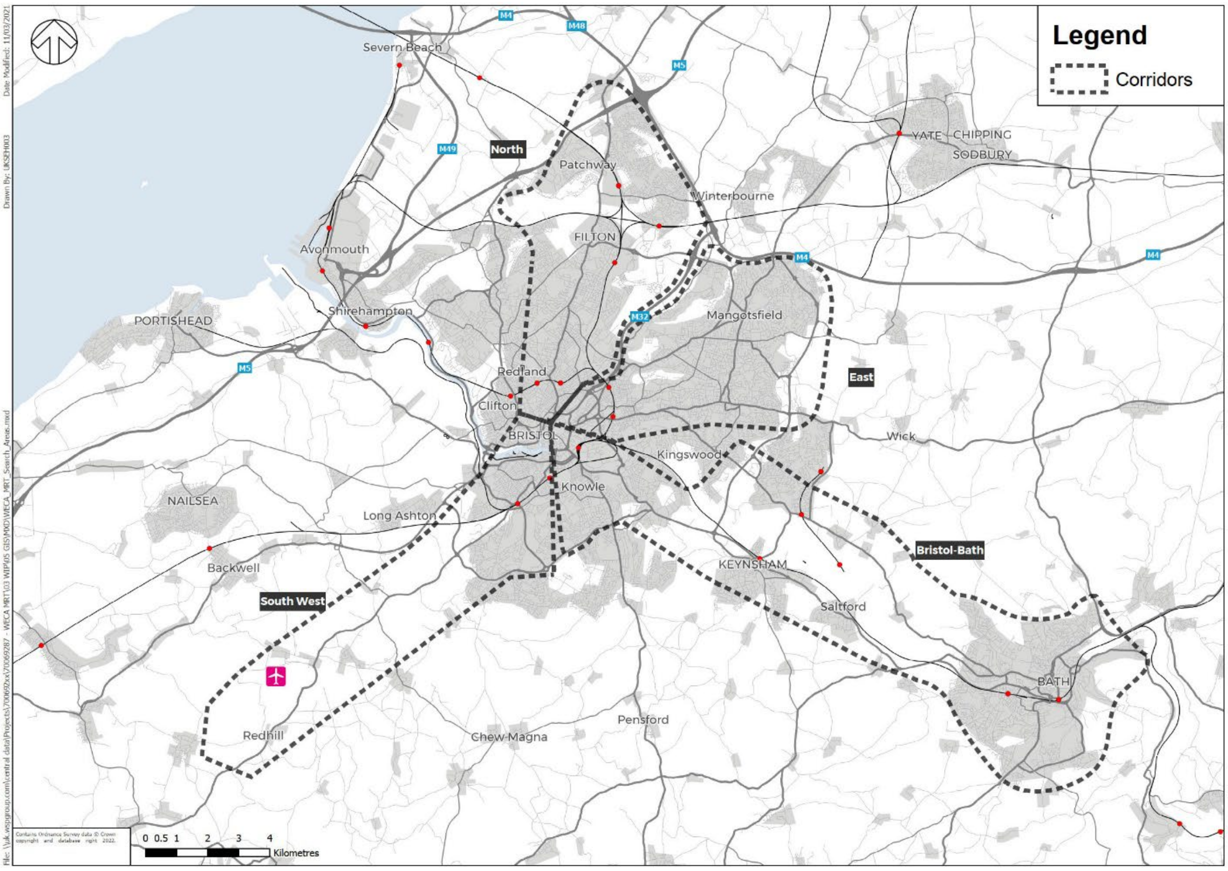
1.1.5. The proposition for a mass transit solution is not without challenges. To this end, this section contains an overview of mass transit interventions successfully carried out in other cities, as well as some of the associated challenges with creating similar conditions for success within the West of England.

1.2 Location

1.2.1. The proposed Mass Transit scheme is located in the South-West of England, spanning the three unitary authorities (UAs) of Bath & North-East Somerset Council (B&NES), Bristol City Council (BCC), South Gloucestershire Council (SGC) that make up the Combined Authority, as well as North Somerset Council (NSC). While NSC is not formally a part of the Combined Authority, it is a partner in the project. All four UAs are part of the West of England Local Enterprise Partnership (LEP).

1.2.2. Four proposed corridor search areas were derived as part of the OAR process (North, East, South-West, and Bristol – Bath), as illustrated in Figure 1-1.

Figure 1-1 - Mass Transit corridor search areas



1.3 The Need for Mass Transit

1.3.1. The West of England region has large-scale ambitions for the next decade. With a climate emergency declared by each UA in the region in 2019, *the West of England Climate and Ecological Strategy and Action Plan* has committed the region to meeting net zero carbon by 2030, well ahead of the national agenda.

1.3.2. Over the same period, the region's aspirations for growth target the creation of an additional 65,000 jobs, spread across its cities, development zones, and across the region. In addition, the *West of England Housing Delivery Strategy* has demonstrated a need for over 6,000 new houses a year to 2036, made increasingly urgent by its rapidly accelerating population growth.

1.3.3. This level of growth will put pressure on the transport network, currently dominated by private car use, and is likely to worsen the ongoing climate emergency.

1.3.4. Private vehicles are the primary mode of transport within the West of England region. This has contributed to severe congestion within all four corridors and comes at an estimated cost of over £300m in lost time each year[1]. It was estimated in the West of England's *Joint Local Transport Plan* (JLTP4) that without intervention, this is likely to increase to £800m by 2036. With transport as the highest contributor of carbon emissions in the West of England – at 32% compared to 26% nationally, standing and slow-moving traffic is hampering the region's progress towards net zero.

1.3.5. Congestion has also resulted in a poor perception of public transport within the region. Low bus reliability and frequency limitations result in only 1 in 11 journeys being made via public transport. This attitude extends to active travel, with consultation on the region's Walking and Cycling strategy reporting a perceived lack of safe walking and cycling options due to the number of cars on the roads.

1.3.6. Access to high-quality, frequent, reliable public transport is important for all the region's residents, businesses and visitors, but absolutely critical in the region's pockets of deprivation, where a lack of high-quality alternatives to private car ownership currently limits access to opportunities. To link up existing and planned housing and employment areas in a sustainable way, a solution must be put in place that shifts people away from private car use, and onto a combination of public transport and active travel modes that enable end-to-end journeys.

1.3.7. A transformational mass transit system in the West of England, integrated with first-mile last-mile solutions and existing public transport will provide a step-change in public transport connectivity, changing the way people travel, and enabling the region to push forward with its vision for regeneration and growth. In doing so it is expected to not only address the climate emergency but reinforce the West of England's unique regional identity, while ensuring that all of its residents, visitors, and businesses are able to access housing and employment opportunities in a green, sustainable manner.

1.4 Background

1.4.1. The ambition for a mass transit system in the region was outlined in the 2017 *Joint Transport Study* (JTS), which aimed to establish a clear direction for the long-term development of transport in the West of England. Looking to 2036 and beyond, the JTS targeted not only current challenges, but also aimed to accommodate future growth.

1.4.2. The JTS considered and developed transport options across the region under a number of packages with different areas of focus, including economic, urban, sub-regional and strategic connections. Mass transit options formed part of each of the packages, segmenting the region into four geographic quadrants.

[1] Joint Local Transport Plan (JLTP4), West of England, 2020

1.4.3. Following on from the JTS, the Combined Authority published JLTP4 in 2020. JLTP4 recognised the challenges faced by the region in terms of growth in travel demand and the increased need to improve the offer of more sustainable modes of transport in the context of climate considerations. It built on the vision established in the JTS, placing a mass transit solution at the centre of its strategy to create:

"A well-connected public transport network, focused around mass and rapid transit, supported by a comprehensive walking, cycling, local bus and rail network."

1.4.4. JLTP4 established four potential corridors for mass transit, shown in Figure 1-1. These have since been renamed as:

- Bristol – Bath Corridor (BBC)
- South-West Corridor (SWC)
- North Corridor (NC)
- East Corridor (EC)

1.4.5. Further information on the development of the four corridors can be found within the OAR.

1.4.6. Public consultation on the draft JLTP4 was undertaken in 2019, receiving over 4,000 responses. 65% of respondents agreed with the vision and objectives identified within JLTP4, with ranked responses prioritising:

- New and improved rail services
- Creating a comprehensive and safe network to support active travel
- Reallocating highway space to public transport, walking, and cycling
- The construction of a mass transit network
- Improving bus facilities

1.4.7. Further consultation was undertaken as part of the *West of England Bus Strategy* in 2020, with 80% of respondents feeling that rural communities could be better served by connections to transport hubs. An even higher 82% felt that transport solutions other than a conventional bus service should be explored to serve those rural communities.

1.4.8. A *Future of the Region* survey was carried out by the Combined Authority in 2020, exploring the potential priorities for the region's development. Over 1,000 responses were documented from both individuals and organisations, including equalities groups, residents' groups, local businesses, and environmental and heritage groups. Key themes in the *Future of the Region Engagement Report* noted that:

- Public transport was a key priority, with requests for affordable, reliable, and frequent systems. Access to a public transport network that provides a connection urban and town centres, as well as sites for employment, was viewed as important
- Walking and cycling infrastructure were the most commonly cited requirements, with requests for improved quality and safety of provision, through segregated and connected infrastructure
- There are high levels of support for activity to address and prioritise responding to the climate emergency

1.4.9. In 2019, the Combined Authority and the UAs commissioned a *Mass Transit Feasibility Study Early Phase Options Report* (EPOR). The EPOR considered the feasibility and viability of a mass transit system in the Greater Bristol area, building on an *Underground Metro Pre-Feasibility Study* carried out in 2017. The EPOR considered the need for intervention as well as potential routes on the four corridors (noting the Bristol – Bath Corridor was previously only considered to Keynsham).

1.4.10. The work undertaken demonstrated that a mass transit system would provide major opportunities for unlocking housing growth and stimulating the economy in the wider West of England area. Enhanced public transport connectivity and fully connected interchange facilities would be transformational for how people live and travel around the region.

1.5 Conditions for Success

1.5.1. In November 2020 a review of the different types of mass transit technology was undertaken, looking at the principles of mass transit systems, and where solutions were successfully implemented in cities throughout the UK and internationally.

1.5.2. The following section summarises this exercise, drawing out lessons learned across the UK and ultimately the conditions for success required for a mass transit solution in the West of England. The full review (WECA Mass Transit Study – Types and Case Studies) includes a number of international case studies, as well as a review of types of mass transit.

Case Studies

Metrobus, West of England

1.5.3. Metrobus is a bus rapid transit service that serves the Greater Bristol Area. It uses conventional bus vehicles with off-vehicle ticketing operating along existing highways and along dedicated infrastructure, including a section of guided busway.

1.5.4. The construction cost of the scheme was approximately £230m, with funding contributions from the DfT, NSC, BCC, and SGC. A significant amount of the funding was spent on complementary highway works.

1.5.5. While an important component of the region’s public transport network, the metrobus scheme is not without challenges, notably on the M32 where metrobus has no dedicated right of way and on the A4174 2+ lanes, which are used by ineligible vehicles during peak periods. In both instances the resultant lack of priority and congestion causes delays and poor reliability, which in turn increases journey and waiting times for passengers. A lack of segregation is common among all routes including Bristol City Centre and sections of the Long Ashton Route.

1.5.6. A Monitoring and Evaluation Report[2] was commissioned by the Combined Authority in 2022. It suggests that the scheme has had minimal impact on overall congestion on metrobus routes, though patronage on the m1 and m3/m3x routes was higher than expected.

1.5.7. Emerging key lessons from the evaluation process included:

- Close working between officers and consultants at design stage is important in terms of achieving a strong design which is supported by the local authority.
- When bus network improvements are being developed, close working with operators is important in terms of identifying commercially viable service routes, service frequencies and stop location.
- If bus services are to be delivered on a commercial basis, then the operators require a degree of flexibility to adjust service frequencies in response to passenger demand, but without diluting the core principles of what a bus rapid transit scheme seeks to deliver.
- There is a need for realistic programmes that are not amended under pressure due to funding timeline constraints.
- Gaps in pre-tender information and insufficiently developed scheme designs can result in a large number of compensation events, which suggests that if timescales allow, delay the tender process until more information is available and designs are more developed.

Cambridge Guided Busway, Cambridge

1.5.8. The Cambridge Guided Busway is a Kerb Guided Bus system, which was introduced to the city in 2011, connecting Huntingdon in the north of the city with Trumpington to the south. The network itself is comprised of a mixture of guided operation, bus-only roads (segregated busway) and conventional on-street bus lanes, with maximum speeds reached approximately 55mph.

1.5.9. Key considerations when designing the busway included the provision of links with cycling and walking facilities to increase the catchment area for the scheme. A 16-mile cycle path connects St Ives with the north of Cambridge, and Cambridge Rail Station with the Trumpington Park and Ride and Addenbrookes Hospital. Now part of National Cycle Network Route 51, it is designed to be used by horse riders, pedestrians, and cyclists. In addition, covered and CCTV monitored cycle parking is available at eight Guided Busway stops[3].

1.5.10. The Cambridge Guided Busway experienced delays during implementation, largely due to adverse weather conditions and communication breakdowns, Maintenance costs for the

[2] Evaluation of the Greater Bristol metrobus schemes (one year after), West of England Combined Authority, January 2022
[3] Cambridge & Peterborough Combined Authority, Cycle Routes

route have also been costly, with the concrete track between St Ives and Cambridge costing £36.5m to repair. In contrast, the Leigh-Salford-Manchester Bus Priority project chose to use Slip formed concrete over the precast concrete alternative used in Cambridge and has not faced high maintenance costs to date.

Docklands Light Railway, London

1.5.11. The first automatically operated (driverless) railway in the UK, the Docklands Light Railway (DLR) serves 45 stations in southeast London with a system length of approximately 31km. The system is a driverless light rail system, which operates in the Docklands area of south-east London. Of the 45 stations, five are underground. The system predominantly operates north of the River Thames.

1.5.12. The need for regeneration was the driving force behind the implementation of the light railway, with the Docklands Joint Committee formed in 1974 to address housing and employment needs in the area. To resolve a policy-making deadlock, the Joint Committee was comprised of representatives from the Greater London Council, London boroughs, government representatives and community organisations.

1.5.13. A strategic plan for public consultation was published by the committee two years later, with an overall vision of:

"Using the opportunity provided by large areas of London's Dockland becoming available for development to redress the housing, social, environmental, employment/economic and communications deficiencies of the Docklands area and the parent boroughs, and thereby providing the freedom for similar improvements throughout East and Inner London."

1.5.14. The plan included the routing of roads and public transport and indicated development areas for housing and industry over the coming years.

1.5.15. Public participation was crucial to the process. In response to early plans for the area that ran counter to local interests, a Forum was created to represent a broad range of community interests, from local action groups and trade unions to the Chamber of Commerce and environmental groups. Initially chaired by a member of the Docklands Joint Committee, it ultimately gained its own constitution with elected members to represent its views at each meeting of the Joint Council.

1.5.16. The construction of the resulting Docklands Light Railway was planned as phased, with the strategic vision for phase one starting around established district centres and new housing. The second phase expanded around housing development, with the third phase addressing challenging areas around the docklands where the Docklands Joint Committee did not own the land and was therefore dependent on private landowners and the availability of significant funding.

1.5.17. The system's capacity could not initially meet demand for the service, resulting in overcrowding and consequently reliability. The system has been significantly upgraded since this point in time, continuing the DLR's history of phased development.

1.5.18. Ultimately, the DLR is an example of conversion of existing railway lines and corridors to an automated transit system, using smaller vehicles and a frequent service. It highlights the importance of a strategic vision, and stakeholder engagement in establishing that vision.

Tyne and Wear Metro, Newcastle/ Gateshead / Sunderland

1.5.19. The Tyne and Wear Metro was influential in electrifying urban routes that had lost patronage and that were operated by trains coming to the end of their working life. The system covers a track length of approximately 78km and serves 60 stations, providing a service to approximately 36.4m people annually.

1.5.20. The system is comprised of overground routes linked by an underground beneath the centres of Newcastle and Gateshead. The engineering of the underground segments of the network triggered substantial public utility diversions, and measures were put in place to avoid impacting the architectural heritage of Newcastle City Centre.

1.5.21. There were several delays in the programme, with additional clarity needed around the ownership and operating of the system. The system's implementation was also hit by the financial crisis of 1976, which saw a freeze on capital projects in the public sector.

1.5.22. The Tyne and Wear metro is an example of regeneration using existing rail lines and connecting them with a cross-city underground sector that improves city centre accessibility.

Manchester Metrolink, North of England

1.5.23. Manchester Metrolink consists of 99 stops along 64 miles across eight lines, making it the most extensive tram system in the United Kingdom. The system includes a mixture of on street track shared with other traffic, segregated tram provision and converted railway lines. The vehicles are powered electrically by overhead wires and have a capacity of up to 200 people.

1.5.24. While initially conceived as an underground link between the two mainline stations, the need to modernise routes to the north of Manchester and to avoid the expensive capital works of tunnelling beneath the city brought light rail forward as a viable solution. This made use of existing and renewed railway lines, creating a new regional transport network.

1.5.25. Like the Tyne and Wear Metro, Manchester Metrolink has used existing rail lines and connected them with a cross-city section, though in this case favouring an on-street (overground) solution.

1.5.26. Manchester Metrolink has found success through phased construction, with the planning and construction of phase one focusing on Bury, Altrincham and Manchester City Centre, phase two on Salford Quays and Eccles, phase three on Oldham, Rochdale, and South Manchester (3a), and Ashton, East Didsbury and Manchester Airport (3b). The Second City Crossing opened in 2017.

1.5.27. Funding for the initial Metrolink scheme was granted by the HM Treasury under the constraint that the system be constructed in phases[4]. Each phase consequently drew on different funding streams, including:

- HM Treasury
- European Regional Development Fund
- Greater Manchester Passenger Transport Authority
- Private development
- Bank lending
- Council tax levies
- Metrolink fares, for later stages

1.5.28. Greater Manchester's Transport Strategy 2040[5] continues to expand Metrolink, while recognising challenges around the demand for road space from competing and often conflicting modes of travel. The strategy outlines a goal for better network integration, with buses acting as feeder services to rail and Metrolink services, thereby extending commuter options and providing wider travel opportunities.

Nottingham Express Transit

1.5.29. The Nottingham Express Transit is a conventional LRT system inaugurated in March 2004. Covering a network of 32km, the system serves approximately 32 million passengers a year across 51 stations in the city, seven of which are Park & Rides. The system was delivered in two phases, with Phase 2 adding 17.5km of new track and 28 new stops to serve 20 of the 30 largest employers in the city.

1.5.30. Nottingham City Council introduced a Workplace Parking Levy (WPL) in 2012 as a means to tackle problems associated with traffic congestion. The WPL provides a revenue stream for improving public transport and acts as an incentive for employers to manage their parking provision. Car use in Nottingham has dropped by 7% since 2002, and public transport use has increased by the same amount. Carbon dioxide emissions have fallen by a quarter since 2015.

Conditions for Success

1.5.31. Successful mass transit systems across the UK have uniformly responded to a need within the region, often driven by growth, regeneration, or planned development. Based on the case studies reviewed, the following conditions for success are considered beneficial:

- Strategic planning that both identifies and incorporates the need for intervention

[4] Metrolink, Ogden Eric; Senior John, 1992
[5] Greater Manchester Transport Strategy 2040, Transport for Greater Manchester

- Phased planning and construction, staged in response to a need or constraint (e.g. development, funding, regeneration, impact on the highway network)
- Extensive stakeholder engagement and public participation, ensuring a strong understanding of local needs
- Use of ready-made corridors and/or space, where possible
- Integrated transport, using feeder services and first-mile last-mile solutions to expand catchment areas
- Policy measures to support demand for the scheme, as well as financing
- Careful consideration of funding and financing solutions

1.5.32. It is recognised that not all of these conditions are immediately available within the study area. This does not mean that a mass transit solution is unachievable; where challenges do exist, these are either expected to be addressed as the scheme progresses, or it may strengthen the need for other success conditions. The following reviews the conditions for success in the West of England at a high level.

Strategic Planning

1.5.33. As noted in section 1.4, the foundation for a mass transit solution in the region was first established in the 2017 JTS and built upon as part of JLTP4. Both documents recognise that there is expected to be substantial growth in travel demand in the coming years and look to face these challenges with a well-connected sustainable transport network that prioritises walking, cycling, and public transport.

1.5.34. Over the coming months, this need is expected to be underscored by emerging local plans from each of the UAs in the West of England, as well as JLTP5. The development goals identified within these documents are expected to help form the framework for a mass transit solution as it progresses to OBC, allowing the scheme to be shaped in response to local needs, and for planning to be considered when it comes to the funding and financing of the scheme.

Phasing

1.5.35. A high-level *Phasing Strategy* has been produced for the proposed scheme at this SOC stage. It is broadly accepted that a mass transit solution will need to be phased, with segmenting the routes into sections making them more manageable in terms of funding, procurement, and construction.

1.5.36. Such an approach, however, does mean that effective coordination of the elements at a programme level will be critical. Any approach to phasing will need to align with the objectives for the scheme as a whole, with individual components needing to demonstrate how they contribute to planning policy and wider objectives for the region.

1.5.37. The availability and timescales associated with the financing of work packages (and their associated business cases) will inform what can be delivered and when. Likewise, the operation and maintenance of completed work packages may impact how others are sequenced. The Mass Transit programme will also need to respond suitably to demand, factoring in future growth and development.

1.5.38. It is recognised that decisions on phasing will ultimately be driven by finance availability and interdependencies across the region and will need to be considered fully at OBC stage.

Engagement and Public Participation

1.5.39. The principles underscoring a mass transit solution in the West of England have been consulted on as part of several strategic planning exercises, including JLTP4, the *West of England Bus Strategy*, and a *Future of the Region* survey.

1.5.40. Early engagement specifically around a mass transit scheme commenced in 2021, focusing on what the concept of mass transit meant to respondents, their priorities for a mass transit system, and potential barriers to uptake. The identified themes and comments raised by stakeholders were taken into account in the development of the options and underscored the objective refinement process.

1.5.41. It is recognised that in order to best understand the impact and operation of a mass transit solution, participation will need to be sought from a wide range of groups, from potential users to existing and potential operators of other public transport systems within the region. The Combined Authority has drafted a *Communications and Engagement Plan* to ensure all actions are clear, thereby enabling meaningful engagement as the scheme progresses towards OBC.

Use of Existing Space

1.5.42. As part of the option assessment stage, documented in the OAR, consideration was given to the use of existing transport corridors that could be utilised for a mass transit solution. The Bristol to Bath Railway corridor was longlisted, but removed from shortlisting for reasons of public acceptability, physical constraints in the form of bridges, and a lack of proximity to key destinations along the route.

Integrated Transport

1.5.43. JLTP4 stresses the need for a journey experience within the West of England that is enhanced through an integrated and connected transport network. This includes working with operators to focus local bus services on connecting to high-frequency services, and expanding the catchment areas served by a mass transit solution through first-mile, last-mile interventions and active travel. It is expected that as a mass transit solution evolves, it will work in tandem with the Local Cycling and Walking Infrastructure Plan, and other regional priorities.

1.5.44. Passenger surveys on existing mass transit systems in the UK have found that the following proportions of passengers walk or cycle to access the system:

- Manchester Metrolink: 82%
- Sheffield Supertram: 75%
- West Midland Metro: 57%

- Blackpool Transport: 84%

1.5.45. Consideration was therefore given to the strategic interchange and network-building opportunities of the shortlisted options. This work can be found as part of the *Development and Assessment Report*, and looks at:

- Key destinations presently identified for a mass transit service
- Proposed development sites known at the time of issue
- Existing strategic cycle routes
- Connecting public transport services

1.5.46. It should be noted that this SOC does not set out how transport interventions should link with Mass Transit in more detail. It is however considered important to the success of the scheme, and will therefore be considered fully as the scheme progresses into individual OBC work packages, and detail around routes emerges.

Policy Measures

1.5.47. Policy measures, including demand management, are likely to be necessary alongside infrastructure improvements to help reduce the number of car trips within the region. This may include a review of the wider spatial strategy, enabling substitute trips, physical demand management (access/capacity constraints), and pricing measures. This is recognised as part of JLTP4, which notes that:

“To encourage people to move away from cars, we will need to provide transformational alternatives such as a new mass transit network. This may not be enough, so we will also consider ways to manage demand possibly through congestion charging, emissions charging and workplace parking levy-type schemes.”

1.5.48. Delivery of such a range and scale of benefits is usually associated with ‘transformational programmes and portfolios’ rather than individual schemes – with a programme of connected infrastructure schemes and policy initiatives needed to work in tandem over a long period (often in excess of 10 years). A mass transit solution is considered to be part of such a transformational programme.

1.5.49. A benefit of such an approach is that schemes working together can deliver benefits greater than the sum of the parts, in addition to offsetting some of the potential deficiencies or risks of individual schemes. For example, mass transit schemes are usually extremely costly to deliver (affordability risks) and offer challenges around value for money (due to the high costs and / or demand lower than is required).

1.5.50. When paired with strong demand management initiatives, such as a congestion charging or clean air zone scheme, such risks can be partially mitigated: revenue generated can be used to fund a scheme or subsidise public transport fares. This can improve both affordability and value for money, and the increased travel costs (associated with charging) for private motor vehicles, and make public transport use more attractive from a cost perspective. This, in turn, increases mode shift away from the private car, and can maximise the decarbonisation potential.

1.5.51. Recent thinking suggests that transport interventions offer greater impact on mode shift and decarbonisation when packaged with other drivers of behaviour change than they can when progressing in isolation. Evidence of such impacts are being investigated and compiled as part of the Decarbonisation Policy Playbook being developed by Midlands Connect to serve as the primary source of benchmarking evidence on the potential carbon impact of different policy interventions to support LTPs, which is due to be published in 2023. This strengthens the case for an integrated network, with a mass transit solution supported by other forms of public transport, and strong first-mile last-mile initiatives to expand the catchment areas served.

1.5.52. Additional detail around the potential interdependencies between demand management measures and mass transit interventions can be found as part of the *Mass Transit and Decarbonisation* technical note.

Funding and Financing

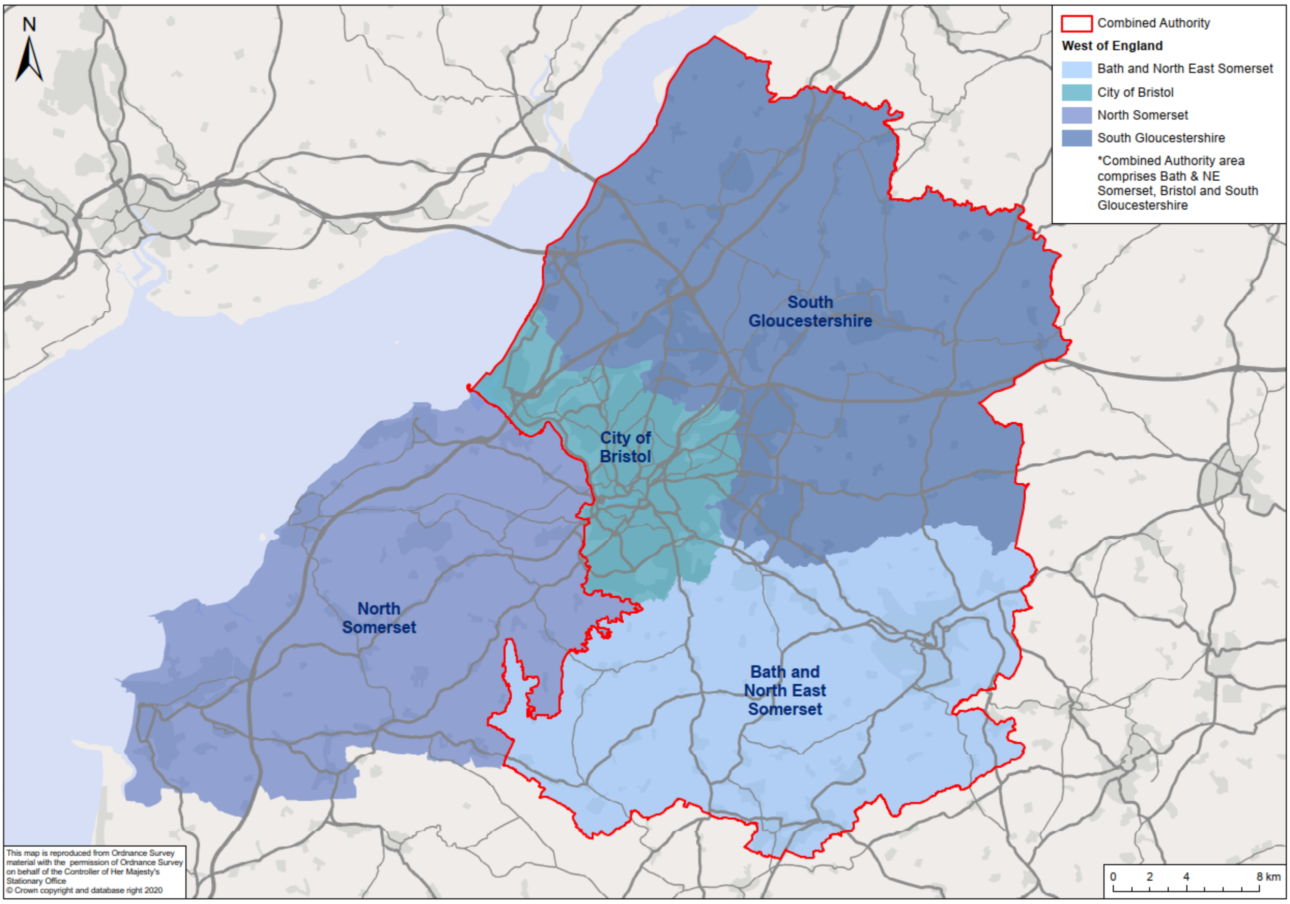
1.5.53. As part of the SOC works, Pinsent Masons was commissioned to produce an early-stage *Funding and Financing Strategy* for the proposed scheme. The strategy set out strategic options that will be expanded and interrogated as the development of the scheme progresses to OBC. It is likely that there will not be a single solution that meets all the needs and objectives of the scheme (or a phase of the scheme). Multiple options will likely need to be used together to deliver various elements of the programme.

1.6 Local Context

1.6.1. The Combined Authority area is comprised of three UAs in the West of England – B&NES, BCC, and SGC. NSC, though not formally a part of the Combined Authority, is also a partner in the project. All four UAs are part of the West of England LEP.

1.6.2. Figure 1-2 shows the Combined Authority area, its constituent UAs, as well as North Somerset.

Figure 1-2 - West of England region



1.6.3. Including North Somerset, the West of England is one of the most densely populated areas in the South-West, with 1,173,000 people living across the four UAs[6]. The West of England hosts a highly skilled workforce, being home not only to the biggest aerospace industry cluster in the UK, but also thriving financial and professional services and creative sectors. With four prestigious universities, an international airport, and cultural and heritage assets that make it a tourism hotspot, the West of England plays a central role in the UK economy[7].

1.6.4. Despite its strengths, the West of England and North Somerset have challenges that must be addressed for it to meet its full potential. Since 2009, while the region's population is growing faster than the UK average, its output per person (Gross Value Added, GVA) has grown more slowly. Accessibility and inclusivity are key, with disparity in working population, skill levels and opportunity across its constituent parts.

[6] Nomis, 2020
[7] West of England Local Industrial Strategy, July 2019

1.6.5. The region's transport network has come under increasing pressure in recent years, constraining growth and impacting both the environment and individual user experience.

1.6.6. The region's demographic, economic, and transport context are all explored as follows.

Demographic Profile

Resident Population

1.6.7. As of 2020, the population of the West of England is just over 1,173,000, including the BCC, B&NES, SGC and NSC areas. The BCC area has the largest population of the four UA areas, accounting for 40% of the region's overall population.

1.6.8. Table 1-1 shows the total population and breakdown for each of the four UA areas, the West of England, the South-West and England.

Table 1-1 – Population Estimates, ONS, 2020

Area	Population by age range						
	All Ages	Aged 0 to 15	%	Aged 16 to 64	%	Aged 65+	%
BCC	472,400	78,300	17	333,400	71	60,800	13
B&NES	193,400	29,600	15	126,300	65	37,400	19
NSC	216,700	35,800	17	129,000	60	52,000	24
SGC	290,400	49,900	17	186,400	64	54,100	19
West of England	1,173,000	193,600	17	775,100	66	204,300	17
South-West	5,701,200	905,000	16	3,522,700	62	1,273,800	22
England	56,489,900	9,838,700	17	36,249,800	64	10,401,400	18

1.6.9. There is a higher proportion of working age residents (aged 16-64 years) within the West of England compared to both the South-West and England averages. This is most prominent in the BCC area, where 71% of the population is aged 16-64 years, compared to 62% for the South-West and 64% for England.

1.6.10. The population structure of the NSC area, however, suggests an ageing population, with 24% of the population aged over 65 compared to 22% in the South-West and 18% in England. Accordingly, there is also a lower proportion of economically active people in the NSC area compared to the other West of England areas.

Population Trends

1.6.11. Population growth in the West of England has accelerated in the last 10 years, increasing by 9.5% over the period. 2020 Office of National Statistics (ONS) projections indicate that the West of England will grow by 11% by 2030.

1.6.12. In that time period, the population aged over 65 is expected to increase by approximately 2%, accounting for 19% of the total population. By 2043, the proportion of people aged 65 years and over is expected to reach almost 28% in North Somerset, the most significant increase across the West of England. In particular, the working age population in the BCC area is forecast by the ONS to increase by 2,000 to 3,000 each year to 2043, meaning there is likely to be a broad labour pool for businesses in the area.

1.6.13. This increase in the West of England's population will place a further strain on housing and transport infrastructure across the region. Investment in new infrastructure will therefore play an important role in delivering new housing to cope with the increased population demand.

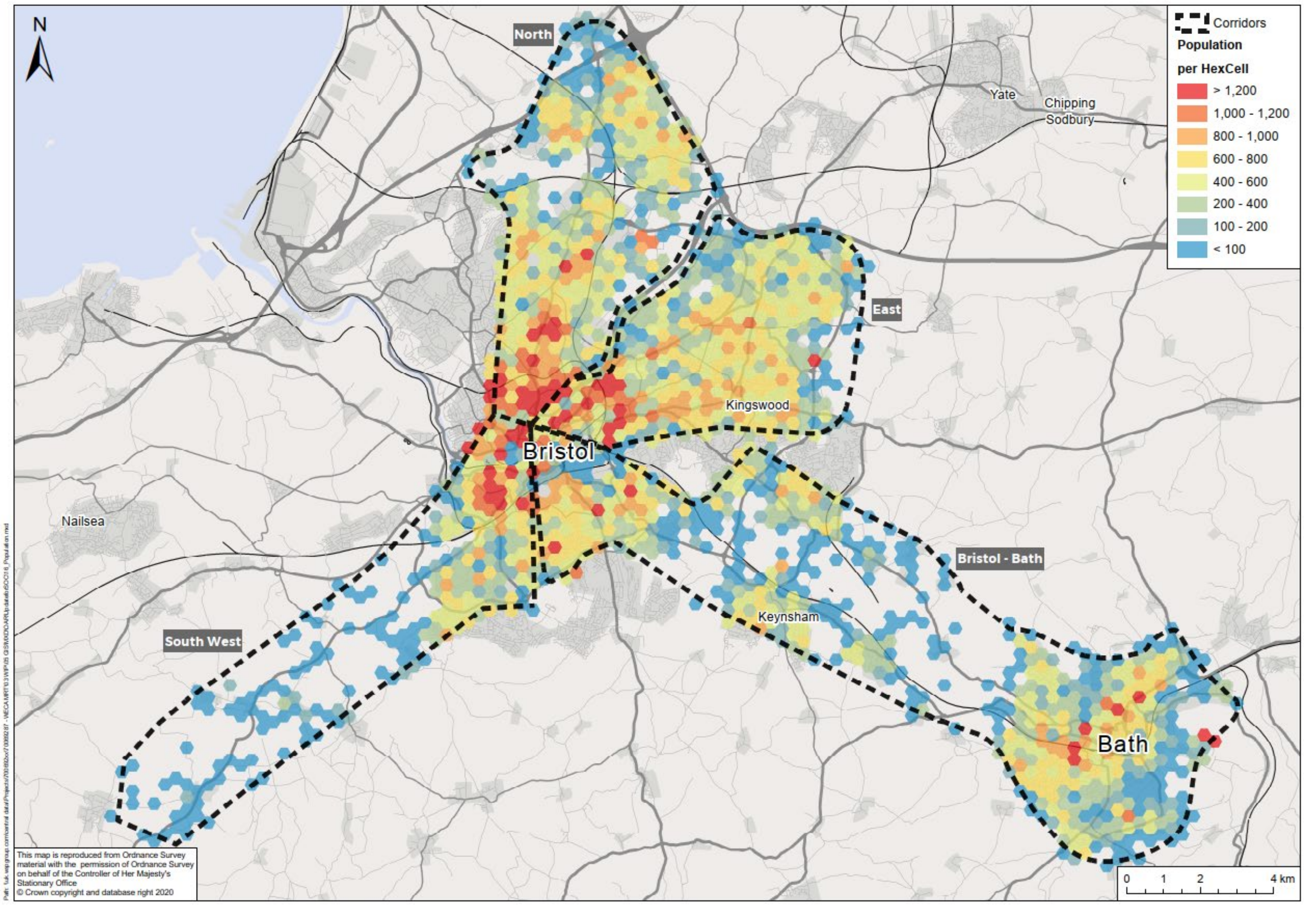
Population Density

1.6.14. Figure 1-3 shows the population density within each of the four corridors[8]. The North and East corridors encompass the densely populated areas of Montpelier, Filton, Horfield, Bradley Stoke, St George, Staple Hill, and Kingswood. On the South-West and Bristol – Bath corridors, population density decreases the further away from Bristol City Centre, with the exception of Bath itself. Within these corridors there are concentrations of residential population, including Bedminster, Hengrove and Knowle on the South-West Corridor, and Brislington, Keynsham and Saltford on the Bristol – Bath Corridor.

1.6.15. Significant residential development is expected on each of the four corridors over the next decade. Additional detail can be found in section 1.6.47.

[8] Census, 2011

Figure 1-3 - Population density



Deprivation and health

1.6.16. Across the four corridors, there are 85 Lower Layer Super Output Areas (LSOAs[9]) in the top 20% most deprived and 42 LSOAs in the top 10% in England and Wales, measured against the Indices of Multiple Deprivation (IMD). The IMD includes various factors influencing the level of affluence in an area including income, employment, education, health, crime, barriers to housing services and the living environment.

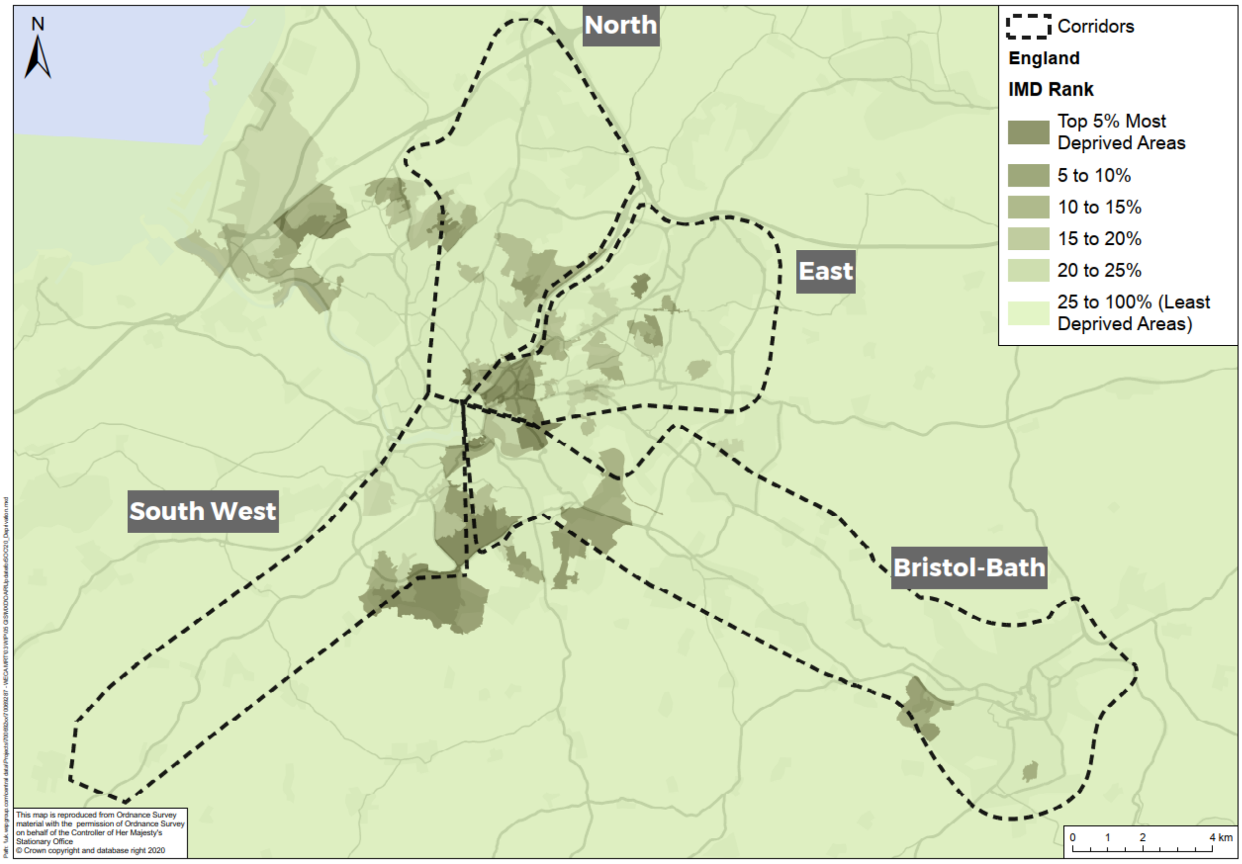
1.6.17. Within each of the four corridors there are areas of high deprivation. These are illustrated in Figure 1-4 and include:

- **North Corridor**: communities close to the M32 (Baptist Mills, Eastville, Stapleton, and St. Pauls), Lockleaze, Cheswick Village, Northville, Southmead, Stokes Croft
- **East Corridor**: Easton, Greenbank, Eastville, Fishponds, Hillfields and Bromley Heath

[9] Geographical areas of a consistent size with similar social characteristics, created to allow for the comparison of data sets, including Indices of Deprivation. Lower Layer Super Output Areas (LSOAs) contain a population of between 1,000 and 3,000, or between 400 and 1,200 households. (ONS)

- **South-West Corridor**: Bedminster, Bedminster Down, Highbridge, Knowle West, Bishopsworth, Hartcliffe, Hengrove and Filwood
- **Bristol – Bath Corridor**: Stockwood, Brislington, St. Philip's Marsh and Temple Meads

Figure 1-4 - Levels of deprivation



1.6.18. One of the challenges faced by these deprived communities is transport. Poor public transport connectivity was identified within JLTP4 as a barrier to employment for individuals within these areas, with gaps in the local bus network and an overreliance on private cars as contributing factors.

1.6.19. The inequalities in the region are also reflected in the health of residents in the West of England. Table 1-2 demonstrates the performance of each UA area against the national average across a wide range of health indicators[10]. There are 30 indicators including life expectancy, injuries and ill health and inequalities.

1.6.20. The B&NES and SGC areas are observed to score above the national average for over half of the indicators, demonstrating overall better health outcomes. The NSC area scores

[10] Unitary Authority Health Profiles, Public Health England

slightly worse, with six indicators that score below average. The BCC area performs the worst out of the authorities with nearly half of indicators scoring below the national average.

Table 1-2 – Health Indicators in the West of England

Performance of indicators compared to national average	B&NES	BCC	NSC	SGC
Above national average	21	7	15	16
Not statistically significantly different to national average	6	9	9	11
Below national average	3	14	6	3

1.6.21. Table 1-3 shows the variations in life expectancy for the most and least deprived areas within each UA area for both males and females. In the BCC and NSC areas, the difference in life expectancy between low and high areas of deprivation is almost ten years for males. For females in the NSC area the difference is similar (almost 10 years), while for the BCC area it is less pronounced at almost eight years. These substantial variations demonstrate that health outcomes in deprived communities are significantly different than those in the least deprived communities.

Table 1-3 – Life Expectancy

	Male Life Expectancy Difference (years)	Female Life Expectancy Difference (years)
B&NES	6.8	2.9
BCC	9.8	7.7
NSC	9.7	9.6
SGC	5.7	6.9

Economic Context

1.6.22. The West of England is a prosperous region with a highly skilled workforce, diverse business base, economy, and communities, and is worth £25.5bn per year. Driven by four world-class universities, specialist engineering innovation centres, and rich cultural heritage, the area is one of the fastest-growing regional economies in the UK.

1.6.23. As a whole, the region has a productive working age population, with an employment rate of 79.1% (2018). GVA per hour worked in the West of England LEP area is slightly below the UK average at £36.40 compared to the UK average of £37.70[11]. This accounts for those

[11] Sub regional productivity: labour productivity indices by economic enterprise region, 2020, ONS

who are actively employed, including those who commute into the region. From 2004 to 2018, GVA per hour has grown by 45%, faster than the UK average of 42%. By 2030, Oxford Economics baseline growth projects 65,000 jobs and 2.6% GVA growth in the region.

1.6.24. There are, however, marked variations regarding employment rates between different parts of the region. Of the four UAs within the West of England, Bristol has the highest unemployment rate at 3.9% in 2019. The city has the highest proportion of young people without qualifications (4.5%), leading to a disparity in skills levels and a poor take-up of apprenticeships. Growth levels across a large number of businesses remain small, with productivity gains held back by slow uptake of technology and modern management practices[12].

1.6.25. As part of the West of England LEP ambition, higher and further education are committed to opening pathways and widening participation of under-represented groups to ensure that all education and training leads to employment. This will address the current and future skills needs of businesses whilst focusing on growth, sustainability, and inclusion.

1.6.26. The demand for highly skilled workers is growing[13]. The *National Employer Skills Survey* found the West of England reported to have a higher (at a rate of 19%) propensity of skills shortage or skills gaps than almost any other LEP area. Vacancies linked to skills shortages are particularly prevalent in high skilled occupations (at a rate of 42%) whereas for middle skilled occupations this is 32%[14].

1.6.27. High-quality infrastructure is important for economic growth as it boosts productivity and competitiveness by connecting businesses and people together. Well-developed transport and infrastructure networks allow businesses to grow and expand through benefits such as extending supply chains and deepening labour and product markets[15]. These benefits can be particularly prevalent in city regions, such as Bath and Bristol, where agglomeration can enhance benefits.

The Impact of Coronavirus

1.6.28. The coronavirus pandemic has had a significant impact on the UK economy with many industries struggling, in particular the hospitality sector. The extent of this is shown by the sharp fall in Gross Domestic Product (GDP). In April 2020 the UK GDP fell by over 20% relative to March[16]. This is the largest monthly fall historically observed and reflects a widespread fall in GDP across most sectors of the economy. The UK experienced the

[12] West of England Local Industrial Strategy, 2019
[13] Employment and Skills Plan Evidence Base, 2019
[14] Employer Skills Survey 2019: England results
[15] National Infrastructure Strategy, 2020
[16] Coronavirus and the impact on output in the UK economy, ONS 2020

largest decline in GDP at -9.7% among the G7 in 2020. While the long-and-short term effects of the coronavirus pandemic on the economy and travel behaviour continue to evolve, Table 1-4 lists the short-term impact that the virus had on the West of England region.

Table 1-4 – Short-term impact of coronavirus

Short-term impacts	Description
Labour market	Approximately 4.8% of the region's workforce claimed out of work benefits in January 2021 (35,675). This is lower than the average figure for England (6.3%). By January 2022, approximately 3.3% of the region's workforce was still claiming out of work benefits.
Furlough	As of 31 January 2021, 77,500 West of England employees were estimated to be on furlough, representing around 14% of those eligible. This compares to an estimated take-up rate of 16% for the UK. The furlough scheme was a short-term measure, which is unlikely to have a long-term impact.
Businesses	National lockdown restrictions over 2020-2021 forced non-essential businesses such as restaurants, retail, cinemas, theatres, and hotels to close their doors for months at a time. The future of these types of businesses is uncertain, particularly in light of ongoing cost-of-living challenges.
Travel[17]	As of March 2022, 57% of adults travelled to work and did not work from home; this number has risen from 40% in March 2021. Conversely, around 12% of working adults worked from home exclusively, down from circa 32% in March 2021. Around 14% are reporting working both from home and from the office, a number that has only shifted a few percentage points over the last year[18]. In February 2022, 84% of workers who had worked from home due to the pandemic stated that they planned to carry out a mix of working from home and in the office in the future. Hybrid and homeworking increase by income bracket, with low earners less likely to report hybrid working. Only 8% of those earning up to £15,000 report hybrid working between April and May 2022. This combination of needs means that the West of England needs to plan for both the increase in home workers, and those still having to, or choosing to, commute. The proportion of businesses reporting using or intending to include homeworking as a permanent business model has increased from 16% in 2020 to 23% in April 2022; this varies significantly by industry, with accommodation and food services and construction reporting at 3% and 5% respectively[19]. Additional data from the DfT, however, suggests that people are still travelling for other means outside of commuting. When compared to February 2020, motor vehicle traffic across Great Britain in August 2022 has almost fully recovered. While car usage is down 3%, light commercial vehicles on the roads have increased by approximately 8%, and heavy goods vehicles have held steady. Public transport use has not recovered as steadily, with national rail use down by 5-10%, and bus use outside of London between 62% and 70%. Both forms of

[17] Transport use during the coronavirus pandemic, Department for Transport, 31 August 2022
[18] Coronavirus and the social impacts on Great Britain, ONS, April 2022
[19] Is hybrid working here to stay, ONS, May 2022

	public transport have considerably higher recovery rates at the weekend, though rarely come above 90% of their pre-pandemic use.

1.6.29. Post-pandemic, the West of England has developed an ambitious programme to build back better, greener and stronger. The *West of England Recovery Plan* aims to re-build across five pillars: rebuilding businesses; getting residents back into jobs; strengthening inclusion; supporting a green recovery; and renewing places. This includes a £320m+ investment in the region's transport and housing by 2025.

1.6.30. The *National Infrastructure Strategy* notes that infrastructure investment is expected to play a key role in recovering from the coronavirus pandemic by creating conditions for long-term sustainable growth[20].

1.6.31. Schemes such as Bristol's Temple Quarter will also provide a boost to the economy, with £95m awarded by the UK Government in June 2022, and BCC's Cabinet giving formal approval to enter into agreements with the Combined Authority in October 2022 to enable delivery of work in and around Bristol Temple Meads station.

Cost of Living

1.6.32. The cost of living in the West of England is high and has increased significantly in recent years, with house prices and rents above the national average. Between 2010 and 2020, house prices across the West of England increased by 63%, with the BCC area observing the highest price increase of 67%[21]. House prices present a significant challenge to the region, with residents in the B&NES and NSC areas experiencing the highest ratio of median house prices to median earnings at 11.91:1 and 9.88:1 respectively, noticeably higher than the 2021 average for England and Wales of 8.92:1[22]. For those in the lowest 10% income bracket, all four UA areas in the West of England have a house affordability ratio higher than the average for England residents. In particular, the B&NES area has the highest house affordability ratio.

1.6.33. In terms of rent, rent prices in the BCC, B&NES and SGC areas are 37%, 39% and 33% of average monthly income respectively, all above the England average of 27%[23]. Only the NSC area has a mean monthly rent at a similar level to the England-wide average, at 26% of monthly income.

1.6.34. In the context of the projected population increase the housing affordability and rent spend challenges will put pressure on housing supply in the West of England, demonstrating that

[20] National Infrastructure Strategy, 2020
[21] Median house prices for administrative geographies, HPSSA dataset 9, 2021
[22] Median house price to residence-based earnings ratio, ONS, March 2022
[23] Median house prices for administrative geographies: HPSSA dataset 9, 2021, Private rental market Summary Statistics

not only new housing is needed, but also more affordable housing. The *West of England Housing Delivery Strategy* suggests a need for 6,621 new homes per year to 2035, with over 30,000 thereof being affordable homes[24]. Without investment in supporting infrastructure this is unlikely to be delivered at the required level.

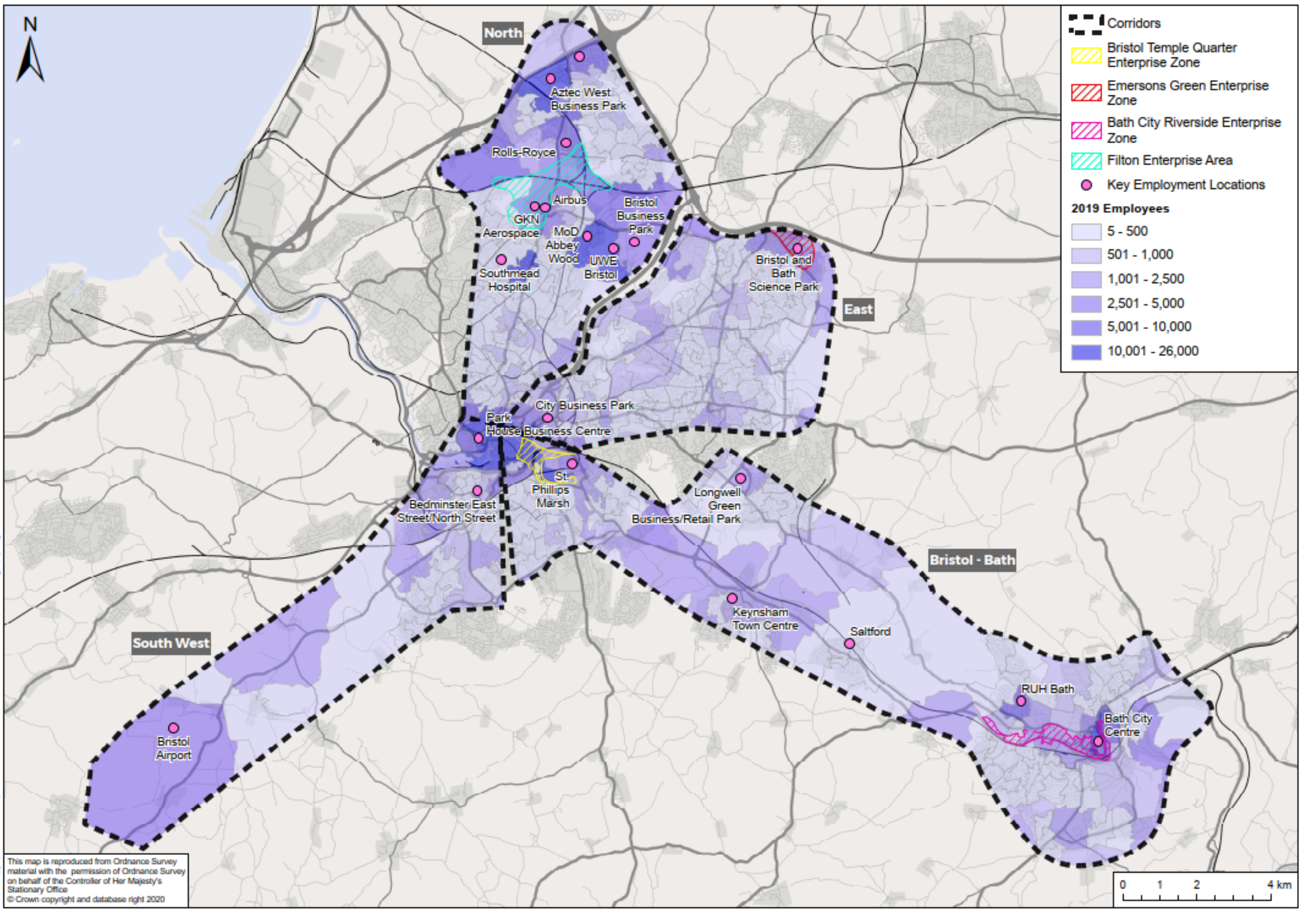
1.6.35. The soaring price of fuel will particularly impact lower-income car owners, young drivers, and rural residents forced to drive much higher mileages than most. Those worst affected by the rising cost of living may have to sell their vehicle and not replace it as a result, resulting in a loss of access to services and opportunities, and reliance on public transport and active modes[25].

Key Employment Areas

1.6.36. In order to re-establish and maintain a positive trajectory, economic growth must be shared across the region, with barriers to that growth removed or mitigated against. Both physical and digital infrastructure are therefore key to the region's *Local Industrial Strategy* (see section 2.3). To consolidate infrastructure, the West of England has established three Enterprise Zones and four Enterprise Areas. These, along with additional key employment sites and the number of employees in a given area,[26] are shown in Figure 1-5.

[24] A Strategy for Homes, West of England Housing Delivery Strategy
[25] AA Poll, 2022
[26] Census 2011

Figure 1-5 - Key Employment Areas



1.6.37. Prior to the coronavirus pandemic, nearly half of all jobs (44.8%) and enterprises (40.1%) in the West of England region were in Bristol.[27] The city has a number of high-value industries, including advanced engineering, the low carbon sector, professional and financial services, and the digital and creative industries.

1.6.38. Like Bristol, Bath itself is a key economic hub within the West of England. The dominant sectors for employment in Bath are health and education. This is demonstrative of the scale of employment undertaken by Bath's Royal United Hospital (RUH) and the universities. The hospitality and retail industries also employ substantial numbers in the city, which is likely to be contributed to heavily by tourism. Bath holds two designations as a UNESCO World Heritage Site (WHS) and possesses significant cultural heritage. In 2019, this resulted in over six million visitors to B&NES, spending a total of £458.7m[28].

[27] Bristol Key Facts, 2022
[28] https://www.visitwest.co.uk/about-the-regional-visitor-economy/research

1.6.39. In addition to the core employment areas in Bristol and Bath city centres, there are large employment sites within the North Corridor, including the Filton Enterprise Area (FEA) within South Gloucestershire, which is a major employer and home to the UK's largest aerospace cluster[29]. The FEA is already the established home for a number of world class aerospace, advanced engineering and manufacturing businesses including Airbus, Rolls-Royce, and GKN who benefit from the unrivalled location, profile, access and highly skilled workforce.

1.6.40. Bristol Airport is a major destination for employment in the South-West Corridor. As the main international gateway for the South-West of England and South Wales, Bristol Airport is a direct employer of circa 4,000 staff[30], supports an estimated 15,000 local jobs and generates £1.3bn per year in GVA[31]. In February 2022, Bristol Airport was granted planning permission (18/P/5118/OUT) to increase the current passenger capacity from 10 to 12 million passengers per annum. This decision is set to create around 800 new jobs, support inbound tourism, and will reduce millions of road journeys made to London airports each year[32].

1.6.41. Towards Bristol City Centre, there are employment sites along East Street and North Street in Bedminster, and Park House and Saville Court Business Parks.

1.6.42. While the East Corridor is primarily a residential area with fewer key employment sites, it is home to Emersons Green Enterprise Area in South Gloucestershire, which specialises in hosting businesses from the digital, creative and micro-electronics sectors, and to the Bristol and Bath Science Park, which has scope to employ over 6,000 people, and is a world-class home for businesses in science and advanced technology. It also incorporates the National Composite Centre, the national leader on research and design. South Gloucestershire is home to over 10,000 businesses[33], with areas such as Kingswood home to a wide range of small businesses, providing local employment opportunities.

1.6.43. The Bristol Temple Quarter Enterprise Zone (BTQEZ) and St Philip's Marsh Industrial Estate are both located on the Bristol – Bath Corridor. The BTQEZ is based around Bristol Temple Meads railway station and will include the University of Bristol's Temple Quarter Campus. The area is focused on creative, media and micro-electronics sectors, and has the goal of creating 17,000 jobs and 2.5 million square ft of employment space. 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 Retail Park.

[29] West of England Local Industrial Strategy, 2019
[30] Bristol Airport, Annual Monitoring Report 2020
[31] Acuity Analysis, Airport Profiles, 2017; York Aviation, 2017
[32] Bristol Airport Appeal Decision Report, 2022
[33] South Gloucestershire: Open for Innovation

1.6.44. Educational facilities are also key destinations and employers within the region. This includes:

- **The University of Bristol**: a Russell Group research intensive university, with around 26,000 students enrolled and 6,200 staff employed
- **The University of the West of England (UWE)**: one of the largest providers of higher education in the South-West, with 30,000 students enrolled and 3,800 staff employed
- **South Gloucestershire and Stroud College**: a further education and higher education college which teaches around 15,500 full time and part time students every year
- **Bristol City Centre College**: a further education college which offers full and part-time study opportunities from entry to degree level
- **University of Bath**: with over 15,000 students, up from 10,000 full time equivalent students in 2007
- **Bath Spa University**: home to 7,000 students and 1,000 staff, and spread across multiple campuses, the largest of which is at Newton Park, approximately 5.5km to the west of the city centre. Secondary campuses are situated at Sion Hill, Corsham Court and Locksbrook

1.6.45. In line with the region's *Local Industrial Strategy*, many of these key employment sites have growth aspirations. Specifically, the UWE has announced plans to develop an innovative engineering development that will accommodate 1,600 undergraduates and create 100 jobs for academic and technical staff. Responding to a shortage of engineers in the region, the building will help address a current and future skills gap in the region by creating opportunities for graduates who are equipped with the right industry skills, experience, and knowledge.

1.6.46. This growth potential and the benefits of a successful economy must be shared, addressing the pockets of high deprivation across the region (see section 1.6.16). Transport infrastructure, already under pressure, will be key in delivering these ambitions.

Housing Development Sites

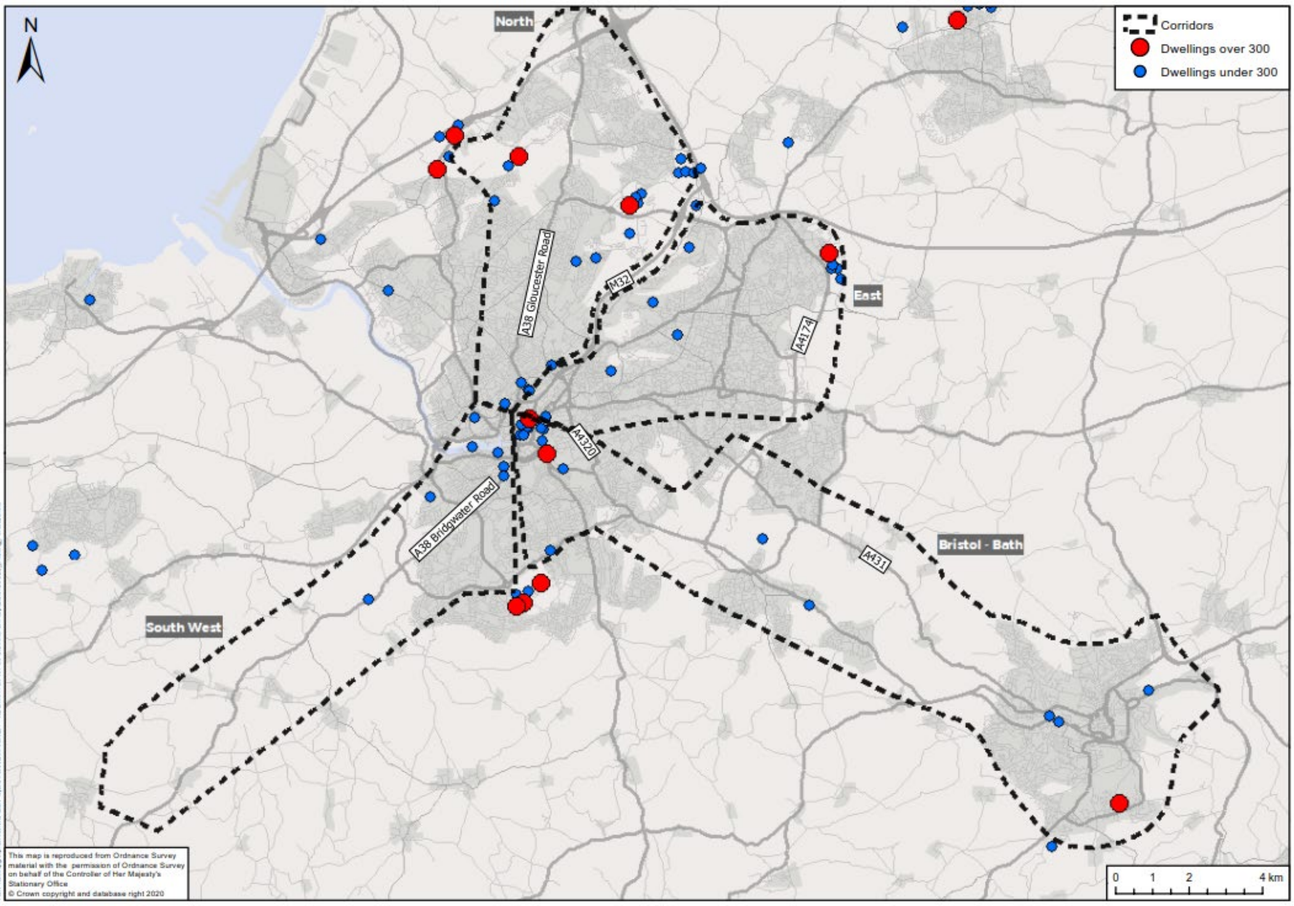
1.6.47. As noted in section 1.6.32, housing affordability, and therefore delivery, is a critical issue in the region.

1.6.48. The West of England Housing Delivery Strategy suggests a need for approximately 6,621 new homes per year; in 2019/20, only 4,899 were delivered. According to a *Strategic Housing Market Assessment* for Wider Bristol and B&NES, carried out in 2018, the West of England will require 30,000 affordable homes to meet requirements to 2036.

1.6.49. The locations of committed housing schemes are shown in Figure 1-6. As local plans currently in development are published by the UAs, additional housing stock is expected to be confirmed across the region.

WSP

Figure 1-6 - Committed Housing Development



1.6.50. Additional proposals for housing development are contained within each Authority's Local Plan. North Somerset's proposals for its *Local Plan 2038* contain significant development along the South-West Corridor, with a proposed residential site along the Woodspring Golf and Country Club. B&NES has undertaken housing and economic land availability assessments, with areas under consideration including Seven Acre Wood and areas around Keynsham and Saltford. While SGC is in the early stages of updating its Local Plan, its current core strategy makes provision for 28,335 homes to 2027, with development focused on the Bristol North Fringe and East Fringe urban areas. Housing schemes within Bristol itself are generally smaller in scale but greater in number, with Bristol's *'Big Housing Conversation'* reviewing the current housing allocation scheme.

1.6.51. The addition of new homes will meet a need for the region, but it is also recognised that the number of targeted additional dwellings will add pressure to the existing transport network – both during and after construction. Addressing those transport challenges now is expected to both enable the delivery of various housing sites, and future population growth.

Transport Context

1.6.52. Transport infrastructure is one of the key challenges in the West of England. There is a high dependence on the private car, with two-thirds of commutes taking place by car. Two out of every five of those journeys are less than 5km in distance[34]. Congestion is consequently a key issue throughout the region, particularly in the urban areas of BCC.

1.6.53. JLTP4 estimates that without intervention, the cost of congestion could be £800m per year by 2036, individuals will suffer a 74% increase in time spent queuing in traffic, and delays would increase by 40%.

1.6.54. The following sections set out the transport context for the region, and evidence some of the key transport challenges.

Active Travel

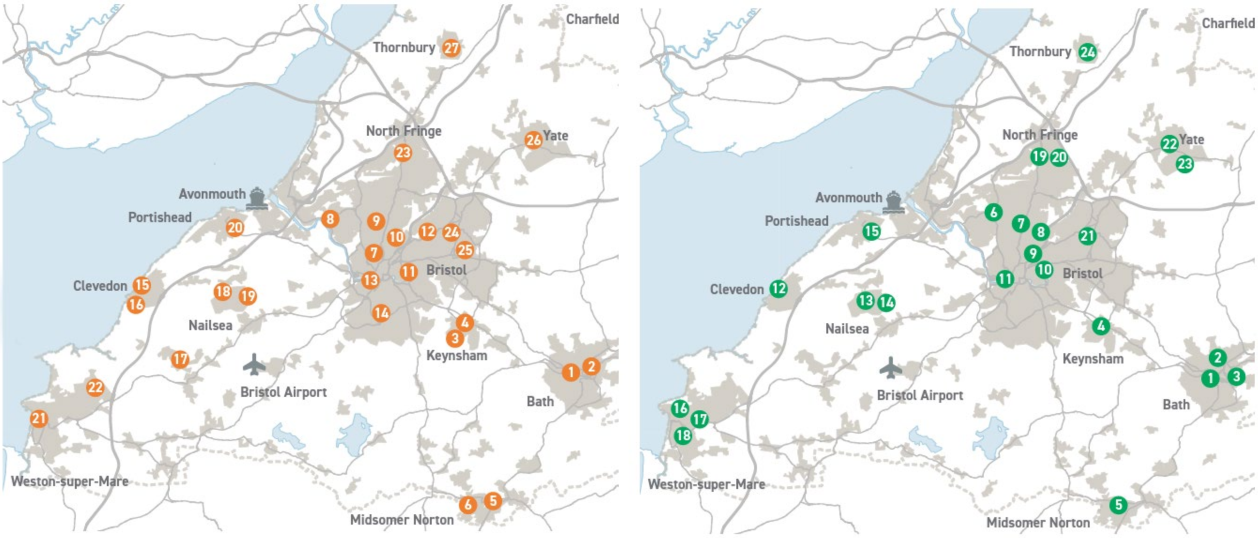
1.6.55. The West of England authorities have a strong track record of successfully delivering walking and cycling schemes. Bristol was the first city in the UK to gain Cycling City status, and in the following years BCC and SGC embarked on a major programme to increase the number of dedicated cycle lanes and better cycling facilities. Metrobus brought with it further walking and cycling improvements, something that the proposed Mass Transit scheme plans to build on.

1.6.56. The Sustrans National Cycle Network runs throughout the region and provides extensive maintained and accessible active travel infrastructure. The Bristol to Bath Railway Path (BBRP) is a traffic-free walking and cycling route, which can be joined from the East and Bristol – Bath corridors and provides a connection between Bristol and Bath using the former Midland railway line. The BBRP was used for 2.4 million trips in 2007[35], increasing by 10% per year ever since. This amounts to over 6,500 trips each day, with 56% of these journeys being for work. Sustrans note that 58% of users surveyed could have used a car for their journey but chose not to, whilst 55% of people use the path because of its high ‘amenity value’. In addition, 47% use the route because it is free of motorised traffic, and they feel safe using it.

1.6.57. Walking and cycling routes identified as part of the *West of England Local Cycling and Walking Infrastructure Plan* (LCWIP), are shown in Figure 1-7, with a list in Appendix A.

[34] West of England Local Industrial Strategy (2019)
[35] Sustrans, January 2019

Figure 1-7 - West of England Walking (Left) and Cycling (Right) Routes



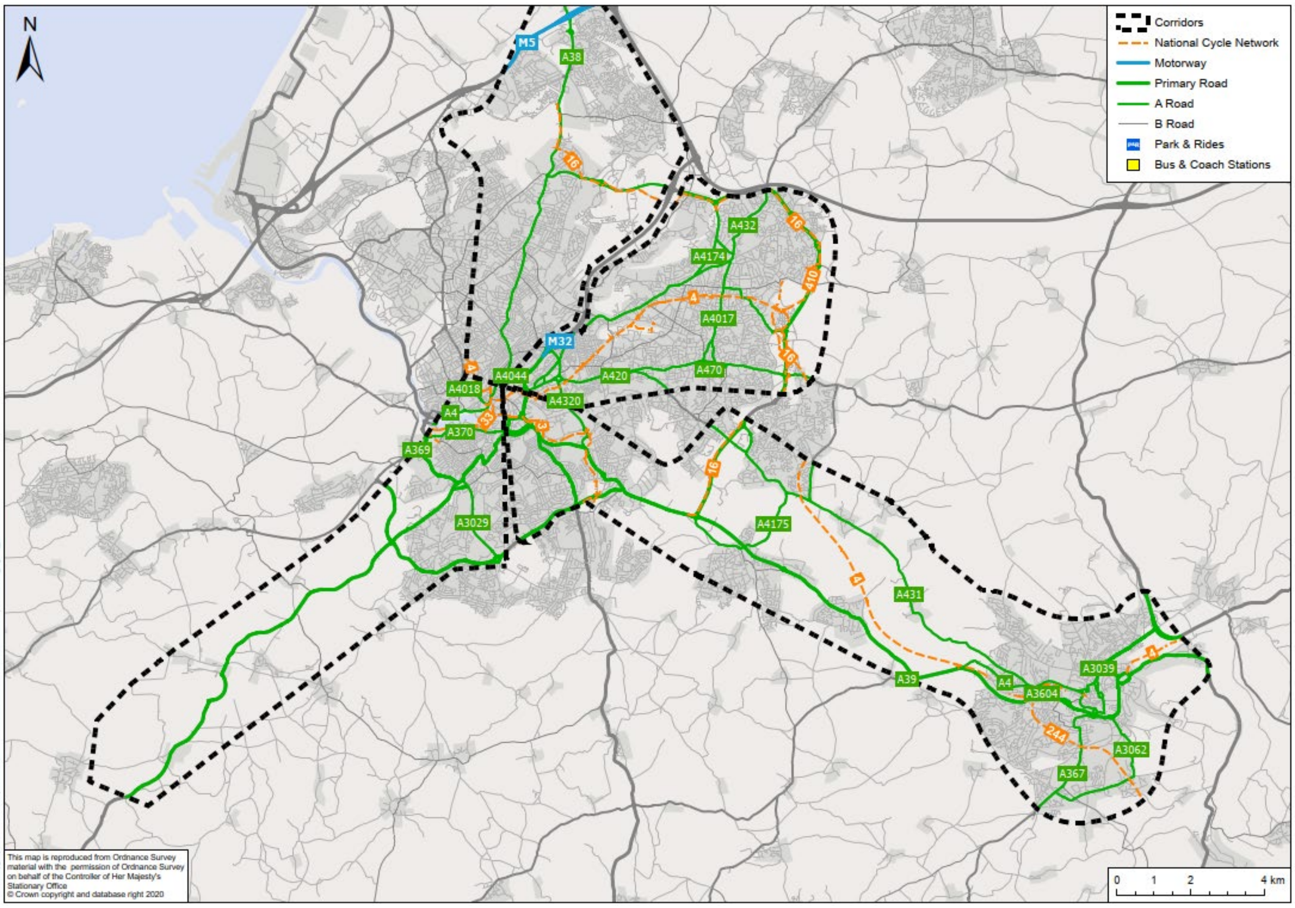
1.6.58. The LCWIP proposed capital investment of £411m by 2036, as a result of collaborative efforts between the Combined Authority, the West of England councils, and stakeholder groups. Ambitions for greater increases in walking and cycling are also part of JLTP4, and in respective UAs existing and emerging strategies and plans.

1.6.59. Additional detail on the perception of walking and cycling within the region can be found in section 2.6.18.

Highway Network

1.6.60. The key radial and orbital roads within each corridor are shown in Figure 1-8. Within the North, Bristol – Bath and South-West corridors there is generally one main arterial route that is radial from Bristol City Centre, namely the A38(N), A4 and A38(S) respectively. The East Corridor contains two main radial routes to/from Bristol City Centre, the A420 via Kingswood and the A432 via Fishponds. There are limited continuous parallel routes radiating out of Bristol City Centre, as well as limited continuous orbital routes. Within Bath, the A4 and A36 run parallel towards the city centre, with one link between them along the A3604.

Figure 1-8 - Highway network



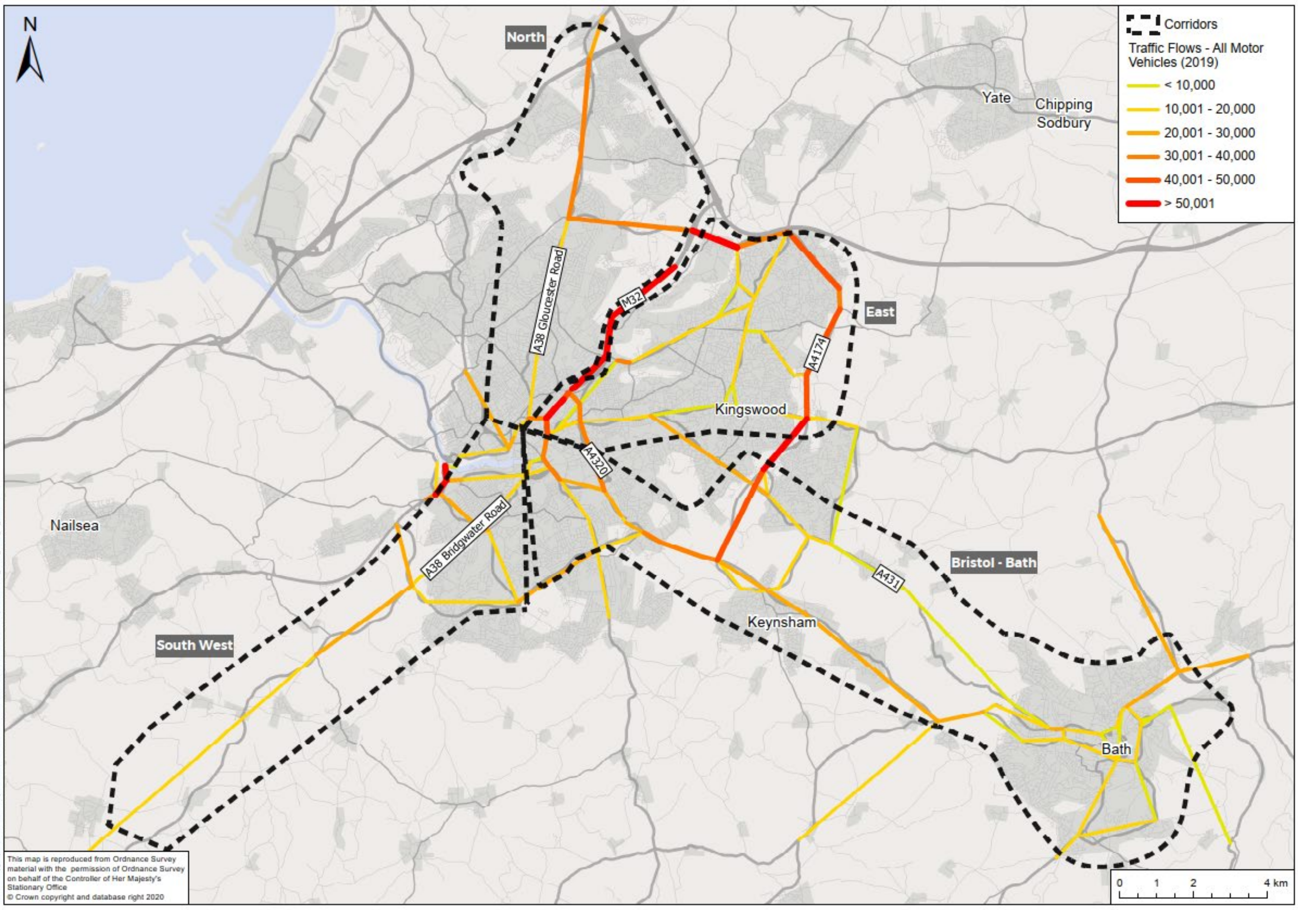
Traffic Flows

1.6.61. Existing traffic flow data for all motor vehicles, buses and coaches has been extracted from the DfT's Road Traffic Statistics for all roads within the corridors (see Appendix A). Traffic flows, highway capacity and distribution of traffic at peak times all influence the resilience of a network.

1.6.62. Figure 1-9 shows that traffic flows are highest on the M32, the A4174 outer ring road, A4 Bath Road, the A38(N) via Filton and the A38(S), the latter roads making up the main arterial routes on the Bristol – Bath, North and South-West corridors. Traffic flows within the East Corridor are slightly lower on the A432 and the A420, likely as there are two main routes within this corridor and traffic is distributed between them. Within Bath, the traffic flows are split evenly between the two main routes into the city centre, the A4 and the A36.

1.6.63. The flows shown in Figure 1-9 are based on DfT 2019 data. During the coronavirus pandemic, travel patterns were significantly affected, with a national 24.7% decrease in car traffic between 2019 and 2020[36]. Between October and November 2021, weekday peak car travel was 10% lower than pre-pandemic levels, while LGV and HGV traffic rose back to – and above – 2019 levels.

Figure 1-9 - Average Daily Traffic Flows, All Motor Vehicles, 2019



1.6.64. Figure 1-10 illustrates the average flows for bus and coach services. Each corridor presents a similar pattern, with significantly higher bus movements towards Bristol City Centre and Bath City Centre. The two arterial routes within the East Corridor have similar levels of flows for buses and coaches, suggesting that services are evenly split between the two routes.

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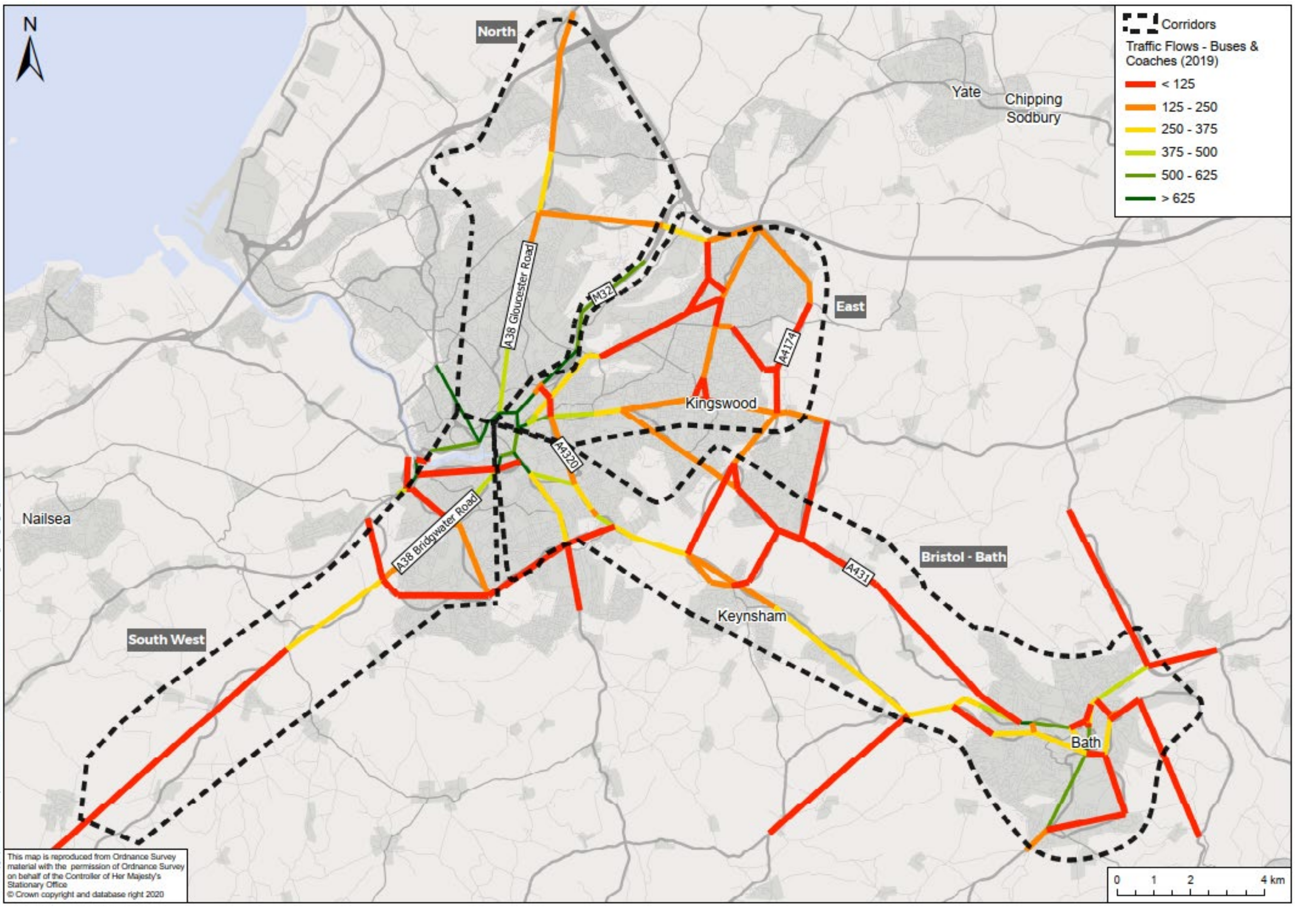
[36] DfT Quick Statistics

Figure 1-10 - Average Daily Flows, Buses and Coaches, 2019



Congestion and Delays

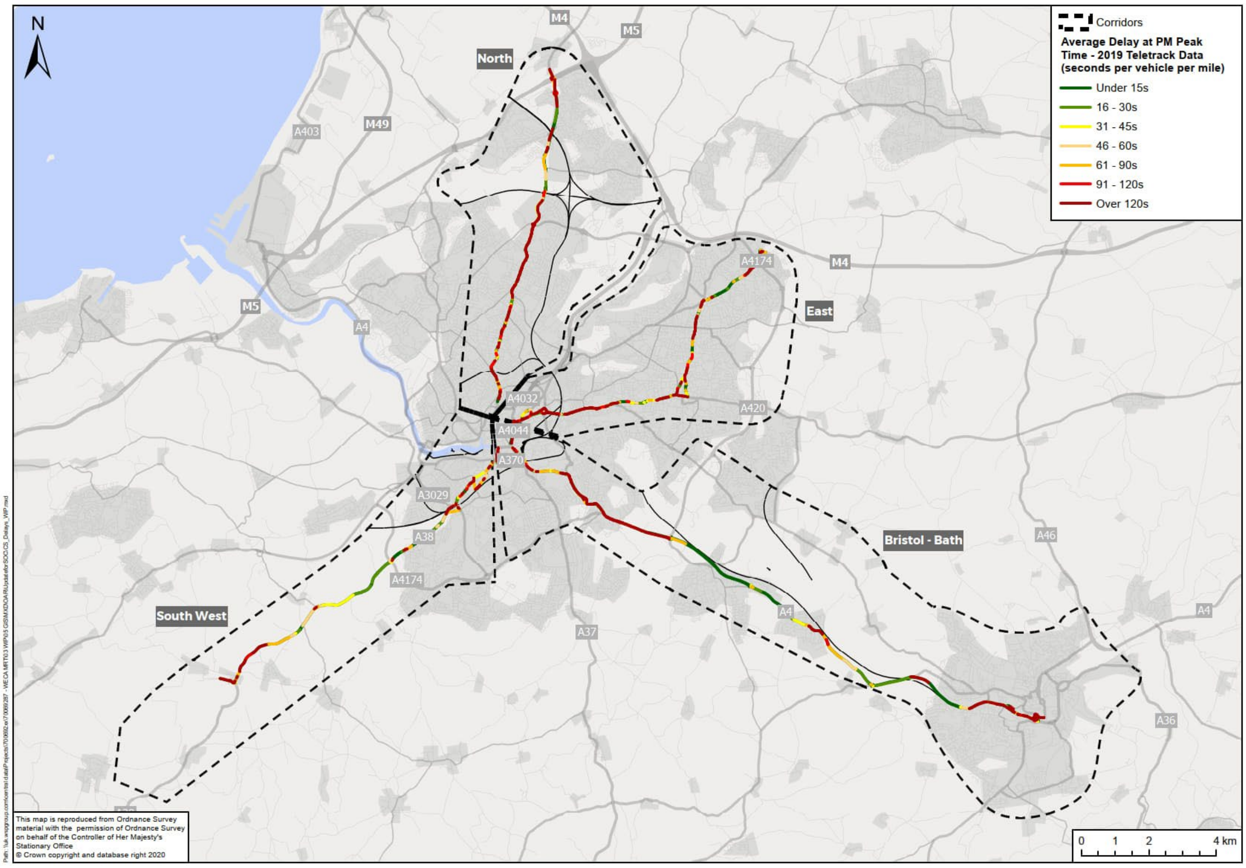
1.6.65. Speed, delay and reliability statistics produced by the DfT show that the average vehicle delay on local (non-Strategic Route Network [SRN]) A-roads in the UK between 2017 and 2019 was 25 seconds per vehicle per mile and the average speed was 46 miles per hour.

1.6.66. Across the four corridors, the average delay on A-roads is 72 seconds per vehicle mile – significantly higher than the UK average. The delay on the four corridors in the PM peak is shown in Figure 1-11.

1.6.67. The highest average delays are experienced on the A432 and A420 (on the East Corridor) and the A38 (North Corridor and South-West Corridor in South Bristol). These A-roads consistently show over 120 seconds of delay per vehicle mile, bringing average vehicle speeds to between 11 and 13mph.

1.6.68. Vehicle delay and speeds for the A-roads within the corridors are set out in Appendix A.

Figure 1-11 - Average observed delay on corridors, DfT, 2019 PM Peak (17:00-18:00)



1.6.69. In 2021, the Bristol urban area was the third most congested area in the UK, after London and Cambridge[37]. Even with a 36% reduction in traffic levels from 2019 caused by the pandemic, drivers typically lost 67 hours / year on average to congestion in 2021. This represents a 90% increase on the 2020 data[38], showing that congestion is returning quickly to pre-pandemic levels.

1.6.70. JLTP4 notes that congestion costs the region £300m annually, and that without action this could increase to £800m by 2036.

1.6.71. Congestion is a significant issue across the majority of the highway network in the West of England. All A-roads within Bath and nearly all radial routes from Bristol City Centre were identified within the JTS as congested, as well as a number of orbital routes in particular to

[37] 2021 INRIX Global Traffic Scorecard
[38] 2020 INRIX Global Traffic Scorecard

the north and south of the city. Many of the congestion hotspots identified along these routes are at junctions and roundabouts.

1.6.72. Within the North Corridor, the A38(N) was highlighted as experiencing congestion, with a congestion hotspot where it meets the A4174 at Filton. Similar issues were evident on the A38(S) between Bristol City Centre and the A3029, and where the South Bristol Link Road meets the A38(S). The A4 is heavily congested between Bristol City Centre and Keynsham, with a number of congestion hotspots. The A36 also suffers from material congestion, between Twerton Fork and Bath City Centre. Within the East Corridor, the A420 was identified as congested for the length of the route, with a hotspot where it joins the A4174. Congestion was also observed on the A432, but not to the same extent as the A420. Many of the congested sections identified in the JLTP4 have traffic flows between 10,000-20,000 a day (as shown in Figure 1-9).

1.6.73. 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.

1.6.74. Without intervention, these issues will be further exacerbated by population growth. This growth is expected to lead to additional travel demand, including journeys to and from work, business travel, deliveries and servicing traffic and leisure journeys. Based on the current level of car dependence, JLTP4 expects this additional demand to result in increased congestion, with the potential for a 9% increase in journey times and 74% increase in time queuing in traffic[39] by 2036.

Road Safety

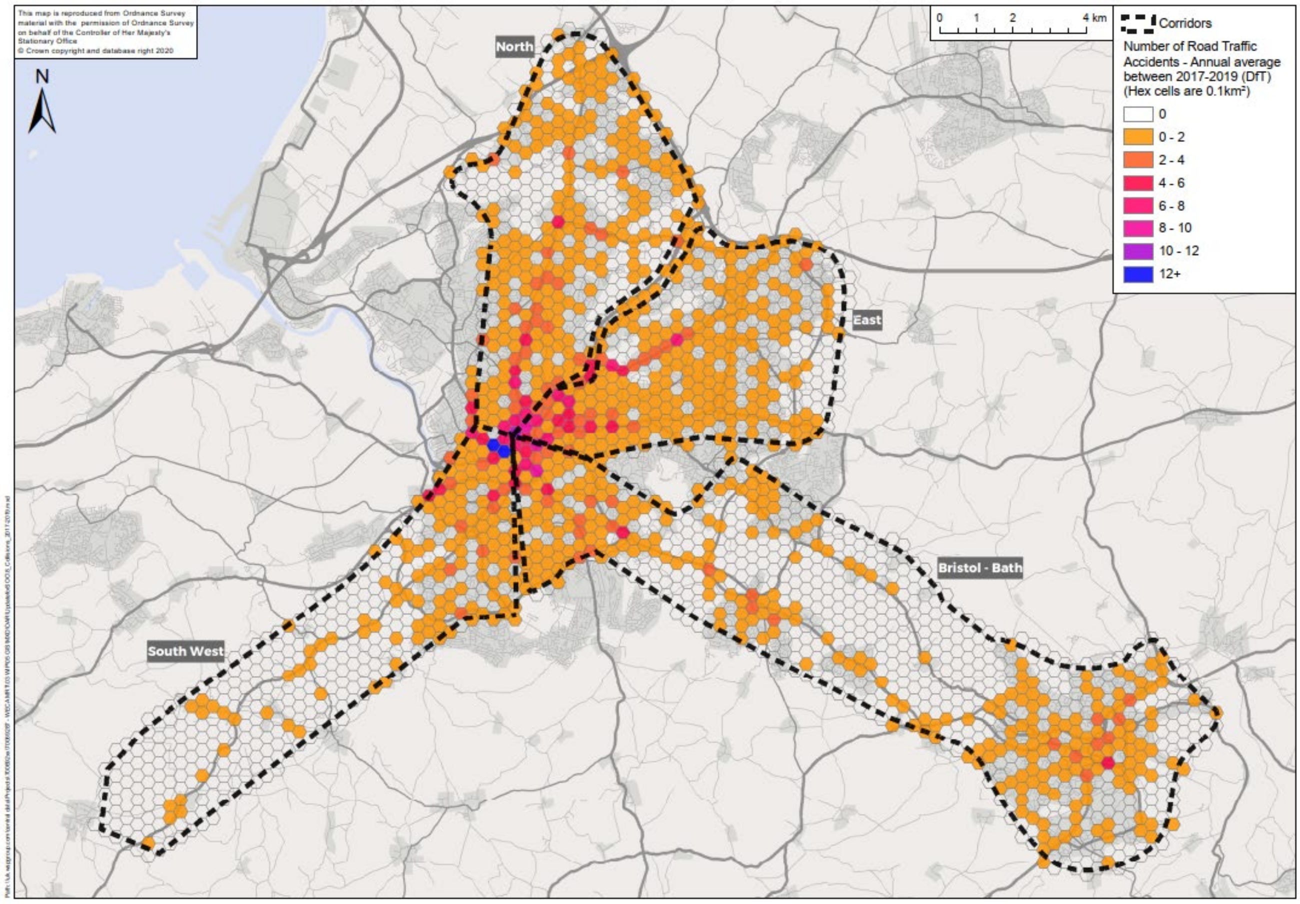
1.6.75. Figure 1-12 shows the annual average number of personal injury collisions in the corridors from 2017 to 2019, using DfT collision data. There is a concentration of collisions within Bristol City Centre and Bath City Centre, where the road network is dense and the potential for vehicle/vehicle and vehicle/pedestrian collisions is high.

1.6.76. There is a further concentration of collisions along heavily trafficked A-roads, including the A432, the A38(N) and the A4 Bath Road. As discussed previously, the high levels of congestion on these routes affects the impact of incidents and network resilience. There are fewer collisions around the peripheries of the corridors.

1.6.77. Out of the 3,386 accidents recorded between 2017 and 2019 in the study area, 977 involved cyclists and 642 involved pedestrians.

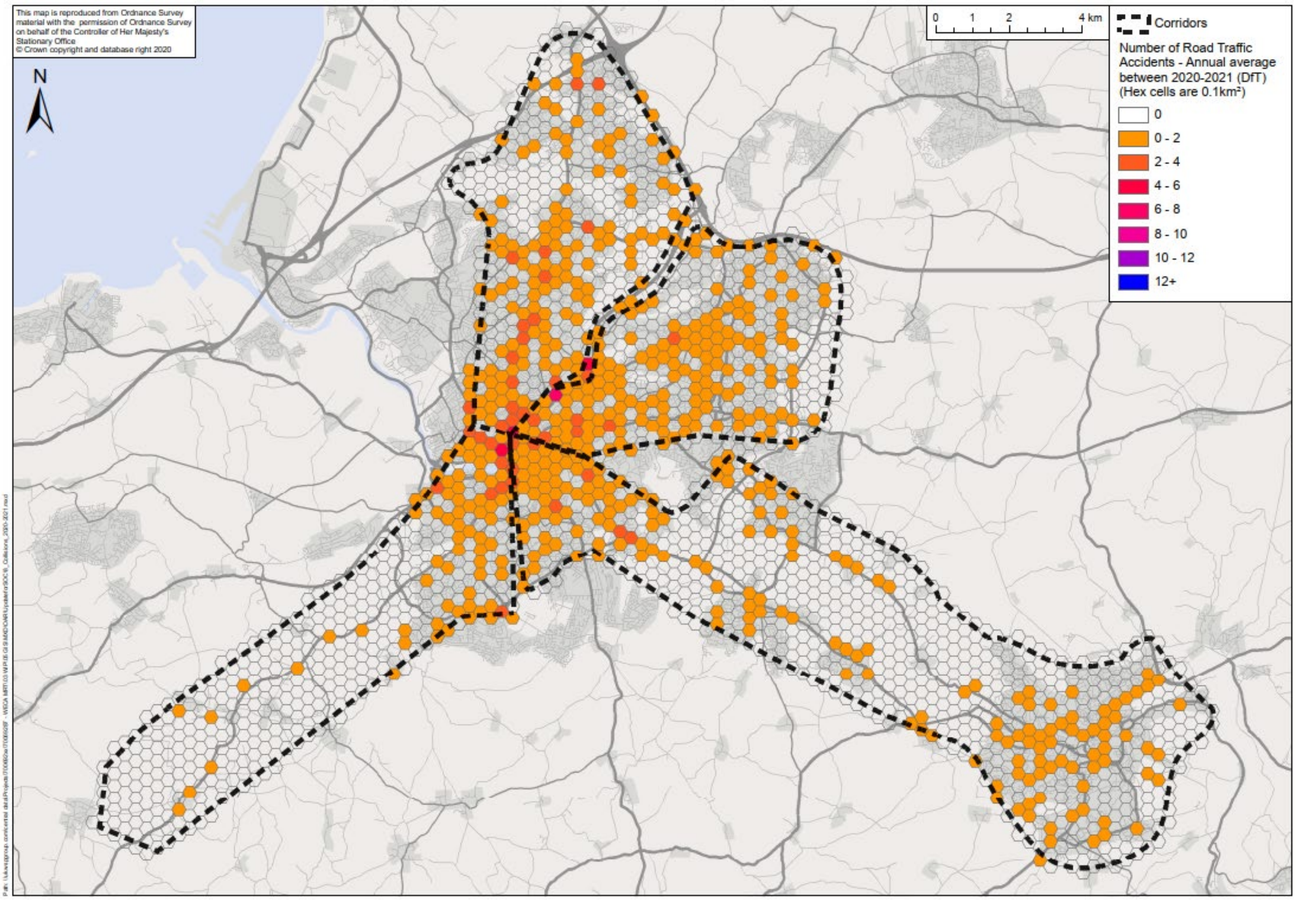
[39] Joint Local Transport Plan 4, 2020

Figure 1-12 - Collisions Across Corridor Areas, DfT, 2017-2019



1.6.78. Figure 1-13 shows the annual average number of personal injury collisions for the 2020-2021 period. While there is the expected overall drop in collisions that reflects the reduction in traffic during this period due to the coronavirus pandemic, similar patterns can be observed, with concentrations of collisions around Bristol City Centre, and the heavily trafficked A-roads.

Figure 1-13 - Collisions Across Corridor Areas, DfT, 2020-2021



1.6.79. Accidents have been analysed by severity ratio and the results provided in Table 1-5. The analysis shows a slight drop in severity ratio between 2017-19 and 2020-21. Over both periods of analysis, the proportion of people killed and seriously injured in accidents is lower than the national average of 21.4%[40]. This is likely to reflect the urban nature of the road network in the West of England, where speeds are lower.

Table 1-5 - Accident Severity in the West of England, 2017-19 and 2020-21

	2017-19		2020-21	
Fatal	21	0.6%	7	0.6%
Serious	288	8.5%	94	8.1%
Slight	3,077	90.9%	1,053	91.2%
Total	**3,386**		**1,154**	

[40] DfT reported road casualties Great Britain, annual report: 2021

Public Transport

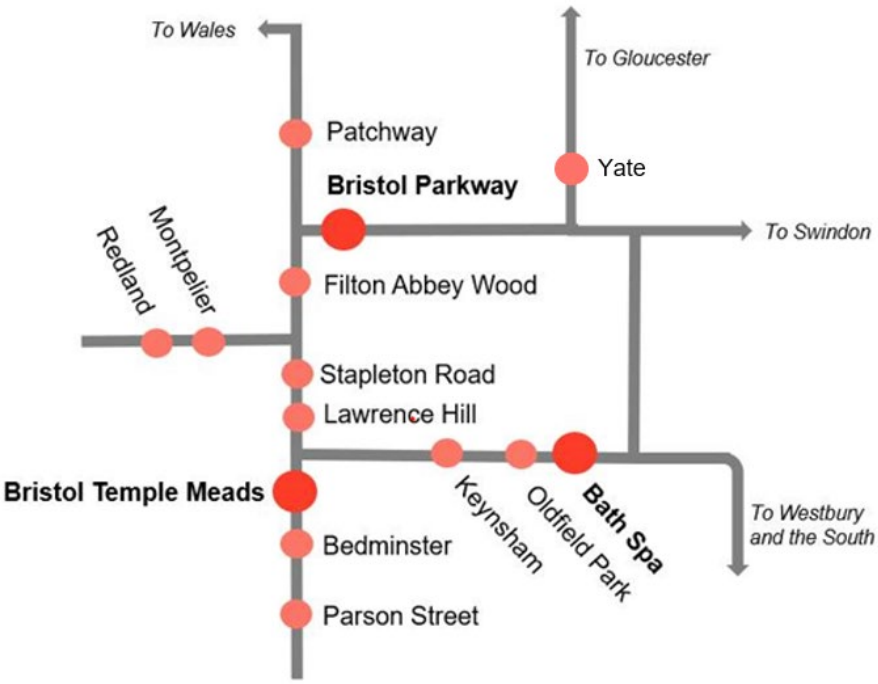
1.6.80. The South-West region has historically had limited transport funding. In the period 2012/13-2016/17, for example, the region had the second lowest average overall spending per capita on public transport of all regions, with only the East Midlands being lower[41].

1.6.81. In terms of GVA spent on transport, the region ranks the lowest of all regions at £49.76 per £1,000, compared to the national average (excluding London) of £58.48[42]. The UK Government's 2022 publication on Levelling Up the United Kingdom recognised the need to level-up investment across the country; transport is fundamental in doing so.

Railway Services

1.6.82. Figure 1-14 shows the existing railway network within the corridors, consisting of 11 railway stations. The services provided from each railway station within the corridors, along with railway station passenger entries and exits are presented in Appendix A.

Figure 1-14 - Railway Network



1.6.83. The main railway stations of Bristol Temple Meads, Bristol Parkway and Bath Spa have higher frequency, faster services, as they are calling points on national routes. The

[41] Joint Local Transport Plan 4 (2020)
[42] Joint Local Transport Plan 4 (2020)

remaining stations have local stopping services, which national routes pass through but generally do not serve.

1.6.84. The North Corridor has a well-established railway network with five railway stations. There is, however, a gap in provision to the west of the A38 within the North Corridor and the stations in the North Corridor are not directly connected to key destinations, such as Southmead Hospital and Cribbs Causeway.

1.6.85. While Lawrence Hill and Stapleton Road stations fall within the East Corridor, the rail line then continues north to Filton Abbey Wood within the North Corridor. Past Lawrence Hill, the majority of the East Corridor does not have any rail connectivity to the rest of the Mass Transit corridors or indeed to Bristol City Centre.

1.6.86. The South-West Corridor has two railway stations, Bedminster and Parson Street, which connect to Bristol Temple Meads. There is no rail connectivity to Bristol Airport, meaning that access to the Airport is currently limited to car and bus.

1.6.87. The Bristol – Bath Corridor has four railway stations, Bristol Temple Meads, Keynsham, Oldfield Park, and Bath Spa. Services between Bristol Temple Meads and Keynsham run hourly, with services between Bristol Temple Meads and Bath Spa running four or five times an hour. These rail services continue beyond Bristol and Bath in either direction, and are therefore used heavily for longer trips, in addition to trips within the corridor.

1.6.88. Oldfield Park is located to the west of Bath City Centre. This station is served by many of the non-London Paddington services to and from Bristol Temple Meads. Although stopping patterns vary throughout the day, these are generally hourly. According to the *Current and Futures Report*, customers at Bath Spa and Oldfield Park stations are generally dissatisfied with the availability of seats, frequency, and punctuality of services.

1.6.89. The future development of services around Bath is limited by the constrained line capacity between Bathampton Junction (northeast of Bath Spa) and Bristol Temple Meads. This twin-track section provides for a mixture of stopping and non-stop passenger services as well as freight. This therefore poses limitations in terms of increasing the frequency of stopping services between Bristol and Bath.

1.6.90. The region has aspirations to develop the railway network further, with schemes, including a station at Saltford, an expanded MetroWest offering, and a proposed stop at St Annes Park station in various stages of consideration. These are expected to complement Mass Transit and provide users options to best suit their needs.

Bus Services

1.6.91. Approximately 70m passenger journeys were made on bus services within the West of England[43] in 2020/21. With the exception of Bristol, compared to other core city regions in the UK, the number of trips made per head by local authority is comparatively low[44]. The different authority areas are shown in Table 1-6 as follows, compared to other core city regions across the UK.

Table 1-6 – Annual bus trips per head by local authority

Local Authority	2015/16	2016/17	2017/18	2018/19	2019/20
B&NES	69.9	65.8	63.1	76.7	62.3
Bristol	79.5	86.1	83.6	92.3	87.0
North Somerset	28.7	36.5	35.7	25.9	24.4
South Gloucestershire	32.1	38.2	37.3	32.9	29.5
Average for West of England authorities	52.6	56.7	54.9	57.0	50.8
Other core city regions in the UK					
Tyne and Wear ITA	104.2	101.9	96.9	98.7	93.0
Greater Manchester ITA	74.5	72.3	69.5	67.3	62.6
West Midlands ITA	94.1	92.0	89.2	89.7	84.2

1.6.92. There are a number of bus services operating along the corridors, which connect the city centres with surrounding neighbourhoods, communities and key destinations. Bus services throughout the region are provided by multiple operators, predominantly First Group. A full list of services and their frequencies in the study area is included in Appendix A.

1.6.93. With regard to facilities, Bristol Bus & Coach Station (co-operated by First Group and National Express) is located in central Bristol – 1.5km north-west of Bristol Temple Meads railway station (approximately a 20-minute walk or a 12-minute bus trip). The site is located off St James Barton Roundabout, where the A38 (The Haymarket), A38 (North Street)

[43] Local bus passenger journeys (BUS0109), Department for Transport
[44] Table BUS0110a Passenger journeys on local bus services per head by local authority. England from 2009/10, Department for Transport

meets the A4044 (Marlborough Street) and B4051 (Bond Street). Pedestrian access to the site via Whitson Street is not currently well-signed, and congestion around the coach station can provide challenges.

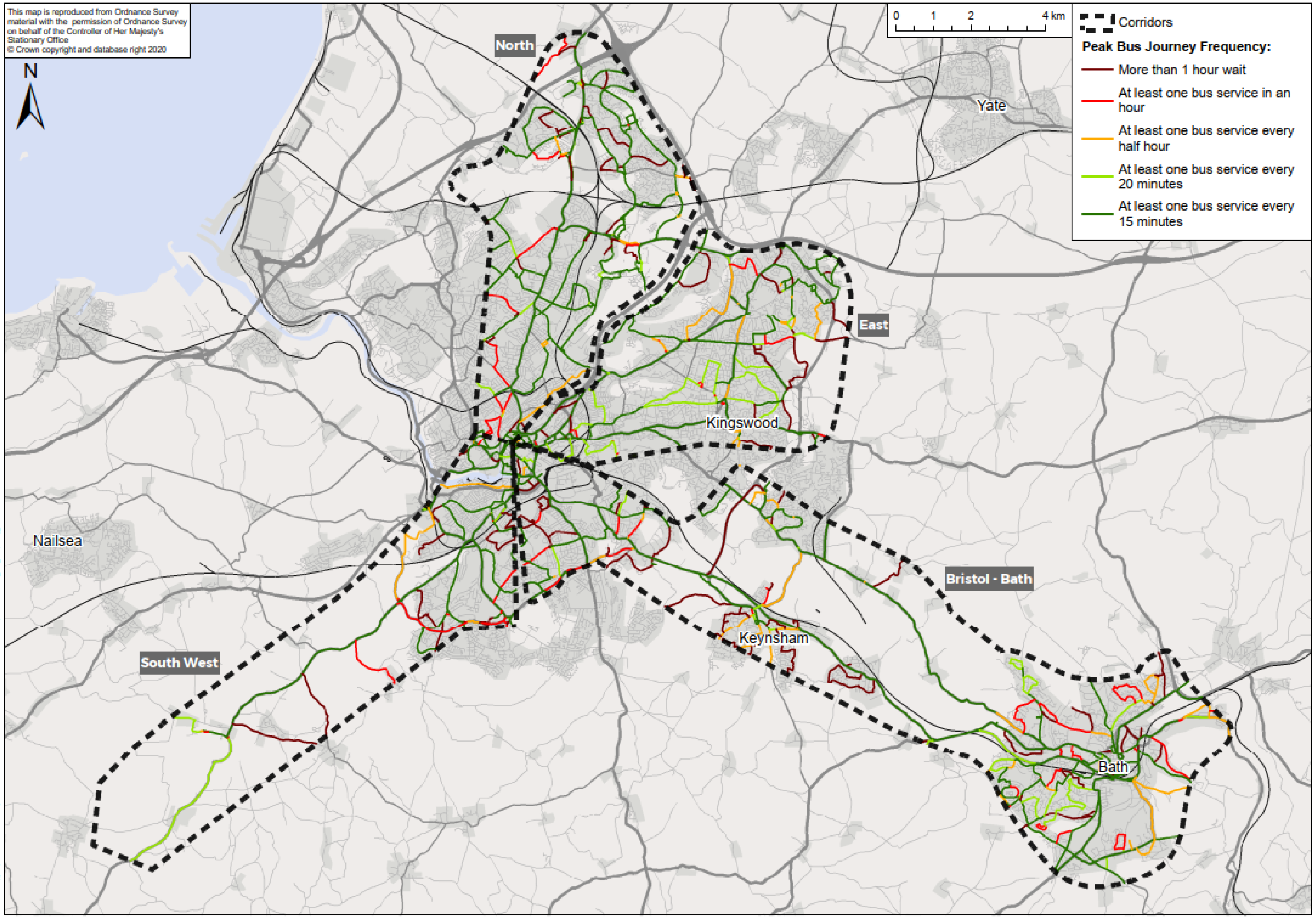
1.6.94. Bath Bus Station (operated by First Group) is located in central Bath, adjacent to Bath Spa railway station (less than 100m, approximately a 1-minute walk) and opposite Southgate Shopping Centre, providing multi-modal interchanges. The site is located off the pedestrianised Brunel Square on the A3039 (Dorchester Street). Access to the site for users is step-free and well-signed, however due to its central location, parking and drop-off facilities are not available.

1.6.95. Work on a new £6.8m bus interchange in Weston-super-Mare began in January 2022.

1.6.96. JLTP4 reported that only 1% of respondents strongly agreed that bus services were reliable whilst other issues highlighted included poor rural connectivity and difficulty planning journeys. Further information on this consultation can be found in section 2.6.3.

1.6.97. The peak hour frequency of bus services across the corridors based on July 2022 data is shown in Figure 1-15. The main arterial routes along each corridor have at least one bus service every 15 minutes, but this is largely a result of overlapping services with lower frequencies, which continue outside of the main A-roads, as indicated by the orange and red lines.

Figure 1-15 - Peak Hour Service Frequency (based on Tuesday AM period for July 2022)



Bus Accessibility

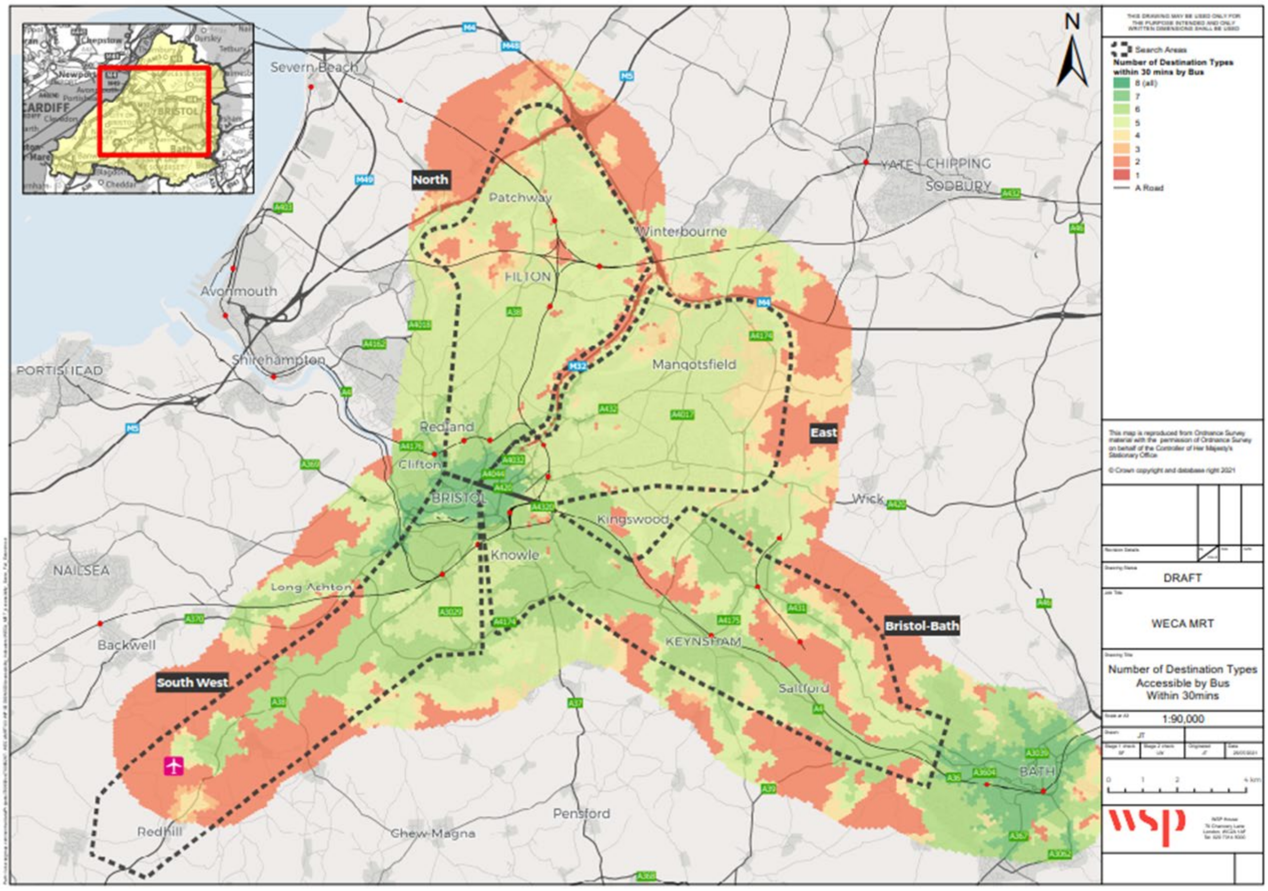
1.6.98. As part of the options assessment process for the OAR, an assessment was undertaken to establish the extent to which key destination types were accessible within a 30-minute bus journey on the four corridors. Using TRACC software, bus journey times were assessed from origin points within the corridor to eight destination types:

- Bus / coach stations
- Railway stations
- Park and Ride sites
- Employment sites
- Hospitals
- GP / healthcare facilities
- Primary schools
- Secondary schools

1.6.99. At the point of analysis, public transport accessibility was highest within Bristol City Centre, with seven of the destination types accessible within 30 minutes. As shown in Figure 1-16, access decreases in line with distance from the city centre, with those at the edge of corridors often having access to only one or two destination types within the given window.

1.6.100. This pattern was broadly similar across the corridors, offering clear opportunities for improved access to destination and services.

Figure 1-16 - Destination Types Accessibly by Bus within 30 minutes



Metrobus

1.6.101. The national policy document *Bus Back Better* showcases Bristol's metrobus network as an example of how buses have been successful. The metrobus is a bus-based rapid transit network that was launched in the West of England in 2018-19. It offers faster, limited stop journeys, with an emphasis on quality and reliability. There are 90 metrobus stops with new high-profile shelters and 'iPoints' that provide real-time information and sell tickets. The network uses new low-emission biomethane buses in a bespoke livery, and all ticket sales take place off-bus to ensure quick boarding.

1.6.102. Existing metrobus services are:

- m1: Cribbs Causeway to Hengrove Park
- m2: Long Ashton P&R to The Centre
- m3 / m3x: Emerson Green to The Centre
- m4: Bristol Parkway to The Mall at Cribbs Causeway (from 2023)

1.6.103. The m1 service currently operates between the North Corridor and south Bristol, serving some of the South-West Corridor. It provides an express service along the M32 and serves key destinations such as UWE, Cribbs Causeway, Bristol City Centre, Bedminster and Hengrove Park. The service operates on average every 12 minutes and costs £2.20 for a single ticket and £5.30 for a day ticket. The m2 service also serves part of the South-West Corridor, stretching out from the city centre to Long Ashton Park & Ride. The m3, which operates every 10 minutes, connects Emerson Green and UWE (on the East Corridor) to Bristol City Centre.

1.6.104. The upcoming m4 service intends to provide a link between Bristol Parkway Station and The Mall at Cribbs Causeway, benefiting communities in Stoke Gifford, Patchway and the forthcoming development on the former Filton Airfield.

1.6.105. There are no metrobus services along the Bristol – Bath Corridor.

1.6.106. The metrobus is a successful bus service in the region and provides strategic links between key destinations in the area. This is partly accomplished by taking more express routes, e.g., along the M32 instead of the A38(N). The routes taken by the metrobus services, however, serve fewer dense residential areas in the region, which do not benefit from services of equally high quality.

Park and Ride Sites

1.6.107. There are currently five Park & Ride (P&R) sites within the corridors:

- **Brislington P&R** is located to the west of Hicks Gate Roundabout within the Bristol – Bath Corridor. Brislington P&R currently offers 1,300 spaces and is open Monday to Saturday 05:15 – 22:40
- **Newbridge P&R** is located to the west of Bath City Centre in the Bristol – Bath Corridor. 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
- **Long Ashton P&R** is located within the South-West Corridor. The site currently offers 1,500 spaces and is open Monday – Saturday, 05:00 – 22:30, with service running between 06:00-22:20
- **Lyde Green P&R** is located within the East Corridor. The site currently offers 246 spaces and is open Monday to Sunday, from 05:30 – 22:45, with services running between 05:45-22:20
- **Parkway North** is located within the North Corridor. The site currently offers 210 spaces and is open 24 hours a day. Services run between 07:12-20:30 Monday to Friday, 09:17-20:40 on Saturdays and 10:01-20:30 on Sundays

1.6.108. Under JLTP4, improvements to the Newbridge P&R are planned as part of a sustainable travel package for Bath.

Airport Services

1.6.109. Bristol Airport is connected to the region via three services:

- A1 Bristol Flyer: express bus service linking Bristol Airport with central Bristol that operates every 20 minutes
- A3 Weston-super-Mare Flyer: express bus service linking Bristol Airport to Weston-super-Mare which operates hourly

- A4 Air Decker: bus service linking Bristol Airport to south Bristol, Keynsham and Bath Flyer which operates hourly

1.6.110. Patronage on services between Bristol Airport and central Bristol grew by 7% between 2018 and 2019. The increase in patronage has been supported by service improvements, such as the A2 service beginning in October 2018. Following the coronavirus pandemic, the A2 was later suspended, and the A1 service extended to provide the connection into Bristol City Centre.

Travel Patterns

1.6.111. This section considers the current situation journey patterns (investigating origin-destination information and key locations with regard to employment and tourism) and behaviours (with regard to mode share and traffic volumes), and highway safety in the study area. In recognition of the limitations around the *2011 Census*, a separate exercise was also undertaken to assess existing demand along the Mass Transit corridors by analysing 2019 mobile telephone (Telefonica) data (see 2.6.10).

Origins and Destinations

1.6.112. *2011 Census* Origin and Destination (OD) datasets provide the location of usual residence and place of work.

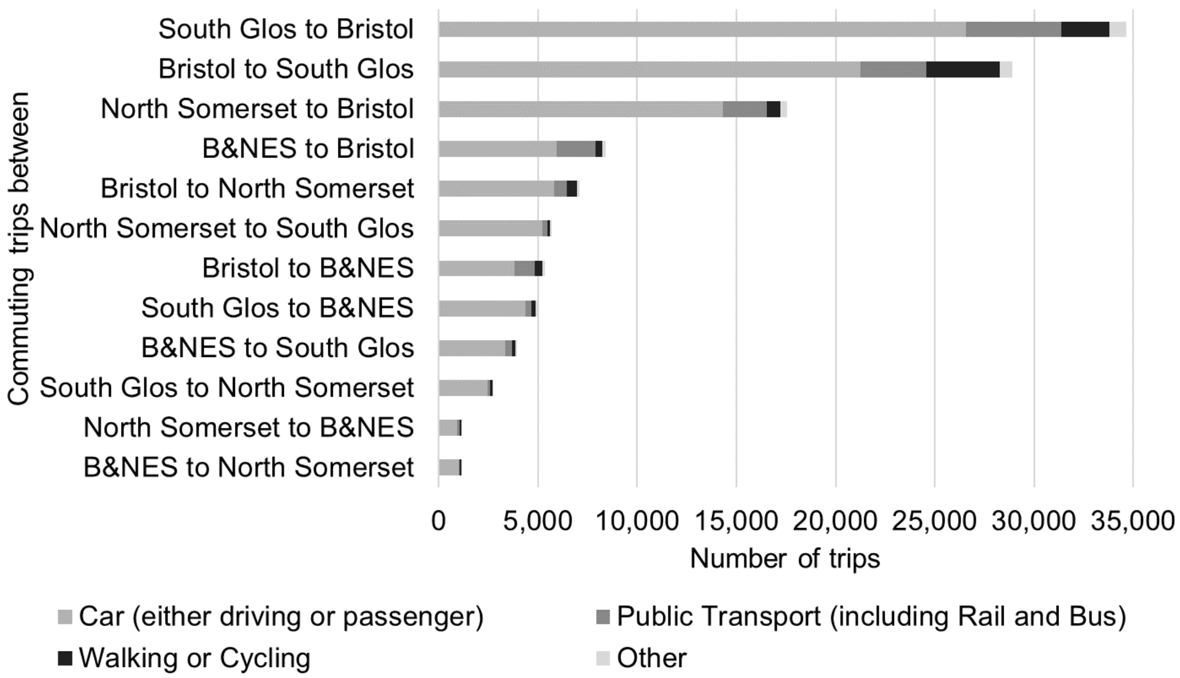
1.6.113. 58% of commuting trips for South Gloucestershire and North Somerset occur within the county, which increase to 65% and 69% for Bath and North East Somerset and Bristol respectively.

1.6.114. Just under 10% (42,521) of the commuting trips originating from the four UAs are going outside of the region, while 458,497 commuters to the region come from outside the four UAs. 202,492 of commuting trips from outside of the region are towards Bristol, and an additional 118,823 are towards South Gloucestershire. Many of those trips will involve travelling along the Mass Transit corridors, as they all converge in Bristol.

1.6.115. Figure 1-17 illustrates the total person trips between the UA areas and how these are split between different travel methods. Six of the eight highest commuting movements are to or from Bristol, and four are to or from South Gloucestershire, aligning with the distribution of jobs discussed in section 1.6.36. Some of the lowest numbers of commuting trips are between North Somerset and Bath and North East Somerset and South Gloucestershire and Bath and North East Somerset.

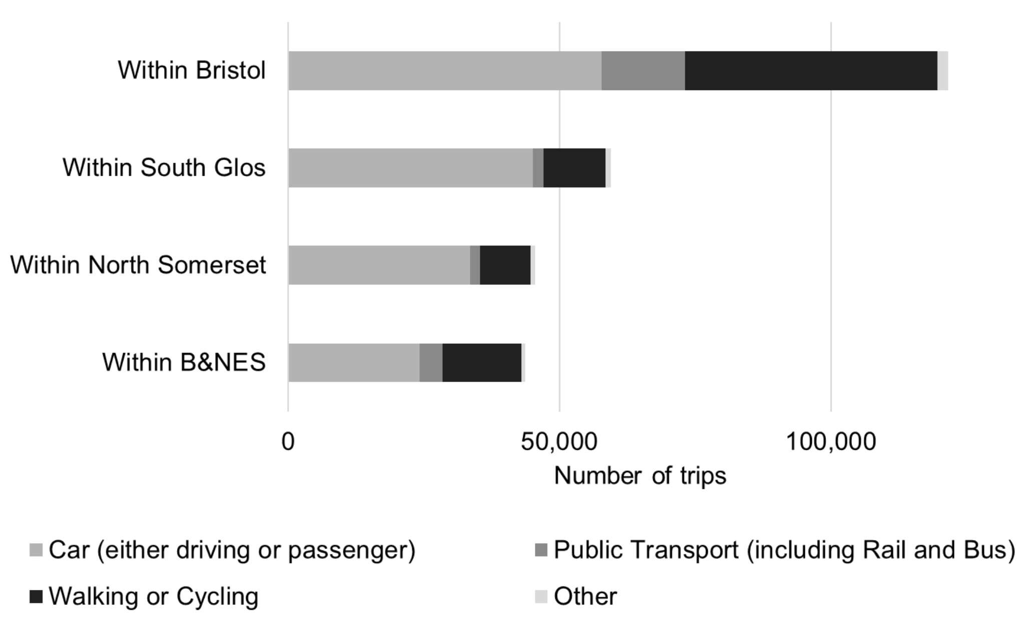
1.6.116. Overall, 78% of all commuting trips between different UA areas are by car, with public transport trips representing only 6% and active travel 7%. The highest public transport modal share is between Bristol and Bath and North East Somerset at 21%. Of these public transport trips, 64% (1,823 trips) are by rail.

Figure 1-17 - Total person trips made between unitary authority areas by method of travel, 2011 Census



1.6.117. When considering commuting trips within each UA area, as shown in Figure 1-18, the modal share is significantly different, with on average 30% of the trips made by walking or cycling.

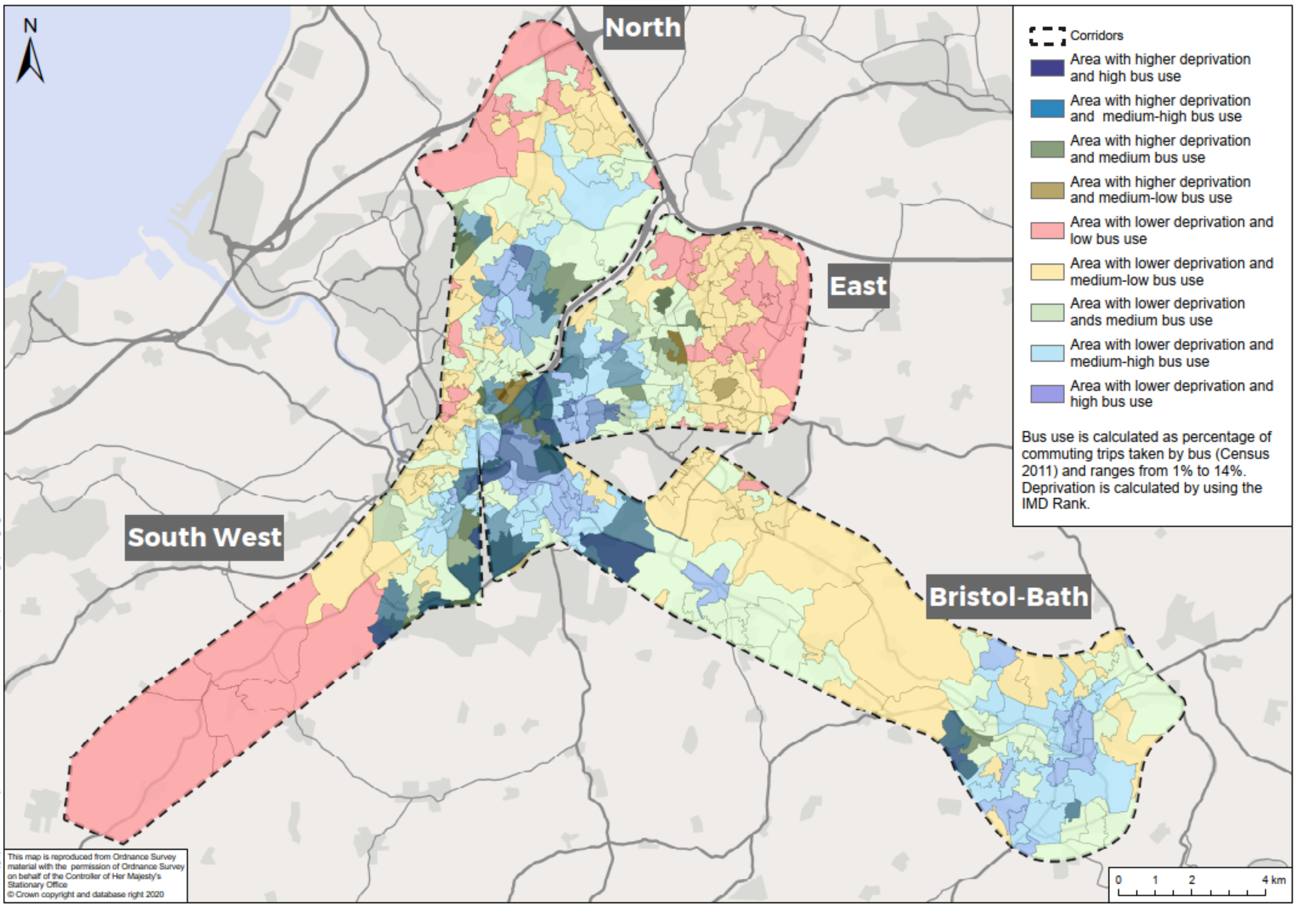
Figure 1-18 - Total person trips made within unitary authority areas by method of travel



1.6.118. While overall public transport usage for commuting is low at an average 9%, Figure 1-19 illustrates the link between bus use and deprivation in the study area, with the majority of higher deprivation areas having high bus use for commuting. There is a likely link between deprivation and car availability, with a 68% correlation between household deprivation rank and the lack of access to a vehicle. These communities therefore need reliable access to public transport services.

1.6.119. Those locations with higher bus use also tend to be five to ten kilometres away from high-employment areas (Figure 1-5).

Figure 1-19 - Distribution of bus use and deprivation



1.6.120. Figure 1-20 shows the composition of commuting trip lengths both within the same UA and between UAs, and Figure 1-21 shows the modal split of these trips.

1.6.121. There are more shorter distance commuting trips undertaken within a UA area. 35% of commuting trips within a UA area are less than 2km, and a further 37% are between 2 - 5km. However, only 39% of trips within UAs are via public transport or active modes; a significant proportion of these shorter distance trips are made by car.

1.6.122. As would be expected, commuting trips between UA areas tend to be longer in length, with half of these trips over 10km and an additional 34% between 5-10km. 78% of commuting trips between UAs are by car, and only 13% by public transport or walking or cycling.

Figure 1-20 - Length of commuting trips in the region, Census 2011

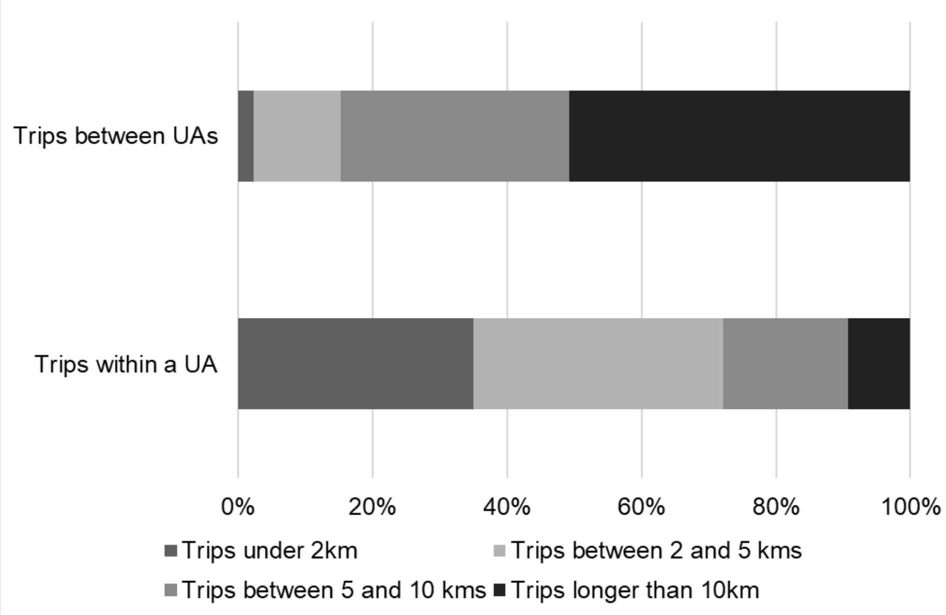
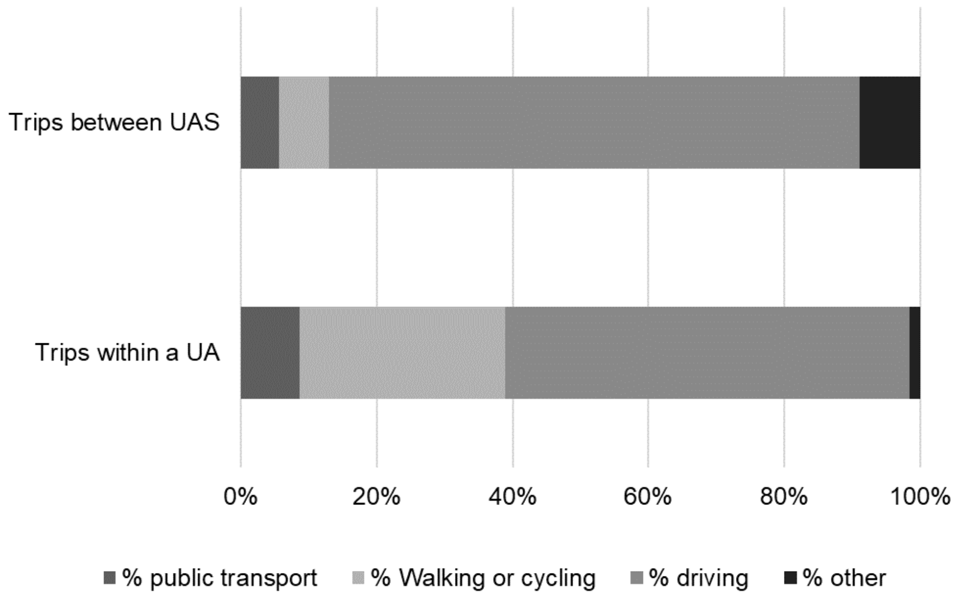


Figure 1-21 - Modal split of commuting trips within the region, Census 2011



Environmental Context

Carbon and the Climate Emergency

1.6.123. At a national level, transport is the largest contributor to the UK's domestic greenhouse gas (GHG) emissions, responsible for 27% in 2019. The same remains the case in the West of England, with transport responsible for 32% of emissions in the region.

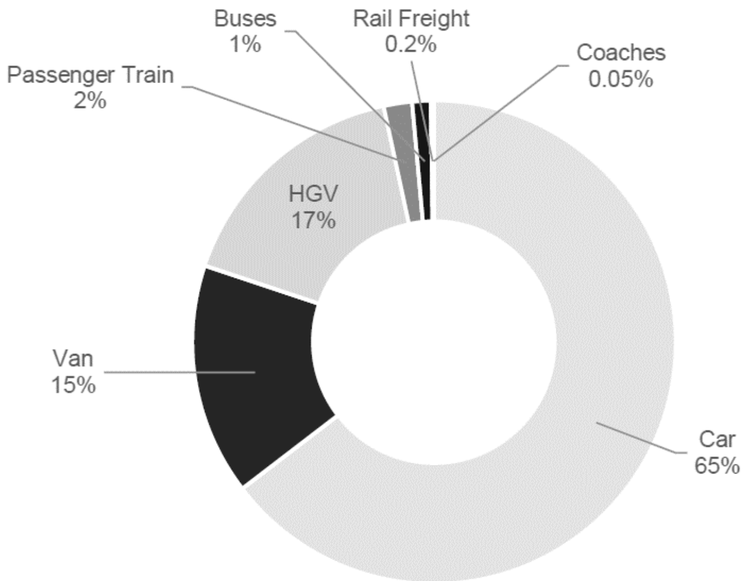
1.6.124. In recognition of the need for urgent action to address the challenge of climate change, and in recognition that transport-related emissions had only fallen by 5% across the area since

2005, a ‘Climate Emergency’ was declared by the Combined Authority and each of the UAs in 2019. In doing so, a commitment was made and captured in the *West of England Climate Emergency Action Plan* to work towards delivering net zero carbon by 2030, 20 years in advance of central Government targets. Additional detail on the various climate emergency action plans produced by the UAs can be found in section 2.3 and Appendix B.

1.6.125. JLTP4 was adopted by the West of England Joint Committee in March 2020 and sets the strategic direction for the transport network up to 2036. It states that “a reduction in transport emissions has been achieved over the last decade through improved fuel efficiency and some mode shift”, but that there is a significant risk of this trend reversing due to population growth. Major action is required to hit the ambitious 2030 target.

1.6.126. Figure 1-22 provides a breakdown of carbon emissions by mode in 2019. Across all authorities, road transport generates the highest proportion of carbon emissions, with over two-thirds of emissions generated through private vehicle use.

Figure 1-22 – Proportion of carbon emissions (tCO2e) by mode



1.6.127. In light of this, as well as new guidance on Local Transport Plans expected from the DfT in 2023 that will stress the need for robust, measurable plans for decarbonisation, the Combined Authority plans to produce an addendum to the JLTP4, informed by quantified analysis of how emissions will change throughout the JLTP4 period. This analysis is already underway and will inform the Combined Authority’s infrastructure plans going forward.

1.6.128. To meet the demands of net zero by 2030, behaviour change is vital. This will need to include reducing the number of car trips, increasing the uptake of low carbon vehicles and creating a transformational change in the use of public transport and active modes[45]. This was recognised as part of JLTP4, which noted that:

> *"To encourage people to move away from cars, we will need to provide transformational alternatives such as a new mass transit network. This may not be enough, so we will also consider ways to manage demand possibly through congestion charging, emissions charging and workplace parking levy-type schemes."*

1.6.129. Additional detail on the proposed Mass Transit scheme's carbon strategy can be found in the *Carbon Management Strategy* and section 6.9 of the Management Dimension.

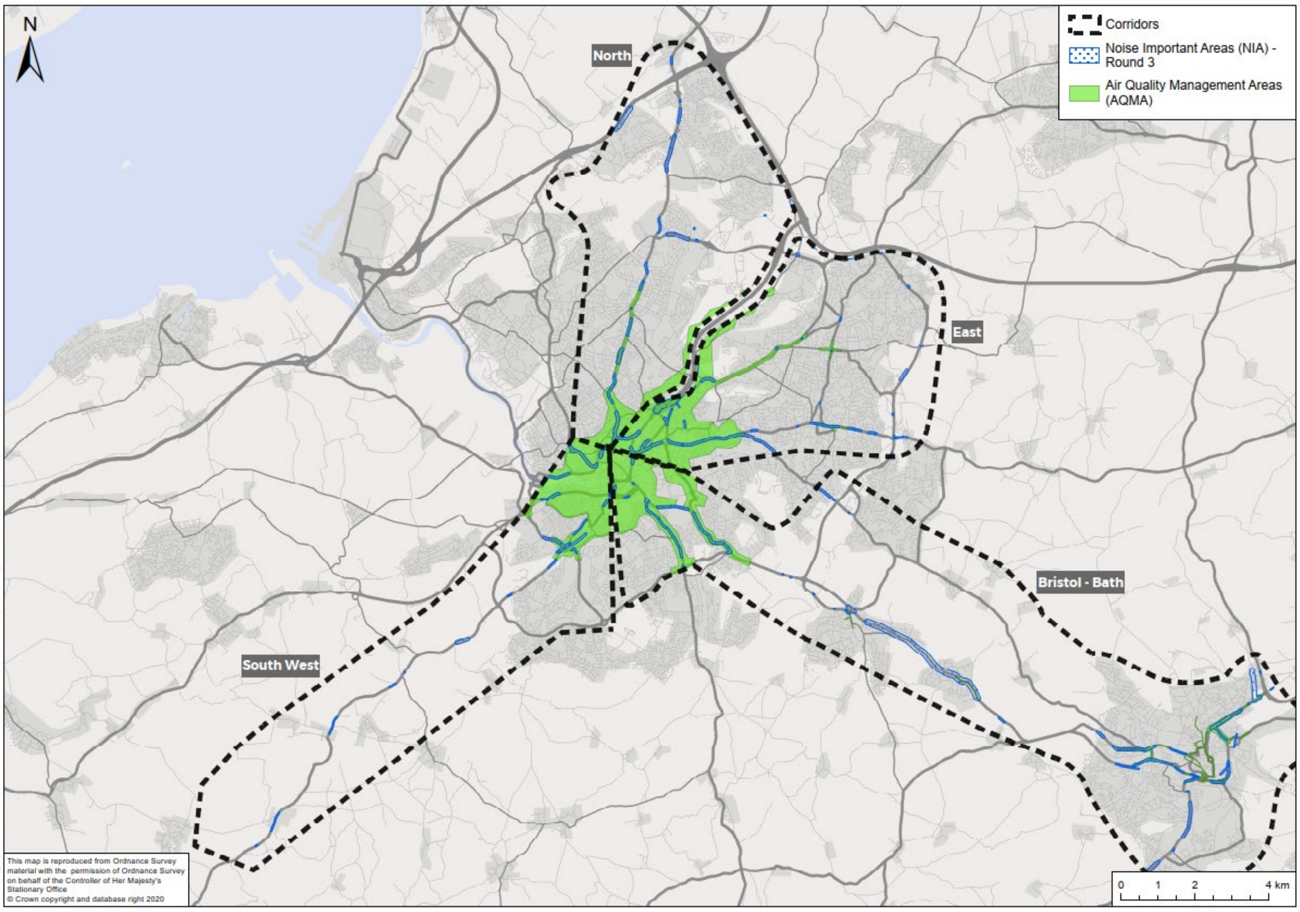
AQMA and Noise Important Areas

1.6.130. Concentrations of pollutants are most elevated and exceed the annual mean nitrogen dioxide (NO2) and particulate matter (PM10) air quality objectives in the Bristol Air Quality Management Area (AQMA). This radiates out from central Bristol following major roads, including the A38, M32, A432, A4 and A37 and covers much of the southern portion of the East Corridor, the northern portion of the South-West Corridor and the western portion of the Bristol – Bath Corridor. There are five Air Quality Management Areas (AQMAs) in B&NES where levels of NO2 exceed the national annual average.

1.6.131. Figure 1-23 captures the AQMAs and Noise Important Areas (NIA) within the study area.

[45] West of England Climate Emergency Action Plan, 2020

Figure 1-23 - AQMA and NIA



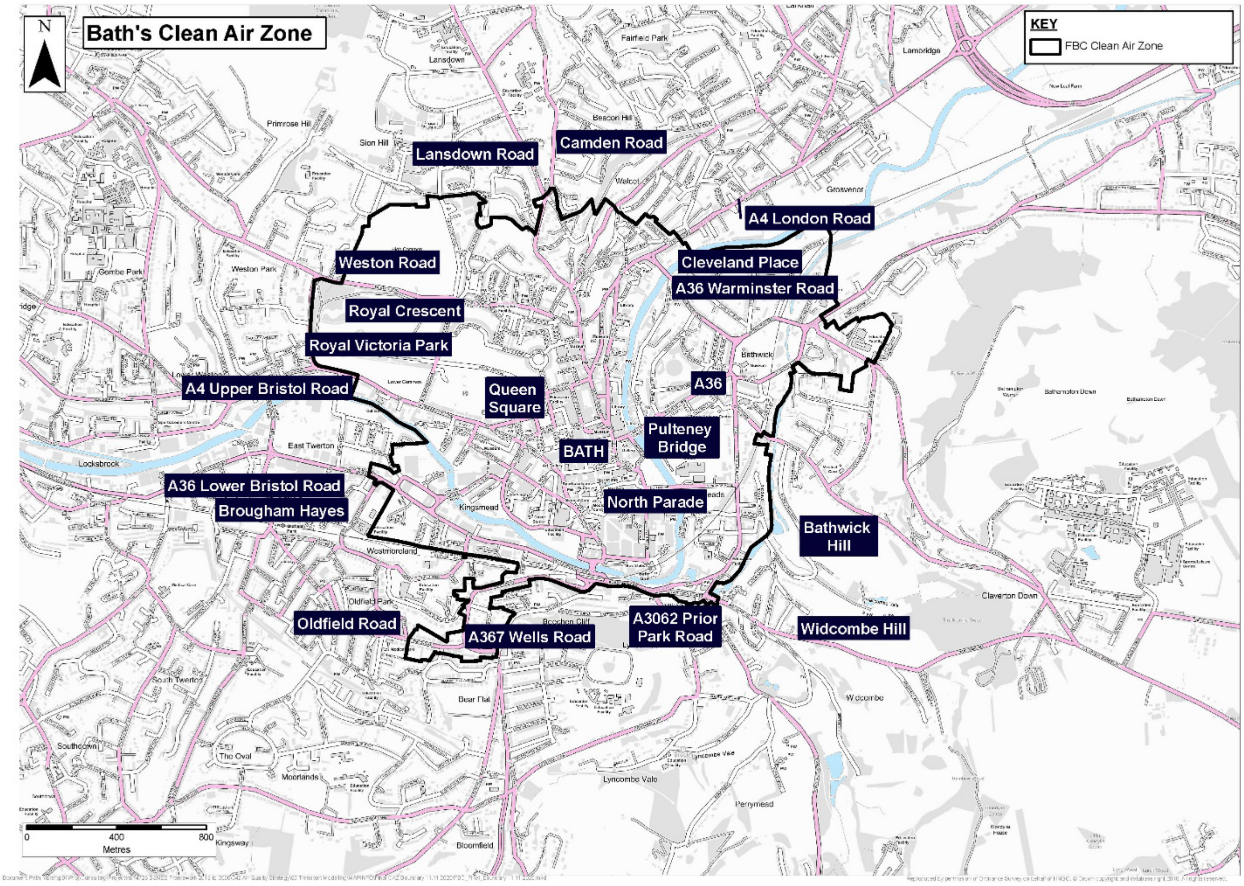
1.6.132. Bath's Clean Air Zone (CAZ), shown in Figure 1-24, became operational on 15 March 2021. Drivers now have to pay a daily charge to drive in the zone if their vehicle does not meet required emission standards. Private cars and motorbikes are not being charged in Bath's CAZ, regardless of emissions (i.e. Class C CAZ). The zone covers the city centre.

1.6.133. The *April-July 2021 Monitoring Report* identified that the CAZ is having its intended effect and improving the city's air quality through changing travel behaviours. The average nitrogen dioxide concentrations across monitoring sites within the CAZ were found to be 12.6% lower than the same period in 2019[46], with similar reductions found in the Bath urban area outside the zone's boundary. Traffic flows are 9% lower in the CAZ area compared with the same period in 2018, although it is noted that the coronavirus pandemic continues to impact on travel behaviours. More work, however, remains to be done, with three

[46] https://beta.bathnes.gov.uk/sites/default/files/Bath%20Report%20Aug%202020%20-%20Final%20edited.pdf

locations still exceeding the required legal limits (Dorchester Street, Queen Square, Wells Road/Wellsway).

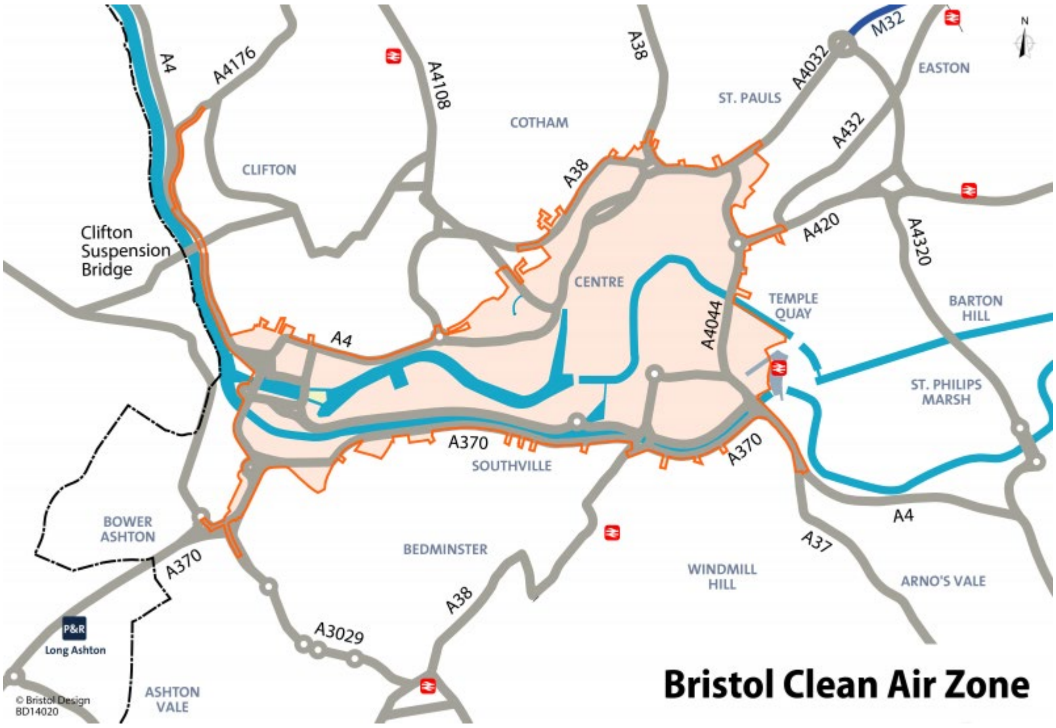
Figure 1-24 - Bath Clean Air Zone



1.6.134. Bristol's CAZ came into effect in November 2022. A daily charge applies to older and more polluting vehicles driving in the zone and is intended to encourage drivers and businesses to update their vehicles, change their travel patterns, or negate the trip in its entirety.

1.6.135. Revenue generated through this will be reinvested back into the local community, supporting individuals and businesses to switch to cleaner vehicles, ongoing work to make it easier to walk and cycle, and the introduction of green public transport. The zone, which covers the Cumberland Basin and the Portway, as well as those areas where air quality is the worst and targets can be met in the shortest possible time, is shown in Figure 1-25.

Figure 1-25 - Bristol Clean Air Zone



Noise Important Areas

1.6.136. The number of NIAs – those areas exposed to the highest levels of noise in each of the corridors, are:

- 36 NIAs concentrated towards the western section of the East Corridor, associated largely with traffic on A-roads, including the A4044, A4032, A420 and A431 as well as the M32, and some rail movements
- 28 NIAs concentrated at the northern, eastern, and southern sections of the North Corridor, predominately associated with traffic on the A-roads, including the A38 and the motorway network
- 23 NIAs concentrated at the north-eastern corner of the South-West Corridor, predominately associated with traffic using A-roads, including the A38 and A4018, and some rail movements
- 19 NIAs concentrated towards the north-western and south-eastern sections of the Bristol – Bath Corridor, predominately associated with traffic on A-roads, including the A4 and A37

1.7 Description of the Scheme / Scope

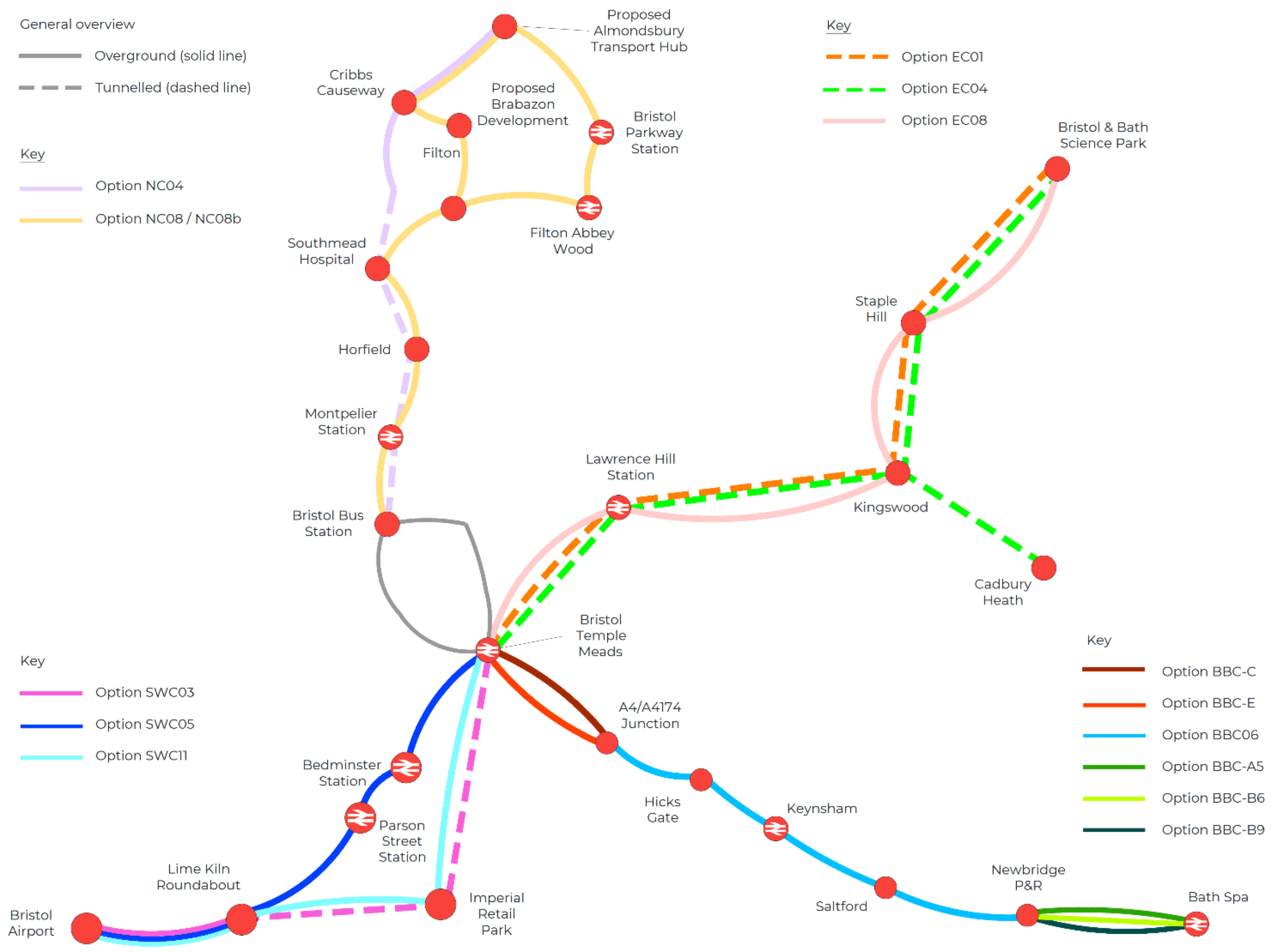
1.7.1. The proposed Mass Transit scheme will be a programme of works to deliver a transformational public transport network across four corridors in the West of England, which are linked within Bristol City Centre:

- North Corridor (Bristol City Centre – Proposed Almondsbury Transport Hub)
- East Corridor (Bristol City Centre – Bristol & Bath Science Park)

- Bristol – Bath Corridor (Bristol City Centre – Bath Spa railway station)
- South-West Corridor (Bristol City Centre – Bristol Airport)

1.7.2. The shortlisted corridor options are shown in Figure 1-26. It is expected that the corridors will be phased into a number of work packages, each of which will contribute to the improvement of the network as a whole. As these packages are broken down into discrete Outline Business Cases, they will be accompanied by first-mile-last-mile solutions to increase access to the network and encourage mode shift. A *Biodiversity Net Gain Strategy* is also being developed for Mass Transit, which will be taken into account as further detailed design is undertaken and a preferred set of options is established.

Figure 1-26 - Shortlisted Mass Transit Options



1.7.3. This SOC is based on a fully segregated, 3.2m-wide corridor in each direction, which allows the proposed mass transit system to run separated from general traffic, frequently and reliably. Both overground solutions and solutions with significant tunnelled components have been explored across four possible modes, broken down into two broad categories:

- Rubber-wheeled solutions: Bus Rapid Transit, Trackless Light Transit
- Steel-wheeled solutions: Very Light Rail, Light Rail Transit

1.7.4. The proposed scheme will also include transport improvements to Bristol's City Centre, combining the four corridors into a cohesive network. Three illustrative networks have been assessed to give a better understanding of the potential scale of influence. These are for appraisal purposes only, with no further options having been removed from shortlisting at this stage. These networks should not be interpreted as the final options for the scheme.

- Network #1 (Figure 1-27)
  - Connecting the East corridor (EC08) with the South-West Corridor (SWC11)
  - Connecting the North corridor (NC08b) with the Bristol – Bath Corridor (BBC-C+BBC06+Bath A5)
  - Bristol City Centre Option B
- Network #2 (Figure 1-28)
  - Connecting the South-West Corridor (SWC11) with the North Corridor (NC08b)
  - Connecting the East Corridor (EC08) with the Bristol – Bath Corridor (BBC-C+BBC06+Bath A5)
  - Bristol City Centre Option E
- Network #3 (Figure 1-29)
  - Connecting tunnelled options on three corridors (NC04, EC04, SWC03) with the overground Bristol – Bath Corridor (BBC-C+BBC06+Bath A5)

Figure 1-27 – Network #1

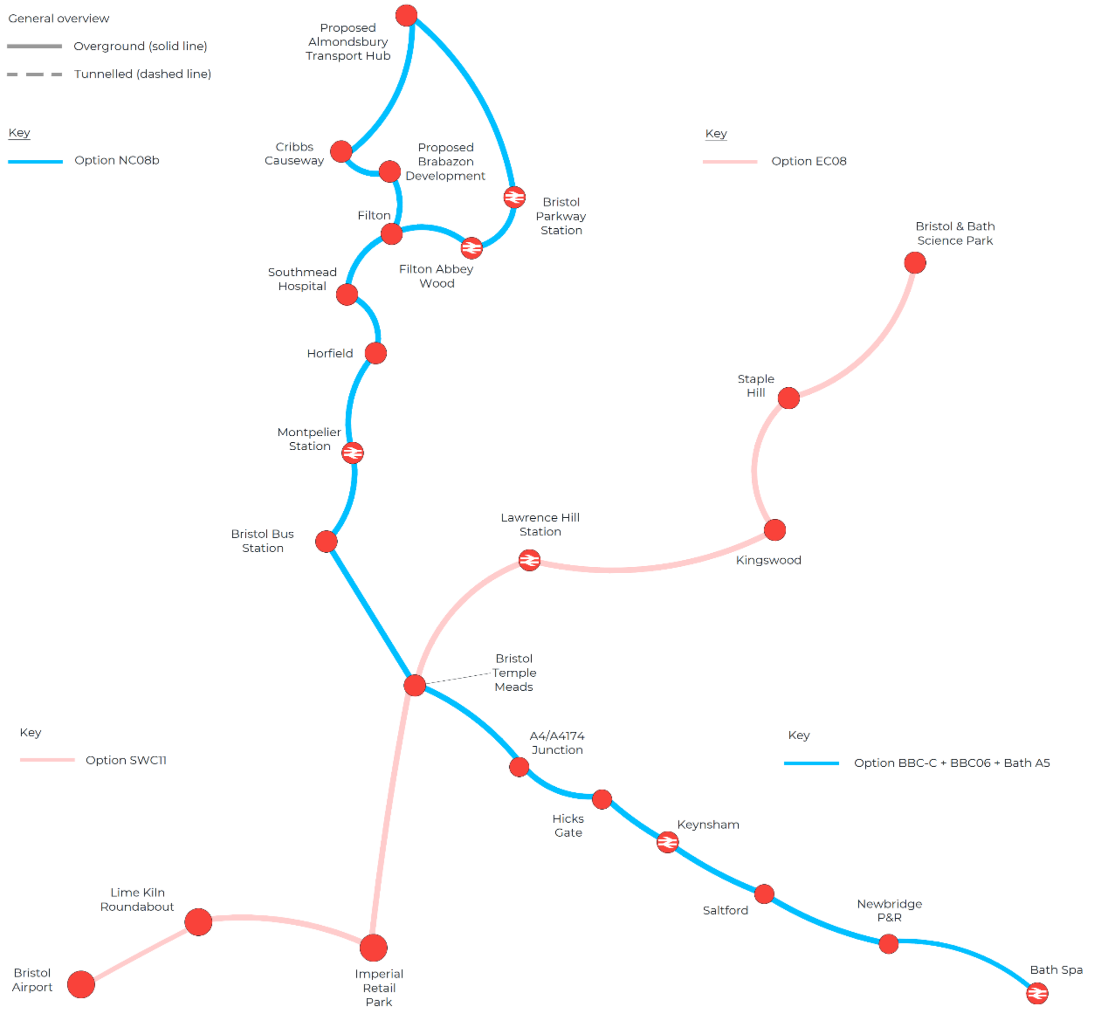


Figure 1-28 - Network #2

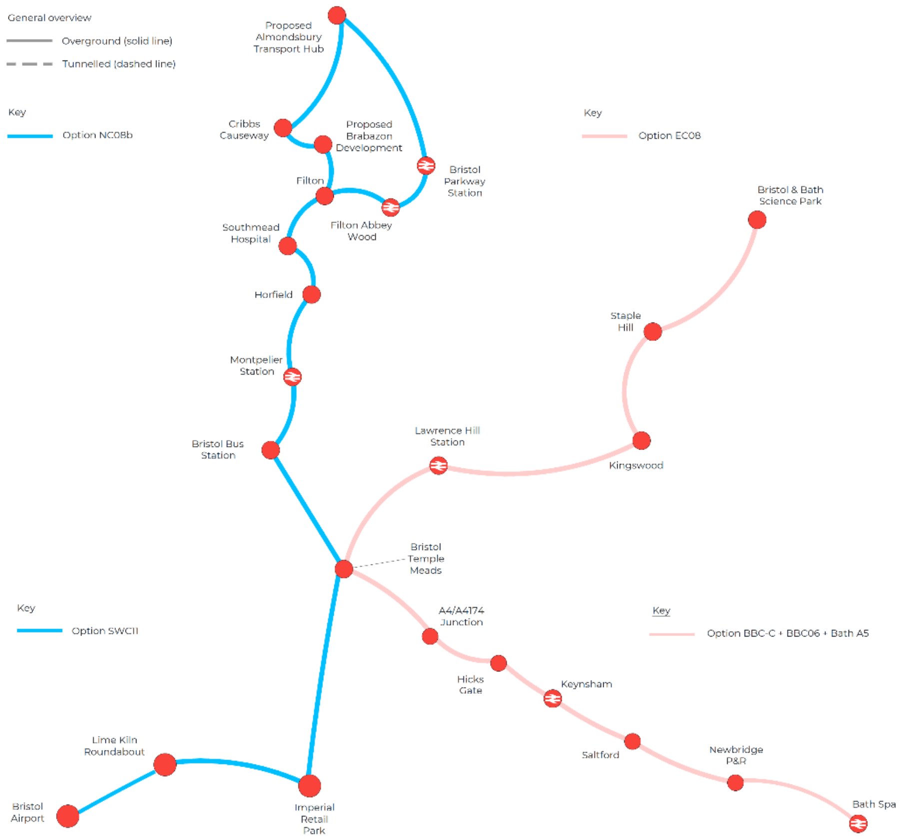


Figure 1-29 – Network #3

1.7.5. A geographical map of these options can be found in Appendix C.

1.7.6. Additional detail on the design of each of the four corridors can be found in the *Feasibility Design Summary Report*. The *Integrated Service Plan* (ISP) explores connectivity in Bristol City Centre, operational characteristics, and the development of network options. Information on potential phasing solutions can be further explored in the *Phasing Strategy*.

1.8 The Five Dimensions

1.8.1. The business case is made up of five separate yet interwoven dimensions. Together these set out that:

- There is a robust case for change that is closely aligned to strategic, regional, and local policy objectives – **the Strategic Dimension**
- The scheme provides value for money – **the Economic Dimension**
- The scheme is affordable – **the Financial Dimension**
- The scheme is commercially viable – **the Commercial Dimension**
- The scheme is achievable in practical terms, and how it will be managed to ensure it achieves its objectives – **the Management Dimension**

1.9 Summary of the Strategic Dimension

Strategic Fit

1.9.1. The proposed Mass Transit scheme is closely aligned with national, regional and local policies and plans, contributing to shared goals of decarbonisation and levelling up pockets of regional deprivation.

1.9.2. The scheme is designed to provide a step-change in public transport connectivity in the West of England, shifting users away from private car use, which is currently dominating the region, and onto a combination of attractive and convenient public transport and first-mile, last-mile active travel solutions that link housing and employment opportunities.

1.9.3. A transformational mass transit solution has been identified in the region's Joint Local Transport Plan, noting that road space should be reallocated to modes of transport that carry people more efficiently. This mode shift is fundamental in addressing the region's ambitious climate aspirations, which seek to achieve carbon neutrality by 2030.

1.9.4. Addressing existing congestion and connectivity challenges will create a more resilient network that offers access to opportunities for all as plans for 65,000 new jobs by 2030 and 6,000 new houses a year are realised.

Need for the Scheme

1.9.5. The main problems that the proposed scheme aims to address are:

- **Climate emergency** – reducing transport-related emissions in the region by reducing the number of private car journeys
- **Low public transport use** – creating a public transport system with increased connectivity that improves public perception of unreliable, infrequent, and expensive services, thereby shifting trips away from private car use
- **Barriers to walking and cycling** – making active travel a preferred choice by reducing conflicting traffic on direct routes and linking public transport with walking and cycling for end-to-end journeys
- **Congestion and delay** – addressing current and predicted congestion and delay on the region's radial routes, which results in poor associated **environmental externalities**
- **Safety** – reducing accidents, particularly with regard to vulnerable road users, where the number of collisions is higher in highly congested areas
- **Regional inequality and deprivation** – addressing the transport challenges experienced by deprived communities without access to private vehicles, and linking current and future housing and employment opportunity sites
- **Enabling regeneration and economic growth** – enhancing recovery efforts and increasing regional labour mobility to unlock clean and inclusive economic growth

1.9.6. If the scheme is not provided, these problems are expected to get worse. Growth in the West of England will come at a price of increased congestion and worsening environmental conditions, as well as a less resilient transport network overall.

1.9.7. The overall aim of the scheme is therefore to deliver a world-class, transformational, public transport system that:

- Connects the West of England region, thereby reducing deprivation and inequality, and contributing to the levelling up agenda
- Supports sustainable, economic growth and enables regeneration
- Contributes to delivering Carbon Net Zero
- Improves local environmental conditions and air quality
- Makes sustainable transport the preferred option for short to mid-distance journeys

1.10 Summary of the Economic Dimension

1.10.1. A robust optioneering process has been followed for the West of England Mass Transit programme, considering route options for each corridor and within the city centre and in parallel potential technology types. The OAR provides the details of the option identification and assessment work that has been undertaken to date. The output of this has been a set of shortlist options that have been appraised as part of the SOC.

1.10.2. The appraisal considers each corridor option and also three networks providing connectivity across the four corridors. These networks are not intended as a final shortlist of options, nor remove any further routes from consideration.

1.10.3. The appraisal has been undertaken for the Mass Transit scheme as specified in the scheme description and reflects a solution that is fully segregated from general traffic from end-to-end.

1.10.4. The VfM of the shortlist options has been assessed in line with DfT's TAG and Value for Money Framework, considering both quantified and qualitative impacts from an economic, environmental and social perspective in the round to provide an overall assessment. Impacts have been considered over a 60-year period, and, where quantified, the costs and benefits have been adjusted to a consistent price base and unit of account to allow comparison between them.

1.10.5. The appraisal at this point has been based on the tools available and is reflective of the early stage of scheme development. It is recognised that the modelling framework used is based on inputs from GBATS / G-BATH, which both have dated base years, and modal shift is not fully reflected within the approach used. This is a known constraint and once WERTM becomes available for use there is an opportunity to revisit the modelling assessment of the Mass Transit options.

1.10.6. The benefits considered within the appraisal at this stage include the journey time and cost impacts on transport users, carbon emissions, decongestion impacts including noise, air quality and accidents and impacts on indirect tax revenues to central Government. It has been assumed that the Mass Transit system would be operated by the private sector, and so the PVB also includes the costs and farebox revenues associated with the operation. The costs of delivering the scheme are assumed to be incurred by the public sector and Therefore form part of the PVC.

1.10.7. Overall, based on its current scope and available modelling framework, it is suggested that a fully segregated version of the scheme with current demand offers very poor to poor VfM. The appraisal of the scheme demonstrates the challenges associated with delivering a fully segregated system in a constrained urban area. Although all options deliver against the objective of journey time benefits for public transport users, for the options that are predominantly overground the level of impact on the highway network is substantial. For options with a tunnelling component, however, there are significant associated capital costs and generating benefits of the same magnitude is difficult.

1.10.8. Sensitivity tests show that there is the potential for an overground Mass Transit network to deliver medium value for money based on only the monetised impacts. This is achieved under a scenario where there is high demand and the impacts on remaining highway users are not considered in the monetised appraisal. This test is suggestive of the fact that the ways in which people travel are likely to change significantly in the coming years with further policy measures to reduce the use of private car and increase sustainable travel modes. These measures would form part of wider demand management strategies across the region, and will be considered at future stages of the project. Under this test, the remaining uplift required in the PVB of an overground network to achieve high VfM is ~£80m (2010 PV), this is prior to the potential contribution of any wider economic impacts or non-monetised impacts. The remaining sensitivity tests, linked to reductions in costs, lower demand scenario and reduced demand at off-peak times have a lesser impact on the BCR for each network.

1.10.9. High-level consideration of potential wider economic opportunities shows that, were a viable solution for both public transport and highway users to be implemented, sizeable productivity and land value benefits could arise from the successful delivery of a mass transit system. This analysis shows the potential scale of change that a mass transit system could deliver. At this stage these impacts have not been estimated following the detailed approaches outlined in TAG; more detailed work would be required as the scheme develops.

1.10.10. A scheme of this nature, scale and coverage is anticipated to have both place-based and distributional impacts. Going forwards to OBC these assessments would be undertaken.

1.10.11. The appraisal is based on the current specification and assumptions of the Mass Transit system concepts, which were established by the Combined Authority at the start of the SOC stage. At this stage a fully segregation solution has been considered for the extent of the route in order to maximise potential system user benefit, but with a corresponding impact on both costs and non-user impacts. To meet the VfM requirements at the OBC stage, it is likely to require consideration of value engineering, measures to reduce private car use and increase demand on the Mass Transit system, detailed consideration and quantification of wider economic impacts attributable to the scheme and careful consideration of the phasing of corridors and work packages. The Strategic Outline Case Addendum sets out early-stage value engineering analysis that indicates the direction of travel between SOC and OBC for this aspect. This early-stage analysis has demonstrated the potential benefits which undertaking value engineering will have, seeking to balance the challenges identified within this SOC between the costs of operating underground and the impacts at surface level of above ground operation.

1.11 Summary of the Financial Dimension

1.11.1. There are significant costs associated with constructing and operating such a complex and extensive mass transit network, in particular for the capital costs for options requiring tunnelled sections. At this stage of scheme development there is not a clear position of how the Mass Transit system would be paid for and / or operated. The *Funding and Financing Strategy* identifies that it is likely that many of the funding and financing avenues may be required for discrete elements of the programme but are unlikely to be able to deliver it in its entirety as there is no single pot of money and delivery solution that can deliver such a large programme at one time. The *Phasing Strategy*, which is being developed to support the SOC, considers different ways in which the programme could be phased and delivered.

1.11.2. A comparison of high-level operating, maintenance and renewal costs and farebox revenue shows that for some corridors and networks the revenue generated could sustain the ongoing operation of the system. However, it is noted that these estimates are based on indicative operating cost estimates using benchmarks from similar schemes and revenue estimates from the catchment-based spreadsheet which is subject to the limitations discussed in the Economic Dimension.

1.11.3. As the programme develops, affordability and strategies for funding and financing will be considered in more detail as approaches to phasing are better understood, there is more detail of the options in terms of costs and revenues and the economic landscape becomes clearer in terms of potential inflation in the short to medium term.

1.12 Summary of the Commercial Dimension

1.12.1. The Commercial Dimension acknowledges that all options remain valid for the procurement model, route to market, contracting model and contract type.

1.12.2. Before the commencement of the OBC, the Combined Authority expects to undertake the following tasks which are key to informing the procurement model:

- Define the Target Operating Model for the Mass Transit programme
- Undertake a Delivery Model Assessment building on the output of the Client Approach workstream of the Value Toolkit
- Consider the most optimal Client Model to deliver the Mass Transit programme

1.13 Summary of the Management Dimension

1.13.1. While the Combined Authority has delivered several high profile, multifaceted projects and programmes, the Mass Transit scheme will be a significant and complex undertaking. In response to this, the *Phasing Strategy* starts to consider the best possible approach to de-risking and reducing the complexity of delivering the programme of works.

1.13.2. An appropriate governance structure is essential to the delivery of the scheme. The Combined Authority will build on the existing working groups to formalise a Programme and Project Steering Group, which will be accountable to the Mayor and Leaders. This aligns with best practice programme management guidance and the constitution of the Combined Authority. However, it is acknowledged that the governance structure for the programme is likely to change as the Delivery Model, Client Model and Procurement Model evolve. The primary function of the governance framework will be to continue to support the Mass Transit programme deliver the programme.

1.13.3. The programme is expected to be taken forward in project phases. As a result, a staggered schedule for delivery is anticipated. The schedule will remain a live document, with progress being monitored monthly by the Programme Manager and the Programme Steering Group.

1.13.4. A *Carbon Management Strategy* has been prepared to support the development and implementation of a carbon management process on the Mass Transit programme. This strategy outlines how the programme will track and reduce emissions, govern the carbon management process, train and upskill personnel on legislation and finally ensure the programme complies with standards such as PAS2080. This Strategy will form the basis of the more detailed Carbon Management Plan as the programme develops.

1.13.5. Early stakeholder engagement has been undertaken to raise awareness and build support for the Mass Transit programme. The Combined Authority has drafted a Stakeholder and Engagement Plan and will continue to engage and consult with stakeholders going forwards. The programme constraints and dependencies are discussed in detail in the strategic dimension.

1.13.6. Risk, opportunity and issue management processes will follow best practice guidance throughout the programme lifecycle. A DECA has been conducted, which identifies the key challenges and threats to the 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 Programme Manager track and monitor the programme cost and schedule against the baseline.

1.13.7. 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.

2 Strategic Dimension

2.1 Introduction

2.1.1. The Strategic Dimension demonstrates that the Mass Transit scheme is needed within the West of England region. It shows how the scheme fits into a wider strategy for the region's development, and demonstrates that it aligns with national, regional and local strategic policy objectives.

2.1.2. The West of England region has large-scale ambitions over the next decade. It has committed to net zero carbon by 2030 and is targeting an additional 65,000 jobs over the same period. In addition, its *Housing Delivery Strategy* has demonstrated a need for over 6,000 new houses a year to 2036, made more urgent by its rapidly accelerating population growth. This level of growth will put pressure on the transport network, currently dominated by private car use, and could worsen the ongoing climate emergency.

2.1.3. The provision of a transformational mass transit solution across the West of England will enable the region to push forward with its plans for regeneration and growth, secure in the knowledge that all its residents, visitors, and businesses are able to access new housing and employment opportunities in a green, sustainable manner.

2.1.4. The Strategic Dimension is structured in line with DfT guidance, describing:

- The policy and legislative 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

2.1.5. 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 Mass Transit 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 Combined Authority provides a formal structure for the three authorities within the West of England Area (BCC, B&NES, SGC) to give effect to the devolution deal with the UK Government. This arrangement gives the West of England region greater control over local transport, strategic planning and skills.

2.2.2. As set out under the West of England Combined Authority Order 2017, its objectives are to:

- Contribute to providing strong collective leadership and strategic direction to realise the full economic potential of the West of England
- Support the development and delivery of key strategies to improve the economic conditions across the West of England area
- Contribute to the formulation and expression of joint views (of the West of England Mayor and the local authorities) to central government and other bodies and organisations in respect of legislation, proposed legislation and other matters of concern, interest or relevance to the West of England economy with a particular focus on removing barriers to growth and the delegation of additional powers and funding
- Actively support the coordination of joint local authority activity across the West of England, including the activities of the Local Enterprise Partnership Business Board
- Work with appropriate agencies and bodies both within and beyond the West of England in order to achieve any shared economic objectives
- Ensure arrangements are in place to report the proposals and activities of the Combined Authority to the constituent councils
- Take any decisions required to deliver the West of England Devolution Deal(s) and the relevant Strategic Plans including additional funding, freedoms and flexibilities
- Provide a formal and accountable forum for decision making relating to all relevant West of England Combined Authority functions

2.2.3. The Combined Authority's core functions are outlined in Appendix D, with additional detail in section 6.3 of the Management Dimension, and the *West of England Combined Authority Constitution*.

2.2.4. Although not formally a part of the Combined Authority, NSC is working in partnership with the Combined Authority on the Mass Transit scheme. Together, the Combined Authority and NSC comprise the West of England.

2.3 Policy, Legislation, and Business Strategy

2.3.1. This section sets out the policy context in which the scheme has been developed. It considers the relevant policy, plans and strategies at national, regional, and local scales to identify key themes and priorities. The proposed Mass Transit scheme closely aligns with the following plans, policies and strategies:

National Policies and Plans

- Growth Plan (HM Treasury, 2022)
- Levelling Up the United Kingdom (DfT, Department for Levelling Up, Housing and Communities, 2022)
- National Planning Policy Framework (Department for Levelling Up, Housing and Communities, updated 2021)
- Build Back Better: Our Plan for Growth (HM Treasury, 2021)
- Decarbonising Transport: A Better, Greener Britain (DfT, 2021)
- Bus Back Better (DfT, 2021)

- National Infrastructure Strategy (HM Treasury, 2020)
- Gear Change: A Bold Vision for Cycling and Walking (DfT, 2020)
- Local Transport Note (LTN) 1/20 Cycle Infrastructure Design (DfT, 2020)
- Ten Point Plan for a Green Industrial Revolution (Department for Business, Energy & Industrial Strategy, updated November 2020)
- The Green Book (HM Treasury, updated December 2020)
- Future of Mobility: Urban Strategy (Department for Transport, 2019)
- Inclusive Transport Strategy: Achieving Equal Access for Disabled People (DfT, 2018)
- Transport Investment Strategy (DfT, 2017)

Regional Policies and Plans

- West of England Climate and Ecological Strategy and Action Plan (Combined Authority, 2022)
- A Strategy for Homes' – the West of England Housing Delivery Strategy 2020-30 (Combined Authority, 2021)
- West of England Bus Service Improvement Plan (Combined Authority, 2021)
- West of England Local Plan: Joint Local Transport Plan 4 (2020-36) (Combined Authority, 2020)
- West of England Bus Strategy (Combined Authority, 2020)
- West of England Local Cycling and Walking Infrastructure Plan (2020-36) (Combined Authority, 2020)
- West of England Climate Emergency Action Plan (Combined Authority, 2020)
- West of England Joint Green Infrastructure Strategy 2020-30 (Combined Authority, 2020)
- West of England COVID-19 Recovery Plan (Combined Authority, 2020)
- Western Gateway Strategic Transport Plan (2020-25) (Western Gateway STB, 2019)
- West of England Local Industrial Strategy (Department for Business, Energy & Industrial Strategy, 2019)
- West of England Energy Strategy (Combined Authority, 2019)
- West of England Joint Transport Study (Combined Authority, 2017)
- West of England Strategic Economic Plan 2015-30 (West of England Local Enterprise Partnership, 2015)

Local Policies and Plans

Bristol City

- Bristol Local Plan (Emerging, 2024)
- Bristol One City Economic Recovery Statement of Intent & Economic Recovery and Renewal Strategy (2020)
- Bristol Temple Quarter Enterprise Zone Spatial Framework (2016, updated 2021)
- Bristol Transport Strategy (2019)
- Bedminster Green Framework (2019)
- Bristol City Centre Framework (2018)

Bath and North East Somerset

- Bath and North East Somerset Local Plan Update (Emerging, 2023)
- Journey to Net Zero (2022)
- Bath and North East Somerset Ecological Emergency (2020)
- Bath and North East Somerset Climate Emergency Action Plan (2019)
- Bath and North East Somerset Local Plan (2016-36)
- Bath and North East Somerset Economic Strategy (2014-30)
- Getting Around Bath – A Transport Strategy for Bath (2014)

South Gloucestershire

- Climate Emergency Strategy (2020-30)
- South Gloucestershire Local Plan: Policies, Sites and Places Plan (Adopted 2017)
- South Gloucestershire Health and Well-being Strategy (2017-21)
- South Gloucestershire Economic and Skills Strategy (2016-20)
- South Gloucestershire Local Plan (2006-27)

North Somerset

- North Somerset Local Plan 2038 (Emerging, 2023)
- North Somerset Economic Plan (2020)
- North Somerset Climate Emergency Strategy (2019)
- North Somerset Local Plan / Core Strategy (2017)

2.3.2. A detailed review of each of the above policies or strategies, and their alignment to the proposed Mass Transit scheme is set out in Appendix B.

2.4 Interdependencies

Statutory Processes

2.4.1. Delivery of the Mass Transit programme depends on the successful completion of a number of statutory processes.

2.4.2. While the majority of the overground options proposed currently fall within existing highway boundaries, it is possible that a Compulsory Purchase Order (CPO) may be required to secure a portion of land to construct Mass Transit. If an option with significant tunnelled sections is progressed, land may also be required for stations or tunnelling access. This is subject to detailed land referencing works, which will be undertaken as part of the OBC to establish all parties with interests in the land required.

2.4.3. If all Orders and permissions are obtained, the completion of CPO powers will not take place until after the final funding has been confirmed.

2.4.4. Additional information on the statutory processes required for Mass Transit can be found in the *Planning and Consents Strategy* and *Land Acquisition Strategy*.

Project Links

2.4.5. The West of England region has a far-reaching vision and plan to address gaps in public transport provision. While a fully linked and segregated mass transit system is a long-term solution, a number of smaller schemes, such as the Kingswood Regeneration Project, are expected to either lay the groundwork for or integrate with the Mass Transit scheme over the short and medium term.

City Region Sustainable Transport Settlement

2.4.6. In April 2022, the DfT confirmed the Combined Authority's City Region Sustainable Transport Settlement (CRSTS) for the next five years. The majority of the allocated £540m investment is subject to the Combined Authority's agreed Assurance Framework and will not be overseen directly by the DfT.

2.4.7. Table 2-1 extracts those schemes that are expected to intersect with the shortlisted Mass Transit routes. Of these, Mass Transit is dependent on all sections of the Bristol to Bath Sustainable Transport Corridor (BBSC). Additional detail of the dependency can be found in section 2.4.9.

2.4.8. A full list of the schemes progressing under the CRSTS can be found in Appendix E.

Table 2-1 – CRSTS schemes

Name of Scheme	Description	Location	Dependency
Bath City Centre Sustainable Transport Corridor	Improving the appeal and effectiveness of the public transport offer in Bath City Centre, this project includes upgrading cycling and walking infrastructure, improvements to the Bus Station and links across the river. This will deliver significant multi-modal transport benefits across the city.	Bath City Centre	No
Bristol to Bath Sustainable Transport Corridor - Bristol to Emery Road	Improving public transport services along the A4 Strategic Corridor from Bristol Temple Meads to the existing Park and Ride at Emery Road (5km). This already popular public transport service is hampered by a lack of continuous bus priority. This project would address much of the challenges to enable a more reliable and faster service. Walking and cycling infrastructure along the route is also being significantly improved.	A4 Corridor	Yes
Bristol to Bath Sustainable Transport Corridor - Keynsham to Bath	There is no bus priority at present along this 12.5km route that connects Bath to B&NES' largest town - Keynsham. Therefore, improving the public transport offer along this section of the A4 is a priority. Walking and cycling infrastructure along the route is also being significantly improved.	A4 Corridor	Yes
Bristol to Bath Sustainable Transport Corridor - Transport Hub	The existing Park and Ride at Emery Road is near to capacity. Relocation to the A4/A4174 (ring road) junction would not only resolve the capacity issue but would also reduce the amount of travel between the ring road and the existing park and ride. This would reduce air quality issues and trip generation.	A4 Corridor	Yes
Stockwood to Cribbs Causeway Sustainable Transport Corridor	These are a number of activities related to infrastructure improvement regarding the public transport offer in the A37/A4018 corridor. These upgrades include the provision of bus priority measures, road design and enhancement of cycling and walking routes across the covered area.	Bristol city	No
Bristol to Hengrove metrobus extension	This consists of a series of upgrades to the existing metrobus route to Hengrove, in combination with bus stop upgrades and bus priority measures throughout the corridor.	Thornbury and Charfield	No

Bath and North East Somerset Liveable Neighbourhoods	Proposed liveable neighbourhood scheme in Bath (and North East Somerset), which will engage with local residents and business through the 'co-design' process to understand the barriers to walking, cycling, public transport and wider 'liveability'. The project will see improvements to five LCWIP routes and five Core Walking Zones alongside enhancements to local connections, and ecological assets (e.g. Sustainable Drainage Systems, tree planting and parklets)	B&NES	No
Bristol City Liveable Neighbourhoods	Proposed liveable neighbourhood scheme in Bristol focused on delivering four LCWIP routes and one Core Walking Zone alongside enhancements to local connections and ecological assets (e.g. SUDS, Tree planting and parklets). The scheme will interface with the regeneration of the Temple Quarter Enterprise Zone, St Philip’s Marsh and Temple Meads.	Central Bristol	No
Integrated Smart Ticketing	Development of new and simplified bus ticketing options across all buses in the West of England Combined Authority and North Somerset Council areas. It will deliver tap-on, tap-off contactless ticketing. It will allow the introduction of fare capping, faster boarding processes and the removal of the need for prior network knowledge across users.	West of England and North Somerset	No

Bristol to Bath Sustainable Transport Corridor

2.4.9. The BBSC aims to create a high-quality, segregated, and prioritised public transport, cycling and walking corridor on the A4. Multiple SOCs are currently in development that encompass the elements identified along the A4 Corridor in Table 2-1. This includes:

- A fast, reliable, high-quality, zero-emission turn up and go bus service between Bristol Temple Meads and Bath bus station
- A 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 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

2.4.10. The current assumption made within this Mass Transit SOC is that the BBSC scheme will be in place prior to the delivery of Mass Transit, with further infrastructure improvements integrating BBSC with the wider Mass Transit network. As the BBSC is expected to progress ahead of Mass Transit, it has been integrated into the Do Minimum for the scheme.

2.4.11. Collaborative working between both project teams will ensure the progress of the BBSC scheme will continually be reviewed as the Mass Transit scheme progresses through the business case development process, and any assumptions updated accordingly.

Future Planning and Development

2.4.12. The Mass Transit programme is a long-term aspiration that will need to take into account future changes to the region as and when they arise. This includes not only changes to the transport network that may intersect with the proposed routes, but also those decisions that will have an impact on demand and phasing, including:

- Proposed housing development (see section 1.6.47)
- New and expanding employment sites
- Walking and cycling solutions that may form part of first-mile, last-mile measures
- Demand management measures, including town planning interventions and potential user charges
- Additional public transport or road reallocation schemes
- Policy developments, including Local Plan updates, and the Bus Service Improvement Plan (BSIP)

2.4.13. As individual projects develop under the Mass Transit programme, their relationship with new policy and interventions will be tracked as part of a *Dependencies Register*, and further explored.

2.5 Business Needs and Service Gaps

2.5.1. Mass Transit forms a core part of the infrastructure programme set out in JLTP4. This is to provide a high-quality alternative to the use of and reliance on the private car along key corridors (and through interchange with other modes, further afield). It is expected to play a key role in helping to substantially reduce car dependency and its related carbon emissions, as well as help tackle traffic congestion, improve road safety, accessibility, access to job and other opportunities and improve quality of life.

2.5.2. As the Mass Transit programme is progressed and packaged into individual projects and their associated OBCs, a number of key decisions will need to be made around route, mode, design, operations, phasing, and delivery. These are vital for establishing the conditions for success for the scheme.

2.5.3. Work has been done to explore options for each of these, and is detailed in supplementary documents and within this SOC, including:

- Option Assessment Report (70069287-WSP-BCA-0010)
- Feasibility Design Summary Report (70069287-WSP-HWY-0003)
- Integrated Service Plan (70069287-WSP-TPM-006)
- Biodiversity Net Gain Strategy (70069287-WSP-ENV-0001)
- Green Infrastructure Strategy (70069287-WSP-HWY-0005)
- Equality Impact Assessment Strategy (70069287-WSP-TPM-005)
- Carbon Management Strategy (70069287-WSP-CBN-0001)
- Phasing Strategy (70069287-WSP-HWY-0004)
- Value Toolkit (see section 5.2)
- Governance (see section 6.3)

2.5.4. Careful consideration will also be needed around integration with other public transport services. The *Demand Forecasting Report* and *Economic Assessment Report* document the expected demand for a mass transit system in the West of England on a corridor-by-corridor basis. It is recognised that for largely overground options, the majority of the demand currently captured for Mass Transit has switched from existing bus, with a smaller proportion switching from private car. A similar pattern is shown for tunnelled and hybrid options.

2.5.5. In addition, it is recognised that the successful implementation of a transformational mass transit solution would benefit from a number of supporting external factors, including demand management measures, and a targeted decarbonisation campaign. Both of these are being explored within the Combined Authority and individual UAs and are captured as part of other projects.

2.5.6. As the scheme progresses, further consultation on key decisions will be undertaken with key stakeholders and the public.

2.5.7. Finally, in parallel to this SOC, the West of England Regional Transport Model (WERTM) has been developed and integrated. This will update the existing transport model and allow for a number of the limitations of the current model – detailed as part of the *Appraisal Specification Report* to be addressed.

2.6 Problem Identification

2.6.1. The proposed scheme has been developed to address a number of regional challenges, which all either contribute to or result from high private-car use in the region:

- Low public transport use
- Barriers to walking and cycling
- Congestion and delay
- Safety
- Regional inequality and deprivation
- Air quality and climate emergency
- Enabling regeneration and economic growth

Low Public Transport Use

Bus Use

2.6.2. The West of England region currently has the lowest regional percentage of GVA spent on transport in the country. In per capita terms, only the East Midlands region ranks lower.

2.6.3. In 2019 a public consultation was held, seeking views on JLTP4. As part of the consultation, respondents were asked for their opinion on the current challenges related to transport in the region. In relation to bus services, the key findings from responses included:

- **55%** disagree that it’s easy to plan and make a journey by bus
- **59%** disagree that bus services are reliable, with just 1% strongly agreeing that they were reliable
- **58%** disagree that travel by bus is good value for money

2.6.4. As part of the consultation for the now adopted *West of England Bus Strategy* (June 2020), nearly 2,000 responses were received. More than two-thirds of respondents identified the following priorities:

- Improved punctuality
- Cheaper fares
- Better waiting facilities
- More frequent services
- More public consultation on changes

2.6.5. This perception of public transport in the region is borne out in data around travel patterns and mode choice. Almost 80% of commuting trips between the different UAs are made by private car, with public transport representing only 6% of these journeys. Even for trips made within a given UA, while walking and cycling trips increase, public transport is not the mode of choice, with an average 9% of trips. This is despite 72% of trips being under 5km. Overall, only one in 11 commuting trips are made by bus or rail.

2.6.6. As set out in section 1.6.98, which looked at key destination types within a 30-minute bus journey, bus services do not provide a practical option for many journeys within the region, particularly for those living or working further from city centres. The attractiveness of bus travel is undermined by poor information, difficult-to-understand networks (with services from different operators not always shown on maps and timetable information), and complex ticket ‘offers’ which passengers generally cannot use on all buses in their area.

2.6.7. Section 1.6.64 explored the average daily flows for buses and coaches. While Bristol City Centre and Bath City Centre had significantly higher bus movements, services outside of the two major cities were less regular. While main arterial routes along each corridor have at least one bus service every 15 minutes, this is partially a result of overlapping services with lower frequency that continue outside the main corridors.

2.6.8. Bus lanes in the area are discontinuous or not feasible in some places where they are needed. As such, there are competing demands for limited road space on key radial roads, resulting in severe traffic congestion and subsequently poor service reliability. Inbound bus speeds in the AM peak on the A38(N), A38(S) and A420 were found to be 6mph, and 8-11mph on the A4. Congestion is explored further in section 2.6.25.

Rail Use

2.6.9. Across the West of England, some rail services are impacted by the age and low capacity of rolling stock, infrastructure problems and rail company staff shortages. Demand is growing on the local and regional rail network, and trains are overcrowded at peak times, particularly into Bristol and Bath. Capacity constraints on the existing rail network restricts the potential to offer additional services; without an alternative perceived as viable by the public, this further enforces the use of private vehicles.

Public transport connectivity

2.6.10. An exercise was undertaken to assess the existing travel demand along the Mass Transit corridors by analysing 2019 mobile telephone (Telefonica) data. The trips generated are not limited to commuter movements, instead capturing all trips undertaken by chaining together mobile phone events.

2.6.11. The data is not without limitations. The technology used for capturing mobile phone events is limited by the position of mobile phone towers, and therefore generally better at capturing longer trips. In addition, Telefonica consists of O2, Tesco Mobile and Giffgaff, with a combined market share of approximately 32%. As such, the data should be considered only as an indication of trends. To mitigate against these limitations, a parallel check of the *2011 Census* data has been applied. Although indicative, this allows for confirmation that the movement trends are similar (a 95% correlation for commuter trips).

2.6.12. Significant indicative movements identified as part of this analysis are shown in Table 2-2.

Table 2-2 – Top 20 movements between areas

From	To	Daily Trips
North Corridor	**Bristol**	12,865
Bristol	**North Corridor**	12,609
East Corridor	**Bristol**	11,193
Bristol	**East Corridor**	11,103
BBC	**Bath**	8,843
Bath	**Bristol – Bath Corridor**	8,818
Bristol	**South-West Corridor**	6,392
South-West Corridor	**Bristol**	6,214
North Corridor	**East Corridor**	5,166
East Corridor	**North Corridor**	5,077
Bath	**Bristol**	4,887
Bristol	**Bath**	4,638
BBC	**Bristol**	4,015
Bristol	**Bristol – Bath Corridor**	3,884
Bath	**East Corridor**	3,008
East Corridor	**Bath**	2,993
North Corridor	**South-West Corridor**	1,519
Bristol – Bath Corridor	**East Corridor**	1,513
South-West Corridor	**North Corridor**	1,486
East Corridor	**Bristol – Bath Corridor**	1,458

2.6.13. Due to the limitations of the data discussed above, the areas representing the corridors have been selected to enable as much mobile phone data to be used as possible. The origins and destinations listed in Table 2-2 are defined as:

- **East Corridor** – the area surrounding the East Corridor options past St George Park
- **North Corridor** – the area surrounding the North Corridor options past Horfield
- **South-West Corridor** – the area surrounding the South-West Corridor options past Colliters Way
- **Bristol – Bath Corridor** – the area surrounding the A4 between Hick's Gate and Bath
- **Bath** – the entire built-up area of Bath
- **Bristol** – those areas surrounding the central sections of the Mass Transit corridors

2.6.14. The available data appears to indicate that the most frequent movements are to and from the region's major cities, with movements between corridors less common. This data is based on existing travel patterns and does not account for trips not currently being made as they are not attractive due to a lack of connectivity and travel options, or to congestion.

2.6.15. Table 2-3 lists estimated journey times by car versus public transport during both peak and off-peak periods for a sample of potential trips. This demonstrates a significant gap between the duration of a journey made by car, even during peak hours, and a journey made by public transport.

Table 2-3 – Comparative Journey Times

From	To	AM Peak Car	Off Peak Car	AM Peak Public Transport
Hengrove	**Southmead Hospital**	50 min	22 min	1 hr 27
St Philip's Marsh	**Bristol Airport**	45 min	24 min	50 min – 1 hr
Bristol Bath Science Park	**Bristol city centre (Queen's Square)**	40 min	21 min	50 min – 1 hr
Bristol Bath Science Park	**Bath city centre**	35 min	28 min	1 hr 41 min
The Mall Cribbs Causeway	**Keynsham**	40 min	32 min	1 hr 23 min
Bristol Airport	**Filton**	40 min	30 min	1 hr 18 min
Bristol Airport	**Bristol Bath Science Park**	50 min	34 min	1 hr 20 min
Bristol city centre	**South Bristol community hospital**	20 min	17 min	40 min
Emersons Green	**Memorial Stadium**	35 min	18 min	1 hr
Kingswood	**Filton**	40 min	25 min	1 hr 30 min

2.6.16. The location of future housing and employment sites is expected to be a driver of future travel movements. As such, the need for inter-corridor connectivity in an efficient and reliable manner is crucial.

2.6.17. It is expected that the data underpinning the WERTM base model will provide an increased understanding of shorter trips, overcoming many of the limitations that come with the Telefonica data. The model will enable further refinement of this analysis and will feed into future stages of the proposed Mass Transit scheme.

Barriers to Walking and Cycling

2.6.18. While improvements have been made steadily over the years, and more are planned, there is still work to do to encourage travel by walking and cycling.

2.6.19. Despite the Sustrans National Cycle Network running throughout areas in the West of England, there is currently varying quality of active travel infrastructure in the region. Whilst urban centres typically have more extensive walking and cycling infrastructure, rural areas in the region are comparatively less well connected. This creates a fragmented active travel network.

2.6.20. Consultation on the West of England's LCWIP was held in 2020 and attracted over 1,800 responses. As part of the consultation responses:

- 82% of people said that public safety has either completely, regularly, or sometimes prevented them from walking
- 74% stated that personal safety prevented them from cycling completely, regularly, or some of the time
- Busy roads were the biggest issue preventing people from engaging with active travel in the region, with 80% of pedestrians, and 89% of cyclists saying busy roads either completely, regularly, or sometimes prevented them from doing so
- The majority of people would support walking and cycling improvements, even if this meant less space for other road traffic
- Where people did not choose to walk for short distance trips, 38% were likely to take a private vehicle instead

2.6.21. Comments noted in the LCWIP included:

- I know so many people who want to cycle but have to drive because they are scared.
- I live in Easton and should be able to cycle everywhere. It is not safe with small kids, and it should be. Amsterdam wasn't always a cycle city but with a long-term vision it managed to become one.
- We have declared a climate emergency. One of the responses to this must be bold, committed, and largescale implementation of actual improvements to cycling and walking and public transport.

2.6.22. The available mode-choice data echoes these concerns. Active travel infrastructure across the West of England varies in quality. Major roads provide a physical and perceived barrier to walking and cycling, and while 30% of trips within a given UA are made by walking or cycling, this number drops to only 7% when considering trips between UAs.

2.6.23. Perceptions of danger are a major factor in attitudes to cycling, with almost 90% of people within the region hesitant to cycle because of the fear of heavy or fast traffic.

2.6.24. Given the West of England's success with walking and cycling schemes to date, there exists an opportunity not only to make active travel a preferred choice by reducing conflicting traffic on direct routes, but also to increase the number of trips made between authority areas by linking public transport with first-mile, last-mile solutions.

Congestion and Delays

2.6.25. Given the dominance of car-use in the region, congestion within the West of England is swiftly returning to pre-coronavirus pandemic levels. In 2021, drivers lost 67 hours to congestion – a 90% increase on 2020 data. JLTP4 estimates that congestion costs the region £300m a year, and that without action this is expected to increase to £800m by 2036.

2.6.26. As noted in 1.6.69, the Bristol urban area is one of the most congested urban areas in the UK, after only London and Cambridge. Two in five commuting car journeys are less than 2km, leading to a number of congestion hotspots into central Bristol, and consistent delays of over 100 seconds per vehicle mile (see Figure 1-11 and section 1.6.65 for detail).

2.6.27. Table 2-4 shows the delays experienced specifically on the Mass Transit corridors in 2019 by comparing peak and off-peak travel times. Delays are significantly exacerbated during peak hours, demonstrating the increased pressure on the network and the impact on its users during core commuting hours.

Table 2-4 – Observed Delay, Teletrac Average March, September and October 2019

Trip	AM peak (08:00-09:00) (s)	**PM peak (17:00-18:00)** (s)	Off-peak (19:00-20:00) (s)	Variation between AM peak and Off-peak (s)	Variation between PM peak and Off-peak (s)
Bristol – Bath Corridor (Westbound)	2,388	2,437	1,592	796	845
Bristol – Bath Corridor (Eastbound)	2,999	2,723	1,633	1,366	1,090
South-West Corridor (Southbound)	3,057	2,895	1,908	1,149	987
South-West Corridor (Northbound)	3,455	2,844	1,943	1,511	901
East Corridor (Eastbound)	1,423	1,513	1,125	297	388
East Corridor (Westbound)	2,445	1,390	1,104	1,341	286
North Corridor (Northbound)	1,996	1,891	1,465	531	425
North Corridor (Southbound)	2,041	2,094	1,523	518	571

2.6.28. Congestion is significant across the majority of the West of England's highway network. JTS listed all A-roads within Bath and nearly all radial routes from Bristol City Centre as congested, as well as a number of orbital routes to the north and south of the city.

2.6.29. Without intervention, these issues will be further exacerbated by population growth. This growth is expected to lead to additional travel demand, including journeys to and from work, business travel, deliveries and servicing traffic and leisure journeys. Based on the current level of car dependence, JLTP4 expects this additional demand to result in increased congestion, with the potential for a 9% increase in journey times and 74% increase in time queuing in traffic[47] by 2036.

2.6.30. Additional detail on the expected impact of not changing can be found in section 2.7.

Safety

2.6.31. Heavy car use and resulting congestion has given rise to a concentration of serious collisions along highly trafficked arterial routes into Bristol City Centre and Bath City Centre. The City of Bristol experienced the highest annual road traffic accidents in the region between 2020 and 2021, with 59 killed or seriously injured.

2.6.32. In 2020[48], the following number of people were killed or seriously injured per billion vehicle kilometres in each area:

- B&NES: 29
- BCC: 49
- NSC: 21
- SGC: 24

2.6.33. Comparatively, in the South West[49] there were 72 killed or seriously injured per billion vehicle kilometres and with 94 per billion vehicle kilometres in England over the same period.

2.6.34. The perception of risk surrounding personal security is an important influencing factor for journey planning. The LCWIP consultation results demonstrate that fear and apprehension about personal security has resulted in lower levels of active travel, with people in the region hesitant to walk or cycle due to highly trafficked routes perceived as dangerous.

2.6.35. JLTP4 identified that many people in the West of England are concerned by road safety and are discouraged to make walking and cycling trips due to a lack of safe crossing points.

Regional Inequality and Deprivation

2.6.36. Within each of the four corridors there are ‘hot spots’ of deprivation, ranked in the top 5% of the most deprived locations in England and Wales.

2.6.37. One of the challenges faced by these deprived communities is transport. Poor public transport connectivity was identified within JLTP4 as a barrier to employment for individuals

[47] Joint Local Transport Plan 4, 2020
[48] RAS0403: Reported road collision and casualty numbers and rates by severity, road user type and local authority, Great Britain, ten years up to 2021
[49] RAS0402: Reported road collision and casualty numbers and rates by severity, region and country, United Kingdom, ten years up to 2021

within these areas, with gaps in the local bus network and a regional over-reliance on private cars contributing.

2.6.38. Areas such as Lockleaze, St. Pauls and Easton are not only some of the most deprived areas within the four corridors but are also among the most congested. Heavy traffic congestion has led to poor air quality, which is likely to have disproportionately impacted the health and wellbeing of residents within these areas. Exposure to transport-related air pollution is associated with adverse health impacts, contributing to heart disease, stroke, and lung cancer.

2.6.39. In the BCC and NSC areas, where the highest amount of regional deprivation is observed, the difference in life expectancy between low and high areas of deprivation is almost ten years for males.

Climate Emergency and Air Quality

Climate Emergency

2.6.40. Population growth coupled with poor public transport access across the West of England means that car trips are expected to increase by a further 8% by 2030[50], intensifying already high levels of carbon emissions from concentrated road traffic.

2.6.41. A Climate Emergency was declared by the Combined Authority and each of the UAs in 2019. The climate emergency presents clear risks to the region, including flooding, habitat loss, and changing weather patterns. North Somerset, the city centres of both Bristol and Bath and the Severnside Enterprise Area are at risk of flooding. Severe weather, particularly high winds, intense rainfall, and intense heat, often causes dangerous conditions and major disruption to the transport network. In turn, poor network resilience constrains productivity and economic growth, and inhibits social mobility. Extreme weather patterns may make forms of active travel less attractive, particularly in areas with minimal shade.

2.6.42. In response, the West of England has set an ambitious goal for tackling climate change, committing to net zero carbon by 2030. Although the region has achieved significant cuts to carbon emissions in recent years, transport related emissions have only fallen by 5% across the area since 2005.

Air Quality

2.6.43. Air pollution is readily associated with a number of health impacts, contributing to heart disease and respiratory conditions. The World Health Organisation has evidenced links between exposure to air pollution and diabetes, obesity, and dementia. Within the UK, long-

[50] West of England Climate and Ecological Strategy and Action Plan, 2022

term exposure to particulate air pollution is estimated to have an effect equivalent to 29,000 deaths a year, and costs to NHS and social care are estimated at £43m as of 2017[51].

2.6.44. To protect the built, natural, and historic environment, AQMAs now cover much of the East Corridor, the northern portion of the South-West Corridor and the western portion of the Bristol – Bath Corridor. Approximately 100,000 people live within the boundaries of the Bristol AQMA, with two smaller AQMAs also stretching out into South Gloucestershire – in Kingswood/Warmley and Staple Hill.

2.6.45. Bristol's 2021 Annual Status Report shows that where nitrogen dioxide exceeds air quality objectives, over 80% of this pollution has been shown to be from local traffic sources. Decisions made around car-use – nationally, regionally, locally, and at an individual level – directly impact the level of pollution in the city and surrounding region.

Enabling Regeneration and Economic Growth

2.6.46. Prior to the pandemic, the West of England had a diverse employment base, providing economic resilience as well as an average employment rate of 79.1%. The West of England is the most productive city region in England outside London, with GVA per head having grown 45% between 2004 and 2018 – faster than the UK average by 3%.

2.6.47. Oxford Economics baseline growth listed as part of the West of England Enterprise Partnership's Strategic Economic Plan projects 65,000 jobs and 2.6% GVA growth in the region by 2030. The LEP remains ambitious for levels of growth higher than the baseline.

2.6.48. The City of Bristol, a key driver of the West of England's economy, is set to be one of the UK's fastest growing cities. Bath and North East Somerset is also targeting significant growth, expecting to deliver 16,900 new jobs by 2030.

2.6.49. But growth has slowed in recent years and poor connectivity is a significant factor holding the region back. The West of England recognises a number of challenges to economic growth and regeneration. Pockets of low-level skills, economic inactivity and poor educational attainment are spread across the West of England, leading to social exclusion in some communities. The *West of England Employment and Skills Plan* reports that unemployment is highest amongst young people, disabled people, ethnic minorities and those with low skills. Across the West of England in 2017, 6.6% of 16- and 17-year-olds were Not in Education, Employment or Training (NEET), above the national average of 6.0%[52].

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[51] Estimation of costs to the NHS and social care due to the health impacts of air pollution, Public Health England, 2018
[52] West of England Employment and Skills Plan, 2019

2.6.50. A mismatch between skills provision and employment opportunities in growth sectors has also been identified. This is noted in 1.6.26, with the West of England reporting a higher propensity for skills shortage than almost any other LEP area. To cater for the increase in demand for skilled workers, linkages are needed between skilled workers and businesses.

2.6.51. The West of England has also developed an ambitious programme to build back better, greener and stronger post the impacts of the coronavirus pandemic on the economy and region. Table 2-5 shows the expected outcomes of the West of England Recovery Plan, which aims to re-build across five pillars. This includes a £320m+ investment in the region's transport and housing by 2025.

Table 2-5 – West of England Combined Authority coronavirus recovery outcomes by 2025

Rebuilding business	▪ Over 11,200 businesses supported to adapt operations, boost staff skills and innovate ▪ £90m investment in innovation facilities and research and development projects, and a pipeline of new projects of £300m+
Getting residents back into jobs	▪ 1,800+ jobs created, plus 750 construction jobs a year across our investments ▪ 22,000+ training and skills placements each year
Strengthening inclusion	▪ Support residents to access good, secure jobs ▪ Delivering careers advice to 95 schools and colleges ▪ 10,000 people take online mental health at work course ▪ Widen community access to business and skills support
Supporting a green recovery	▪ Support retrofit of homes ▪ 1m new rail journeys and walking and cycling transformed in 30 high streets ▪ 60 new low carbon business grants
Renewing places	▪ £320m+ in transport and housing by 2023 ▪ Strategies for the town and city centres most vulnerable to changing movement and shopping patterns

2.6.52. The links between transport investment and productivity are widely accepted, with transport infrastructure changing both the effective density of people in an affected area, and the jobs that are available to skilled workers. The region's plans for growth and regeneration are ambitious, and expected to increase pressure on the existing transport and housing infrastructure.

2.6.53. Continued economic development is dependent on attracting new businesses and increasing the productivity of existing firms. Enhancing regional labour mobility will be essential to unlocking further clean and inclusive economic growth if the area is to remain competitive.

2.7 Impact of Not Changing

2.7.1. Large-scale employment and housing growth are planned in the West of England over the next decade. With over 65,000 jobs projected by 2036, population growth outpacing the rest of England, and associated housing needs at over 6,000 homes per year, the travel demand associated with this growth is expected to exacerbate the problems already identified.

2.7.2. Without significant intervention that encourages mode shift and the reallocation of road space, it is not expected that the West of England region will be able to achieve its highly ambitious carbon reduction targets.

2.7.3. The following sections detail expected trajectories, based on 2036 modelling for the area captured by the Greater Bristol Area Transport Study Model (GBATS), and 2031 modelling for the Bath study area (Greater Bath Strategic model, G-BATH).

Congestion and Delay

2.7.4. Transport modelling undertaken to assess the need for the scheme predicts that traffic volumes are expected to grow by approximately 12% between 2013 and 2036 in the study area. Table 2-6 shows forecast traffic growth figures to 2036, split by AM Peak, interpeak, and PM peak periods.

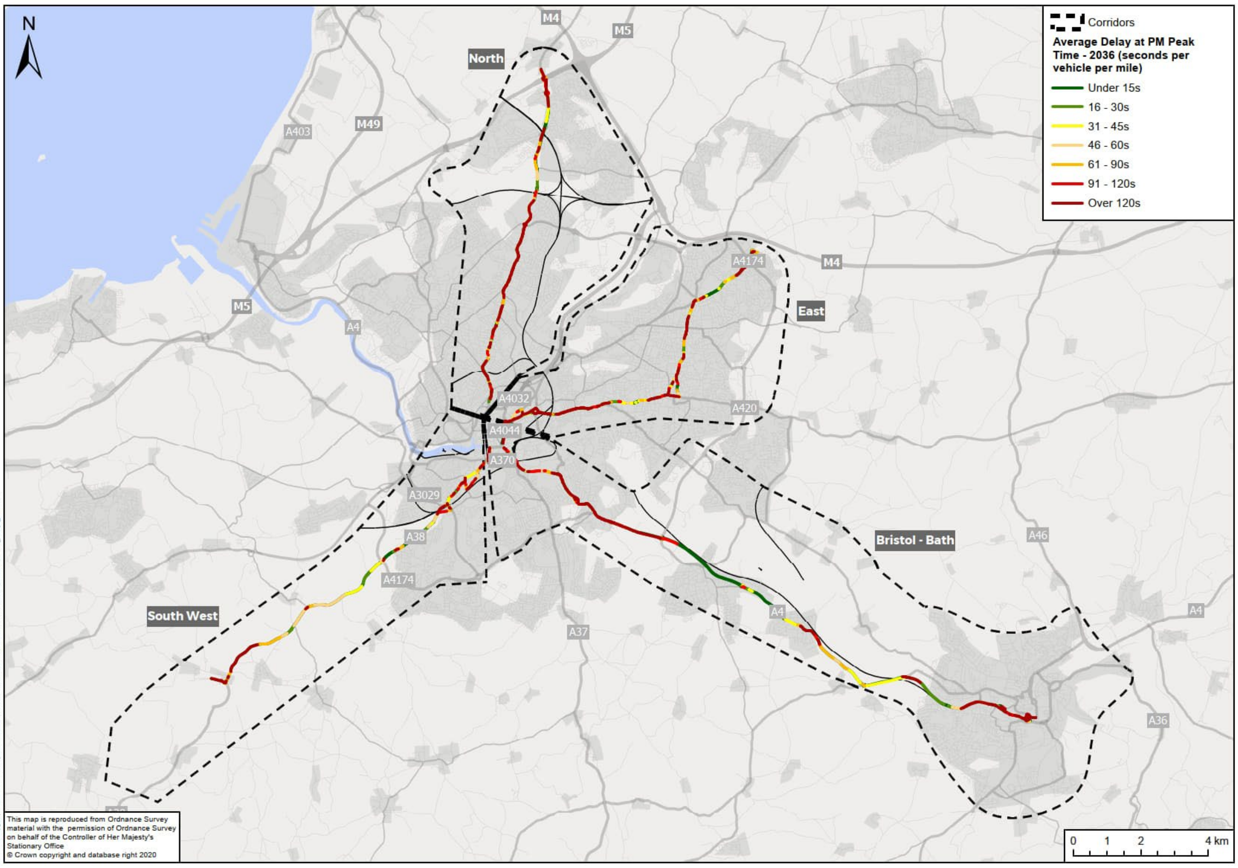
Table 2-6 – Forecast traffic growth to 2036

	Vehicle Class	2013	2036	% Growth
AM peak	Car	98,464	110,652	12%
	Light Goods Vehicles	14,372	22,993	60%
	Heavy Goods Vehicles	13,316	15,216	14%
	All vehicles	**126,152**	**148,862**	**18%**
Inter peak	Car	76,650	89,255	16%
	Light Goods Vehicles	16,420	26,212	60%
	Heavy Goods Vehicles	14,134	16,094	14%
	All vehicles	**107,204**	**131,561**	**23%**
PM peak	Car	106,519	119,334	12%
	Light Goods Vehicles	12,004	19,137	59%
	Heavy Goods Vehicles	7,297	8,347	14%

	All vehicles	125,820	146,818	17%

2.7.5. The increase in traffic growth shown in Table 2-6 is expected to impact the regional road network. Figure 2-1 shows the forecast delay in the PM peak hour (17:00-18:00) using the observed data shown in Figure 1-10 and growth in delays predicted by GBATS, forecast forward to 2036. It is noted that GBATS is an aged model (with a base year of 2013, developed in 2014) and is due to be replaced by WERTM. Outputs should therefore be taken as indicative only.

Figure 2-1 - Estimated delay in 2036 on corridors in PM Peak (17:00-18:00)



2.7.6. The predicted journey times for the Mass Transit corridors in the 2036 PM peak (17:00-18:00) are shown in Table 2-7. As in the 2013 scenario (shown in Table 2-4), delays are significantly worse during peak hours. When compared to 2013 data, the average delay to the Mass Transit corridors in the AM peak worsens by almost two minutes when compared to off-peak travel times.

Table 2-7 - Journey Time Delay, 2036

Trip	AM peak (s)	PM peak (s)	Off-peak (s)	Variation between AM peak and Off-peak (s)	Variation between PM peak and Off-peak (s)
Bristol – Bath Corridor (Westbound)	2,561	2,576	1,592	969	984
Bristol – Bath Corridor (Eastbound)	3,355	2,880	1,633	1,722	1,247
South-West Corridor (Southbound)	3,091	2,904	1,908	1,183	996
South-West Corridor (Northbound)	3,801	3,067	1,943	1,857	1,123
East Corridor (Eastbound)	1,479	1,596	1,125	353	471
East Corridor (Westbound)	2,636	1,396	1,104	1,533	292
North Corridor (Northbound)	2,103	1,987	1,465	638	522
North Corridor (Southbound)	2,173	2,263	1,523	650	739

2.7.7. Congestion is expected to further enforce existing travel patterns, with road users continuing to use private vehicles rather than changing travel behaviour to utilise public transport services that are perceived as unreliable. This, in turn, will reinforce safety perceptions around active travel, and worsen climate considerations.

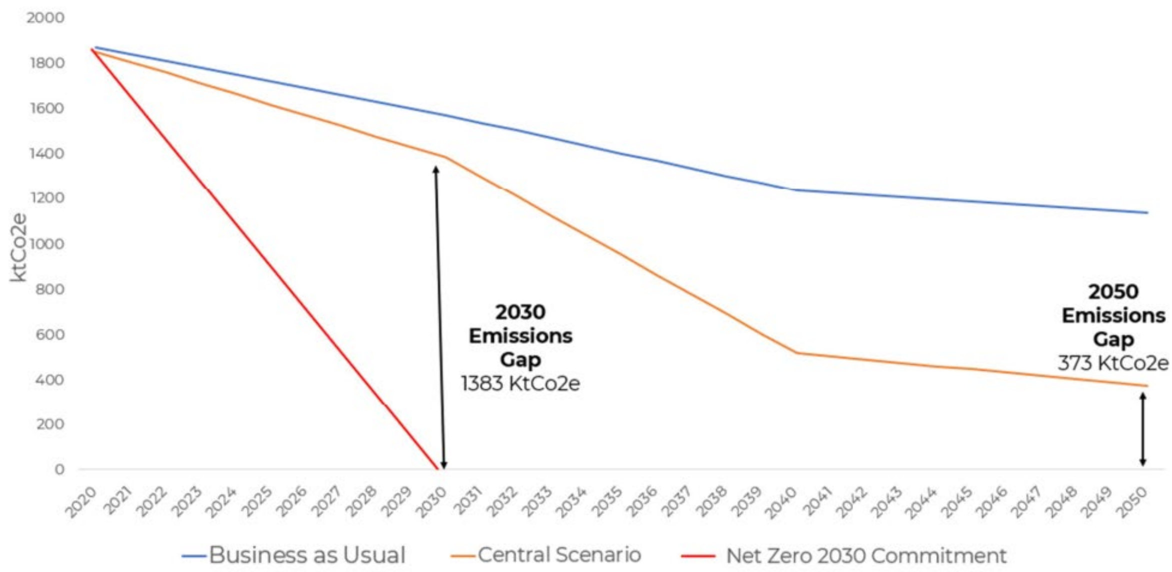
Climate Emergency

2.7.8. In July 2019, the Combined Authority committee declared a climate emergency, committing the region to carbon neutrality by 2030. In 2022, the *Combined Authority Climate and Ecological Strategy and Action Plan* was published, which stressed low carbon transport and increased use of public transport as the top priority for the region.

2.7.9. Emerging findings from the Transport Decarbonisation Study show that there is a considerable gap between forecast carbon emissions reductions and 2030 ambitions.

2.7.10. Assessment in line with the DfT TAG showed that if no further local interventions are delivered, by 2030 carbon emissions in the West of England are forecast to be around 17% lower than those in 2019, due in part to the electrification and improved efficiency of the vehicle fleet. This leaves an emissions gap of 1,383 ktCO2e in 2030, as shown in Figure 2-2.

Figure 2-2 - Decarbonisation Pathway



2.7.11. The study found that in order to reach the 2030 net zero target, a substantial reduction must be made in private car mileage, reducing the number of trips and their length. Infrastructure improvements must be made for public transport, walking, and cycling to enable quality, alternative travel choice to the private car. In addition, it is expected that a range of policy measures will be needed to help reduce the number of car trips within the region. This may include a review of the wider spatial strategy, enabling substitute trips, physical demand management (access/capacity constraints), and pricing measures.

2.7.12. This was recognised as part of JLTP4, which noted that:

"To encourage people to move away from cars, we will need to provide transformational alternatives such as a new mass transit network. This may not be enough, so we will also consider ways to manage demand possibly through congestion charging, emissions charging and workplace parking levy-type schemes."

Future Growth

Economic Growth

2.7.13. The absence of a well-connected mass transit system is likely to affect business investment and growth, both locally and regionally. Key employers and development areas are located in or adjacent to the study area (including the Bristol Temple Quarter Enterprise Zone, Emersons Green Enterprise Zone, Bath City Riverside Enterprise Zone and the Filton Enterprise Zone). The increased journey time along corridors radiating out from Bristol City Centre will lead to increased vehicle operating costs and productivity inefficiencies.

2.7.14. Business clustering is also negatively affected by congestion. This compromises the potential agglomeration benefits that would be expected to occur from businesses being in easy reach of one another and thereby producing productivity gains. Improving transport links effectively brings businesses closer together, and results in better integrated supply chain.

2.7.15. A lack of intervention presents an opportunity cost for those working within the region, or those looking for work. Existing high levels of movement across the region demonstrate that the four UAs form part of the same labour market. Mass Transit impacts are expected to be felt both by those already making commuting journeys, as well as unemployed or underemployed individuals looking to enter the labour force or improve access to better paying jobs. Without intervention, these potential benefits will be lost.

2.7.16. In an effort to better understand the impact a potential mass transit solution might have for the region, an analysis of wider economic impacts was done. This showed that should a viable solution for both public transport and highway users be agreed and implemented, sizeable productivity and land value benefits could arise from the delivery of a mass transit system. Additional detail on the analysis, and its impact on the scheme's value for money, can be found in section 3.9 of the economic dimension.

2.7.17. A mass transit system that enables end-to-end journeys across the region will provide an opportunity not only to address the already existing skills gap in the region, but also to reduce disparity of access to employment and opportunities for those in pockets of deprivation.

Housing

2.7.18. As set out in section 1.6.50, proposals for additional housing development are currently in development as part of each Authority's emerging Local Plans. North Somerset's proposals for its *Local Plan 2038* contain significant development along the South-West Corridor, with a proposed residential site along the Woodspring Golf and Country Club. B&NES has undertaken housing and economic land availability assessments, with areas under consideration including Seven Acre Wood and areas around Keynsham and Saltford. While SGC is in the early stages of updating its Local Plan, its current core strategy makes provision for 28,335 homes to 2027, with development focused on the Bristol North Fringe and East Fringe urban areas.

2.7.19. It is expected that the level of housing growth needed within the region will put further strain on an already congested network.

2.8 Objectives

2.8.1. In 2019, objectives for the Mass Transit programme were first developed by the Combined Authority and the UAs, aligned with regional priority outcomes and policy aims. These objectives were approved by the then Transport Board, and through Mayors and Leaders. The resulting vision for a mass transit system in the West of England was:

"To provide a high-quality mass transit solution that provides a step change in public transport connectivity in the West of England, manages growth, facilitates modal shift in public transport usage, is a key contributor to tackling the climate emergency and helps

unlock significant housing and employment growth over and above the growth outlined in adopted and draft Local Plans."

2.8.2. Since that time, the UK Government published its *National Infrastructure Strategy*, the *Ten Point Plan for a Green Industrial Revolution*, and an updated *Green Book* in late 2020. The update to the Green Book placed an increased emphasis on the Strategic Dimension and ensuring that the appraisal process delivers on relevant policy objectives. Business cases require a robust narrative that sets out how the scheme will achieve its objectives. Proposals that do not meet their strategic objectives "cannot represent value for money" (DfT, 2020).

2.8.3. An exercise was therefore undertaken to revalidate and review the objectives, taking into account evolving policy drivers, and the engagement undertaken to date. This process is documented in the *Objective Development Report*.

2.8.4. The resulting objectives for the West of England Mass Transit scheme are as follows:

Operational Objectives

2.8.5. The operational objectives form the foundation of a successful mass transit system, and are necessary for the specific objectives and strategic outcomes to be achieved. These objectives will be further refined as a technology mode is selected and the scheme progresses to detailed design as part of the OBC process.

- A transport system that provides integrated end-to-end journeys for users
- Increased capacity on the public transport network
- Frequent, affordable and reliable services
- An accessible, inclusive, safe and secure solution

Specific Objectives

2.8.6. The specific objectives for the Mass Transit scheme have been developed to support the strategic outcomes and respond to the local and regional challenges identified. These are:

- To improve user experience of public transport and active travel
- To reduce overall carbon emissions and improve air quality in the region
- To increase connectivity of services across the network
- To improve reliability and frequency of services on the four corridors by prioritising public transport
- To reduce journey times and congestion across the region
- To increase accessibility across the region for all
- To enhance the natural and built environment
- To deliver modal shift from private car to public transport and active travel

Strategic Outcomes

2.8.7. The Mass Transit scheme's strategic outcomes or high-level objectives support the principal aims set out in the vision for a mass transit system as agreed in 2019. These objectives establish the foundation of what mass transit should be, and reflect the ambition for a better-connected, more prosperous region that works for all.

- Delivering a world-class, transformational, public transport system that:
  - Connects the West of England region, thereby reducing deprivation and inequality, and contributing to the levelling up agenda
  - Supports sustainable, economic growth and enables regeneration
  - Contributes to delivering Carbon Net Zero
  - Improves local environmental conditions and air quality
  - Makes sustainable transport the preferred option for short to mid-distance journeys

2.8.8. The objectives were approved by the UAs at the Mass Transit Director's Board in June 2021. As the scheme progressed to SOC, the objectives formed part of the assessment process for the shortlist. The results thereof can be found in section 2.11.

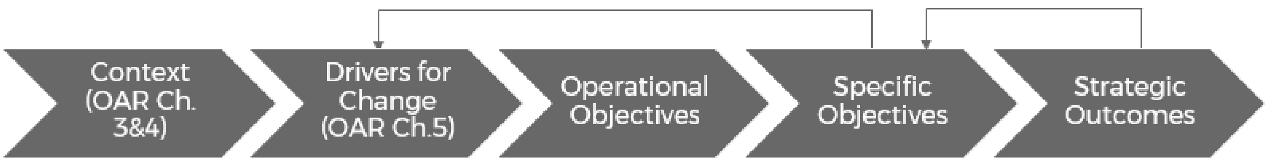
2.8.9. As the project continues and a specific mode is selected, it is intended that the objectives be further refined to become more specific, thereby ensuring their suitability for the longer-term monitoring of the scheme and its delivery. This could include corridor-specific objectives to reflect local needs and objectives.

2.9 Strategic Benefits

2.9.1. Building on the responses to both the initial stakeholder engagement, as well as work undertaken to establish the need for the scheme as part of the OAR, a Theory of Change logic mapping exercise was undertaken to support the further development of the objectives.

2.9.2. The creation of a Theory of Change diagram is a DfT recommended exercise to strengthen the evaluation of strategies for interventions. It assists in establishing internal consistency in the development of the scheme and sets out the steps a scheme will take to achieve a set of preferred outcomes. It demonstrates how different factors are interwoven in determining objectives and assists in the later monitoring and evaluation of the scheme. A high-level illustration of the approach is shown in Figure 2-3, with the full Theory of Change diagram contained in Appendix F.

Figure 2-3 – Logic Mapping



2.10 Measures of Success and Planning Delivery

2.10.1. Building on those objectives identified within section 2.8, the impact of the Mass Transit scheme has been 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 2-8. The interdependencies of the scheme impacts, and objectives are discussed above in section 2.9.

Table 2-8 – Measures of success / scheme impacts

Objective	Measure of success / impacts
To improve user experience of public transport and active travel	Increased customer satisfaction on public transport Reduce overall network accident rate Reduce the number of people killed or seriously injured on roads in the area Minimise highway safety impacts and severance
To reduce overall carbon emissions and improve air quality in the region	Reduce measured levels of NOx Reduce number of AQMAs along each corridor Support improvements in local air quality Minimise impact of scheme on climate change Minimise adverse environmental impacts arising from construction
To increase connectivity of services across the network	Use mass transit to increase interconnectivity options across the region, including existing bus and rail services, as well as walking and cycling infrastructure Increase first mile last mile solutions to broaden the catchment area positively impacted by a mass transit solution
To improve reliability and frequency of services on the four corridors by prioritising public transport	Increase the number of services running on the four corridors Increase timetable consistency for public transport services running on the four corridors
To reduce journey times and congestion across the region	Reduction in levels of congestion and more reliable journey times Improve journey times on identified scheme corridors Reassignment of traffic away from existing routes where needed to achieve the improved reliability of public transport services
To increase accessibility across the region for all	Improve accessibility to key employment, housing and education sites Improve accessibility to green areas Improve access to the cycle and Public Right of Way networks Increase perception of safety Actively mitigate against the issues identified under the programme's Equality Impact Action Plan
To enhance the natural and built environment	To deliver biodiversity net gain Minimise impact on landscape Minimise impact on heritage, particularly the WHS and underground vaults in Bath Not affect the integrity of the River Avon

Objective	Measure of success / impacts
To deliver modal shift from private car to public transport and active travel	Increase in number of trips taken by walking, cycling and public transport over current levels Increase access to public transport, walking and cycling facilities

2.11 Option Generation and Assessment Process

Overview

2.11.1. The development of the West of England Mass Transit programme to date has followed the approach set out in the DfT's Transport Appraisal Process[53]. This methodology ensures that a robust and evidence-led approach has been used, considering first the need for intervention and objectives prior to identifying potential solutions. The full detail of the option development work undertaken to date is set out in the OAR and is summarised as follows.

2.11.2. The need for a mass transit solution specifically, has long been recognised in regional policy. As part of the JTS, concept options were developed to overcome the transport issues identified within the study. These concept options were considered under themes including walking and cycling, pinch points and bottlenecks and new mass transit options. A sifting exercise was undertaken, considering options against a multi-criteria framework to identify a Reference Case, which included mass transit. JLTP4 then built on this concept by considering the four corridors in more detail, and these policies provide the foundation of the option generation and assessment for the SOC.

2.11.3. There are a number of forms a 'mass transit' system could take; the option generation and assessment process has therefore focused on both the potential route options and technology types.

2.11.4. The longlisting process considered 12 different technology types, which all require different lives of infrastructure, intervention, and ultimately investment. Four remain on the shortlist at this SOC stage, including lower cost (i.e. BRT) and higher cost (i.e. LRT) alternatives.

2.11.5. Initial feasibility designs have been prepared for the shortlisted options. Where possible, these designs are based on a mass transit solution being defined as a fully segregated, 3.2m-wide corridor in each direction, which allows the proposed system to run separated from general traffic, frequently and reliably.

2.11.6. Using this ambition as the first stage of scheme specification ascertains the feasibility of this scale of intervention and provides a basis for further optioneering work based on the outcomes. At this early stage, Mass Transit is considered as a standalone; to meet the full scale of its objectives, it is expected that this would form part of a package of measures

[53] The Transport Appraisal Process, Transport Analysis Guidance, Department for Transport, May 2018

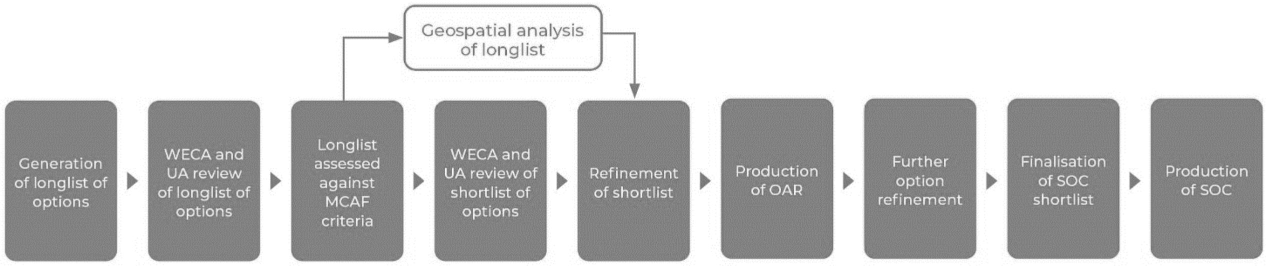
including first mile / last mile solutions and likely be implemented alongside a suitable selection of demand management measures.

Corridor Option Appraisal

2.11.7. Figure 2-4 shows the option development process followed to date, with the following sections setting out the details and output of each step. Additional detail can be found in the OAR.

2.11.8. At this stage of option development, a mode-agnostic approach was taken with an initial focus on route options. Following a review of UK and international case studies and considering their potential applicability to the West of England, a separate technology sift reduced the list of potential Mass Transit modes.

Figure 2-4 - Option assessment approach



Generation of Longlist Options

2.11.9. Four proposed corridor search areas were derived as part of the OAR process (North, East, South-West, and Bristol – Bath), as illustrated in Figure 1-1. These search areas, or corridors, consolidate a long-term ambition for a mass transit solution across the BCC, B&NES, NSC and SGC areas, and the need for intervention identified in previous chapters.

2.11.10. The JTS considered and developed transport options across the region under a number of packages with different areas of focus including economic, urban, sub-regional and strategic connections. Mass transit options formed part of each of the packages. Within the JTS the region was segmented into four geographic 'quadrants' with concept options for mass transit recognised within each of these. The JLTP4 then presented high-level mass transit corridors within these quadrants.

2.11.11. As the mass transit concept has progressed, its geographical scope has been further defined. As part of the development of the OAR, the four corridors identified in the JLTP4 were considered in further detail to identify an appropriate boundary for each. The identification of the corridor boundaries was driven by the challenges identified both now and in the future, and the need for intervention. In terms of aligning this to specific boundaries, the following additional factors were considered:

- Population distribution
- Workplace population

- Key demand attractors and generators
- Transport infrastructure

2.11.12. Once the corridor boundaries were determined, the option identification exercise focused on addressing the need for intervention and supporting the realisation of the scheme objectives, whilst being mindful of the constraints within each corridor boundary. A longlist of options was developed for each corridor, the boundaries of which are shown in Figure 1-1. Initially, the route options on each corridor were considered independently of the other corridors and potential connectivity within Bristol City Centre.

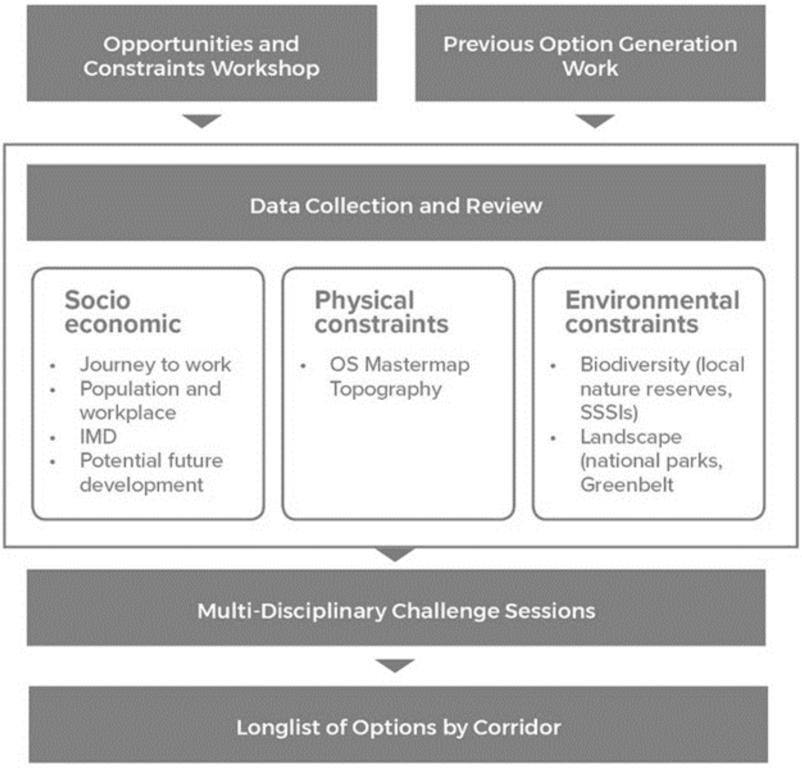
2.11.13. In the early stages of the Mass Transit programme, a series of workshops was held with the Combined Authority and the UAs to understand the opportunities and constraints within each of the corridors, as well as previous option generation work undertaken. The outputs of these workshops were supplemented with further data collation and review to generate a longlist of options. Multi-disciplinary challenge sessions were held to review the longlist of options from a range of perspectives including local context, engineering constraints, integration with the wider network and stakeholder perception / acceptability. Following these sessions, the longlist of options for each corridor was refined and finalised.

2.11.14. Figure 2-5 shows the option generation process undertaken and data drawn upon.

2.11.15. The options have been developed with an understanding of the current key trip attractors and generators for each corridor. As detailed in section 1.6.50 of the Strategic Dimension, the constituent Local Plans are being prepared in parallel to this Mass Transit programme. The revised Local Plans will set ambitions for the scale and distribution of housing and employment growth in the region. Once these policies are adopted, the impacts of these on the route options will be considered.

2.11.16. A range of options have been generated, covering different topographical solutions (including above ground, significantly tunnelled or hybrids). At this stage, options with significant tunnelled sections have been identified without the use of sub-surface information and alignment. The options generated address all routes considered reasonable along the existing road / land infrastructure. For sections with significant tunnelling components and some of the rail-based options, extra land may be required.

Figure 2-5 - Option generation process



North Corridor

2.11.17. The main artery route in this corridor is the A38, heading north out of Bristol towards the M5 and M4 motorway interchange. There are several key demand attractors and generators identified, including Bristol Temple Meads, Stokes Croft/Montpelier, Horfield, Southmead Hospital, UWE, Bristol Parkway, Cribbs Causeway, Filton (and the proposed Brabazon development) and Aztec West.

2.11.18. Figure 2-6 provides an overview of the longlist of options for the North Corridor.

East Corridor

2.11.19. The main arterial routes in this corridor are the A432 / A420 / A4174 and the A4017 heading out of Bristol from the East. There are several key demand attractors and generators identified, including Bristol Temple Meads, Lawrence Hill Station, Emersons Green, Staple Hill, Kingswood, Lyde Green P&R and the Science Park.

2.11.20. Figure 2-7 provides an overview of the longlist of options for the East Corridor.

Bristol – Bath Corridor

2.11.21. The options for the Bristol – Bath Corridor build on the BBSC infrastructure. As part of the development of BBSC, a number of different scenarios have been considered with differing levels of infrastructure. For the purposes of including BBSC in the Mass Transit SOC, the ‘Medium’ scenario has been assumed. Further detail is provided of this scenario in

Appendix G. The option development for the Bristol – Bath Corridor has been considered in two stages. First, options between Bristol City Centre and Newbridge P&R, which is situated to the west of Bath City Centre, were considered. As part of a separate project being undertaken by B&NES, route options between Newbridge P&R and Bath Spa were then considered. This was to allow coordination with wider proposals for the Bath area.

2.11.22. The main arterial route in this corridor is the A4 heading towards Bath, from the southeast side of Bristol. Between Newbridge P&R and Bath Spa there are two main routes – the A4 and the A36. There are several key demand attractors and generators identified, including Bristol Temple Meads, Bath Spa, St Philip's Marsh, Brislington P&R, Hicks Gate, Keynsham, Saltford, Newbridge P&R and central Bath.

2.11.23. There are a number of options for routing at the Bristol City Centre and Bath City Centre ends of the corridor. The options for the Bristol – Bath Corridor have therefore been segmented into route sections.

- Bristol City Centre – Newbridge P&R
  - BBC01 to BBC05 and BBC13 are end-to-end underground / hybrid, or conventional rail options between Bristol City Centre and Newbridge P&R
  - BBC-A to BBC-E are overground options for the section of the corridor between Bristol City Centre and A4 / A4174 junction
  - BBC06 to BBC14 are overground options for the section of the corridor between A4 / A4174 junction and Newbridge P&R
- Newbridge P&R – Bath Spa
  - Option 2 is an underground option between Newbridge P&R and Bath Spa
  - Options A and B are overground options between Newbridge P&R and Windsor Bridge
  - Options 5 – 9 are overground options between Windsor Bridge and Bath Spa

2.11.24. Figure 2-8 provides an overview of the longlist of options for the Bristol – Bath Corridor.

South-West Corridor

2.11.25. The main artery route in this corridor is the A38 heading south from Bristol City Centre. There are several key demand attractors and generators within this corridor, including Bristol Temple Meads, Redcliff, Bedminster, Parson Street railway station, Ashton Gate stadium, Long Ashton P&R, Imperial Park and Bristol Airport. Bristol Airport is currently only accessible via the road network and has no railway links.

2.11.26. Between Lime Kiln Roundabout and Bristol Airport, the only existing highway route is the A38 Bridgewater Road. There are a number of potential constraints along the A38 including the Barrow Gurney Reservoirs. Option SWC12 offers an alternative route for this section, requiring a new link to be constructed between Lime Kiln and Bristol Airport. The alignment of SWC12 between central Bristol and Lime Kiln Roundabout could facilitate any of the end-to-end options on this section.

2.11.27. Figure 2-9 provides an overview of the longlist of options for the South-West Corridor.

Figure 2-6 - North Corridor longlist options

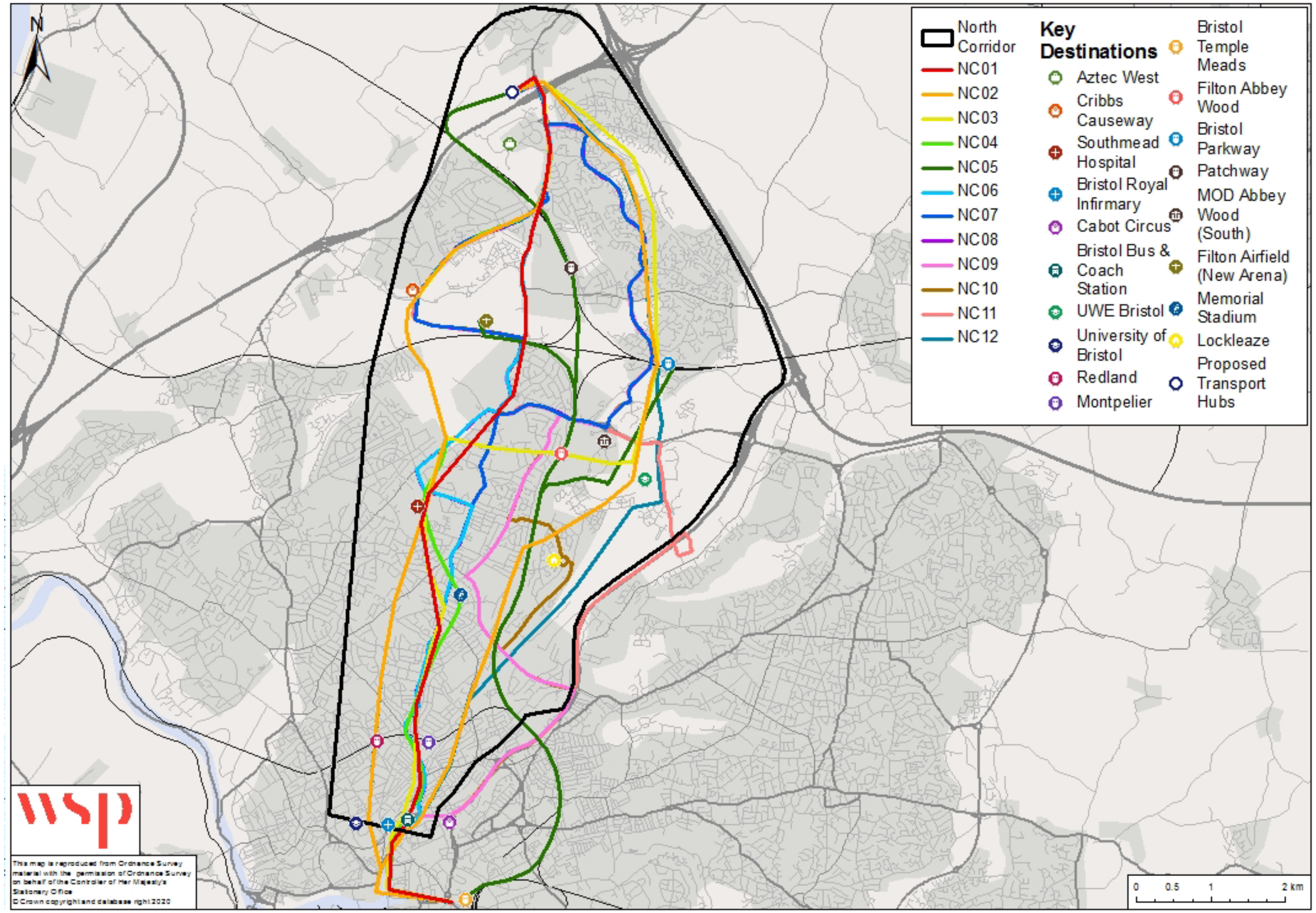


Figure 2-7 - East Corridor longlist options

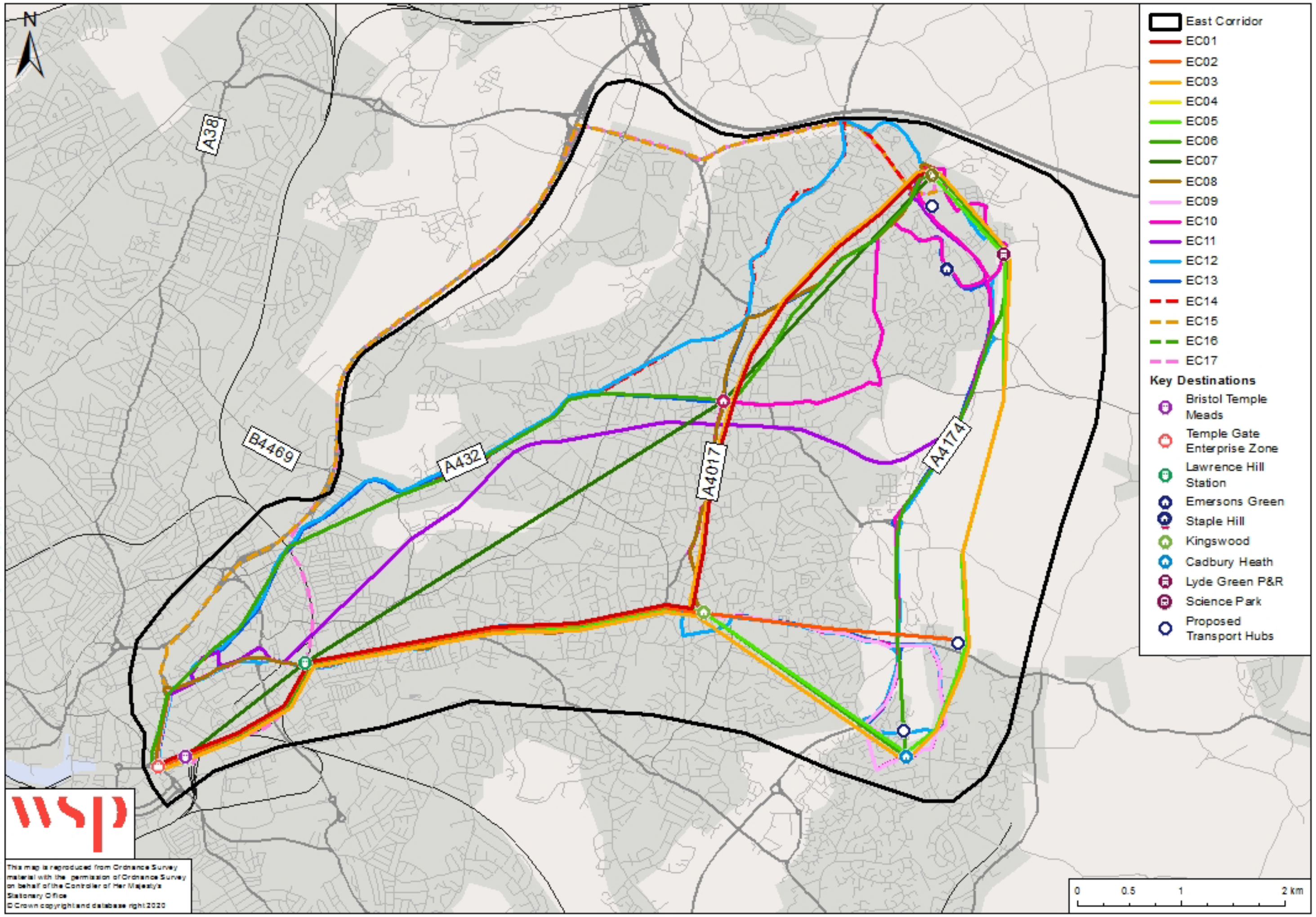


Figure 2-8 - Bristol - Bath Corridor longlist options

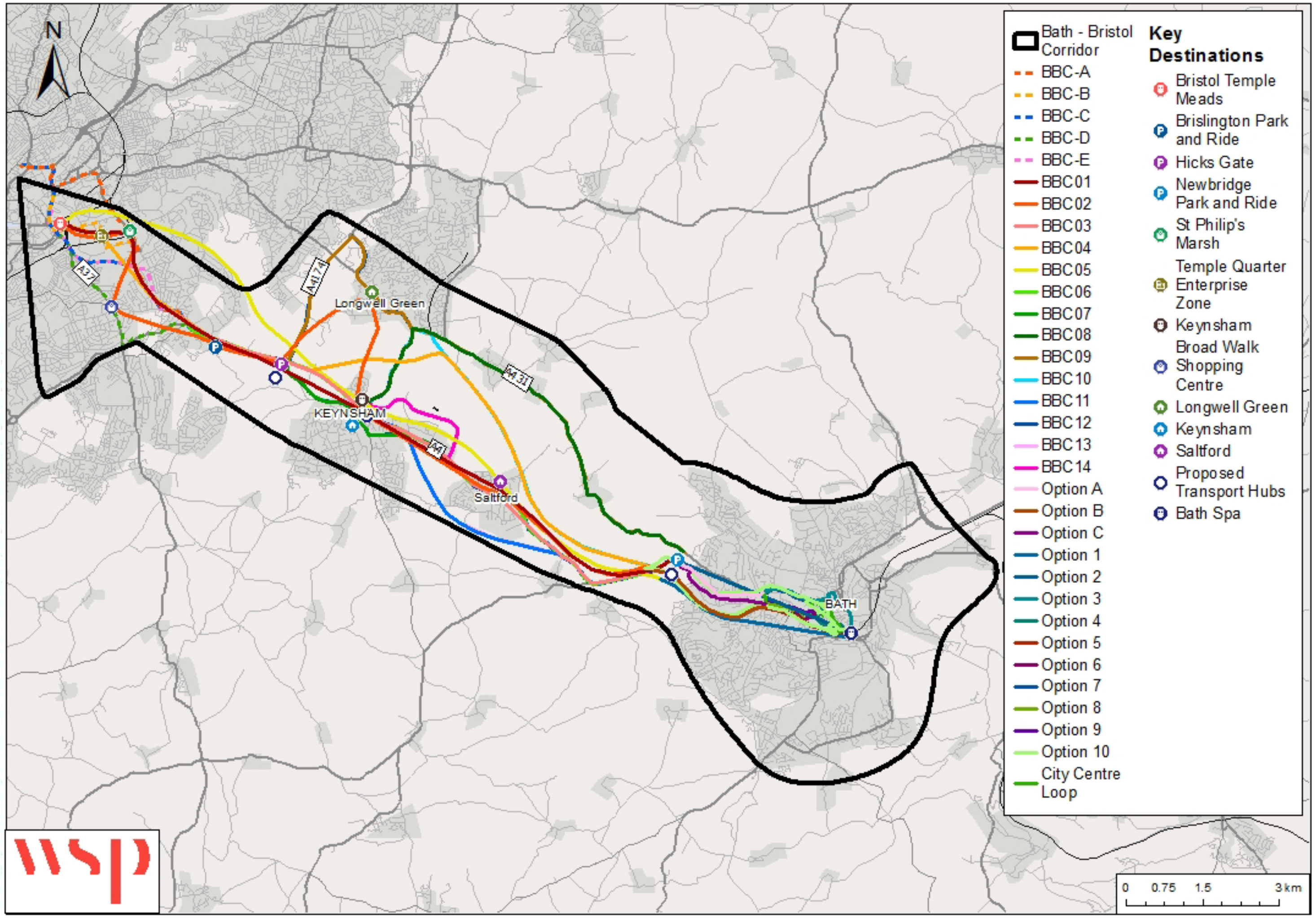
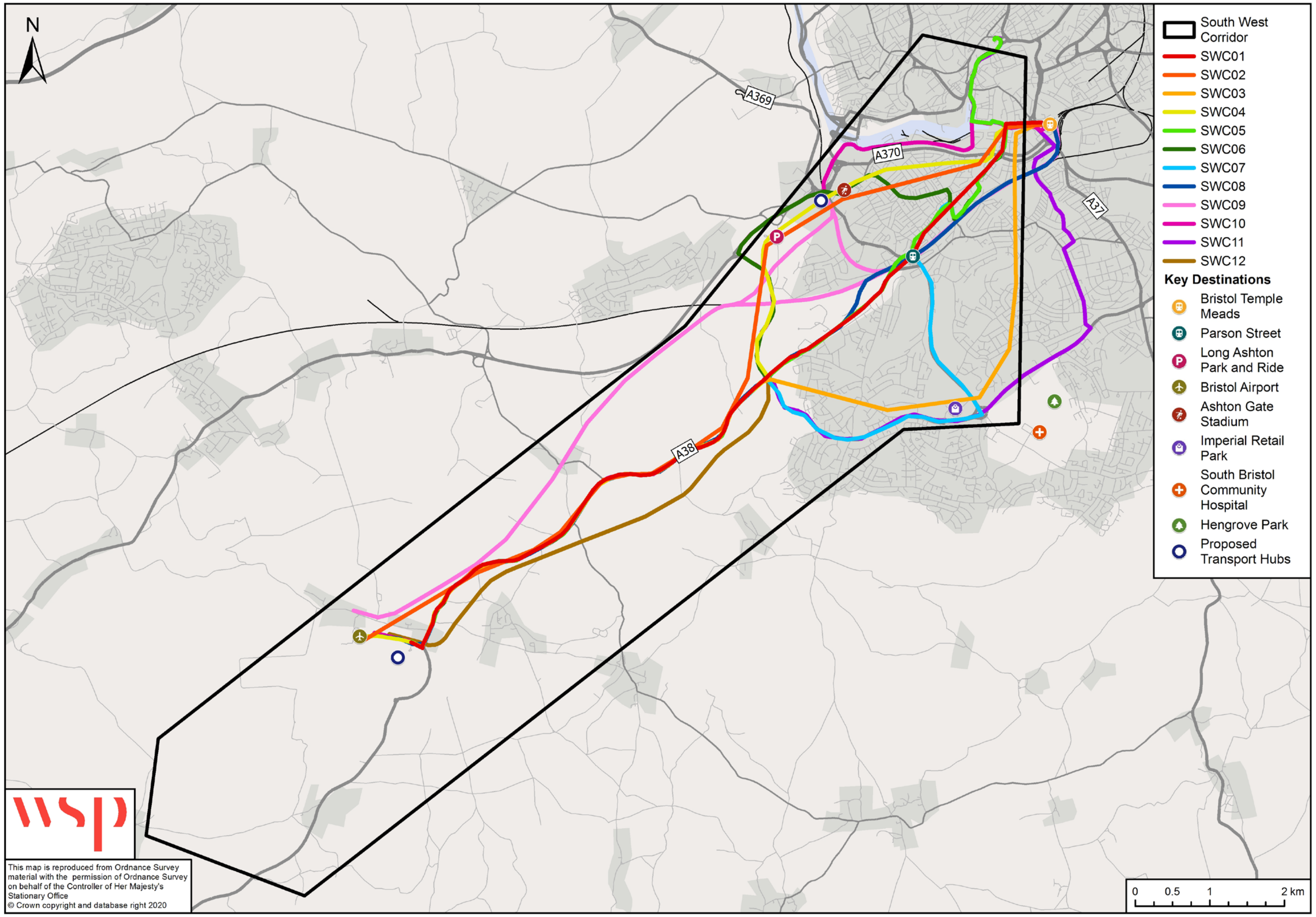


Figure 2-9 - South-West Corridor longlist options



Multi-Criteria Assessment Framework

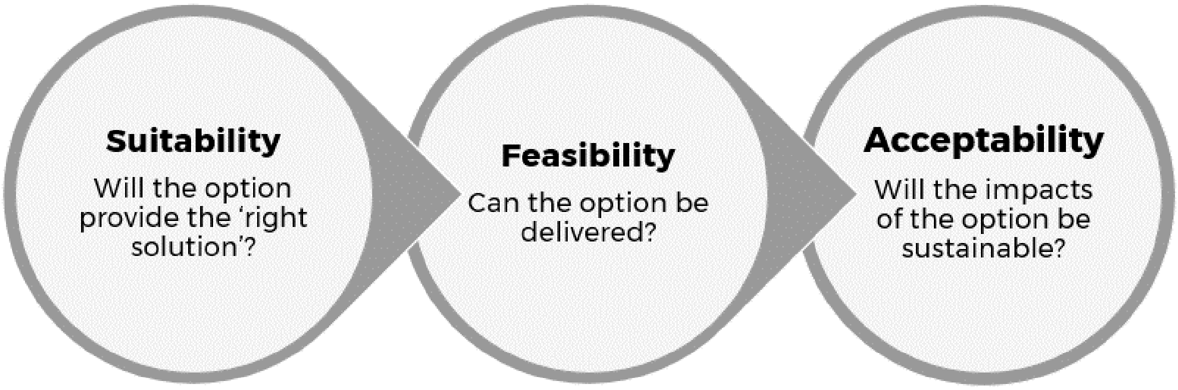
2.11.28. Following the establishment of the longlist, a staged approach was used to assess each option, and reduce the longlist to a shortlist. This approach drew on input from the Combined Authority and the UAs.

2.11.29. Consistent with HM Treasury's *Green Book* guidance on the Five Case Model and the DfT *Transport Appraisal Process*, a Multi-Criteria Assessment Framework (MCAF) has been used for the option assessment process and to capture its findings. The longlist has been assessed qualitatively using the MCAF. The MCAF addresses three themes, which have been considered in turn. The themes, shown in Figure 2-10, are:

- Suitability
  - Assessment in terms of alignment to the vision and objectives for Mass Transit
- Feasibility
  - Assessment in terms of deliverability, viability, levels of support and future proofing
- Acceptability
  - Assessment in terms of the economic, social and environmental impacts

2.11.30. The detailed criteria and sub-criteria under each of these themes are set out fully in Appendix H.

Figure 2-10 - MCAF assessment themes



2.11.31. Options have been assessed on a seven-point scale for each assessment sub-criteria, as shown in Table 2-9. This assessment system and its description (e.g. "Moderate Adverse") align with DfT's standard approach set out throughout their transport analysis guidance and has been used throughout the MCAF tool. Options that did not meet the requirements under these themes were sifted out. The indicative shortlist was then reviewed by the Combined Authority and the UAs, identifying any 'showstoppers' that resulted in options either being discounted or retained.

Table 2-9 – MCAF 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
Large Beneficial (LB)	+3

2.11.32. Appendix I provides the assessment results for each option within each corridor using the assessment scoring shown in Table 2-9. Given the different nature and context of the four corridors, the specific considerations within the options assessment varied for each corridor, with options scoring higher or lower against various criteria to reflect this. The OAR should be referred to for the full details of the option assessment.

2.11.33. The distribution of scores and the consideration of each option against the sub-criteria informed whether an option was shortlisted. The overall score is a useful measure; it has not however been considered in its own right as a determinant of whether or not an option should be shortlisted. As stated above, the MCAF is a tool to allow consistent comparison between options and consideration of options from a range of perspectives. It is this process that identifies the better performing options as opposed to the scoring provided.

2.11.34. The outputs of the MCAF have been supplemented by discussions with the Combined Authority and the UAs to inform the shortlisted options. The results of this MCAF process, complemented by feedback through engagement with project partners, resulting in the identification of recommended shortlisted options distributed as follows:

- South-West Corridor: five options (SWC01, SWC03, SWC05, SWC11 and SWC12)
- North Corridor: three options (NC03, NC04 and NC08)
- East Corridor: five options (EC01, EC02, EC03, EC04 and EC08)
- Bristol – Bath Corridor: six options (BBC03, BBC-C, BBC-E, BBC06, BBC07 and BBC14)

Further Option Refinement

2.11.35. Prior to feasibility design work as part of the SOC, a further option refinement process was undertaken. A series of workshops were held to revisit the above shortlisted options on each corridor. The purpose of the workshops was to:

- Revisit the need for intervention on each corridor
- Understand how Mass Transit aligns with other programmes on each corridor
- Identify any further options that could be discounted based on changes in context / circumstance since the option development work

2.11.36. The detailed outputs of these workshops are documented in the OAR. As a result of the workshops and follow-on work the shortlist of options on each corridor was further reduced prior to the SOC.

2.11.37. The most significant changes as part of this further option refinement were related to the options on the Bristol – Bath and North corridors.

2.11.38. On the Bristol – Bath Corridor the route options between Newbridge P&R and Bath Spa were rationalised. Primarily, the route through Bath City Centre has been simplified to ensure the objectives for Mass Transit are maintained. The options to the east of Windsor Bridge have been linked up with those in the west to give end-to-end options between Newbridge P&R and Bath Spa. As a result of this exercise there were three shortlisted options between Newbridge P&R and Bath Spa:

- **Bath A5**: routes Mass Transit along the A36 to the south of the River Avon. To accommodate a fully segregated Mass Transit route within the width constraints, it is necessary to provide a route to general traffic in one direction only, with displaced journeys routed along the A4. There are also sections of shuttle working of Mass Transit and some re-routing of the cycleway along the A36. The route terminates at Churchill Bridge Roundabout, where an existing pedestrian footbridge provides access to the bus station and Bath Spa railway station.
- **Bath B6**: routes Mass Transit along the A4 to the north of the river, before crossing to the south and following the A36 for approximately 1km. Over this section, general traffic would be one-way, with traffic in the opposing direction being displaced onto the A36 and A4 respectively. The route then returns north of the river where road closures to through traffic are required in the centre of Bath. Some shuttle working and re-routing of the cycleway is necessary throughout the option. Existing constraints in the city centre restrict Mass Transit access to the bus station and Bath Spa railway station. It therefore loops around the A367 gyratory, which would require reallocation of a significant amount of road space.
- **Bath B9**: follows the same route as Bath B6 until the point where it passes to the south of the River Avon. It routes through a combination of development land and a residential street that could be closed to through traffic. It then requires some closures to through traffic and re-routing of the cycleway to remain segregated in the centre of Bath. As with option BBC-B6, Mass Transit does not interchange directly at the bus station and Bath Spa railway station but terminates on the A367 gyratory.

2.11.39. As part of this further refinement, the resultant impact of NC08 on highway operation was considered in more detail. Under NC08 the A38N would be closed to southbound through traffic between Ashley Road and Ashley Down Road, with traffic diverted onto Ashley Down Road. A further option, NC08b, was established which would see the full closure to through traffic on the A38N between Ashley Road and Ashley Down Road with traffic re-routing on the remaining network. The Mass Transit alignment does not change between these options. NC08b was added to the shortlist.

Shortlisted Options

2.11.40. Following the extensive option development process, a shortlist of corridor options has been identified for each corridor. The shortlisted options described below are shown in Figure 2-11 and summarised in Table 2-10, along with a high-level overview of their relevance to the scheme's objectives ('suitability'). It is recognised that as the scheme is currently defined, the shortlisted options in isolation do not meet the full scale of the objectives set out. It is therefore expected that complementary measures, including first-mile / last-mile solutions will be packaged alongside the core mass transit intervention at the next stage.

2.11.41. As part of the SOC, feasibility designs to provide a **fully segregated mass transit solution** wherever possible have been prepared for each of these options. In order to achieve this, there are a number of alternative arrangements, including running underground, shuttle working for general traffic and diversions for general traffic. Additional information can be found in the *Feasibility Design Summary Report*.

North Corridor - NC04

Bristol Temple Meads to Southmead Hospital, Cribbs Causeway, Aztec West and Almondsbury

2.11.42. This option would run underground between Bristol Temple Meads and Filton Golf Club following the general alignment of the A38(N). The option would run overground from the southern extent of Filton Golf Club, passing through the golf course, Brabazon development and the residential and industrial development to the south of the Airfield.

North Corridor - NC08

Bristol Temple Meads loop via A38 to Southmead Hospital, Cribbs Causeway, Aztec West, Bradley Stoke, Bristol Parkway and UWE

2.11.43. This option remains largely on existing highway corridors and includes a combination of shuttle working and general traffic diversion measures to enable Mass Transit to remain fully segregated along the constrained sections of Stokes Croft, Cheltenham Road and Gloucester Road. Between Ashley Road and Ashley Down Road this option assumes that only northbound traffic can use the A38(N), with southbound traffic diverted onto Ashley Down Road. This option has a shallow underground section between Ashley Down Road and Muller Road. At Filton the route splits into a loop, with the western side continuing north on the A38(N) before heading east through the new Brabazon development and connecting into existing public transport infrastructure through Patchway before re-joining the A38(N). Following this route north, the option passes under the M5 to the location of a future transport hub in Almondsbury. The eastern loop uses Bradley Stoke Way and Brook Way to pass through Bradley Stoke and then runs along Orpheus Avenue to Hatchet Road to Stoke Gifford. Finally, the route runs along Brierly Furlong and Great Stoke Way to connect with Filton Road to join back to the route at the A38(N).

2.11.44. It is assumed that two service patterns would be required for this option, such that the loop is served in both directions.

North Corridor - NC08b

Bristol Temple Meads loop via A38 to Southmead Hospital, Cribbs Causeway, Aztec West, Bradley Stoke, Bristol Parkway and UWE

2.11.45. This option is the same as NC08 with the exception of the section along Cheltenham Road and Gloucester Road, where the shuttle-working and one-way closure included in NC08 is replaced by a full closure to through traffic.

East Corridor - EC01

Bristol Temple Meads to Science Park via Kingswood and Staple Hill

2.11.46. This option would run underground for its entire length. Beginning at Bristol Temple Meads this option heads northeast towards Old Market, it then follows the approximate alignment of the A420. At Kingswood, the route curves north to follow the approximate alignment of the Soundwell Road to Downend and then northeast to align with Westerleigh Road and terminates at the Bristol and Bath Science Park.

East Corridor - EC04

Bristol Temple Meads to Science Park via Staple Hill, additional spur to Cadbury Heath

2.11.47. EC04 builds on EC01, also including a further underground section between Kingswood to Cadbury Heath, passing below the A4174.

East Corridor - EC08

Bristol Temple Meads to Kingswood via A420, Staple Hill via A4017, Science Park via Westerleigh Road

2.11.48. In central Bristol EC08 uses shuttle working to provide segregation and avoid impacting on historic and mixed-use buildings. Once at the existing gyratory system on the A420 and onto the Lawrence Hill Roundabout, the Mass Transit will follow these one-way loops, where there is sufficient space to provide a Mass Transit lane. Along Lawrence Hill and Church Road, to the junction with Victoria Parade, the A420 would be closed to through traffic in order to minimise delays and journey times for the Mass Transit. From Victoria Parade to Soundwell Road, a combination of one-way closure to through traffic, and re-routing of the cycle route onto parallel routes is necessary to maintain Mass Transit segregation.

2.11.49. From Kingswood to Downend the Mass Transit is routed along Soundwell Road, Lodge Road, Hillfields Avenue to Shrubbery Road. From Downend to Bristol and Bath Science Park the Mass Transit is routed along Westerleigh Road.

South-West Corridor - SWC03

Bristol Temple Meads to Bristol Airport via Imperial Retail Park and A38

2.11.50. This option would run underground from Bristol Temple Meads to the Highbridge Green junction passing Victoria Park, east of Knowle and Hengrove. At Highbridge Green junction this option continues above ground to the Airport.

South-West Corridor - SWC05

Bristol Temple Meads to Bristol Airport via A38

2.11.51. This option follows the A38(S) for the majority of the route. Initially above ground at Redcliff Roundabout and Redcliff Hill, it then passes underground for a small 'cut and cover' section along East Street and onto Dalby Avenue due to the narrow existing highway corridor. Mass Transit then returns above ground along the A38 to West Street. Along West Street, outbound general traffic would not be permitted, and instead routed via Bedminster Road and Parson Street gyratory. Mass Transit would also operate under shuttle working along West Street to provide segregation but avoid the impact of the historic and mixed-use buildings. Mass Transit will then follow the existing Parsons Street Gyratory where there is sufficient space to provide a Mass Transit Lane. From Bridgewater Road to Bristol Airport the option then routes along the A38(S).

South-West Corridor - SWC11

Bristol Temple Meads to Bristol Airport via Knowle and Bishopsworth

2.11.52. This option follows the A4 Bath Road to Mead Street. Continuing along the residential streets of Ravenhill Road, Ravenhill Avenue, Axebridge Road and Salcombe Road, general traffic is prohibited in one direction and Mass Transit operated under shuttle working to ensure segregation is maintained. This option then utilises the A4174 and A38 to provide access to the Airport.

Bristol - Bath Corridor

2.11.53. The shortlisted options on this corridor consist of three route options within Bristol City Centre, one option between the A4 / A4174 junction and Newbridge P&R and three options between Newbridge P&R and Bath Spa (see section 2.11.37).

2.11.54. There is currently substantial work being undertaken independently of the Mass Transit programme considering how Bath City Centre could look in the future, and the impacts of this on transport operation. For the purposes of the SOC it is considered reasonable to appraise a single option on the Bristol - Bath Corridor. The modelling and appraisal framework utilised at this stage is also unlikely to differentiate between the three options at both the Bristol and Bath ends of the corridor given the close proximity of the various options. Therefore, the following option will be appraised for the Bristol - Bath Corridor within the SOC.

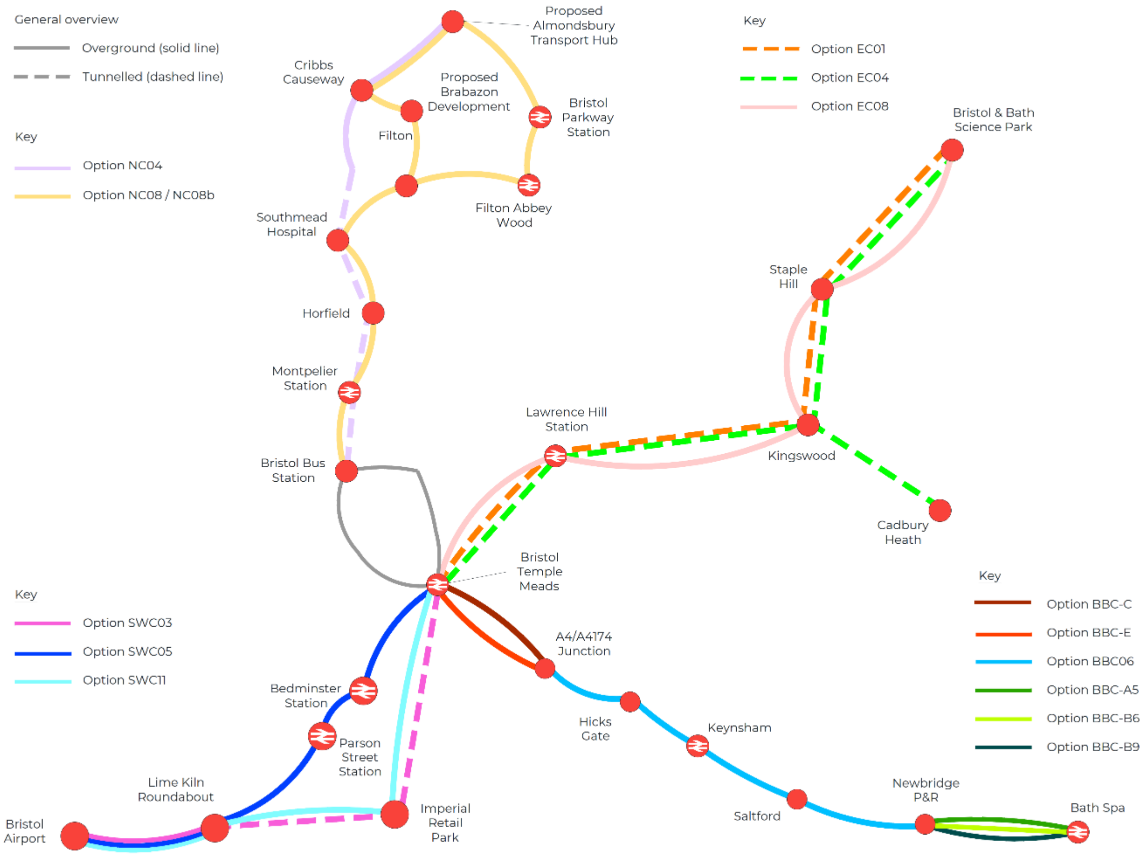
Bristol Temple Meads to Bath Spa via the A4 and A36

2.11.55. Beginning at Bristol Temple Meads, the alignment follows the A4 Bath Road to the Newbridge P&R to the west of Bath, using considerable sections of the proposed BBSC infrastructure, which is assumed to have already been implemented prior to the Mass Transit programme.

2.11.56. Initially this option provides a fully segregated route within the existing infrastructure, with Mass Transit incorporated into the existing Bath Bridge Roundabout. From Totterdown Bridge to Paintworks it is necessary to narrow the cross section by diverting the cycle route over Totterdown Bridge and along the St. Philip's Marsh Cycle Way and shuttle working of the Mass Transit. Shuttle working is also necessary at the pinch point near the Army Cadet building on the hill from St Phillip's Causeway to the Tramway Road junction.

2.11.57. From the Callington Road junction, the infrastructure assumed to be already installed under the BBSC project is utilised along Bath Road and the Keynsham Bypass. Through Saltford, the Mass Transit programme expands on the BBSC measures to provide segregation in both directions. To the east of Saltford, BBSC infrastructure is again used along the Bristol Road and onto Newbridge, over which shuttle working will be required, to Newbridge P&R. From Newbridge P&R, this option will follow the A36 to the south of the River Avon. In order to provide segregation general traffic will be restricted to one direction only with displaced journeys routed along the A4. There will also be sections of shuttle working for Mass Transit and re-routing of the cycleway along the A36. This option terminates at the Churchill Bridge Roundabout where an existing pedestrian footbridge provides access to the bus station and Bath Spa railway station.

Figure 2-11 - Shortlisted corridor options[54]



[54] Although only one option has been appraised on the Bristol – Bath Corridor, all shortlisted options are shown for completeness

Table 2-10 – West of England Mass Transit corridor options

Option	Description	Length (km)	Strategic Alignment
North Corridor			
NC04	Bristol Temple Meads to Southmead Hospital, Cribbs Causeway, Aztec West and Almondsbury Tunnelled section between Bristol Temple Meads and Filton	13.5 Tunnelled: 7.5 Overground: 6.0	• Route is expected to link several employment sites such as Cribbs Causeway, Aztec West and Southmead Hospital to residential areas along the corridor • Serves the area between Cotham / Montpelier, which is amongst the top 5% most deprived areas • Expected links to Montpelier and Redland stations • Assumed to provide higher journey speeds and more reliability than overground options • Expected higher modal shift for options with significant tunnelled sections results in a net carbon saving for both rubber-wheeled and steel-wheeled modes in a standard patronage scenario
NC08	Bristol Temple Meads loop via A38 to Southmead Hospital, Cribbs Causeway, Aztec West, Bradley Stoke, Bristol Parkway and UWE Between Ashley Road and Ashley Down Road this option assumes that only northbound traffic can use the A38(N), with southbound traffic diverted onto Ashley Down Road	20.5	• Route is expected to serve several employment sites such as Aztec West, Cribbs Causeway, Filton, Southmead Hospital and the Ministry of Defence • Provides links to Bristol Bus & Coach station, Bristol Parkway, and Filton Abbey Wood • Passes nearby to Redland / Montpelier stations • Passes nearby to areas of deprivation between Southmead and Filton • Serves the area between Cotham / Montpelier, which is amongst the top 5% most deprived areas • Lower cost • Benefits from increased accessibility for mobility impaired passengers
NC08b	Bristol Temple Meads loop via A38 to Southmead Hospital, Cribbs Causeway, Aztec West, Bradley Stoke, Bristol Parkway and UWE Between Ashley Road and Ashley Down Road this option assumes full closure to through traffic on the A38(N)	20.5	• Route is expected to serve several employment sites such as Aztec West, Cribbs Causeway, Filton, Southmead Hospital and the Ministry of Defence • Provides links to Bristol Bus & Coach station, Bristol Parkway, and Filton Abbey Wood • Passes nearby to Redland / Montpelier stations • Passes nearby to areas of deprivation between Southmead and Filton • Serves the area between Cotham / Montpelier, which is amongst the top 5% most deprived areas • Lower cost

Option	Description	Length (km)	Strategic Alignment
			• Benefits from increased accessibility for mobility impaired passengers
East Corridor			
EC01	Bristol Temple Meads to Science Park via Kingswood and Staple Hill Tunnelled for full length	10.7	• Tunnelled solution provides a step-change in PT connectivity • Links with residential sites such as Emerson's Green • Links with employment sites such as Temple Gate Enterprise Zone and Bristol & Bath Science Park • Encourages modal shift from private car along the A420 and north via Staple Hill • Assumed to provide higher journey speeds and more reliability than OG options • Could serve four notable areas of deprivation • Links with existing Metrobus route and Lyde Green P&R
EC04	Bristol Temple Meads to Science Park via Staple Hill, with additional spur to Cadbury Heath Tunnelled for full length	13.1	• Tunnelled solution provides a step-change in PT connectivity • Links with residential sites such as Emerson's Green, Staple Hill, Cadbury Heath • Links with employment sites such as Temple Gate Enterprise Zone and Bristol & Bath Science Park • Encourages modal shift from private car along the A420 and north via Staple Hill and south-east via Warmley Hill • Assumed to provide higher journey speeds and more reliability than OG options • Could serve four notable areas of deprivation • Links with existing Metrobus route and Lawrence Hill rail station (but not Lyde Green P&R) • Expected higher modal shift for options with significant tunnelled components results in a net carbon saving for both rubber-wheeled and steel-wheeled modes in a standard patronage scenario
EC08	Bristol Temple Meads to Kingswood via A420, Staple Hill via A4017, Science Park via Westerleigh Road A420 closed to general traffic / restricted to one-way on multiple sections	10.5	• Could serve Temple Gate Enterprise Zone and Bristol & Bath Science Park • Links with the existing Metrobus route and two rail stations • Could serve four areas of deprivation • Benefits from increased accessibility for mobility impaired passengers • Net carbon saving for rubber-wheeled modes only in a standard patronage scenario • Lower cost

Option	Description	Length (km)	Strategic Alignment
South-West Corridor			
SWC03	Bristol Temple Meads to Bristol Airport via Imperial Retail Park and A38 Tunnelled section between Bristol Temple Meads and Highbridge Green junction	15.0 Tunnelled: 7.0 Overground: 8.0	• Tunnelled solution provides a step-change in PT connectivity • Links with employment sites such as Temple Gate Enterprise Zone and Imperial Retail Park • Links with residential sites such as Knowle West • Terminates at Bristol Airport, provides a strong link to other modes of transport and encouraging inward investment • Provides a direct link with the existing Metrobus route • Depending on stop locations, has the potential to serve some of the most deprived areas in the city
SWC05	Bristol Temple Meads to Bristol Airport via A38 Along West Street, outbound general traffic would not be permitted, and instead routed via Bedminster Road and Parson Street gyratory	12.0	• Could serve Temple Gate Enterprise Zone • Follows much of the existing highway, Parson Street Station and the existing Metrobus route • Potential to provide indirect interchange with Parson Street Station and Bedminster Station • Terminates at Bristol Airport, provides a strong link to other modes of transport and encouraging inward investment • Benefits from increased accessibility for mobility impaired passengers • Lower cost
SWC11	Bristol Temple Meads to Bristol Airport via Knowle and Bishopsworth General traffic is prohibited in one direction along Ravenhill Road, Ravenhill Avenue, Axebridge Road and Salcombe Road	15.5	• Could serve Temple Gate Enterprise Zone and Imperial Retail Park • Terminates at Bristol Airport, provides a strong link to other modes of transport and encouraging inward investment • Expected to serve areas of deprivation • Benefits from increased accessibility for mobility impaired passengers • Lower cost
Bristol - Bath Corridor			
BBC	Bristol Temple Meads to Bath Spa via the A4 and A36	15.5	• Expected to provide access to Keynsham town centre and rail station • Serve existing and future population along A4 • Provides connectivity between residential areas between Bristol and Bath

Option	Description	Length (km)	Strategic Alignment
	Utilises and builds on infrastructure delivered as part of BBSC. Routes along A4 and A36, with restrictions to general traffic within central Bath		• Links to employment sites at Brislington Retail Park and Keynsham centre, and Bath City Centre • Links to Bath Spa Railway Station • Serves the Park & Ride facilities at Brislington and Newbridge • Route passes through area of deprivation at Brislington • Benefits from increased accessibility for mobility impaired passengers • Lower cost

Bristol City Centre Connectivity

2.11.58. The route options above considered each corridor individually and did not address connectivity within Bristol City Centre itself. A separate optioneering exercise has been undertaken to consider how the four corridors could be connected. The ISP and OAR set out further details of the development and assessment of city centre options.

2.11.59. The following objectives were established for operations within the city centre:

- To reach all identified key destinations, including Temple Meads, Bristol Royal Infirmary (BRI), Cabot Circus / Broadmead, Old Market and the Centre
- To maximise stop catchment coverage and accessibility across the city centre
- To minimise the need to interchange
- To minimise journey times across the city centre
- To create a coherent and legible network
- To achieve the highest average speed between stops
- Infrastructure deliverability challenges

2.11.60. The recently adopted *West of England Bus Strategy and Bus Service Improvement Plan* set out the ambition to reintroduce high frequency, cross-city services. In line with the public transport strategies for the region, the city centre connectivity options have been developed so that through running services are enabled, i.e. corridor services are linked in pairs to create two lines through the city centre.

2.11.61. Seven city centre connectivity options were developed for an overground network, and three options for a network with significant tunnelled compoents. Following assessment against the above objectives, seven options have been retained and used to develop full network options. Figure 2-12 and Figure 2-14 show the above and below ground shortlisted options for the city centre, and Table 2-11 describes these options in more detail.

Figure 2-12 - West of England Mass Transit Bristol City Centre options (above ground options B and D)

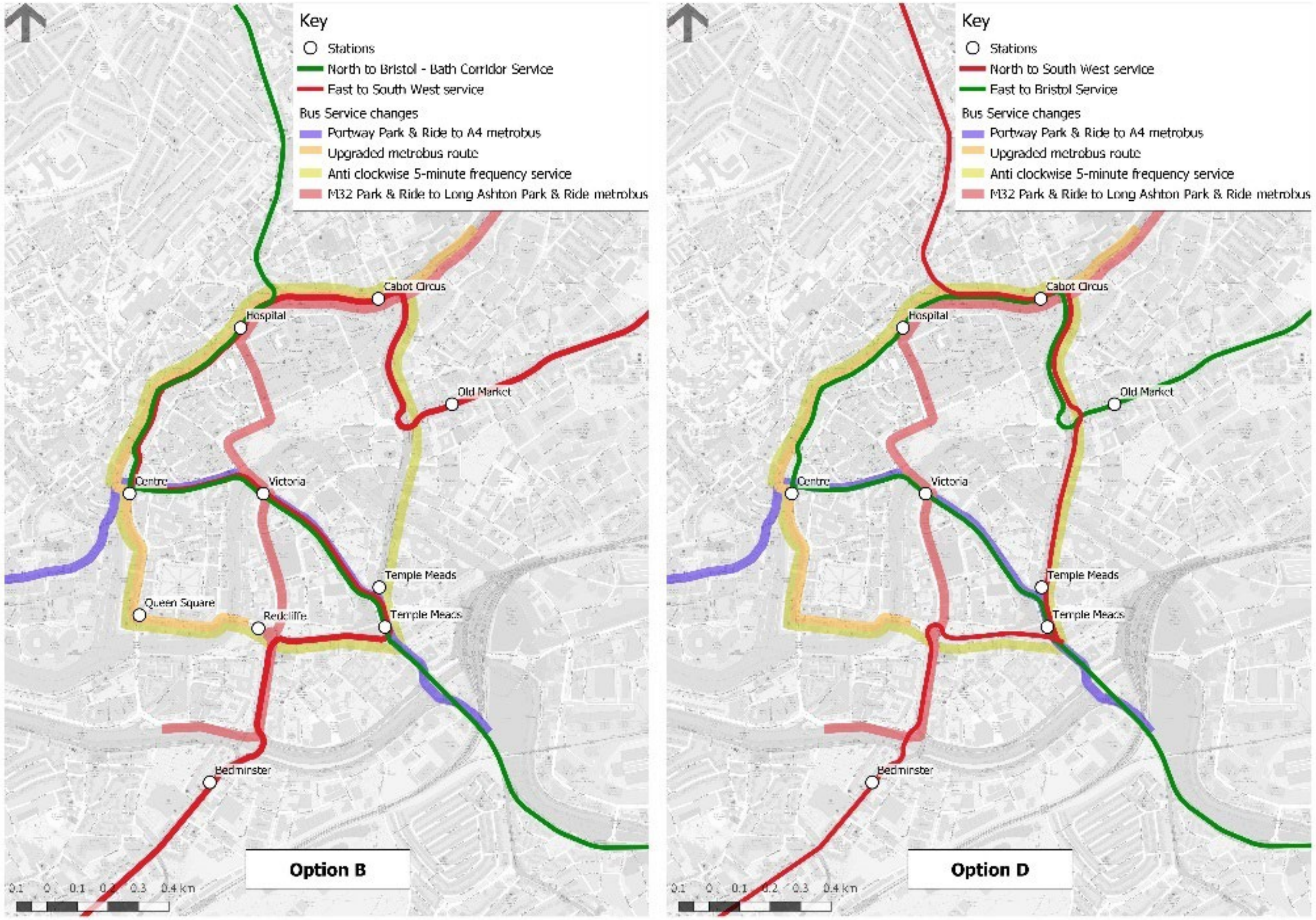


Figure 2-13 - Bristol City Centre options (above ground options E and G)

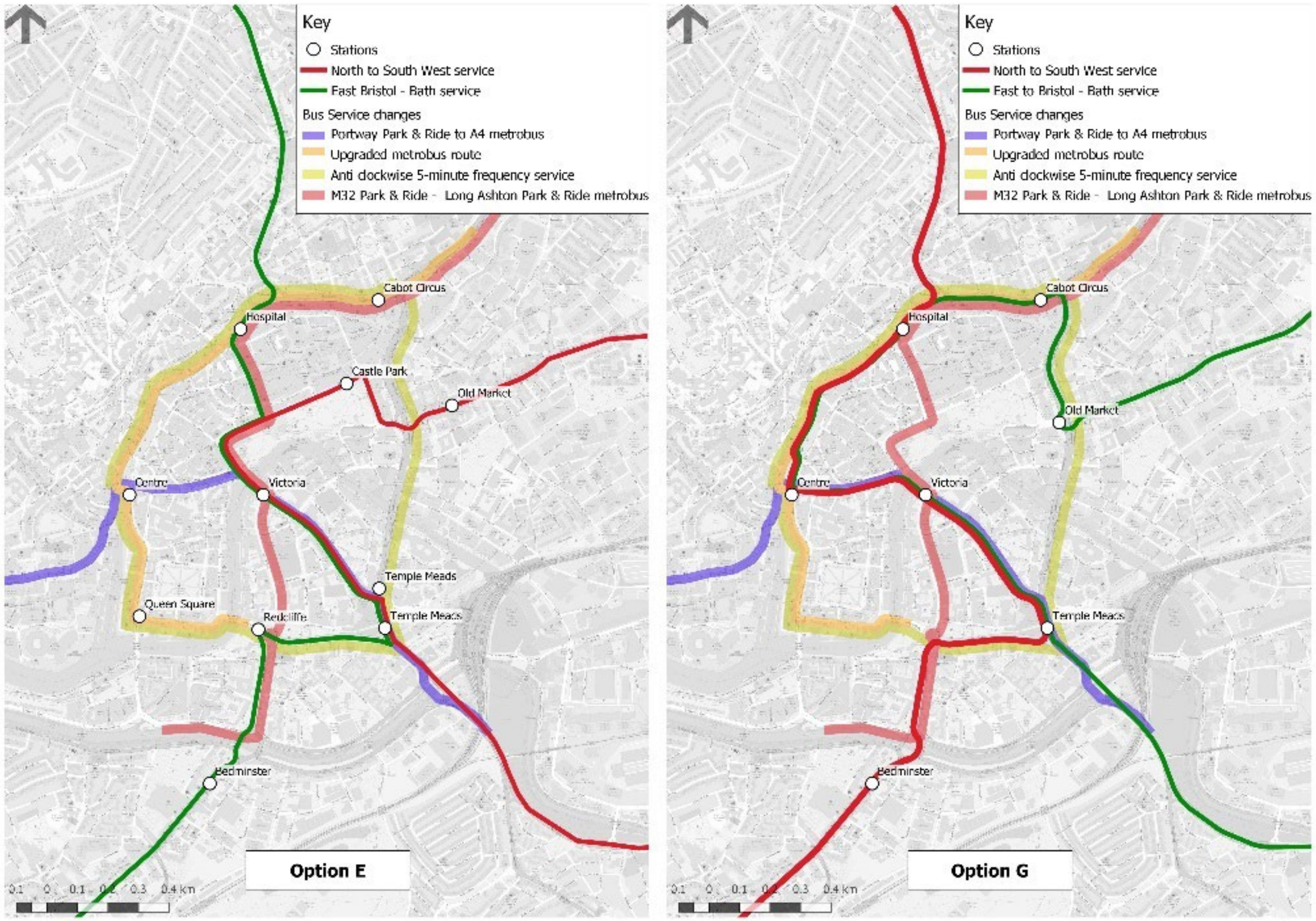


Figure 2-14 - West of England Mass Transit Bristol City Centre options (below ground)

Table 2-11 – West of England Mass Transit Bristol City Centre options

Option	Corridors connected	Description
Above ground		
B	East <> South-West North <> Bristol - Bath	Route 1: East to South-West service: providing direct access from both corridors to Old Market, Cabot Circus, Bristol Royal Infirmary (BRI), Centre and Temple Meads. This would also serve Victoria and Bedminster Route 2: North to Bristol – Bath service: providing direct access from both corridors to the BRI, Centre, Temple Meads. This would also serve Victoria
D	North <> South-West East <> Bristol - Bath	Route 1: North to South-West service: providing direct access from both corridors to Cabot Circus, Old Market, and Temple Meads. The service would also serve Bedminster. Route 2: East to Bristol – Bath service: providing direct access from both corridors to Old Market, Cabot Circus, BRI, Centre, and Temple Meads. The service would also serve Victoria
E	East <> Bristol – Bath North <> South-West	Route 1: East to Bristol – Bath service: providing direct access from both corridors to Old Market and Temple Meads Route 2: North to South-West service: providing direct access from both corridors to BRI, Victoria and Temple Meads
G	North <> South-West East <> Bristol - Bath	Route 1: North to South-West service: providing direct access from both corridors to BRI, Centre and Temple Meads Route 2: East to Bristol – Bath service: providing direct access from both corridors to Old Market, Cabot Circus, BRI, Centre and Temple Meads
Below ground		
1	North <> East (below ground) East <> South-West (below ground) North <> South-West (below ground) Bristol – Bath (above ground)	Route 1: Tunnelled cross-city service connecting the North and East corridors Route 2: Tunnelled cross-city service connecting the East and South-West corridors Route 3: Tunnelled cross-city service connecting the North and South-West corridors Route 4: Overground Bristol-Bath Corridor service
2.A	North <> East (below ground) Bristol – Bath (above ground) South-West (above ground)	Route 1: Tunnelled cross-city service connecting the North and East corridors Route 2: Overground Bristol-Bath service, terminating at BRI/Bearpit Route 3: Overground South-West service, terminating at BRI/Bearpit
2.B	North <> East (below ground) Bristol – Bath (above ground) South-West (above ground)	Route 1: Tunnelled cross-city service connecting the North and East corridors via Temple Meads Route 2: Overground Bristol-Bath Corridor service Route 3: Overground South-West Corridor service

Consideration of Modes

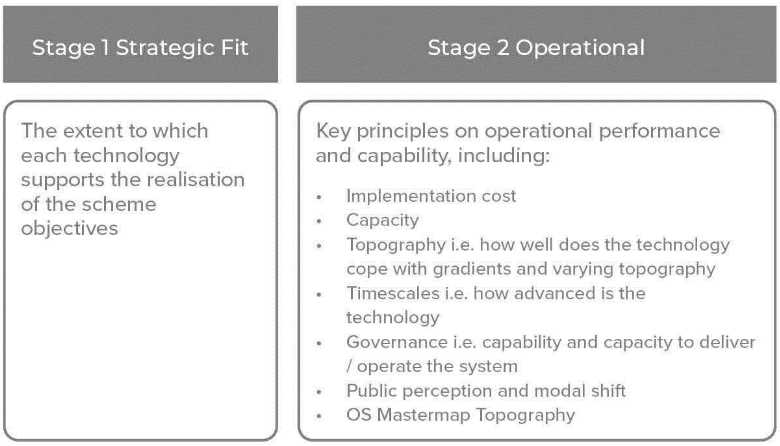
2.11.62. At this stage of development, the options assessment process for the Mass Transit programme has remained mode agnostic with specific technology options not being identified for route options. In parallel to the generation of route options, a technology sift has been undertaken to reduce the number of mass transit modes.

2.11.63. As part of the development of the OAR a range of case studies of mass transit systems in the UK and internationally have been considered and captured within the *Mass Transit Case Studie*s note. The *Technology Options Refinement Report* considers the advantages, disadvantages, key specifications and applicability to the West of England of the following technology options identified through the case studies review:

- Bus Rapid Transit (BRT), including unguided and kerb guided
- Trackless light transit (TLT)
- Light rail:
  - Light rail (steel-wheel tracked)
  - Ultra-light rail
  - Driverless Light Rail
- Guided light transit (rubber-wheel tracked)
- Tram-train
- Monorail
- Metro (steel or rubber-wheeled)
- Personal Rapid Transit (PRT)
- Cable Propelled Transit
- Hyperloop

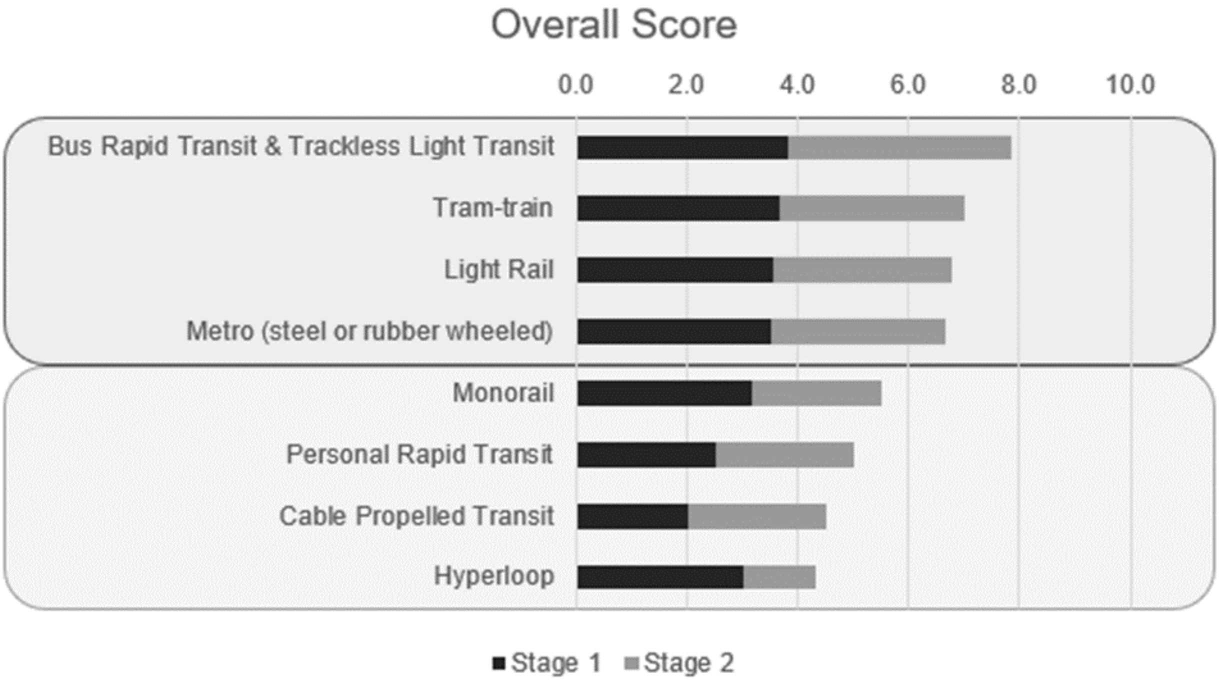
2.11.64. As part of the technology option refinement, a two-stage sifting process has been undertaken to consider which of the above could be appropriate options for mass transit in the West of England. Figure 2-15 presents the approach for the two staged process.

Figure 2-15 - Technology option sifting process



2.11.65. The 12 technology options above were scored against the criteria at each stage, on a five-point scale, from large negative through to large positive. The results were then combined into a score out of ten, as shown in Figure 2-16. Following assessment, BRT and TLT have been combined due to their similar scoring assessments and infrastructure requirements.

Figure 2-16 - Technology option sifting assessment



2.11.66. The worst performing technology types were hyperloop and cable propelled transit. These technologies would likely be limited by low passenger capacity and would require careful consideration in terms of integration with the existing transport network. In addition, these options present challenges in terms of implementation costs, timescales and governance.

2.11.67. PRT was not considered to provide the required step change, as private car would likely still be required for some travel. In addition, PRT cannot offer the capacity in terms of passenger numbers.

2.11.68. The high implementation costs of monorail and the inability to integrate the track with other vehicles resulted in this technology type not performing strongly in Stage 2.

2.11.69. The top four options shown (BRT & TLT, tram-train, light rail, and metro) scored well in terms of their ability to deliver the scheme objectives, maximising interchange opportunities and integration with the existing transport network. These technology options also performed better in terms of how advanced the technology is and capability and capacity to deliver / operate the system. Following this assessment, these four options were shortlisted.

2.11.70. Prior to the development of the SOC, further consideration was given to the remaining technology types. Due to the lack of capacity on the current network, none of the shortlisted corridor options utilise the existing heavy rail infrastructure. Consequently, tram-train has been removed from the shortlist of potential technology types. In addition, as part of the *Development and Assessment (D&A) Report* some of the technology types that have previously been grouped up were considered as distinct options:

- BRT
- TLT
- VLR
- LRT
- Metro

2.11.71. A further sifting exercise was undertaken for these technology types to reduce the number of potential options prior to the SOC. Figure 2-17 below shows the mode sifting framework that has been used.

Figure 2-17 - Further modal sifting approach

2.11.72. Following this assessment it was recommended that **metro should be discounted from the shortlist of technologies** due to:

- Constraints in terms of flexibility and accessibility
- Likely very high operating costs
- Adverse impacts on a number of the Outcome Statements from the Value Toolkit detailed in section 5.2 of the commercial dimension and *Objective Development Report*

2.11.73. Metro has optimal operational efficiency in situations where there is a strategic need for high-capacity public transport to connect higher density residential areas with city centres and other large attractors such as regional shopping centres. Metros are less suitable for directly serving local communities located between the metro stations. These communities would require the provision of connecting feeder public transport links to the metro stations. Therefore metro has been discounted from the shortlist of potential technology options for Mass Transit.

2.11.74. **Rubber wheeled solutions (BRT / TLT) and LRT / VLR remained on the shortlist** of technologies due to:

- BRT / TLT performing most strongly against the framework based on their flexibility to capture demand and comparable lower costs. Maintaining flexibility to future changes in the way people travel was a point raised by DfT during an engagement meeting for Mass Transit. It is, however, noted that TLT is not as mature a technology as some of the other modes; the capability of the UK market to deliver this solution is therefore less evidenced.
- LRT offering greater capacity than BRT / TLT, however it requires additional infrastructure, which reduces flexibility in the future. As further information regarding

demand becomes available the case for LRT as a potential technology will be reviewed, however at this stage it is proposed to retain this on the shortlist
- VLR having the potential to offer a lower cost solution, however similar to TLT there is still very little evidence of this mode in operation

2.12 Risks and Constraints

Risk

2.12.1. As part of the development work for the Mass Transit SOC, a risk identification exercise was undertaken using the Delivery Environment and Complexity Analytic (DECA) tool created by the National Audit Office.

2.12.2. DECA considers strategic factors to give insight as to the key challenges, complexities and risks that could be encountered in achieving the scheme's objectives. These factors are:

- Strategic importance
- Stakeholders and their influence
- Requirements and benefit articulation
- Stability
- Financial impact and potential impact on value for money
- Execution complexity, including technological considerations
- Interrelationships and dependencies
- Range of disciplines and skills required
- Organisational capability
- The extent of change required to meet the objectives

2.12.3. The output of DECA was incorporated into the project's *Strategic Risk Register*. The risk register is used in line with the risk management process set out in section 6.11 of the Management Dimension.

Constraints

2.12.4. Physical, environmental, and stakeholder constraints were considered in the development of the options longlist. The following are explored at length within the *Constraints Register* (contained within the OAR):

- Historical mining in Bristol
- Topography - difficulty in horizontal and vertical alignment
- Unknown existing underground conditions, including Statutory Undertakers equipment
- Limited carriageway / adopted highway width (limited space) / bridge constraints
- Highly populated / residential streets and essential residents parking
- Routes subject to excessive traffic congestion
- Likely large number of different stakeholders with differing priorities (e.g. National Highways, Network Rail, residents, local businesses)

2.12.5. Constraints identified within the registers were used to inform the evaluation of options within the multi-criteria assessment, with the consideration of physical constraints particularly prevalent within the feasibility assessment.

2.12.6. As part of the feasibility design process for the shortlisted options, constraints within each corridor were then assessed to identify any high-level risks that may result in a designed route being unfeasible. Both overground options and options with significant sections of tunnelling were considered (e.g. mapping of overground risks for highway routes, geology assessment for tunnelling).

2.12.7. The approach to environmental, land-use, and utility constraints considered during the feasibility design process is outlined as follows.

Physical Constraints

2.12.8. Along each of the corridors considered, the existing highway network has numerous structures, which limit the ease with which changes to the highway network can be implemented.

2.12.9. Table 2-12 lists the number of structures along each of the route options considered for each corridor.

Table 2-12 - Number of existing underbridges and overbridges along proposed Mass Transit routes

Corridor Section	Alteration to existing bridges; underbridge	Alteration to existing bridges; overbridge
BBC-C & BBC06	12	4
Bath A5	2	0
Bath B6	2	0
Bath B9	2	0
EF08	2	0
NC04	0	2
NC08 East	4	5
NC08 West	2	1
SWC03	0	0
SWC05	2	0
SWC11	1	1
BCC-OPB	1	1
BCC-OPD	4	1
BCC-OPE	1	0

2.12.10. A particular constraint within Bath is the presence of a significant number of underground vaults. Identifying the exact locations where the vaults exist is an ongoing exercise for B&NES. From the current surveys it is anticipated that there are in excess of 7,200 vaults beneath the roads in Bath, and this is not an exhaustive list with surveys ongoing. The breadth of coverage of the vaults, and their limited depth below the surface (less than 1metre in some instances) make even minor construction incredibly challenging in this setting.

Environmental constraints

2.12.11. The *Baseline Environment Report* provided a high-level desk study review of the current environmental baseline conditions that may form either constraints or opportunities for Mass Transit options.

2.12.12. The topics discussed in the report are in line with DfT TAG and the Combined Authority Transport Appraisal Guidance Advice note (produced by Atkins, 2020):

- Noise and vibration
- Air quality
- Landscape and townscape
- Historic Environment
- Biodiversity
- Water environment
- Geology, soils and contaminated land

2.12.13. Building on the initial iteration of the feasibility design, an environmental review was undertaken on the feasibility proposals to minimise environmental impact and maximise opportunities for betterment.

Land use constraints

2.12.14. There are many listed structures, scheduled monuments and listed parks and gardens adjacent to the proposed Mass Transit routes, particularly in the centres of Bristol and Bath. Any construction that required the modification or demolition of a listed structure was considered unfeasible. The location of listed structures was represented in the digital design model, so that the impact on listed structures could be minimised.

2.12.15. In addition, the extents of the City of Bath are a World Heritage Site, including the presence of the below ground vaults with significant coverage within the city.

2.12.16. There were additional challenges in locations where corridors passed dense residential areas, where the widening and reallocation of highway width would result in the removal of on-street parking and driveways. This would impact residents significantly and require careful consideration around a parking strategy.

2.12.17. Additional detail on the constraints taken into account for the feasibility design of the shortlisted options on each corridor can be found in the *Feasibility Design Summary Report*.

Utilities

2.12.18. Strategic utility infrastructure was identified and included on opportunities and constraints drawings conducted as part of the OAR process. At this stage of the scheme development, C2 Stats have not been obtained for the full shortlist of route options; additional data may expand or alter design detail as the project progresses to OBC.

2.12.19. The impact on utilities has therefore been considered qualitatively in the development of feasibility design. Some specific large risks to construction and operation have been considered, with a more complete review required as the scheme progresses to OBC.

2.13 Stakeholder Views and Requirements

Early Engagement

2.13.1. In February and March 2021, the Combined Authority held a number of online briefings, webinars and focus groups with community groups, businesses, transport organisations, and environmental stakeholders. This initial engagement aimed to build awareness and support for the Mass Transit scheme with a range of stakeholder groups and individuals.

2.13.2. The Combined Authority's communication and technical teams worked together with their equivalent positions in the partner authorities to identify attendees for these initial engagement sessions. Parish councils and wards within the West of England regional boundaries, from parish to parliamentary constituency level, were mapped to identify elected representatives to invite. Communication leads from each UA were also asked to identify community groups representing the cross-section of their local authority areas.

2.13.3. Conversations were held with the following groups:

- Regional Mayor and council leaders / mayors
- Regional MPs and their parliamentary staff
- Business and economic interest groups
- Transport partners and policy groups
- Ward and parish councillors
- Environmental action and campaign groups
- Transport action and campaign groups
- Community representatives from across the region

2.13.4. Due to the coronavirus pandemic, all events were held virtually. Table 2-13 provides the schedule of events.

Table 2-13 – Stakeholder event schedule

Group	Date	Overview
Business West Initiative briefing	4 February 2021 11.00	Briefing presentation to provide an introduction to project need and benefits, timeline and next steps
Community session	11 February 2021 18:00	Introduction to mass transit as a concept, focus group on project objectives and potential barriers to mass transit use, Q&A

Group	Date	Overview
Environmental stakeholder focus group	22 February 2021 15:30	Briefing focusing on the environmental considerations of the project and Q&A
Briefing to the Business West Planning, Transport and Climate Change group	23 February 2021 08:30	Briefing presentation to Business West to provide a progress update, an introduction to project need and benefits, timeline and next steps
Business webinar	25 February 2021 13:00	Webinar for wider business community to capture views on objectives and potential barriers to mass transit usage
Transport Amenity Group webinar	25 February 2021 16:00	Webinar for transport amenity and campaign groups focusing on transport need and benefits of the project. Included a poll on project objectives and potential barriers to mass transit use, and Q&A
Parish Council and ward councillor webinar	11 March 2021 08:30	Webinar for Parish Council members and ward councillors across the region including a poll on project objectives and potential barriers to mass transit use, and Q&A
Transport Partners focus group	18 March 2021 09:00	An informal briefing session for transport partners, including a Q&A and conversation around the transport context for mass transit
MP Briefing	18 March 2021 15:00	Presented the outcomes of discussions with a range of stakeholder groups and organisations to date, setting out who has been engaged with and what was identified as the barriers to mass transit, the potential benefits and what mass transit means to them.

2.13.5. While discussion topics varied depending on group attendance, they were focused on what the concept of mass transit meant to them, their priorities for a mass transit system, and potential barriers for uptake. The identified themes and comments raised by stakeholders were taken into account in the development of the options and underscored the objective refinement process.

2.13.6. This high-level engagement exercise demonstrated that stakeholders' priority objectives for a mass transit system were:

- To offer freedom and flexibility on transport options
- To reduce carbon emissions
- To put work, housing, and education opportunities within reach of everyone in the region
- To reduce inequality with an inclusive, affordable, and safe network

2.13.7. The barriers to uptake of a mass transit system included:

- The reliability of transport
- Speed of service
- Frequency of services
- Affordability

2.13.8. Further details of the responses to these questions are outlined in the *Engagement Outcomes Report*.

Engagement Planning

2.13.9. As of Autumn 2022, the Combined Authority has drafted a *Communications and Engagement Plan* to outline the engagement approach that will be taken with stakeholders and the community on future transport plans for the region, including the Mass Transit scheme. The Plan has been developed to ensure all actions are clear, thereby enabling meaningful engagement as the scheme progresses towards OBC.

2.13.10. This includes:

- An analysis of the strengths, weaknesses, opportunities and threats as related to engagement on the Mass Transit scheme
- An engagement approach for key stakeholders, tailored to specific stakeholder needs
- The mapping of different stakeholder groups, as well as a full list of stakeholders
- Tactics for the successful engagement of different stakeholder groups
- A breakdown of expected content and material to ensure effective engagement

2.13.11. It is expected that this Engagement Plan will be agreed and further developed as the scheme, and other external influences including Local Plan development, progress.

2.14 Summary

Strategic Fit

2.14.1. The proposed Mass Transit scheme is closely aligned with national, regional and local policies and plans, and contributes to the UK Government's goals of decarbonisation and levelling up pockets of regional deprivation.

2.14.2. The scheme is designed to provide a step-change in public transport connectivity in the West of England, shifting users away from private car use, which is currently dominating the region, and onto a combination of public transport and first-mile, last-mile active travel solutions that link housing, employment, and social opportunities and services.

2.14.3. A transformational mass transit solution has been identified in the region's Joint Local Transport Plan, noting that road space should be reallocated to modes of transport that carry people more efficiently. This mode shift is key in addressing the region's ambitious climate aspirations, which seek to achieve carbon neutrality by 2030.

2.14.4. Addressing existing congestion and connectivity challenges will create a more resilient network that offers access to opportunities for all as plans for 65,000 new jobs by 2030 and 6,000 new houses a year are realised.

Need for the Scheme

2.14.5. The main problems that the proposed scheme aims to address are:

- **Low public transport use –** creating a public transport system with increased connectivity that improves public perception of unreliable, infrequent, and expensive services, thereby shifting trips away from private car use

- **Barriers to walking and cycling** – making active travel a preferred choice for short distance journeys by reducing conflicts with traffic on direct routes and linking public transport with walking and cycling for end-to-end journeys
- **Congestion and delay** – addressing current and forecast congestion and delay on the region’s radial routes, which results in reduced **journey time reliability** and associated environmental externalities
- **Safety** – reducing accidents, particularly with regard to vulnerable users, where the number of accidents is higher in highly congested areas
- **Regional inequality and deprivation** – addressing the transport challenges experienced by deprived communities with more limited access to private vehicles, and linking current and future housing and employment opportunity sites
- **Climate emergency** – reducing transport-related emissions in the region by reducing the number of private car journeys
- **Enabling regeneration and economic growth** – enhancing recovery efforts and increasing regional labour mobility to unlock clean and inclusive economic growth

2.14.6. Without delivery of the scheme, these problems are expected to get worse. Growth in the West of England will come at a price of increased congestion and worsening environmental conditions, as well as a less resilient network overall.

2.14.7. The overall aim of the scheme is therefore to deliver a world-class, transformational, public transport system that:

- Connects the West of England region, thereby reducing deprivation and inequality, and contributing to the levelling up agenda
- Supports sustainable, economic growth and enables regeneration
- Contributes to delivering Carbon Net Zero
- Improves local environmental conditions and air quality
- Makes sustainable transport the preferred option for short to mid-distance journeys

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 HM Treasury's Green Book and the relevant guidance from DfT's TAG. 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[55], In assessing value for money, all of these impacts are consolidated to determine the extent to which the scheme's benefits outweigh the costs.

3.1.3. The Economic Dimension summarises the scheme appraisal. More detail is provided in the *Economic Assessment Report* (EAR).

3.2 Options Appraised

Do Minimum

3.2.1. Within the appraisal, each of the Mass Transit options has been compared to a Do Minimum scenario. As discussed in more detail in section 3.3, the transport user benefits have been assessed using GBATS and G-BATH highway assignment models and a catchment-based spreadsheet model, which has been built using demand matrices from GBATS. The 2036 forecast models developed from GBATS4 account for the interventions and developments considered as part of the JSP, based on a demand and supply uncertainty log from 2015. The JSP was withdrawn in 2019, and constituent authorities are currently updating their own Local Plans. Therefore, the schemes and developments included within the Do Minimum scenario are based on the best data currently available but will be updated when Local Plan information becomes available.

3.2.2. As part of the DfT's CRSTS, the West of England Combined Authority was awarded £540m to improve transport provision in the region. A key project within this was developing and delivering the BBSC. This scheme proposes new bus, cycling and walking improvements along the A4 between Bristol and Bath. The vision for the programme is to deliver a "high-quality, segregated and prioritised public transport and cycling corridor that will provide 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".

[55] Value for Money Framework, Department for Transport, 2015

3.2.3. Given the clear overlap with Mass Transit on this corridor, BBSC has been included within the Do Minimum scenario. Although this scheme is not yet formally committed, it has funding earmarked for it and the DfT identified this as a flagship scheme within the West of England CRSTS bid, and its presence in the UK Government's Growth Plan 2022 as a project ideal for acceleration. Therefore, it is considered reasonable to include this scheme within the Do Minimum of the economic appraisal based on the information available at the SOC stage. This assumption will be revisited at the OBC stage.

3.2.4. In order to represent BBSC in the demand and benefits modelling, adjustments have been made to increase bus service frequencies (from existing 4 services to 6 services per hour) and reduce journey times (from existing 55-60 minutes to 40 minutes) on the Bristol – Bath Corridor in the Do Minimum.

Do Something

3.2.5. Initially, each of the corridor options shown in Table 2-10 have been appraised individually to allow an understanding of their relative performance. When considering the corridor options individually it has been assumed that all options terminate at Bristol Temple Meads, to ensure that an option's performance is not influenced by its end point. However, as the SOC is centred around the Mass Transit programme in the West of England, these corridor options have then been combined to form a number of different network scenarios:

- Network #1
  - The best performing overground option on each corridor
  - Under this network the following corridors are directly linked within Bristol City Centre:
    - North and Bristol - Bath
    - East and South-West
- Network #2
  - The best performing overground option on each corridor
  - Under this network the following corridors are directly linked within Bristol City Centre:
    - North and South-West
    - East and Bristol - Bath
- Network #3
  - The best performing options with significant stretches of tunnelling on the North, East and South-West corridors
  - The best performing overground option on the Bristol - Bath Corridor (this will be the same options as networks 1 and 2)
  - Under this network the following corridors are directly linked within Bristol City Centre:
    - North, East and South-West
    - Bristol - Bath

3.2.6. These networks are only for illustrative purposes to inform the SOC. It is not intended that only these options be taken forward to later stages of development.

3.2.7. Figure 3-1 to Figure 3-3 show the corridor options that have been combined to form the above networks. The rationale for the selection of the individual options is set out in the OAR.

3.2.8. Within the appraisal, the different potential technology types have been considered where possible and proportionate for this stage of option development:

- Scheme costs
  - Capital expenditure - the costs for each option have been estimated for rubber wheeled and steel wheeled individually. The four technology types have been assigned to rubber and steel wheeled
  - Operating, maintenance and renewal costs - the costs for each option have been estimated for each of the four technology types
- Scheme impacts - the demand and benefits associated with the scheme are mode agnostic at this SOC stage, therefore there is no differentiation between the four technology types.

3.2.9. Within the SOC it has been assumed that BRT is representative of a rubber-wheeled solution and LRT is representative of a steel-wheeled solution. The EAR provides the appraisal outputs for each of the four technology types, however it is noted that only the costs change by mode with the demand, benefits and revenue remaining consistent across the four.

3.2.10. The operation of the Mass Transit system is underpinned by a number of operating assumptions. As part of the development of the SOC, an ISP was produced. This sets out the high-level operating principles of the proposed Mass Transit system based on analysis and comparison with other UK mass transit systems. The analysis undertaken to inform the ISP has been mode agnostic, with differences only identified for above and below ground elements. It is assumed that Mass Transit would operate for 16-hours a day at a frequency of 7.5 services per hour (8 min headway). The ISP sets out the assumed stop locations for each option and the run times.

Figure 3-1 - Network #1

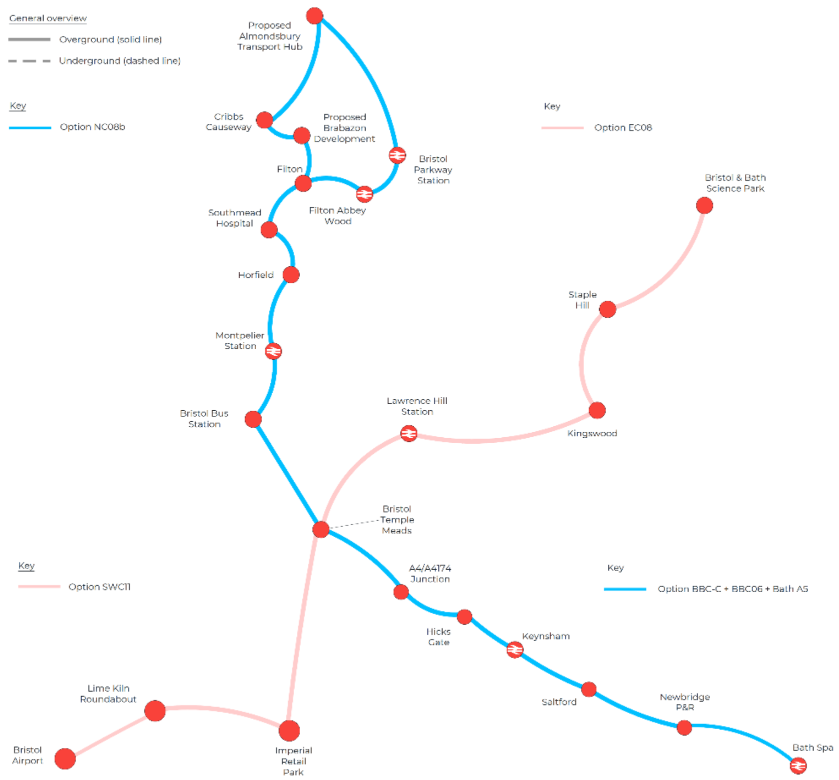


Figure 3-2 - Network #2

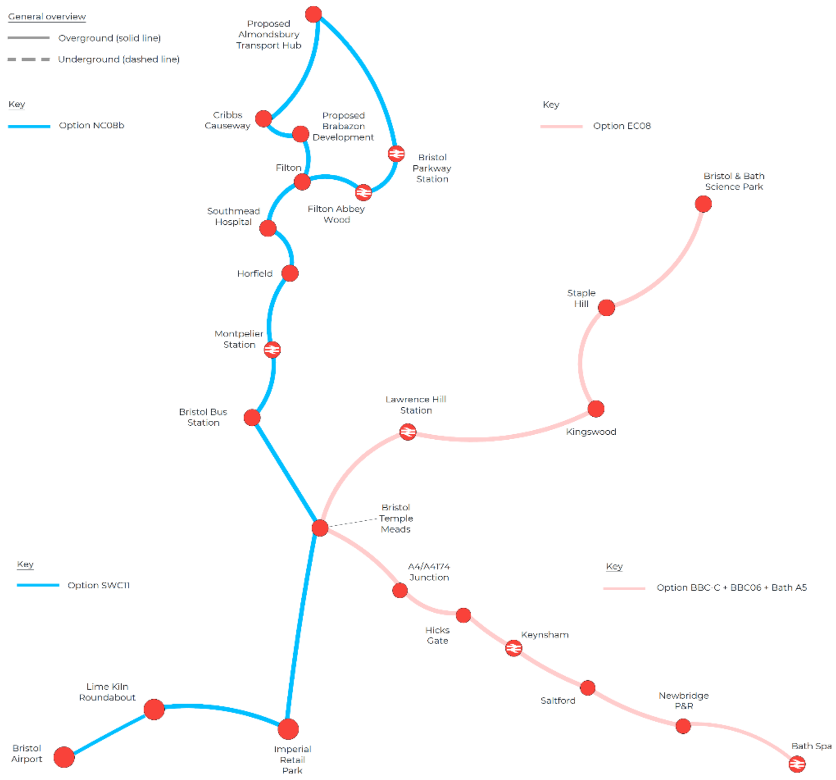
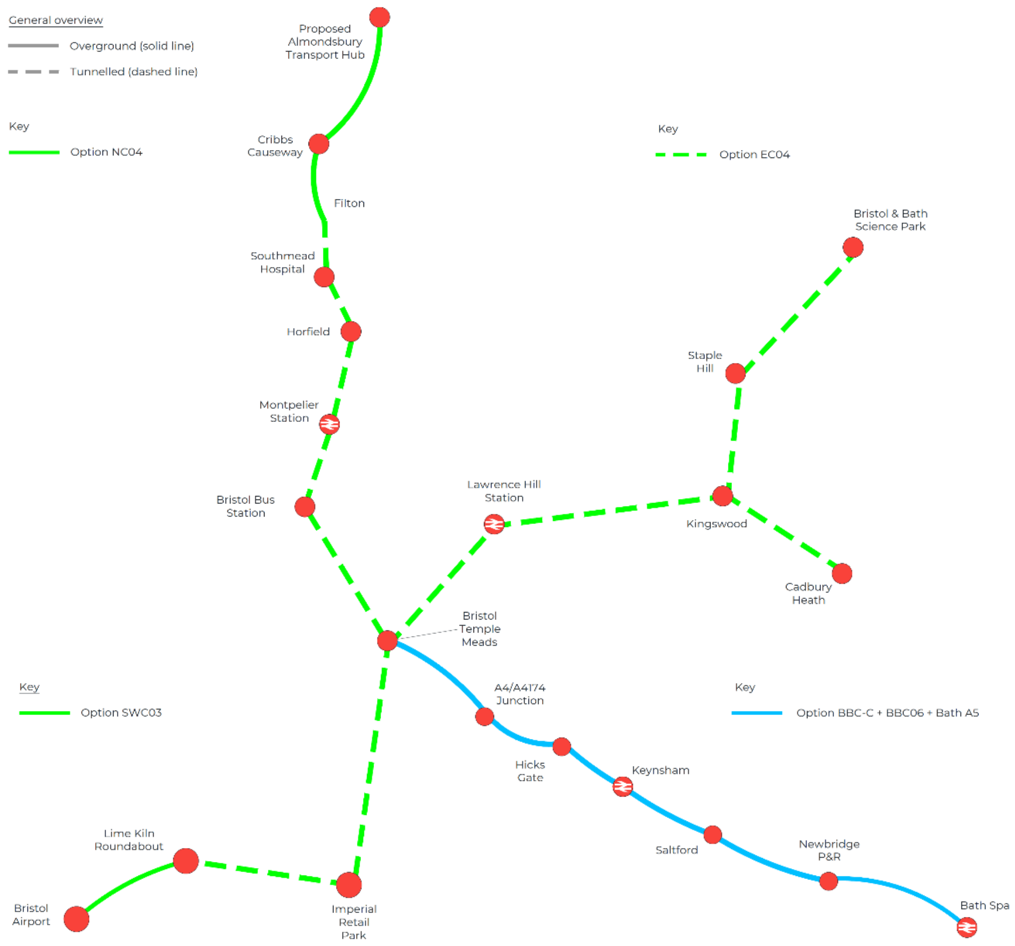


Figure 3-3 - Network #3



3.3 Appraisal Methodology and Results

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, operating and maintaining the scheme.

3.3.2. The appraisal has been undertaken in alignment with HM Treasury's *Green Book*, the DfT's TAG, the West of England Combined Authority *Assurance Framework* and the West of England Mass Transit *Appraisal Specification Report* (ASR).

3.3.3. The DfT's Value for Money Framework[56] 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.

3.3.4. It is an 'in the round' consideration of these three levels of impact which inform the overall VfM assessment. In July 2021 there were a number of significant updates to the HM Treasury Green Book. Part of this update recognised the importance of the alignment to policy priorities and reducing the weight given to the BCR in the assessment of schemes. This emphasises the importance of consideration of Level 2 and 3 impacts within the overall VfM assessment, and giving appropriate weight to these.

3.3.5. Figure 3-4 below shows an overview of the economic appraisal process that has been followed to inform the VfM assessment.

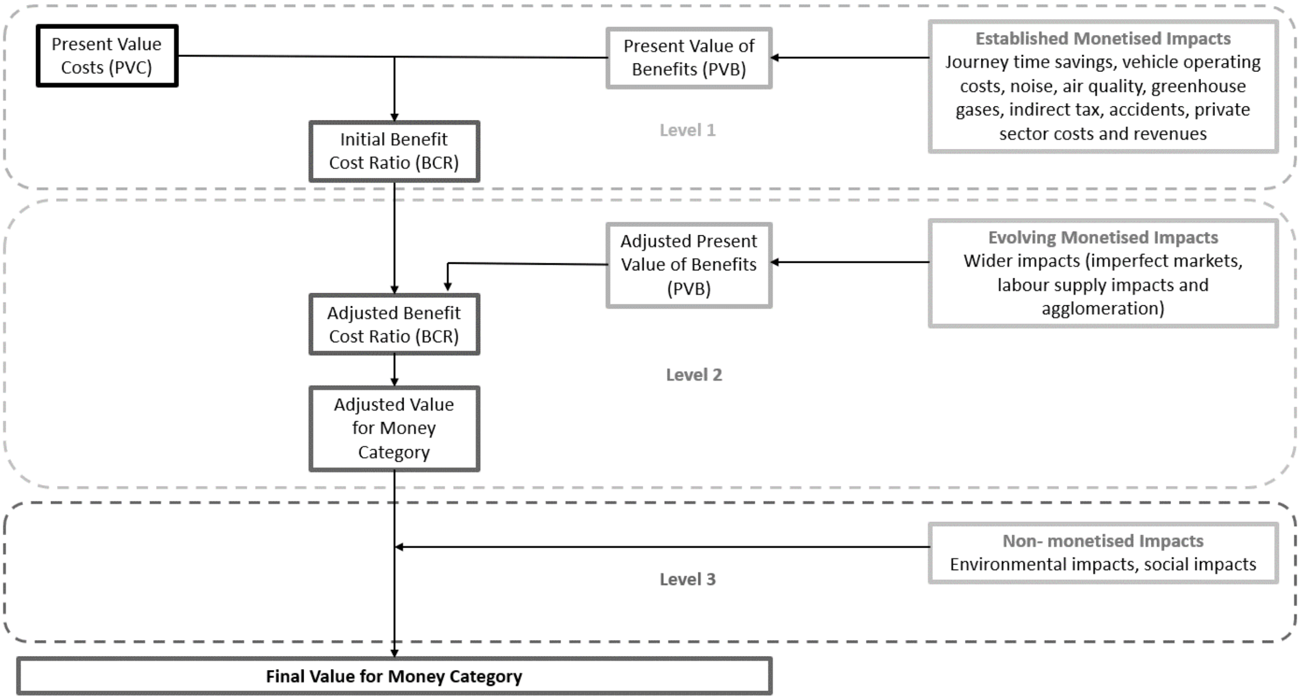
3.3.6. Within the appraisal, benefits and whole-life costs have been considered over a 60-year appraisal period from scheme opening in 2036, and design and construction costs are considered prior to scheme opening. All costs and benefits are presented in the DfT's base year (2010), present values (PV) and 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* (May 2022, v1.18). Impacts have been converted to PV using social or health discount rates as set out in the *TAG Data Book*. Where required, impacts

[56] Value for Money Framework, Department for Transport, 2015

have been adjusted to market prices from the factor unit of account using the adjustment factor within the *TAG Data Book*.

3.3.7. This Economic Dimension summarises the scheme appraisal. The EAR provides full detail of the approach and outputs of the monetised appraisal of the scheme.

Figure 3-4 - Value for money assessment



Overview of Transport Modelling

3.3.8. The appraisal of the scheme is based on the modelling of travel patterns in the West of England under the Do Minimum and Do Something scenarios.

3.3.9. The modelling framework used to inform the SOC appraisal reflects a proportionate approach given the scale and complexity of the project. It also reflects the Combined Authority's position in terms of the development of a new regional transport model. Based on the current programme, WERTM should be developed and available for use on projects from Autumn 2022. Until this point, the modelling approach for the SOC uses the existing GBATS model as part of a catchment-based spreadsheet tool, and the GBATS and G-BATH highway models. The GBATS and G-BATH models have base years of 2013 and 2017 respectively, and therefore do not reflect the latest position in terms of planning and infrastructure or travel patterns.

3.3.10. The approach to both public transport and highway modelling is captured in detail in the ASR, EAR, *Demand Forecasting Report* and *Traffic Forecasting Report*. An overview is set out as follows.

3.3.11. The public transport impacts have been assessed using a catchment-based spreadsheet which utilises a logit model to estimate the propensity to use Mass Transit drawing on the travel cost between zones under the Do Minimum and Do Something scenarios. For the purposes of an SOC appraisal, it was considered appropriate to utilise the model in a pragmatic way together with G-BATH, as opposed to a more complex method involving both models, which will later be superseded by WERTM. The highway and PT assignment matrices for the GBATS4 Do Minimum forecast models provide the initial estimates for the Mass Transit market in the spreadsheet model. These GBATS4 Do Minimum matrices have been developed using the GBATS4 demand model.

3.3.12. The impact of the Mass Transit options on highway users has been estimated utilising the highway assignment from GBATS4 and G-BATH. The impact on highway capacity of each option has been coded into the model using a set of assumptions informed by the feasibility designs.

3.3.13. Given the available models, there is no variable demand element and as such modal shift to Mass Transit has not been captured within the highway model. For this reason the highway impacts are considered a 'worst case' scenario.

Scheme Costs

3.3.14. The following cost lines have been considered within the economic appraisal:

- Capital expenditure
- Operating, maintenance and renewal costs

3.3.15. The Financial Dimension provides further detail of how the costs have been estimated for the options and networks by mode.

Capital expenditure

3.3.16. At SOC stage, scheme infrastructure costs have been based on feasibility designs for options, applying unit rates from SPONS 2022 to the bill of quantities. The construction cost estimates also include costs associated with stations, depot and overbridges / underbridges. These costs have then been uplifted to account for indirect costs and risk. Cost estimates were initially prepared for a rubber-wheeled solution. The costs of a steel-wheeled solution were then estimated assuming a percentage uplift to the applicable items of the rubber-wheeled costings based on benchmarking of costs of other schemes. Vehicle purchase costs have been estimated for each mode. For the inclusion in the appraisal, steel-wheeled costs have been applied to modes VLR and LRT and rubber-wheeled costs have been applied to BRT and TLT.

3.3.17. The costs have been profiled over the design and construction period and adjusted for inflation to reflect the year in which the costs are incurred.

3.3.18. The Financial Dimension presents the capital expenditure and spend profile for each option and network. Although these costs have been adjusted to account for risk within the Financial Dimension, for inclusion in the economic appraisal this risk allowance has been removed and replaced by optimism bias. *TAG Unit A1-2* states that a comparison should be made between the risk-adjusted costs and optimism bias adjusted costs and the greatest value used within the appraisal. At this SOC stage a 40% risk adjustment has been applied to the scheme costs, and the recommended optimism bias level is 46% for roads and 56% for rail. Given the uncertainty over mode, it is currently assumed that the appropriate optimism bias level for the scheme is the mid-point of the road and rail values (51%). This level of optimism bias is greater than the risk adjustment, therefore the optimism bias adjusted costs have been used within the appraisal in line with guidance. A sensitivity test has been undertaken reducing the assumed optimism bias.

3.3.19. The *Funding and Financing Strategy* considers potential avenues for delivery, however at this stage there is not a determined funding and financing strategy for the scheme. Therefore, for the purposes of the economic appraisal it has been assumed that the capital costs would be incurred by the public sector, and therefore they form part of the Present Value of Costs (PVC).

3.3.20. Table 3-1 shows the capital expenditure for each route and network for each mode in 2010 PV, market prices.

Table 3-1 - Capital expenditure (£m, 2010 PV market prices)

	Rubber-wheeled (BRT)	Steel-wheeled (LRT)
North Corridor		
NC04	1,673	1,973
NC08	195	219
NC08b	193	217
East Corridor		
EC01	1,650	1,949
EC04	2,078	2,457
EC08	76	90
Bristol – Bath Corridor		
BBC[57]	122	142
South-West Corridor		
SWC03	1,496	1,765
SWC05	128	146
SWC11	155	175
Network options		
Network 1	559	638
Network 2	545	624
Network 3	5,373	6,337

[57] These are the additional costs required to implement Mass Transit on the Bristol – Bath Corridor assuming that the medium scenario for BBSC has been delivered

Operating, maintenance and renewal costs

3.3.21. Operating, maintenance and renewal (OMR) costs have been estimated over the appraisal period. The following cost line items have been included in the estimate:

- Vehicle maintenance and renewal costs
- Electricity cost
- Station operating cost
- Infrastructure maintenance cost
- Staff costs (onboard, station and office based)

3.3.22. In general costs have been assumed to grow in line with RPI, with the following exceptions:

- Electricity cost: indexed with electricity price forecasts from the TAG Data Book
- Staff cost: indexed with average earnings index forecasts from the *TAG Data Book*
- Infrastructure maintenance costs: indexed with CPI

3.3.23. The Financial Dimension shows the OMR costs for each option and network across the 60-year appraisal period. For the Bristol – Bath Corridor the OMR costs associated with BBSC are included within the Do Minimum, therefore the costs in the table for this corridor are additional to these.

3.3.24. In the economic appraisal, an optimism bias value of 20% has been applied to the OMR costs. The OMR costs have then been deflated and discounted to 2010 prices and values, and adjusted to market prices. Table 3-2 presents the total OMR costs over the appraisal period for each of the four modes.

3.3.25. At this stage it has not been decided how the Mass Transit system would be operated. For the purposes of the economic appraisal it has been assumed that the system would be operated by the private sector (whether a private company or a delivery vehicle set up by the Combined Authority), and therefore the operating costs and revenues are considered as part of the Present Value of Benefits (PVB).

Table 3-2 – OMR costs (£m, 2010 PV market prices over 60-year appraisal)

	Rubber-wheeled (BRT)	Steel-wheeled (LRT)
North Corridor		
NC04	226	308
NC08	46	167
NC08b	47	167
East Corridor		
EC01	287	337
EC04	347	396
EC08	35	121
Bristol – Bath Corridor		
BBC	2	114

	Rubber-wheeled (BRT)	Steel-wheeled (LRT)
South-West Corridor		
SWC03	211	288
SWC05	39	137
SWC11	47	171
Network options		
Network 1	131	574
Network 2	131	573
Network 3	786	1,106

Benefits Assessment Approach and Results

3.3.26. This section provides a description of the methodology used within the economic appraisal of the West of England Mass Transit programme and the resulting outputs.

Mass Transit demand

3.3.27. The Mass Transit demand in 2036 has been estimated using the catchment-based spreadsheet as discussed in paragraph 3.3.11.

3.3.28. The *Demand Forecasting Report* details the methodology and outputs of the demand modelling. The EAR shows the annual demand for each option and network scenarios for the above catchment areas and for P10, P50 and P90 probability levels.

3.3.29. Table 3-3 below shows the estimated 2036 daily and annual Mass Transit demand. Within the appraisal model it is assumed that demand will ramp up once the scheme has opened, with 80% of forecast demand in 2036 increasing up to 100% in 2040. From 2040 onwards demand is assumed to grow in line with population forecasts from the *TAG Data Book*.

3.3.30. Sensitivity tests have been undertaken to understand the impact of more aggressive or conservative assumptions regarding catchment areas and probability levels on demand.

3.3.31. The routes with sections of tunnelling have the highest demand driven by the larger catchment area and the faster journeys due to higher assumed speeds than overground. The highest demand is seen on options on the North Corridor, reflecting that these options serve dense residential areas for the majority of their length. The lowest levels of demand are seen on the Bristol – Bath Corridor and the overground options on the South-West and East corridors.

3.3.32. The network demands are lower than the sum of the constituent options due to overlap of the demand by corridor. The demand is very similar for the overground networks. The only difference between these networks is which of the four corridors are connected in Bristol City Centre. This output suggests that, based on the trip patterns in the current demand matrices, there is little difference in demand for direct connections between the North and Bristol – Bath corridors and East and South-West corridors, and between the North and South-West corridors and East and Bristol – Bath corridors.

Table 3-3 – Daily and annual demand estimates (2036, pre-application of ramp up)

Option	Alignment	Daily demand	Annual demand (m)
North Corridor			
NC04	Hybrid	49,192	16.3
NC08	Overground	35,764	11.8
NC08b	Overground	35,764	11.8
East Corridor			
EC01	Tunnelled	20,951	6.9
EC04	Tunnelled	31,396	10.4
EC08	Overground	11,403	3.8
Bristol – Bath Corridor			
BBC	Overground	17,573	5.8
South-West Corridor			
SWC03	Hybrid	19,320	6.4
SWC05	Overground	11,979	4.0
SWC11	Overground	10,354	3.4
Networks options			
Network #1	Overground	69,389	22.9
Network #2	Overground	69,382	22.9
Network #3	North and South-West: Hybrid East: Tunnelled Bristol – Bath: Overground	107,632	35.6

3.3.33. For comparison, Table 3-4 below shows the annual demand for various mass transit systems in the UK. It should be noted when comparing directly that the coverage and characteristics of the mass transit systems will be different.

Table 3-4 – Mass transit demand case studies

Mass transit system	2019/20 passenger journeys (m)[58]
Manchester Metrolink	44.3
Tyne and Wear Metro	33.1
Nottingham Express Transit	18.7
Sheffield Supertram	10.5

[58] Department for Transport Statistics, Table LRT0101

West Midland Metro	8.0
Edinburgh Trams	7.1
Blackpool Tramway	4.8

Transport user benefits

3.3.34. The principles behind the valuation of transport user costs have been based upon monetising the transport scheme changes in:

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

Travel time

3.3.35. Public transport travel time impacts have been assessed using outputs from the catchment-based spreadsheet tool and using economic parameters from the *TAG Data Book*. The catchment spreadsheet provides the journey time impacts in 2036, the modelled year. Within the appraisal model these impacts have been extrapolated across the appraisal period. Demand has been assumed to grow in line with population forecasts taken from the *TAG Data Book*. The value of journey time savings has also been assumed to grow in line with value of time growth from the *TAG Data Book*.

3.3.36. The GBATS and G-BATH models have been used to calculate journey time changes to highway users as a result of the scheme. The DfT's Transport User Benefit Appraisal (TUBA) software has been used to calculate, and monetise, the time impacts for highway users. The appraisal uses the latest version of TUBA available at the time of undertaking the highway modelling which utilises the economic parameter file version 1.19 based on *TAG Data Book v1.17* (December 2021). The outputs from TUBA are in 2010 PV market prices.

3.3.37. The TUBA outputs for 2036 have been input to the appraisal model. Similarly to the public transport journey time impacts, the model then extrapolates these over the appraisal period assuming growth in line with population and value of time.

3.3.38. The SOC modelling framework does not consider variable demand, therefore the modal shift to Mass Transit has not been reflected within the highway modelling. Within the economic appraisal, Marginal External Cost (MEC) rates for congestion have been applied to the change in highway-kilometres that are captured within the catchment-based spreadsheet tool showing the impact of modal shift to Mass Transit. The net impact of the TUBA outputs and MECs have been used within the appraisal to provide an indication of the overall impact on highway users.

3.3.39. Options with significant sections of tunnelling show the greatest level of journey time benefits. This is due to these options generating the most demand (as shown in Table 3-3)and the higher operating speeds assumed for these options. The lowest level of journey time benefits is seen for BBC. This is driven by the fact that BBSC is assumed to have come forwards in advance of Mass Transit and therefore captures some of the benefits that would otherwise be attributed to the Mass Transit scheme.

3.3.40. Corridor route options that are fully tunnelled and / or with overground sections that do not change the operation of general traffic are assumed to have no journey time impacts on highway users. The highway impacts for these options are the modal shift impacts calculated using MECs.

3.3.41. When considering the corridor route options individually, EC08 and BBC have the most significant impact on highway users. For EC08 this is due to the extent of restrictions on general traffic on the A420 where large sections of this road between Bristol City Centre and Kingswood are closed to through traffic. For BBC these disbenefits are experienced almost wholly within Bath City Centre where there are significant road closures and re-routing to allow Mass Transit to run fully segregated.

3.3.42. Of the network options, network #3 is the only one to experience overall journey time benefits where the highway impacts do not outweigh the public transport benefits.

3.3.43. The journey time impacts for each route and network option are presented in Table 3-5.

Vehicle operating costs

3.3.44. Similarly to the travel time impacts for highway users, the impact of the scheme on fuel and non-fuel vehicle operating costs has been estimated using the GBATS and G-BATH models. TUBA has then been used to calculate, and monetise, the vehicle operating cost impacts. The outputs from TUBA are in 2010 PV market prices. These VOC impacts only account for changes in trips within the highway modelling, the impacts of modal shift from private car to Mass Transit have not been quantified.

3.3.45. The changes to VOCs are presented in Table 3-5. NC04 is the only option where there is an estimated reduction in highway kilometres and therefore there are VOC savings of £3m PV. It is noted that this reduction in VOCs is likely to be due to model noise as opposed to a direct impact of the scheme given there are assumed to be no changes to the highway alignment at surface level. The remaining options with partial or fully tunnelled sections (EC01, EC04 and SWC03) are assumed to have no impact on the highway network and therefore there is no change in VOCs. For all other options it is anticipated that there will be an increase in highway kilometres and, in turn, VOCs. The level of VOC impact by option / network aligns with the observations made for the highway travel time impacts.

Table 3-5 – Journey time and VOC impacts for PT and highway users (£m, 2010 PV over appraisal period)

	Journey time impacts (PT)	Journey time impacts (highway)	Total journey time impacts	Fuel VOCs	Non-fuel VOCs	Total VOCs
North Corridor						
NC04	283	216	**498**	2	1	**3**
NC08	115	-145	**-30**	-9	-7	**-16**
NC08b	115	-122	**-8**	-9	-8	**-16**
East Corridor						
EC01	197	82	**279**	-	-	**-**
EC04	295	136	**431**	-	-	**-**
EC08	72	-319	**-247**	-19	-16	**-35**
Bristol – Bath Corridor						
BBC	43	-437	**-394**	-19	-18	**-37**
South-West Corridor						
SWC03	117	63	**180**	-	-	**-**
SWC05	38	-12	**27**	-2	-1	**-3**
SWC11	38	-153	**-115**	-8	-6	**-13**
Network options						
Network 1	329	-917	**-588**	-50	-42	**-92**
Network 2	315	-999	**-684**	-46	-39	**-85**
Network 3	782	401	**1,183**	1	2	**3**

User charges

3.3.46. The change in user charges has not been considered at this SOC stage as the public transport fares and parking costs are assumed to be unchanged in both the Do Minimum and Do Something scenarios. Therefore, there would be no change in user charges as a result of the scheme. This assumption will be revisited as the development of the scheme progresses.

Transport operator revenues

3.3.47. Within the catchment-based spreadsheet public transport fares (for both Mass Transit and other public transport modes) have been assumed to be £0.50 per kilometre travelled with a cap of £7.50 which aligns with the current highest fare for a return by bus in the West of England. It is noted that at the time of developing the SOC there are measures in place to incentivise bus travel, however there remains uncertainty over fares in the longer term. Changes to the assumed fare structure would impact on the potential commercial viability of the corridors / networks.

3.3.48. The impact on transport operator revenues has been estimated using the fares and change in public transport ridership which have been extracted from the catchment-based spreadsheet tool.

3.3.49. Table 3-6 shows the change in transport operator revenue over the appraisal period. As would be expected, the most revenue is generated by the options with the most demand, and in particular the options with the highest levels of demand switching from private car.

3.3.50. Within the appraisal it has been assumed that the Mass Transit system would be operated by the private sector, therefore this revenue has been included within the PVB.

Table 3-6 – Transport operator revenue (£m, 2010 PV over appraisal period)

	Change in operator revenue
North Corridor	
NC04	253
NC08	51
NC08b	51
East Corridor	
EC01	134
EC04	204
EC08	36
Bristol – Bath Corridor	
BBC	8
South-West Corridor	
SWC03	105
SWC05	21
SWC11	19
Network options	
Network 1	130
Network 2	133
Network 3	550

Indirect tax

3.3.51. The change in indirect tax revenues to central Government has been captured within the appraisal. For the appraisal of Mass Transit, the change in tax revenues considers:

- 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)

3.3.52. The changes in tax revenues associated with changes to highway trips has been captured within TUBA (for the re-routing impacts of highway users) and using MECs (for the modal shift from highway to Mass Transit). For changes in indirect tax due to changes in public transport fares this has been quantified based on the change in transport operator revenue, using the indirect tax adjustment factor and the proportion of non-business users.

3.3.53. For inclusion in the appraisal the changes in indirect tax revenues have been adjusted to 2010 present values. In line with *TAG Unit A1-1*, changes in tax revenues have been captured within the PVB in the economic appraisal.

Table 3-7 – Indirect tax revenues (£m, 2010 PV over appraisal period)

	Indirect tax revenues
North Corridor	
NC04	-55
NC08	-6
NC08b	-6
East Corridor	
EC01	-28
EC04	-43
EC08	2
Bristol – Bath Corridor	
BBC	8
South-West Corridor	
SWC03	-22
SWC05	-4
SWC11	0
Network options	
Network 1	-2
Network 2	-4
Network 3	-117

Greenhouse gases

3.3.54. *TAG Unit A3 Section 4* states that appraisal should capture the Whole Life Carbon (WLC) impacts of a scheme. The carbon appraisal at SOC incorporates user emissions and infrastructure carbon.

3.3.55. The embodied emissions have been estimated based on the high-level bill of quantities to determine the cost and quantities of materials required.

3.3.56. The user emissions have been estimated using the change in vehicle kilometres travelled using the available model outputs. The highway model outputs provide a change in vehicle kilometres as a result of re-routing and the public transport model provides a change in highway vehicle kilometres based on modal shift from private car to Mass Transit. As the modelling framework does not capture variable demand and modal shift to the full extent, the net difference of these two vehicle kilometre changes has been used to assess the impact on user emissions. The annual change in vehicle kilometres has been converted to tCO2e using parameters from the *TAG Data Book*, including fleet composition, average fuel consumption and vehicle emissions.

3.3.57. Within the economic appraisal the carbon emissions have then been monetised using values from the *TAG Data Book*.

3.3.58. Table 3-8 shows the user emissions and embodied carbon emissions for each option and network. The emissions have been considered in terms of rubber-wheeled and steel-wheeled. The options which have the greatest level of modal shift from car see the greatest benefits in terms of user emissions. However, the construction required for tunnelled sections, which generally drive the level of modal shift, results in these options having higher embodied carbon emissions. Reductions in carbon emissions are shown as positive numbers (i.e. benefits) and an increase in carbon emissions is shown as a negative number.

3.3.59. The emissions estimated as part of the appraisal reflect the baseline position in terms of carbon impacts. As part of the SOC a *Carbon Management Strategy* has been produced. This sets out the Combined Authority's approach and processes for scheme-level whole-life carbon management, establishes the carbon baseline, highlights potential carbon hotspots, identifies where further / ongoing analysis is required, establishes carbon reduction targets, presents risks and mitigating measures and areas such as carbon management skills and value chain engagement through procurement. It is anticipated that the carbon impacts will reduce as a result of implementing the measures identified within the Strategy. The Strategy will evolve as the scheme develops, ultimately forming a Carbon Management Plan.

Table 3-8 – Carbon impacts (£m, 2010 PV over appraisal period)

	User emissions	Embodied (rubber-wheeled)	Embodied (steel-wheeled)
North Corridor			
NC04	6	-5	-6
NC08	-0	-4	-5
NC08b	-1	-4	-5
East Corridor			
EC01	3	-5	-6
EC04	5	-7	-8
EC08	-3	-1	-1
Bristol – Bath Corridor			
BBC	-1	-2	-3
South-West Corridor			
SWC03	2	-4	-6
SWC05	0	-2	-3
SWC11	-0	-2	-3
Network options			
Network 1	-6	-9	-14
Network 2	-4	-8	-13

	User emissions	Embodied (rubber-wheeled)	Embodied (steel-wheeled)
Network 3	11	-18	-23

Decongestion impacts

3.3.60. Changes in the distance travelled / number of vehicles on the road will have decongestion impacts in the form of:

- Congestion – these have been combined with the re-routing impacts in Table 3-5
- Noise
- Air quality
- Infrastructure maintenance costs
- Accidents

3.3.61. For the congestion impacts, only the highway kilometre change from the catchment-based spreadsheet have been used as the journey time impacts captured in the highway models have already been accounted for in the TUBA outputs. For the remaining indicators the net difference of the highway kilometre change from the PT model and the highway model has been used. Table 3-9 shows the decongestion impacts of the scheme.

3.3.62. As noted as part of the transport user benefits, options with tunnelled elements (NC04, EF01, EF04, SWC03 and Network 3) generate the greatest level of patronage and modal shift from private car. These options also have less impact in the highway model as they do not impact on the existing network operation to the extent that the fully overground options (NC08/08b, EF08, SWC05, SWC11, BBC, Networks #1 and #2) do.

Table 3-9 – Decongestion impacts (£m, 2010 PV over appraisal period)

	Congestion	Noise	Local Air Quality	Accidents
North Corridor				
NC04	188	4	7	57
NC08	38	-0	-0	-1
NC08b	38	-0	-1	-6
East Corridor				
EC01	82	2	3	24
EC04	136	3	5	40
EC08	22	-2	-3	-23
Bristol – Bath Corridor				
BBC	6	-1	-1	-12
South-West Corridor				
SWC03	63	1	2	19
SWC05	14	0	0	2
SWC11	11	-0	-0	-4

	Congestion	Noise	Local Air Quality	Accidents
Network options				
Network 1	89	-4	-7	-56
Network 2	90	-2	-4	-37
Network 3	379	7	12	99

Initial BCR

3.3.63. The above costs and benefits have been combined to form the Present Value of Costs, Present Value of Benefits, Net Present Value (NPV) and the initial Benefit Cost Ratio. The BCR has been calculated for each corridor option and each network by mode.

3.3.64. Table 3-10 and Table 3-11 show the PVB, PVC, NPV and BCR for each option and network by technology type. The full breakdown of the benefit categories is included in the EAR and the appraisal output tables in Appendix J.

3.3.65. For a number of options a BCR is not presented; this is based on guidance in the DfT's *Value for Money Supplementary Guidance on Categories*[59], which states that if the PVB and NPV are negative then the value for money category should be considered as Very Poor Value for Money (VP VfM). This negative PVB is largely driven by the negative impact on highway users within the appraisal, and is therefore mainly seen for overground options as the impact on the highway network is considerably higher than for options which involve significant levels of tunnelling. Given some options do not have a BCR presented, it is therefore useful to compare options' NPV, which shows the absolute difference between benefits and costs. For options involving tunnelling the NPV is considerably more negative given the costs associated with this result in a large PVC.

3.3.66. It should be noted that the appraisal outputs presented are based on consideration of a fully segregated mass transit solution and do not account for the changes required in the transport context to achieve carbon net zero targets. Given an assumed scheme opening year of 2036, the modal share of travel is anticipated to look considerably different by this time. The sensitivity tests presented in section 3.4 explore some of these themes.

[59] Value for Money Framework Supplementary Guidance on Categories, Department for Transport, 2016

Table 3-10 – Corridor option initial BCR

Appraisal results (£m, 2010 PV)	NC04	NC08	NC08b	EC01	EC04	EC08	BBC	SWC03	SWC05	SWC11
Rubber-wheeled (BRT)										
PVB	541	-53	-38	124	291	-309	-435	72	4	-163
PVC	1,672	195	193	1,649	2,078	77	122	1,496	128	155
NPV	-1,131	-248	-213	-1,525	-1,787	-386	-557	-1,424	-124	-318
BCR	**0.3:1**	**VP VfM**	**VP VfM**	**0.1:1**	**0.1:1**	**VP VfM**	**VP VfM**	**0.0:1**	**0.0:1**	**VP VfM**
Steel-wheeled (LRT)										
PVB	458	-176	-160	73	241	-396	-549	-7	-95	-289
PVC	1,972	219	217	1,949	2,456	91	142	1,764	146	175
NPV	-1,514	-395	-377	-1, 876	-2,215	-487	-691	-1,771	-241	-464
BCR	**0.2:1**	**VP VfM**	**VP VfM**	**0.0:1**	**0.1:1**	**VP VfM**	**VP VfM**	**VP VfM**	**VP VfM**	**VP VfM**

* VP VfM = Very Poor Value for Money

Table 3-11 – Network option initial BCR

Appraisal results (£m, 2010 PV)	Network 1	Network 2	Network 3
Rubber-wheeled (BRT)			
PVB	-763	-827	943
PVC	559	545	5,371
NPV	-1,322	-1,373	-4,428
BCR	**VP VfM**	**VP VfM**	**0.2:1**
Steel-wheeled (LRT)			
PVB	-1,211	-1,275	618
PVC	639	624	6,335
NPV	-1,850	-1,899	-5,718
BCR	**VP VfM**	**VP VfM**	**0.1:1**

Wider impacts

3.3.67. The *Economic Narrative* sets out the economic context of the West of England, including evidence to support the presence of market failures and distortions and therefore the inclusion of wider economic impacts.

3.3.68. Based on the evidence included within the Narrative, Mass Transit is expected to result in wider economic impacts in the West of England, including the following:

- Agglomeration and labour supply impacts
- Output change in imperfectly competitive markets

3.3.69. A proportionate approach has been undertaken to quantify and monetise the impacts associated with agglomeration, labour supply and output change. This involved applying a percentage uplift to user benefits for highway and public transport users.

3.3.70. The *DfT's Value for Money Framework* (2017) identifies agglomeration, labour supply impacts and output change in imperfectly competitive markets as 'evolving monetised impacts', meaning they can be included within an adjusted BCR.

3.3.71. Given the differences between PVB and PVC observed for the initial BCRs, the inclusion of the uplifts for wider impacts has a limited impact on the adjusted BCR at this stage. Appendix K shows the adjusted BCR for each corridor route option and network option by mode.

3.3.72. Higher level analysis has been undertaken to explore the potential that a mass transit system could offer in terms of economic returns. This analysis, described in section 3.9, is based on the assumption that a viable mass transit solution can be found for both public transport and remaining highway users.

3.4 Uncertainty Analysis

Sensitivity tests

3.4.1. 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 for the three network scenarios, drawing on the key assumptions made in the core scenario:

- Test 1: High demand scenario:
  - Overground options: increasing catchment area to 750m
  - Hybrid / options with significant tunnelling: increasing probability to P99
- Test 2: Low demand scenario:
  - All options: reducing probability to P25, retaining same catchment areas as the core scenario
- Test 3: Reducing demand in off-peak periods as discussed in paragraph 3.3.18
- Test 4: Reducing optimism bias applied to the capex to OBC (stage 2) values (28%)
- Test 5: Not including the highway impacts in the Present Value of Benefits
- Test 6: Upside scenario:
  - High demand scenario (Test 1)
  - Not including the highway impacts in the Present Value of Benefits (Test 5)
- Test 7: Increasing optimism bias applied to OMR costs to 41%, in line with guidance for heavy rail (whilst it is noted that heavy rail is not being considered as a technology type for Future4WEST this test provides an indication of the impact of a higher level of optimism bias)
- Test 8: OMR costs and revenues incurred by the public sector
- Test 9: Increasing optimism bias applied to the capex to 66% (the upper rate for non-standard civil engineering projects)

3.4.2. Table 3-12 to Table 3-14 below show the resultant PVB, PVC, NPV and BCR for the above tests for each network. For all tests the technology type has been assumed to be BRT.

3.4.3. Test 1, the high demand scenario, results in an increase in PVB for all options. Conversely, the low demand test results in the difference between the PVB and PVC becoming more negative and the networks continue to demonstrate very poor value for money or poor value for money.

3.4.4. Tests 5 and 6 have the most significant impact on the BCR for each network. For both of these tests, the negative impact on highway users is removed from the monetised appraisal. This assumption is to reflect a scenario where policy continues to strengthen to promote and support the use of sustainable modes. By the time the scheme is delivered the level of travel by private car is likely to have reduced significantly in order to achieve policy ambitions such as carbon net zero and improved health and air quality. Therefore, these tests are intended to demonstrate the potential of Mass Transit when there are less users on the highway network and less weight given to these impacts, as opposed to a scenario where there is no negative impact on the highway network.

3.4.5. Test 6 combines Test 1 and Test 5 to show the impact on the appraisal of a high demand scenario twinned with a reduced impact on the highway network. Under this test the two overground networks have BCRs that are above 1.5:1, which demonstrates under this scenario the overground networks could offer medium value for money. This test has a lesser impact on network #3, partly due to the fact that the highway impacts are lower for this option and secondly because the PVC is so significant that a considerable change in PVB is required to result in a change in BCR.

3.4.6. Tests 7 and 9 demonstrate the impact of increases to the optimism bias applied to the OMR and capital costs respectively. It can be seen that these increases have limited impact on the BCR for each network, where there is already a large differential between the benefits and the costs within the core scenario.

3.4.7. Test 8 considers the impact on the appraisal if it were assumed that the system was operated and maintained by the public sector, with both the OMR costs and revenues associated with the system attributed to this sector. For the overground networks, the revenue exceeds the OMR costs over the appraisal period therefore the PVB and the PVC reduce slightly as a result of the test. For network #3, the OMR costs exceed the revenue over the appraisal period, therefore the PVB and PVC increase under the test. This test has limited impact on the overall BCR for each network.

3.4.8. Tests 2, 3 and Test 4 have a limited impact on the BCR for each network.

Table 3-12 – Sensitivity test results (Network #1)

	£m, 2010 PV			
Test	**PVB**	**PVC**	**NPV**	**BCR**
Core scenario	*-763*	*559*	*-1,322*	*VP VfM*
Test 1	-37	558	-596	VP VfM
Test 2	-840	559	-1,400	VP VfM
Test 3	-875	559	-1, 434	VP VfM
Test 4	-763	474	-1,237	VP VfM
Test 5	310	559	-250	0.6:1
Test 6	1,036	558	477	1.9:1
Test 7	-786	559	-1,345	VP VfM
Test 8	-763	559	-1,322	VP VfM
Test 9	-763	615	-1,378	VP VfM

Table 3-13 – Sensitivity test results (Network #2)

	£m, 2010 PV			
Test	**PVB**	**PVC**	**NPV**	**BCR**
Core scenario	*-827*	*545*	*-1,373*	*VP VfM*
Test 1	-99	544	-643	VP VfM
Test 2	-905	545	-1, 451	VP VfM
Test 3	983	545	-1,483	VP VfM
Test 4	-827	462	-1,290	VP VfM
Test 5	323	545	-222	0.6:1
Test 6	1,052	544	508	1.9:1
Test 7	-850	545	-1,395	VP VfM
Test 8	-830	543	-1,373	VP VfM
Test 9	-827	599	-1, 427	VP VfM

Table 3-14 – Sensitivity test results (Network #3)

	£m, 2010 PV			
Test	**PVB**	**PVC**	**NPV**	**BCR**
Core scenario	*943*	*5,371*	*-4,428*	*0.2:1*
Test 1	1,432	5,371	-3, 939	0.3:1
Test 2	229	5,372	-5, 143	0.0:1
Test 3	574	5,372	-4,798	0.1:1
Test 4	943	4,553	-3,610	0.2:1
Test 5	919	5,371	-4,453	0.2:1
Test 6	1,408	5,371	-3,963	0.3:1
Test 7	805	5,371	-4,566	0.1:1
Test 8	1,180	5,608	-4,428	0.2:1
Test 9	943	5,905	-4,962	0.2:1

3.4.9. In addition to the sensitivity tests above, switching value analysis has been undertaken to indicate the scale of change in PVB required to increase the BCRs from the core scenario to low, medium and high value for money (assuming there is no change in the costs). Table 3-15 below shows the required changes in PVB assuming a rubber-wheeled solution.

3.4.10. The Strategic Outline Case Addendum explores the potential impact of changes in cost and benefits as a result of a value engineering exercise. This work is expected to evolve as the scheme progresses towards and into OBC. The core purpose of the OBC is to undertake detailed assessment of those options shortlisted at SOC stage and find an optimum solution for the region.

Table 3-15 - Switching value analysis

(£m, 2010 PV)	Network 1	Network 2	Network 3
Change in PVB for BCR of 1.0	1,322	1,372	4,428
Change in PVB for BCR of 1.5	1,602	1,645	7,114
Change in PVB for BCR of 2.0	1,881	1,917	9,799

3.4.11. In August 2022, the DfT released the *TAG Uncertainty Toolkit*, which seeks to provide guidance to scheme promoters on the analysis and presentation of uncertainty. The guidance was accompanied by a notification of forthcoming change that from November 2022 onwards there will be further requirements for assessing uncertainty within business cases and scheme development including running Common Analytical Scenarios. As the scheme develops any changes in guidance will be considered and implemented where required.

3.5 Environmental Impacts

3.5.1. The environmental appraisal undertaken as part of the SOC aligns with the guidance presented in TAG Unit A3 Environmental Impact Appraisal.

3.5.2. The appraisal has been informed by desk-based sources used in compiling the *Task 4: Environmental Baseline Report* and in undertaking the subsequent options appraisal. Additional desk-based searches as well as consultation with the local authorities has also been undertaken during the SOC stage.

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

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

3.5.4. As discussed in the Decongestion impacts section, a high-level quantified assessment of the impact on noise and air quality as a result of changes in levels of highway travel has been undertaken using the MECs approach. The overall assessment, and assessment for the other impacts, has been undertaken qualitatively.

3.5.5. In producing the environmental appraisal at SOC, it has been assumed that the impact appraisals are based on steel-wheeled modes (LRT, VLR) given the requirement for associated infrastructure which could include track, platforms and overhead line electrification (OLE). It is likely that landscape and visual impacts and impacts on heritage setting would be reduced if rubber-wheeled modes were selected rather than steel-wheeled modes, given the former are already widespread throughout much of the proposed Mass Transit routing and require less associated infrastructure. The impact of the scheme on air quality is not anticipated to change if a rubber-wheeled solution were assumed due to the level of detail of the SOC assessment.

3.5.6. The environmental appraisal undertaken to inform the SOC has been summarised below to provide an overall assessment for the network options. The detailed assessment of each option and network against each of the environmental indicators is included in Appendix L. Although these detailed assessments include the consideration of impacts during construction, *TAG Unit A3* states that it is not usually appropriate to consider environmental impacts during, or as a result of, construction. Therefore the inform the appraisal, the assessment is centred around the operational impacts.

Noise

3.5.7. Overall, the scheme proposals are expected to encourage modal shift thereby reducing the amount of vehicle movements along all four corridors. The overground networks may result in some additional ground traffic noise, particularly associated with the diversion of general traffic along A and B classification routes, anticipated to be largely residential in nature. Network 3 is not expected to result in increased noise levels once operational. Based on the qualitative assessment of each constituent option within each corridor, the operational impact on noise is considered to be **slight beneficial**, while noting the impacts on noise on diversionary routes will be considered in further detail once modal shift and impacts on remaining highway users are better understood.

3.5.8. Based on the MECs calculation, the monetised impact on noise is estimated to be between -£4m and £7m (2010 PV) depending on network option. It is noted that the modelling framework does not consistently capture the impacts of modal shift, which is impacting this result.

Air Quality

3.5.9. Over the long term, it is anticipated that the scheme will improve air quality by encouraging modal shift and reducing the amount of vehicle movements along all four corridors. Available traffic data shows that all networks may produce a significant reduction in traffic flow along the A38 between Bond Street and Ashley Down Road where the Mass Transit route is closed to general traffic; this will reduce emissions of nitrogen dioxide (NO2) and particulate matter (PM) and would improve the air quality in this area. The overground networks are anticipated to increase traffic along dispersal routes taken by general traffic, this will disbenefit the air quality at the sensitive receptors along largely residential streets, such as Muller Road, Kellaway Avenue and Coldharbour Road, and within the vicinity of the section of the Mass Transit route, where closed to general traffic. Based on the qualitative assessment of each constituent option within each corridor, the operational impact on air quality is considered to be **slight beneficial**, while noting the impacts on air quality on diversionary routes will be considered in further detail once modal shift and impacts on remaining highway users are better understood.

3.5.10. Based on the MECs calculation, the monetised impact on air quality is estimated to be between -£7m and £12m (2010 PV) depending on network option. It is noted that the modelling framework does not consistently capture the impacts of modal shift, which is impacting this result.

Greenhouse Gases

3.5.11. Similarly to the assessment of the air quality impacts of the scheme, the reduction in highway kilometres as a result of modal shift will lead to a net decrease in user greenhouse gas emissions. Likewise, the scheme may adversely impact greenhouse gases as a result of increased vehicular traffic along dispersal routes.

3.5.12. Based on the quantified assessment of greenhouse gases described previously, and reflecting the baseline position in terms of carbon, the monetised impact on greenhouse gases is estimated to be between -£7m and -£20m (2010 PV) depending on network option. This reflects both the embodied and user emissions. The Carbon Management Strategy identifies opportunities to reduce the embodied carbon impact of the scheme through the development process and highlights the potential for greater user carbon savings if the scheme is delivered in combination with other measures and complementary policies.

Landscape and Townscape

3.5.13. Overall, it is assumed the setting for the proposed new Mass Transit infrastructure would be in line with the character of the existing local area. The closure of lanes to general traffic may have potential beneficial effects on the streetscape, encouraging active travel and benefitting commercial and residential areas. However there are potential effects on visual amenity that could arise as a result of introducing new transport modes and associated infrastructure and increased traffic flows on diversionary routes for a number of sensitive receptors (residential properties, cycle routes etc).

3.5.14. Network 3 could affect the landscape/townscape character of the local area as a result of the introduction of permanent infrastructure such as station access points and ventilation shafts. Above ground infrastructure would be sensitively designed in the character of the local townscape. Potential effects on visual amenity could arise as a result of introducing new transport infrastructure in view of sensitive receptors.

3.5.15. Overall, the impact of the scheme on the landscape and townscape is anticipated to be **moderate adverse.** For the network 3, this is reflective of the potential for adverse impacts associated with the introduction of permanent infrastructure and locating transport hubs within residential and commercial areas. For the overground networks this reflects that there may be a larger area of impact along the route, however this will be dependent on the mode and associated infrastructure.

Historic Environment

3.5.16. It is predicted that the networks (both overground and tunnelled) have the potential for high impacts to the setting of several heritage assets and Conservation Areas during operation. There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure, however the design process would account for, and protect, these assets.

3.5.17. Overall, the scheme is anticipated to have a **moderate adverse** impact on historic environment. This is considered a worst-case scenario predominantly due to the introduction of additional infrastructure in proximity to sensitive receptors and within the sensitive heritage character area of City of Bath World Heritage Site. The moderate adverse impact is also due to scores being attributed to heritage assets within very close proximity (5m buffer of the route), which was considered appropriate for the assessment at this stage.

Biodiversity

3.5.18. In line with *TAG Unit A3*, the assessment of biodiversity considers environmental resources including designated and non-designated sites, as well as habitats (including those of particular importance). Potential impacts on protected species are only referred to in general terms and have not been appraised at this SOC stage due to the need for targeted surveys.

3.5.19. Where the route uses the existing road network, it is anticipated that there would be limited adverse effects on the key biodiversity resources beyond the current levels of disturbance. Overhead electrification infrastructure if required for the Mass Transit network, could impact protected species through collision of species with cabling and vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes.

3.5.20. It is anticipated that protected species may potentially be affected by direct impacts, from injury through to mortality of species and indirect disturbance impacts such as from noise and lighting if not suitably mitigated as a result of the operation of the overground networks.

3.5.21. It is not anticipated that there will be a significant adverse impact on key biodiversity resources during operation of the tunnelled sections of the scheme.

3.5.22. There is the potential for the Mass Transit network to have an impact on designated sites, further ecological assessment work in relation to these sites would be carried out as the scheme progresses, as appropriate.

3.5.23. Overall, the impact on biodiversity is anticipated to be **slight adverse**, noting this excludes potential impacts on protected species as this will depend on the outcomes of targeted surveys and further designated site assessments.

3.5.24. Alongside the SOC, a *Biodiversity Net Gain Strategy* has been developed to support the scheme being compliant with new legislative requirements around the creation of new habitats and enhancement of existing habitats so that biodiversity loss is reversed. Biodiversity Net Gain does not consider impacts to protected designated sites nor irreplaceable or very high-value habitats. The strategy, which is a 'live' document and will be updated throughout the project lifecycle, sets out the targets and commitments of the scheme, offsetting opportunities, and includes a high-level strategic Biodiversity Net Gain baseline assessment. As the strategy develops and is taken into account within the wider environmental assessment it is anticipated that there will be a **beneficial** impact on biodiversity as the appropriate net gain is delivered.

Water Environment

3.5.25. All networks will involve infrastructure that passes through areas of surface water associated with the headwaters of small streams where there is the potential for adverse impacts on flood risk. Parts of the route may be at risk of groundwater flooding, due to the presence of groundwater flow barriers. For below ground structures, if they are below the water table, new drainage requirements may be needed. The overground network involves increased risk of spillage / runoff and creating pollutant pathways to groundwater depending on drainage design.

3.5.26. The impact of the scheme on the water environment is considered to be **slight adverse**.

Summary

3.5.27. Table 3-16 summarises the environmental impacts of the scheme based on its current scope and the level of detail of design. As the scheme develops the scope to mitigate impacts and maximise supporting public realm improvements will be considered in detail.

Table 3-16 – Environmental appraisal summary

Environmental Impact	Assessment
Noise	Slight Beneficial (-£4m and £7m (2010 PV))
Air quality	Slight Beneficial (-£7m and £12m (2010 PV))
Greenhouse gases	-£7m and -£20m (2010 PV)
Landscape and townscape	Moderate Adverse
Historic environment	Moderate Adverse
Biodiversity	Slight Adverse[60]
Water environment	Slight Adverse

3.6 Social Impacts

3.6.1. The social appraisal undertaken as part of the SOC aligns with the guidance presented in *TAG Unit A1-4* Social Impact Appraisal.

3.6.2. The following impacts have been considered within the social appraisal:

- Reliability

[60] Excluding potential impacts on protected species and *Biodiversity Net Gain Strategy*

- Physical activity
- Journey quality
- Accidents
- Security
- Access to services
- Affordability
- Severance
- Option values

Reliability

3.6.3. Currently the majority of the highway network in the West of England experiences substantial congestion, particularly in the Bristol urban area. This congestion has a knock-on impact on journey reliability, with unpredictable journey times particularly in the peak periods. Congestion also impacts public transport where a lack of dedicated infrastructure means the carriageway is often shared with general traffic and therefore this is subject to the same delays and lack of reliability.

3.6.4. Consequently, low bus service reliability and frequency has resulted in a poor perception of public transport within the region.

3.6.5. The current scope of the scheme is expected to provide a fully segregated mass transit system in the West of England, allowing it to bypass existing traffic entirely in the form of either overground or tunnelled routes. This will significantly improve the reliability offered by public transport and improve network resilience. The integration of Mass Transit with the wider transport network will improve reliability of end-to-end journeys with seamless interchange within Bristol City Centre and at interchange hubs across the network.

3.6.6. The scheme is considered to be beneficial for Mass Transit users in terms of reliability, although for remaining highway users the scheme is likely to have an adverse impact on reliability where an option impacts on the capacity and operation of the highway. The impact of the scheme on reliability has not been quantified as part of the SOC. Going forwards to OBC, these impacts will be quantified and included within the Adjusted BCR.

Physical Activity

3.6.7. The current high levels of severe congestion and dominance of private cars, that are forecast to worsen within all four corridors, form a barrier for walking and cycling trips in the study area. Perceptions of danger are a major factor in attitudes to cycling, with many people within the region hesitant to cycle because of the fear of heavy or fast traffic. With poor physical activity associated with adverse health impacts, contributing to heart disease, stroke, and lung cancer, barriers to walking and cycling more need to be addressed.

3.6.8. As part of the proposed Mass Transit system there is provision for walking and cycling infrastructure as part of each of the options. This seeks to encourage an increase in sustainable journeys which could have beneficial effects on physical activity and associated health benefits. Further, the use of public transport encourages first mile / last mile trips by active modes to access the network. Therefore, the Mass Transit system is anticipated to encourage the use of active travel through access, egress and the infrastructure provided as part of the scheme, resulting in benefits in terms of physical activity.

3.6.9. At this stage the impact of the scheme on physical activity has not been quantified, however the Mass Transit network is anticipated to have a **beneficial** impact on physical activity.

Journey Quality

3.6.10. *TAG Unit A4-1* groups journey quality into three categories:

- Traveller care: cleanliness, facilities, information and environment
- Traveller views: views of surrounding area
- Traveller stress: frustration, fear of potential accidents and route uncertainty

3.6.11. The attractiveness of public transport can be undermined by poor information, difficult-to-understand networks (with services from different operators not always shown on maps and timetable information etc.) and complex ticket 'offers', which passengers generally cannot use on all buses in their area. The Mass Transit scheme will provide a high-quality, modern public transport system equipped with a high standard of passenger facilities. To further improve journey quality, the scheme will include useful on-board and off-board information and will offer frequent services to avoid issues such as overcrowding.

3.6.12. The segregation of Mass Transit from general traffic, and impacts of this on operation, will reduce the stress / frustration of travelling in the region. This will improve overall journey quality.

3.6.13. *TAG Unit A4-1* states that if the scheme results in an improvement to traveller care, views and stress then the impact is beneficial. The scale of this impact is then determined by the number of people benefitting from this. As the daily demand for each of the networks exceeds 10,000 passengers, the impact is considered to be **large beneficial**.

Accidents

3.6.14. Currently, high car use and subsequent congestion has resulted in a concentration of serious collisions along highly trafficked arterial routes in Bristol City Centre and Bath City Centre. Fear and apprehension about personal security has resulted in lowered levels of active travel.

3.6.15. The reduction in traffic due to modal shift, particularly within Bristol City Centre where the potential for collisions is high, should improve safety for those living and working in the four corridors. However, where there are increases in distance travelled due to re-routing there will be an increase in accidents.

3.6.16. A high-level quantification and monetisation of accident impacts has been undertaken using the MEC approach based on the change in highway kilometres travelled as a result of the scheme. Using the current modelling framework discussed in section 3.3, for overground options there is a net increase in highway kilometres travelled where the re-routing impacts are greater than those from modal shift. This results in a negative accident impact for the overground networks. For Network 3 the modal shift impacts are greater than the re-routing impacts and therefore there is a positive accident impact.

3.6.17. The benefits associated with the scheme are estimated to range between -£56m and £99m (2010 PV) depending on the network.

Security

3.6.18. Personal security is an important influencing factor in journey planning. The Mass Transit system will increase the actual and perceived security of passengers by creating well-lit and visible stop locations and operating secure vehicles which are fitted with CCTV.

3.6.19. *TAG Unit A4-1* states that where there are improvements to security indicators including lighting, visibility and surveillance, and that this benefit is experienced by more than 10,000 passengers per day then the impact is **large beneficial**.

Access to Services

3.6.20. The introduction of the Mass Transit scheme will provide access to key destinations, including employment and leisure facilities within the four corridors. In particular this will provide connections between locations that are currently not well linked by public transport services i.e. the South-West Corridor to the North Corridor, or between Kingswood and Bristol City Centre.

3.6.21. The Mass Transit scheme will have a positive impact on the availability and physical accessibility of transport with the vehicles improving the quality of travel for passengers.

3.6.22. *TAG Units A4-1 and A4-2* state that the assessment of accessibility impacts should be considered as part of the wider Distributional Impacts (DI) assessment. The outputs of the DI screening exercise are shown in section 3.7. In order to make an assessment in line with the 7-point scale, *TAG Unit A4-2* states that a strategic accessibility worksheet must be used. This will be undertaken as part of the next stages of the DI assessment within the OBC. Therefore, at this stage it is concluded that the scheme is anticipated to have a **beneficial** impact on access to services.

Affordability

3.6.23. The Mass Transit scheme endeavours to reduce inequality in the region by providing an affordable and inclusive public transport option that connects users to key sites within the four corridors. The impact of mode shift to Mass Transit is captured in terms of the assessment of user charges and vehicle operating costs. Within the appraisal it has been assumed that fares are consistent between current public transport costs and Mass Transit fares. Therefore, for public transport passengers who switch to Mass Transit there are not considered to be affordability impacts.

3.6.24. Where travellers switch to Mass Transit from car there may be a change in user cost as a result of paying fares and savings in VOCs. However within the logit model the various elements that constitute journey times are compared consistently across modes and where a decision is made to switch modes this is based on the balance of costs and journey times.

3.6.25. *TAG Unit A4-1 and A4-2* state that the assessment of affordability impacts should be considered as part of the wider DI assessment. The outputs of the DI screening exercise are shown in section 3.7. In order to make an assessment in line with the 7-point scale, *TAG Unit A4-2* states that a strategic affordability worksheet must be used. This will be undertaken as part of the next stages of the DI assessment within the OBC. Therefore, at this stage it is concluded that the scheme is anticipated to have a **neutral** impact on affordability based on the information currently available.

Severance

3.6.26. High traffic flows seen across the main radial routes from Bristol City Centre result in severance for pedestrians. The introduction of Mass Transit has the potential to decrease traffic flows through modal shift as more people opt to use the service instead of their cars, thus reducing severance. The scheme will also reduce the dominance of private car by prioritising road space on these main arterial routes for Mass Transit operation. This will improve the pedestrian environment on these routes.

3.6.27. The provision of active travel infrastructure as part of the scheme with further improve movements for pedestrians across the four corridors.

3.6.28. *TAG Unit A4-1* states that severance is considered to be:

- None - where there is little to no hindrance to pedestrian movement
- Slight - where all people are able to make the desired movement, however there may be some hinderance
- Moderate - where pedestrian journeys will be longer or less attractive, to the extent that some people are dissuaded from making some journeys on foot
- Severe - where people are likely deterred from making pedestrian journeys to the extent that they reorganise their activities. Those who do make journeys on foot will experience considerable hinderance

3.6.29. To assess the impact of the scheme on severance the Do Minimum and Do Something level of severance has been compared. Based on the descriptions above it is anticipated that the scheme will result in areas of moderate severance reducing to slight. This is considered a conservative assessment but reflects the scale of the area covered by the Mass Transit network, and the different pedestrian movements included within this.

3.6.30. Where traffic redistributes to other routes as a result of the scheme (i.e. largely for overground options / sections of options where there may be one-way systems or road closures), there is the potential for an adverse impact on severance on these routes. This will be considered further as the modelling framework develops and captures modal shift and wider network impacts of the options in more detail.

3.6.31. Therefore, overall at this stage it is considered that the scheme will have a **slight beneficial** impact on severance. However, it is noted that for overground options and sections of options where traffic redistributes to alternative routes, there could be a more significant negative impact on severance on diversionary routes. This will be considered in more further as the modelling framework allows more detailed consideration of the spatial disaggregation of impacts.

Option and Non-use Values

3.6.32. The Mass Transit scheme will provide a step change in transport service compared to existing transport provision in the West of England. The Mass Transit scheme will provide a segregated, reliable service that will connect communities in and around the West of England.

3.6.33. It is noted that through the introduction of Mass Transit, there may be a rationalisation of bus services on some of the corridors, which may impact on the public transport availability to wider areas. It is anticipated that as part of consideration of first mile / last mile solutions end to end journeys will be provided for, mitigating some of the impacts on bus services.

3.6.34. The impact of the scheme on option and non-use values is considered to be **neutral.**

Summary

3.6.35. Table 3-17 below summarises the social impacts of the scheme.

Table 3-17 – Social appraisal summary

Social Impact	Assessment
Reliability	Beneficial (for Mass Transit users), Adverse (for highway users)
Physical activity	Beneficial
Journey Quality	Large Beneficial
Accidents	-£56m and £99m (2010 PV)
Security	Large Beneficial
Access to Services	Beneficial
Affordability	Neutral
Severance	Slight Beneficial
Option and Non-Use Values	Neutral

3.7 Distributional Analysis

3.7.1. DI considers the variance of transport intervention impacts across different social groups. Both beneficial and / or adverse DIs of transport interventions need to be considered, along with the identification of social groups likely to be affected.

3.7.2. In terms of distributional analysis, the categories that need to be considered include user benefits, accidents, affordability, security, severance and accessibility together with the effects of the scheme on local noise and air quality.

3.7.3. Based on the proportionate approach set out in *TAG Unit A4.2*, the DI assessment for the impacts of the Mass Transit scheme has identified the likelihood of impacts for each indicator. Table 3-18 shows the outputs of the DI screening proforma, providing a qualitative commentary of the potential impacts.

Table 3-18 – DI screening pro-forma

Indicator	Appraisal output criteria	Potential impact	Qualitative comments	Proceed to step 2?
User benefits	The TUBA user benefit analysis software or an equivalent process has been used in the appraisal; and/or the value of user benefits Transport Economic Efficiency (TEE) table is non-zero.	Yes	TUBA and a spreadsheet catchment model have been used to appraise both highway and public transport user benefits. The user benefits for each option are non-zero and will vary spatially.	Yes
Noise	Any change in alignment of transport corridor or any links with significant changes (>25% or <-20%) in vehicle flow as an indicator of significant change.	Yes	The Mass Transit scheme will involve an alteration to the alignment of the existing transport corridors. There is also potential for the scheme to significantly impact vehicle flows due to modal shift and re-routing.	Yes
Air quality	Any change in alignment of transport corridor or any links with significant changes in vehicle flow, speed or %HGV content: ▪ Change in 24-hour AADT of 1,000 vehicles or more ▪ Change in 24-hour AADT of HGV of 200 HGV vehicles or more	Yes	The Mass Transit scheme will involve an alteration to the alignment of the existing transport corridors. There is also potential for the scheme to significantly impact vehicle flows due to modal shift and re-routing.	Yes

Indicator	Appraisal output criteria	Potential impact	Qualitative comments	Proceed to step 2?
	■ Change in daily average speed of 10kph or more ■ Change in peak hour speed of 20kph or more Change in road alignment of 5m or more			
Accidents	Any change in alignment of transport corridor (or road layout) that may have positive or negative safety impacts, or any links with significant changes in vehicle flow, speed, %HGV content or any significant change (>10%) in the number of pedestrians, cyclists or motorcyclists using road network.	Yes	The Mass Transit scheme will involve an alteration to the alignment of the existing transport corridors. There is also potential for the scheme to significantly impact vehicle flows through modal shift and re-routing. As part of the scheme improved active travel infrastructure will be provided, seeking to increase the number of people walking and cycling which will benefit some particular social groups.	Yes
Security	Any change in public transport waiting/ interchange facilities including pedestrian access expected to affect user perceptions of personal security.	Yes	The scheme involves significant changes to public transport waiting/interchange facilities. Vulnerable groups e.g. older people, disabled people, may benefit from the provision of a safe and accessible transport service. The design and implementation of the Mass Transit system will maximise the ‘sense of security’ for these social groups.	Yes

Indicator	Appraisal output criteria	Potential impact	Qualitative comments	Proceed to step 2?
Severance	Introduction or removal of barriers to pedestrian movement, either through changes to road crossing provision, or through introduction of new public transport or road corridors. Any areas with significant changes (>10%) in vehicle flow, speed, %HGV content.	Yes	The scheme will involve the introduction or removal of barriers to pedestrian movement through changes to road crossings or the introduction of a new public transport corridor. Groups that may be vulnerable to the impacts of severance (e.g. elderly, disabled) often experience longer journey times or rely on pedestrian routes that are inappropriate or inconvenient.	Yes
Accessibility	Changes in routings or timings of current public transport services, any changes to public transport provision, including routing, frequencies, waiting facilities (bus stops / rail stations) and rolling stock, or any indirect impacts on accessibility to services (e.g., demolition & re-location of a school).	Yes	The scheme will involve changes in routings of current transport provision in terms of routing, frequency, waiting facilities and vehicles. Transport interventions will have differentiated impacts on different social groups such as older people, people with disabilities or ethnic minorities in terms of access to services such as employment, healthcare and other amenities.	Yes
Affordability	In cases where the following charges would occur; Parking charges (including where changes in the allocation of free or reduced fee spaces may occur); Car fuel and non-	Yes	In the SOC appraisal it has been assumed that the Mass Transit fare structure will be the same as current public transport services, therefore there is no impact on user switching from public transport to Mass Transit. For highway users (remaining and those	Yes .

Indicator	Appraisal output criteria	Potential impact	Qualitative comments	Proceed to step 2?
	fuel operating costs (where, for example, rerouting or changes in journey speeds and congestion occur resulting in changes in costs); Road user charges (including discounts and exemptions for different groups of travellers); Public transport fare changes or Public transport concession availability		switching to Mass Transit) there may be an impact on car fuel and non-fuel operating costs and public transport fares as a result of modal shift, re-routing, journey speeds or congestion. Vulnerable social groups such as people from areas of deprivation or the elderly may suffer disproportionately where they naturally have fewer transport options available to them.	

3.8 Place-based Analysis

3.8.1. Within the HM Treasury *Green Book* (March 2022), place-based analysis is defined as the 'appraisal applied to geographically defined areas within the UK'.

3.8.2. *TAG Unit A4-3* was released in September 2022 and states that place-based analysis is recommended where either or both of the following are relevant:

- For proposals with geographically focused local or regional development objectives referenced in the Strategic Dimension of the scheme and/or in local or regional growth strategies and plans
- For proposals with substantial potential impacts either positive or negative on 'geographical areas in scope'

3.8.3. Mass Transit is a geographically focused scheme as is reflected within the vision and objectives, and is anticipated to have substantial impacts in certain geographic areas. As the scheme develops, and the modelling framework allows for detailed consideration of the spatial disaggregation of impacts, place-based analysis will be undertaken.

3.9 Wider Analysis

3.9.1. As part of the 2022 update to the *Transport Business Case guidance*[61] it now includes a wider analysis section within the Economic Dimension. It is recommended that this includes 'any extra analysis to inform the decision-making process: this could include analysis of various options' performance against the SMART objectives'. It also states that this analysis should be proportionate to the stage of the project.

3.9.2. As part of the longlist appraisal (described in section 2.11) the longlist options were considered against the scheme objectives (shown in section 2.8). The Strategic Dimension also explores how the measures of success align with the objectives. Going forwards this will be further developed identifying the metrics for monitoring and evaluation to demonstrate that the scheme delivers against its ambitions and the objectives.

3.9.3. The Wider Impacts of this Economic Dimension shows the initial wider impacts assessment based on the current model outputs and specification of the Mass Transit scheme.

3.9.4. In addition to this, a high-level assessment of the potential economic impacts of the Mass Transit system has been undertaken to provide insight into the potential transformational effects it could have if a viable solution, for both public transport and highway users, were realised. These impacts demonstrate the potential additional benefits that a mass transit solution could offer; hence being included within the SOC. More detailed analysis is required as the scheme develops to understand the level of benefits attributable to the

[61] Transport Business Case guidance, Department for Transport, 2022

specific scope of the West of England scheme. The *Economic Narrative* provides further detail of the assessment of these potential impacts.

3.9.5. Some of the impacts discussed within this section are not necessarily traditional benefit streams considered under TAG, hence their inclusion within this section of the Economic Dimension as opposed to the *Wider Impacts* section. These impacts are therefore subject to change when the wider economic impacts are considered in more detail as part of any further work.

Productivity

3.9.6. The ‘productivity gap’ in the B&NES, SGC and NSC areas is partly attributable to the relatively poor levels of current accessibility into the city centre. This is one of the key findings of the research by organisations such as Centre for Cities. Their research shows that for those cities in Europe where there is relatively poor connectivity between businesses and workers, productivity levels are measurably lower with productivity gaps emerging when similar ‘city pairs’ are compared to each other.

3.9.7. Based on Gross Value Added (GVA) per worker (the key metric of productivity), the Office of National Statistics (ONS) data[62] shows that the B&NES and NSC areas are lagging behind that in the Bristol UA. This ‘productivity gap’, combined with lower GVA growth, means that the gap is increasing over time. This will only continue without major intervention (such as Mass Transit and the transformative connectivity it will generate).

3.9.8. Based on the case study evidence and research undertaken by various organisations, it is clear that a scheme such as this will have a considerable impact on productivity as workers will be able to access employment opportunities far more easily whilst employers will in turn be able to draw on a much wider pool of suitable labour. However it is noted that although the Mass Transit system will play an important role with respect to boosting productivity, it will not be the only determinant of this as other factors will come into play (such as policy initiatives to help boost training and develop skills etc,).

3.9.9. Reducing the 'productivity gap' in the West of England region has been considered in two complementary ways:

- Reducing the productivity gap between the B&NES, SGC and NSC areas and Bristol (i.e. helping to "Level Up" the local economies in these three areas relative to Bristol)
- Increasing productivity levels within the City of Bristol itself

[62] ONS, Regional gross value added by industry: local authorities by ITL1 region, 2022

"Levelling up" the economies surrounding Bristol

3.9.10. There is a productivity 'gaps' for the three UA areas compared to Bristol (per sector) when comparing GDP per worker for each UA from that in Bristol. Delivering the Mass Transit system will greatly assist the process of closing these gaps and aligns well with the national objective of levelling up, especially with respect to certain areas that are currently underperforming economically.

Enhancing productivity in Bristol

3.9.11. The City of Bristol will also benefit from productivity increases due to the delivery of the Mass Transit system. The Centre for Cities' research has shown that sub-optimal public transport connectivity in Bristol is resulting in an annual productivity gap of £1.787 bn (2020 prices). This is based on TravelTime, ONS, Eurostat data, as well as Centre for Cities' own calculations.

Land value uplift

3.9.12. Although it is anticipated that Mass Transit will unlock development opportunities, the constituent authority Local Plans are being progressed in parallel to this Mass Transit Study. At this stage, development sites that are dependent on Mass Transit cannot be identified, and the appropriate modelling in terms of transport impacts and LVU cannot be undertaken. As Local Plans are progressed and there is further visibility of sites that are dependent on transport infrastructure more detailed analysis will be undertaken.

Helping to unlock residential development

3.9.13. Evidence from other mass transit and major urban public transport interventions has demonstrated that the transformative connectivity enhancements help to unlock and accelerate new residential developments. To understand the potential for Mass Transit to unlock development, engagement with each of the four UA planning teams was undertaken. This identified that BCC and SGC have proposed residential development sites that can, at least in part, be attributed to the impact of introducing Mass Transit to the different proposed corridors.

3.9.14. The extent of attribution of each residential development site to the Mass Transit scheme was based on several factors, including:

- Proximity of each site to the respective Mass Transit corridor
- Particular characteristics of each site (i.e. is the development predicated on the basis of much enhanced transport access being provided?)
- Consultation with each UA planning team to understand the extent of the linkage between each development and the proposed Mass Transit scheme

3.9.15. By supporting additional housing development as well as additional commercial development, Mass Transit may also help to generate revenue streams that will accrue to the public sector (and can be used to fund other activities). These include Council Tax income from the additional housing developments and Business Rate income generated by new businesses that the Mass Transit scheme will support.

3.9.16. The benefits associated with unlocking development will be considered in more detail as the Local Plans come on stream.

Land value uplift to existing properties

3.9.17. As well as the land value uplifts from new developments, research[63] in recent years has demonstrated that station accessibility improvements (including the provision of new stations) generate additional value gains to existing properties.

3.9.18. Steer's 2018 work on the Local Economic Benefits of Station Improvement demonstrated that the clearest localised economic benefits are those associated with property price impacts.

3.9.19. Steer also found that the available empirical evidence suggests property price is positively influenced by transport investment (such as investment in station improvements). The "What Works" report from 2015 also collated the results of 11 studies with increased property prices being evident based on improvements at 11 station schemes.

3.9.20. Specific examples include the impact on house prices near Elizabeth Line stations in London where prices have increased by 31% even before the new line opened. For the Sheffield Station Gateway programme, the improvements generated inward investment of £74m to the station area.

3.9.21. Research by Savills (February 2019) also indicates that there can be a range of property price impacts based on different schemes. These range from over 50% (Jubilee Line extension), over 20% (DLR extension to Woolwich) and 5% (North London Line).

3.9.22. In addition, Savills found that property values would be 10% higher when the improved station becomes operational and that the uplift could be as high as 60% after five years.

3.9.23. Since residential property prices near to stations tend to have the highest value (and decrease with distance from the station), the impacts considered here are based on TfL research[64] whereby there is:

- A 10% premium on property values within 500 metres of the station
- 5% falling to zero premiums on property values at distances of 1,000 and 1,500 metres from a station

[63] The Value of Station Investment - Research on Regenerative Impacts, SDG, November 2011, Local Economic Benefits of Station Investment, SDG, March 2018 and Rail Investment and Land Value Capture Potential - Capture Options and Conclusions, Savills, February 2019
[64] Land Value Capture report, TfL, 2017

3.9.24. It is noted that land value changes to existing properties are not considered within TAG to be a standalone impact, with overlap with the changes in transport accessibility and/or induced investment. In addition, the increase in land values in some locations may be rebalanced by a reduction in other areas not served by the system.

3.9.25. These impacts demonstrate how major transport schemes can potentially tap into various types of 'value gain' as a source of funding. This has been the case with major schemes in London (such as the Elizabeth Line, Jubilee Line Extension and Northern Line Extension). Various public sector agencies in the north of England are currently investigating how several of their transformative transport schemes (such as Northern Powerhouse Rail and potentially West Yorkshire Combined Authority's mass transit scheme) can be at least part funded by 'value capture' methods of funding.

Summary

3.9.26. In addition to traditional transport economics impacts, the implementation of a viable mass transit system could generate a range of further wider economic impacts that would have transformational affects throughout the West of England region over a considerable period of time.

3.10 Value for Money Statement

3.10.1. The appraisal has been undertaken for the Mass Transit scheme as specified in the scheme description (see section 1.7) and reflects a solution offering full segregation from general traffic from end-to-end. Associated with this are significant capital costs to deliver this infrastructure and also substantial impacts on existing road users due to loss of capacity or diversions from the main arterial route.

3.10.2. The modelling framework used to estimate the public transport and highway impacts of the scheme is based on the best available tools at this time given the regional model (WERTM) is currently being redeveloped. The current model framework does not reflect the latest in terms of development and infrastructure proposals, and does not capture modal shift in an integrated way.

3.10.3. Based on the monetised impacts alone, it is suggested that the scheme offers very poor to poor VfM. The main sources of benefit contributing to the PVB are journey time benefits for those using Mass Transit. These passengers will have switched from either existing public transport modes or private car. These benefits are then counterbalanced by negative impacts to remaining highway users associated with reductions in capacity and re-routing.

3.10.4. For the overground options this results in a net disbenefit in terms of transport user impacts. There are then consequential impacts on noise, air quality and accidents, which are driven by resultant increased highway kilometres once re-routing impacts are combined with modal shift effects. The scheme will generate increased public transport revenue which will offset some, if not all, of the costs of operation, maintenance and renewals. Within the appraisal 20% optimism bias has been applied to the OMR costs. It has been assumed that the Mass

Transit system will be privately operated, therefore the revenue and OMR costs have been accounted for in the PVB.

3.10.5. The PVC is comprised of the design and construction costs, and includes 51% optimism bias. The PVC for Network 3 is between £4bn and £8bn depending on mode. The PVC for Networks 1 and 2 is between £500m and £900m depending on mode.

3.10.6. Sensitivity tests show that there is the potential for an overground Mass Transit network to deliver medium value for money based on only the monetised impacts. This is achieved under a scenario in which there is high demand and the impacts on remaining highway users are not considered in the monetised appraisal.

3.10.7. This test is suggestive of the fact that the ways in which people travel are likely to change significantly in the coming years with further policy measures to reduce the use of private car and increase use of sustainable travel modes. Under this test, the remaining uplift required in the PVB of an overground network to achieve high VfM is ~£80m (2010 PV), this is prior to the potential contribution of any wider economic impacts or non-monetised impacts. This test had a limited impact on Network 3 partly due to the fact that the highway impacts are lower for this option and secondly because the PVC is so significant that a considerable change in PVB is required to result in a change in BCR. The remaining sensitivity tests, linked to changes in costs, lower demand scenario and reduced demand at off-peak times have a lesser impact on the BCR for each network.

3.10.8. High-level consideration of potential wider economic opportunities shows that, were a viable solution for both public transport and highway users to be implemented, sizeable productivity and land value benefits could arise from the successful delivery of a mass transit system. This analysis shows the potential scale of change that a mass transit system could deliver. At this stage these impacts have not been estimated following the detailed approaches outlined in TAG; more detailed work would be required as the scheme develops.

3.10.9. There is also the potential for other impacts not currently captured or monetised within the appraisal to positively impact on the scheme benefits and boost the VfM. Mass Transit is anticipated to have a large beneficial impact on journey quality and security. Other social indicators not assessed using the seven-point scale but considered to have a beneficial impact are reliability, physical activity and access to services. The scheme could have a moderate adverse impact on the historic environment, landscape and townscape and a slight adverse impact on the water environment and biodiversity. However, this assessment is based on the current level of detail for the scheme and measures would be taken to mitigate and minimise these impacts wherever possible going forwards.

3.10.10. In undertaking the appraisal, the key risks identified that could impact the VfM include the feasibility and public acceptability of highway restrictions required to provide fully segregated options above ground, and the significant costs of tunnelling. Future optioneering work would consider value engineering in parallel to understanding the levers that could be used to increase the ridership and benefits of the system. There is clear overlap between these two workstreams, and they would therefore be coordinated to identify solutions which balance the requirements of the scheme from various perspectives.

3.10.11. Overall, based on its current scope and available modelling framework, the proposed Mass Transit scheme is most likely to return between very poor and poor value for money, with the differential between costs and benefits outweighing the additional non-monetised impacts. Uncertainty analysis has demonstrated that there is the opportunity to increase the VfM of the scheme through the exploration of value engineering to reduce the costs, increasing ridership and reducing the level of private car use, and identifying potential induced investment once Local Plans come on stream. Consideration of the potential wider economic impacts has demonstrated that the VfM could be considerably higher, should a viable solution for public transport and highway users be realised.

3.10.12. To meet the VfM requirements at the OBC stage, it is likely to require consideration of value engineering, measures to reduce private car use and increase demand on the Mass Transit system, detailed consideration and quantification of wider economic impacts attributable to the scheme and careful consideration of the phasing of corridors and work packages. The Strategic Outline Case Addendum sets out early-stage value engineering analysis that indicates the direction of travel between SOC and OBC for this aspect. This early-stage analysis has demonstrated the potential benefits which undertaking value engineering will have, seeking to balance the challenges identified within this SOC between the costs of operating underground and the impacts at surface level of above ground operation.

Future Context

3.10.13. The appraisal at this point has been based on the tools available and is reflective of the early stage of scheme development. It is recognised that the modelling framework used is based on inputs from GBATS / G-BATH, which both have dated base years, and modal shift is not fully reflected within the approach used. Furthermore, supplementary economic modelling will be needed to establish with more confidence the likely scale of wider economic benefits.

3.10.14. The transport context is likely to change significantly in the timeframe to scheme delivery, and this is not currently reflected within the monetised appraisal. JLTP4 identifies that without fundamental changes in the way in which people travel in the region there will be substantial increases in congestion, time spent queuing in traffic and delay, and the region's ability to meet its environmental targets will be compromised. This is explored further in the Strategic Dimension. JLTP4 recognises that demand management measures may be required as part of a wider regional strategy to encourage modal shift to more sustainable forms of travel and provide an opportunity to reinvest the revenue generated into public transport, cycling and walking. The scale of impact of demand management measures, both generally and on Mass Transit, is dependent on the form of measures and timescales of implementation relative to Mass Transit. Therefore no allowance has been made for demand management within the current appraisal. The implementation of demand management would have a number of impacts for the scheme, including:

- Reduced overall negative impact on highway users due to generally lower levels of demand
- Increased ridership on Mass Transit, increasing user benefits and revenue generated

3.10.15. Sensitivity tests 1, 5 and 6 set out in section 3.4 begin to indicate the potential that increased demand and reduced impact on highway users, which could be achieved through demand management, could have on the case for Mass Transit in the West of England.

3.10.16. Demand management can take a number of different forms from management of parking provision through to road user charging and workplace parking levies. With a national push to reduce carbon emissions, a number of cities have already implemented various forms of demand management. Although the impacts of these are still materialising, some information for some example case studies is provided as follows. Additional detail can be found in the *Mass Transit and Decarbonisation Technical Note*.

Workplace Parking Levy - Nottingham, England[65] Nottingham is the 5th most congested part of England outside of London. Bus journey times have been significantly affected by congestion on key roads. Road traffic has affected air quality, with an Air Quality Management Area across the whole city. Nottingham have had a Workplace Parking Levy since 2012. The charge of £379 per year is levied on approximately 25,000 spaces across the city (42% of total spaces). In the first three years of operation, the workplace parking levy raised £25.3m of revenue, all of which has funded improvements in the city's transport infrastructure. Recent research indicates that the levy has significantly contributed to a **33% fall in carbon emissions**, and a modal shift which has seen **public transport use rise to over 40%**.
Clean Air Zone – Bath, England[66] Introduced in March 2021, the Clean Air Zone (CAZ) charges all higher emission vehicles except private cars and motorcycles which drive into or near the city centre. The scheme is primarily aimed at reducing nitrogen dioxide levels. The April-July 2021 Monitoring Report identified that the CAZ is having its intended effect of improving vehicle compliance, changing behaviours and improving the city's air quality in general. The average nitrogen dioxide concentrations across monitoring sites within the CAZ were found to be 12.6% lower than the same period in 2019, with similar reductions found in the Bath urban area outside the zone's boundary. **Traffic flows are 9% lower in the CAZ area compared with the same period in 2018**, although it is noted that the coronavirus pandemic continues to impact on travel behaviours.
Congestion charging and low emission zones – London, England[67][68][69]

[65] International Case Studies for Scotland's Climate Plan: Workplace Parking Levy, Nottingham, UK
[66] Journey to Net Zero: reducing the environmental impact of transport in Bath, Bath and North East Somerset Council, May 2022
[67] Success stories within the road transport sector on reducing greenhouse gas emission and producing ancillary benefits, European Environment Agency, 2008
[68] Travel in London Report 11, Transport for London, 2018
[69] Central London Congestion Charging Impacts Monitoring Sixth Annual Report, Transport for London, 2008

Transport for London operates various demand management measures including a congestion charge (2003), a Low Emission Zone (2008) and an Ultra-Low Emission Zone (2019).

The congestion charging scheme had immediate benefits, with a **30% reduction in congestion** daily. The **public transport mode share grew to 37% in 2015 from 29% in 2002**. In the first year of the congestion charge TfL recorded a 16% reduction in greenhouse gas emissions, 13% in NO2 and 7% in particulate matter.

3.11 Summary

3.11.1. A robust optioneering process has been followed for the West of England Mass Transit programme, considering route options for each corridor and within the city centre and in parallel potential technology types. The OAR provides the details of the option identification and assessment work that has been undertaken to date. The output of this has been a set of shortlist options that have been appraised as part of the SOC.

3.11.2. The appraisal considers each corridor option and also three networks providing connectivity across the four corridors. The appraisal has been undertaken for the Mass Transit scheme as specified in the scheme description and reflects a solution offering full segregation from general traffic from end-to-end.

3.11.3. The VfM of the shortlist options has been assessed in line with DfT's TAG and Value for Money Framework, considering both quantified and qualitative impacts from an economic, environmental and social perspective in the round to provide an overall assessment. Impacts have been considered over a 60-year period, and, where quantified, the costs and benefits have been adjusted to a consistent price base and unit of account to allow comparison between them.

3.11.4. The appraisal at this point has been based on the tools available and is reflective of the early stage of scheme development. It is recognised that the modelling framework used is based on inputs from GBATS / G-BATH, which both have dated base years, and modal shift is not fully reflected within the approach used. This is a known constraint and once WERTM becomes available for use there is an opportunity to revisit the modelling assessment of the Mass Transit options.

3.11.5. The benefits considered within the appraisal at this stage include the journey time and cost impacts on transport users, carbon emissions, decongestion impacts including noise, air quality and accidents and impacts on indirect tax revenues to central Government. It has been assumed that the Mass Transit system would be operated by the private sector, and so the PVB also includes the costs and farebox revenues associated with the operation. The costs of delivering the scheme are assumed to be incurred by the public sector and therefore form part of the PVC.

3.11.6. Overall, based on its current scope and available modelling framework, it is suggested that the scheme offers very poor to poor VfM. The appraisal of the scheme demonstrates the challenges associated with delivering a fully segregated Mass Transit system in a constrained urban area. Although all options deliver against the objective of journey time benefits for public transport users, for the options that are predominantly overground the level of impact on the highway network is substantial. For options with a tunnelling component, however, there are significant associated capital costs and generating benefits of the same magnitude is difficult.

3.11.7. Sensitivity tests show that there is the potential for an overground Mass Transit network to deliver medium value for money based on only the monetised impacts. This is achieved under a scenario where there is high demand and the impacts on remaining highway users are not considered in the monetised appraisal. This test is suggestive of the fact that the ways in which people travel are likely to change significantly in the coming years with further policy measures to reduce the use of private car and increase sustainable travel modes. These measures would form part of wider demand management strategies across the region, and will be considered at future stages of the project. Under this test, the remaining uplift required in the PVB of an overground network to achieve high VfM is ~£80m (2010 PV), this is prior to the potential contribution of any wider economic impacts or non-monetised impacts. The remaining sensitivity tests, linked to reductions in costs, lower demand scenario and reduced demand at off-peak times have a lesser impact on the BCR for each network.

3.11.8. High-level consideration of potential wider economic opportunities shows that, were a viable solution for both public transport and highway users to be implemented, sizeable productivity and land value benefits could arise from the successful delivery of a mass transit system. This shows the potential scale of change that a mass transit system could deliver. At this stage these impacts have not been estimated following the detailed approaches outlined in TAG; more detailed work would be required as the scheme develops.

3.11.9. A scheme of this nature, scale and coverage is anticipated to have both place-based and distributional impacts. Going forwards to OBC these assessments would be undertaken.

3.11.10. The appraisal is based on the current specification and assumptions of the Mass Transit system concepts, which were established by the Combined Authority at the start of the SOC stage. At this stage a fully segregated solution has been considered in order to maximise potential system user benefit, but with a corresponding impact on both costs and non-user impacts. To meet the VfM requirements at the OBC stage, it is likely to require consideration of value engineering, measures to reduce private car use and increase demand on the Mass Transit system, detailed consideration and quantification of wider economic impacts attributable to the scheme and careful consideration of the phasing of corridors and work packages. The Strategic Outline Case Addendum sets out early-stage value engineering analysis that indicates the direction of travel between SOC and OBC. This early-stage analysis has demonstrated the potential benefits which undertaking value engineering will have, seeking to balance the challenges identified within this SOC between the costs of operating underground and the impacts at surface level of above ground operation.

4 Financial Dimension

4.1 Introduction

4.1.1. The Financial Dimension considers the costs and affordability, in terms of funding arrangements, of the Mass Transit programme. The costs of the programme have been considered in terms of the capital expenditure associated with delivery, the operating costs and the maintenance and renewal requirements. These whole-life costs are considered against the potential farebox revenue that could be generated by the system. The costs and revenues within this Financial Dimension are related to the Mass Transit system only and do not include any resultant impacts on the wider public transport network.

4.1.2. The costs and revenues associated with each corridor option, and where possible technology type, have been considered in turn. The overall costs and revenues associated with the network options have then also been estimated.

4.2 Introduction to Affordability

4.2.1. At this stage of programme development, affordability has been considered at a high-level. As part of the development of the SOC a *Funding and Financing Strategy* has been prepared. This provides a high-level strategic starting point for the funding and financing approach, and includes:

- Identification of various types and sources of funding and finance
- Examples of the different sources
- Highlights some of the relevant legal considerations in terms of structuring the delivery of the scheme
- Highlights the key legal risks associated with funding and financing options

4.2.2. The strategy also includes a number of case studies focused on major transport projects that have been delivered in the UK.

4.2.3. Given the scale and complexity of the Mass Transit programme it faces significant affordability challenges, notably for potential tunnelled sections, and it is most likely to be affordable by being delivered as individual elements; it is unlikely to be funded and financed through a single pot of money. The *Phasing Strategy* considers different ways in which the programme could potentially be phased and delivered.

4.2.4. As the programme, and these strategies, develop, the consideration of affordability will continue.

4.3 Scheme Costs

Capital Costs

4.3.1. The capital costs for each option have been estimated by Quantity Surveyors within WSP. The approach undertaken is reflective of the early stage of scheme development and balances the level of uncertainty inherent at SOC, with the need for proportionate analysis. Where possible, costs have been benchmarked against projects of a similar scale in order to reflect real-world experience.

4.3.2. Within the *Feasibility Design Summary Report*, construction typologies have been applied to sections of the corridor route options depending on their requirements. These typologies are itemised within the feasibility design drawings for each option and dictate the level of intervention required. For each typology, the distance of the route to which it applies has been measured to identify the lengths, areas, and volumes of the different elements of work required. This has then been used for a high-level bill of quantities.

4.3.3. The rates applied to the bill of quantities have been built up using a variety of sources, starting with SPONS 2022, an industry standard rate book used to develop cost estimates. To reflect the recent and ongoing increase in costs across the economy, and uncertainty going forwards, an uplift of 10% has been applied to these rates. This uplift is applied in addition to inflation, the assumptions for which are discussed in paragraphs 4.3.25 and 4.3.26. For those items not covered by SPONS (e.g. alterations to junctions, amendments to underbridges and overbridges), cost estimates have been benchmarked against other projects of a similar nature. This includes mass transit projects for Transport for the South East and Hertfordshire County Council, as well as the Transforming Cities Fund projects in Yorkshire.

4.3.4. For options involving underground sections and therefore tunnelling, the associated costs have been built up from cost data obtained from a number of tunnelling projects, with inflation figures applied to bring them to current prices. The tunnelling costs account for mobilisation and demobilisation, geotechnical and site investigation, access shaft, tunnel, system works and the underground stations that are needed along each route.

4.3.5. As set out in the Economic Dimension, there are a number of mass transit technology options being considered. In terms of capital costs, these technology types have been grouped into rubber-wheeled and steel-wheeled, whereby rubber-wheeled accounts for BRT / TLT, and steel-wheeled accounts for VLR / LRT.

4.3.6. Initially options have been costed as rubber-wheeled solutions in line with the approach described above. A percentage uplift has then been applied to appropriate cost line items to reflect the additional costs associated with steel-wheeled solutions. This uplift, assumed to be 18%, is based on benchmarks from projects of a similar nature that have considered both rubber and steel-wheeled solutions. The vehicle costs have been estimated for each technology type individually, as set out in more detail below.

4.3.7. Appendix M shows the detailed build-up of the capital costs for each option.

Structures

Stations

4.3.8. The ISP identified potential locations for stops / stations for each corridor route option. At this stage of scheme development, the size and fit-out of stations has not yet been detailed.

As such, benchmarking has been applied to allow for a bus hub with a waiting area, amenity facilities and a small office area for overground stations. It is expected that while some of the stations will be larger than this, the scheme will also require a number of smaller stations / stops. As such a standard rate has been applied for all overground stations. For underground stations a standard cost has been based on a previous example for Canary Wharf station. The cost of this station has been adjusted for the likely size of an underground station as part of the West of England Mass Transit network. Similarly to the overground stations, there is not currently detail of the specifics of the scale and fit-out of any underground stations, therefore an assumed cost for each station is used.

Overbridges / underbridges

4.3.9. At this stage a nominal figure has been allowed to cover any potential works that may be required. As additional detail is identified as part of the OBC stage, a cost for each overbridge and underbridge intervention will be applied.

Maintenance depot

4.3.10. It is expected that maintenance depot(s) will need to be constructed, however the scale, number and location is unknown as it will be highly dependent on the number of operational corridors and the form of the network.

4.3.11. At this stage, an indicative figure has been established using HS2 as a benchmark, with a direct construction cost of circa £50m, plus the relevant indirect costs. It is assumed that the space consists of office and workshop areas, the operational area and all relevant external works required to complete the extents. A single £50m figure has been included within the scheme costs at this stage. Given the early stage of development, the location(s) of depot(s) has not been identified, therefore the associated land costs have been excluded from the scheme costs at this stage.

Vehicle costs

4.3.12. For the purposes of the SOC it has been assumed that all vehicles will be purchased as opposed to leased. The total vehicle cost for each option has been estimated based on the peak vehicle requirements from the ISP and the assumed purchase cost is based on experience and industry benchmarks.

Indirect costs

4.3.13. In order to account for indirect costs, a number of uplifts have been made to the direct costs based on benchmarks from other projects and industry standard allowances. The following uplifts have been applied to the direct construction costs in order to estimate the indirect cost:

- Utilities: 30%
- Traffic management: 15%
- Preliminaries: 30%
- Project / design team fees: 10%

- Project management fees: 10%
- Client costs including project teams and internal management: 5%
- Biodiversity Net Gain (BNG): 3%
- Overheads and profit: 15%

4.3.14. For options in which a substantial portion of the route runs underground, applying a flat 30% allowance for utilities is skewed by the scale of the direct construction costs. For these options, a separate line item has been included within the cost estimate with a reduced percentage that reflects the expected scale of intervention. This percentage reflects the risk that significant utility diversions may be required.

4.3.15. Similarly, a separate cost line has been included to account for the traffic management on options requiring tunnelling. Due to the nature of the Tunnel Boring Machine (TBM) process it is expected that traffic management requirements for tunnelled sections will be significant at the site entrance and installation / transport of the TBM machine to site.

4.3.16. A cost allowance has been included for BNG as it is expected that this will become part of detailed design as the project progresses to OBC. This allows for landscaping and provision of betterment, as distinct from environmental mitigation.

4.3.17. In addition to the indirect costs above, a line item for surveys has been included in the estimates. The cost of surveys has been included as a lump sum within each of the options based upon the direct construction costs and benchmarked against projects of a similar nature and value to provide reassurance on indicative value. Such surveys are expected to include, but not be limited to ground investigation, pavement, drainage, utilities, ecology/environmental, arboricultural, and topographical.

Exclusions and limitations

4.3.18. At this stage of the process, both land costs and building demolition costs have been excluded from the cost estimate; this includes all associated legal fees. Due to the potential extent of land requirement, CPO, and other related factors, it would not be proportionate to provide a guide figure. As part of the OBC, the land and building demolition costs will be considered in more detail.

4.3.19. Items related to any public realm improvements and active travel requirements have been excluded from the cost estimates at this stage. Further detail of the scope around first mile / last mile solutions will be considered at OBC.

4.3.20. The purchase of the TBM has been excluded at this stage as the overall requirements are not yet known; it may be that no, or multiple, TBM units would be needed to complete the operation. This will also be dependent on the number of TBMs that are available at the time of construction and the demand of other projects of a similar nature at that time, including HS2. This will be a significant factor affecting the project depending on which options are taken further.

4.3.21. The timeframes until the assumed start of construction will provide a limitation to the costs in line with the current conditions of the construction market. Volatility in material costs, labour and plant availability has meant that the current costs will likely alter within shorter timescales than normal. This may have a significant impact on the anticipated costs of the project.

4.3.22. It is also important to consider how the legal landscape may alter over the years that the design will be undertaken leading up to construction. Any new regulations or expectations will need late-stage changes to be introduced to the project. This may include Net Zero, post-departure adjustments to the regulatory framework as a result of the UK's departure from the European Union, or any wider geopolitical changes which influence the UK's regulatory and economic landscape. Further varying factors could have an impact on the expected costs of the project, in particular if new technology or transport types are introduced that are different to the current expectations.

Risk

4.3.23. At this stage of the scheme development, a Quantified Risk Assessment (QRA) has not been carried out. Therefore, to reflect the uncertainty of the scheme costs a risk allowance of 40% has been included in the cost estimate. This allowance is to mitigate against risks commonly encountered on a project of this scale. This includes, but is not limited to, additional inflationary pressure over and above that currently seen in the market, and generic construction phase risks (e.g. ground conditions while piling, encountering adverse materials). This risk allowance does not account for changes in the scope of the scheme as it develops.

4.3.24. As the scheme develops and undergoes detailed design work, a QRA will be undertaken.

Inflation

4.3.25. The direct and indirect costs have been estimated in 2022 prices. In order to reflect that the design and construction period is not until 2023 to 2036, inflation has been applied to these costs to reflect the year in which they are incurred.

4.3.26. Due to the ever-changing market conditions, it is becoming increasingly difficult to forecast inflation for the construction period. At this stage, inflation has been based upon taking a holistic view of forecasts by the Bank of England, which include 10% inflation in 2023, and 2% each year thereafter.

4.3.27. Table 4-3 and Table 4-4 show the capital cost profile for each option and network.

4.3.28. Table 4-1 and Table 4-2 show the capital cost estimates for each of the corridor and Bristol City Centre route options based on the above methodology for a rubber-wheeled and steel-wheeled solution respectively. These costs reflect the assumptions described previously and do not include land or legal costs. The costs have been split into the following categories:

- Construction:
  - Build costs including stations, overbridges / underbridges, maintenance depot(s)
  - Utilities
  - Traffic management
  - Preliminaries
  - Overheads and profits
- Preparation and admin:
  - Project / design team fees
  - Client costs including project teams and internal management
  - Biodiversity Net Gain
  - Surveys
- Inflation
- Risk
- Vehicle costs

4.3.29. In order to calculate the capital costs of the three networks, the costs of the constituent corridor options have been summed together and combined with the appropriate city centre option. The costs of any overlapping sections have then been removed from the overall estimate, hence do not necessarily equal the sum of the constituent options.

4.3.30. The cost estimates demonstrate the affordability challenges associated primarily with options which require an element of tunnelling. The funding required to deliver these options is significant.

Table 4-1 – Cost estimates (rubber-wheeled) - £m, nominal

Option	Construction costs (£m)	Prep and admin (£m)	Base cost (£m)	Inflation (£m)	Risk (£m)	Vehicle Cost (BRT) (£m)	Total (£m)
North Corridor							
NC04	2,065	406	**2,470**	1,383	988	4	**4,846**
NC08	240	39	**279**	156	112	6	**553**
NC08b	238	39	**276**	155	111	6	**548**
East Corridor							
EC01	2,031	403	**2,434**	1,363	974	3	**4,774**
EC04	2,563	508	**3,070**	1,719	1,228	3	**6,021**
EC08	92	15	**107**	60	43	6	**215**
Bristol – Bath Corridor							
BBC-C + BBC06 + A5	151	25	**176**	99	70	7	**352**
South-West Corridor							
SWC03	1,846	362	**2,208**	1,236	883	4	**4,332**
SWC05	157	26	**182**	102	73	6	**363**
SWC11	189	31	**220**	123	88	6	**438**
Bristol City Centre							
BBC-OPB	35	5	**40**	22	16	-	**78**
BBC-OPD	42	7	**49**	27	19	-	**95**
BBC-OPE	17	3	**20**	11	8	-	**39**
Networks							
Network 1	686	112	**798**	447	319	11	**1,589**
Network 2	668	110	**778**	436	311	25	**1,550**
Network 3	6,624	1,301	**7,925**	4,437	3,170	18	**15,550**

Table 4-2 - Cost estimates (steel-wheeled) - £m, nominal

Option	Construction costs (£m)	Prep and admin (£m)	Base cost (£m)	Inflation (£m)	Risk (£m)	Vehicle Cost (LRT) (£m)	Total (£m)
North Corridor							
NC04	2,426	477	**2,903**	1,626	1,161	23	**5,713**
NC08	255	41	**296**	166	119	35	**616**
NC08b	253	41	**294**	164	117	35	**610**
East Corridor							
EC01	2,397	475	**2,872**	1,608	1,149	16	**5,644**
EC04	3,024	599	**3,623**	2,029	1,449	16	**7,117**
EC08	96	16	**112**	63	45	31	**251**
Bristol – Bath Corridor							
BBC-C + BBC06 + A5	160	26	**186.4**	104	75	39	**404**
South-West Corridor							
SWC03	2,175	418	**2,593**	1,452	1,037	23	**5,106**
SWC05	166	27	**193**	108	77	31	**409**
SWC11	200	32	**232**	130	93	35	**491**
Bristol City Centre							
BCC-OPB	36	6	**42**	24	17	-	**83**
BCC-OPD	44	7	**51**	29	20	-	**100**
BCC-OPE	18	3	**21**	12	8	-	**41**
Networks							
Network 1	725	118	**843**	472	337	140	**1,793**
Network 2	707	115	**822**	460	329	140	**1,751**
Network 3	7,785	1,520	**9,305**	5,221	3,722	101	**18,340**

Cost profile

4.3.31. At this stage a high-level view of the potential design and construction period has been made based on the assumed opening year of 2036. In reality the delivery timescales are likely to be different for overground and tunnelled / hybrid options. However for the purposes of this SOC it has been assumed that all options / corridors would be delivered to the same timescales. The opening year of 2036 is driven by the available forecast year in the current modelling framework.

4.3.32. Table 4-3 and Table 4-4 show the cost profile for each corridor option for rubber and steel-wheeled solutions.

4.3.33. As demonstrated by the cost profiles, the affordability challenges will be significant in the latter years, primarily associated with options that require an element of tunnelling.

Table 4-3 – Capital cost profile (rubber-wheeled) - £m, nominal

Option	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	Total
North Corridor															
NC04	3	6	6	7	10	34	35	36	37	817.3	881	986	993	993	**4,846**
NC08	3	3	3	3	3	3	3	5	5	98	100	102	106	115	**553**
NC08b	3	3	3	3	3	3	3	5	5	97	99	103	105	113	**548**
East Corridor															
EC01	3	6	6	7	10	34	35	36	36	815	878	962	971	975	**4,774**
EC04	4	8	8	8	13	43	44	45	46	1,020	1,087	1,210	1,234	1,249	**6,021**
EC08	1	1	1	1	1	1	1	2	2	38	39	39	40	46	**215**
Bristol – Bath Corridor															
BBC-C + BBC06 + A5	2	2	2	2	2	2	2	3	3	63	64	65	65	74	**352**
South-West															
SWC03	3	6	6	6	9	31	31	32	33	723	813	866	882	892	**4,332**
SWC05	2	2	2	2	2	2	2	3	3	65	66	67	69	74	**363**
SWC11	2	2	2	3	3	3	3	4	4	78	80	81	82	90	**438**
Networks															
Network 1	9	9	9	9	9	10	10	15	15	282	288	295	299	331	**1,589**
Network 2	8	9	9	9	9	9	9	15	18	275	282	288	292	323	**1,550**
Network 3	12	22	22	23	34	111	113	116	119	2,624	2,848	3,130	3,177	3,210	**15,561**

Table 4-4 - Capital cost profile (steel-wheeled) - £m, nominal

Option	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	Total
North Corridor															
NC04	4	7	8	8	12	41	41	42	43	962	1,030	1,142	1,164	1,210	**5,713**
NC08	3	3	3	3	3	4	4	5	6	105	107	109	111	149	**616**
NC08b	3	3	3	3	3	3	4	5	6	104	106	108	110	148	**610**
East Corridor															
EC01	4	7	8	8	12	40	41	42	43	956	1,019	1,130	1,152	1,182	**5,644**
EC04	5	9	10	10	15	51	52	53	54	1,198	1,283	1,427	1,455	1,495	**7,117**
EC08	1	1	1	1	1	1	1	2	2	40	41	41	42	74	**251**
Bristol – Bath Corridor															
BBC-C + BBC06 + A5	2	2	2	2	2	2	2	4	4	66	68	69	69	109	**404**
South-West															
SWC03	3	7	7	7	10	36	36	37	38	859	952	1,013	1,030	1,072	**5,106**
SWC05	2	2	2	2	2	2	2	4	4	69	70	69	73	105	**409**
SWC11	3	3	3	3	3	3	3	4	4	82	84	86	87	124	**491**
Networks															
Network 1	9	9	9	10	10	10	10	16	16	299	306	311	316	462	**1,793**
Network 2	9	9	9	9	10	10	10	15	16	291	298	304	308	453	**1,751**
Network 3	14	26	26	27	40	129	132	136	138	3,085	3,333	3,651	3,718	3,886	**18,340**

Operating, Maintenance and Renewal Costs

4.3.34. OMR costs have been estimated over the appraisal period. The following cost line items have been included in the estimate:

- Vehicle maintenance and renewal costs
- Electricity cost
- Station operating cost
- Infrastructure maintenance cost
- Staff costs (onboard, station and office based)

4.3.35. The OMR costs have been estimated on an incremental rate basis, largely driven by changes in vehicle milage or operating time. The unit rates applied to these changes are based on benchmarks from similar public transport projects. The operating costs presented below are those associated with the Mass Transit operation and do not include any impact on the wider public transport network.

Vehicle maintenance and renewal costs

4.3.36. The vehicle maintenance costs have been calculated on a rate per vehicle mile and the operated distance. These costs are assumed for each year of the appraisal.

4.3.37. The renewal costs are based on an assumed lifespan for each vehicle type and the cost to purchase new vehicles. These costs are incurred within the year which the vehicles reach life expiry.

Electricity cost

4.3.38. It is assumed that all technology types will be electrically powered. The electricity cost is calculated based on an assumed consumption rate and electricity price multiplied by the vehicle mileage. The electricity price is sourced from the May 2022 *TAG Data Book* (Table A1.3.7).

Station operating cost

4.3.39. The station operating cost includes the cost of lighting, electricity and general running of each station. The total station operating cost for each option is calculated based on the number of stations identified in the ISP and an assumed annual cost per station. Similarly, to the capital costs for stations, at this stage it has been assumed that each stop is a station.

4.3.40. The station operating cost is assumed to be higher for VLR and LRT based on benchmarks from similar schemes. The station operating cost is also assumed to be 50% higher for options that are predominantly tunnelled compared to overground. This is to reflect the additional costs associated with the operation of escalators, lifts and a greater area to operate.

Infrastructure maintenance cost

4.3.41. Four types of infrastructure maintenance costs have been accounted for:

- Track maintenance (applicable for steel-wheeled only)
- Electricity maintenance for wires / facilities for electric vehicles to access electricity during operation (applicable for steel-wheeled only)
- Surface maintenance including the costs to maintain the infrastructure for vehicles to use, including:
    - Carriageway maintenance every 20 years
    - Surface cleaning, inspection and maintenance every year of operation
- Tunnel maintenance cost for all hybrid or fully tunnelled options

4.3.42. The tunnel maintenance cost is the most significant infrastructure maintenance cost. Based on benchmarks from similar projects a maintenance cost of £1,250 per metre (2020/21 prices) has been assumed in each year for hybrid and tunnelled options.

Staff costs

4.3.43. The staff costs comprise of:

- Onboard staff
- Station staff
- Office staff

4.3.44. The number of on-board staff is calculated by dividing the total annual operating hours by the assumed annual working hours of one Full Time Equivalent (FTE). It is assumed that rubber-wheeled solutions will have one member of on-board staff (the driver), whilst for steel-wheeled it is assumed there is also a revenue protection / customer facing member of staff on-board.

4.3.45. For all stations it has been assumed that there are cleaning and revenue protection staff, and for steel-wheeled options technical inspection staff. It is assumed that an FTE could cover a number of stations for these purposes, with one FTE could covering five stations for rubber-wheeled solutions and between one and two stations for steel-wheeled solutions. In addition, for underground stations it is assumed that there are five FTEs per station for security regulations. This is based on the assumption that there is at least one member of security staff present at each station at all times, and therefore a requirement for five FTEs.

4.3.46. Office staff costs relate to management and admin, legal or additional office management personnel. It has been assumed that these costs are 5% of the total on-board staff cost for rubber-wheeled solutions and 25% of on-board staff costs for steel-wheeled solutions. This is based on experience of similar projects.

Inflation

4.3.47. In order to reflect the years in which the costs would be incurred, inflation has been applied to each of the cost line items. In general, costs have been assumed to grow in line with RPI, with the following exceptions:

- Electricity cost: indexed with electricity price forecasts from the *TAG Data Book*

- Staff cost: indexed with average earnings index forecasts from the *TAG Data Book*
- Infrastructure maintenance costs: indexed with CPI

4.3.48. Table 4-5 below shows the total OMR costs for each corridor option and network over the 60-year appraisal period. For the purposes of the SOC, BRT is used as an indicator for a rubber-wheeled solution, whilst LRT is used as an indicator for a steel-wheeled solution. Appendix N shows the build-up of these total OMR costs in terms of operation, maintenance and renewals.

4.3.49. For the network options the OMR costs of each of the constituent options have been combined. Although there may be some efficiencies to operating the four corridors as a network, the impact on overall operating costs is not likely to be substantial, in particular given the level of detail reflected in the cost estimates at this stage. For this reason, the two overground networks have the same OMR costs.

Table 4-5 – OMR costs (£m, nominal over 60-year appraisal period)

Option	Rubber-wheeled (BRT)	Steel-wheeled (LRT)
North Corridor		
NC04	3,604	4,936
NC08	817	2,825
NC08b	817	2,825
East Corridor		
EC01	4,490	5,306
EC04	5,433	6,225
EC08	591	2,023
Bristol – Bath Corridor		
BBC-C + BBC06 + A5	855	2,992
South-West Corridor		
SWC03	3,351	4,615
SWC05	675	2,297
SWC11	820	2,884
Networks		
Network 1	3,083	10,671
Network 2	3,083	10,671
Network 3	13,243	18,715

4.4 Operator Revenue

4.4.1. The farebox revenue generated by Mass Transit has been estimated using the spreadsheet catchment model described in the Economic Dimension and the EAR. The approach assumes the existing public transport fare structure applies to Mass Transit trips. It has been assumed that fares will grow in line with general inflation. As the demand is assumed to be the same across all technology types, it follows that the revenue is also unchanged by mode. It is noted that at the time of developing the SOC there are measures in place to incentivise bus travel, however there remains uncertainty over fares in the longer term. Changes to the assumed fare structure would impact on the potential commercial viability of the corridors / networks.

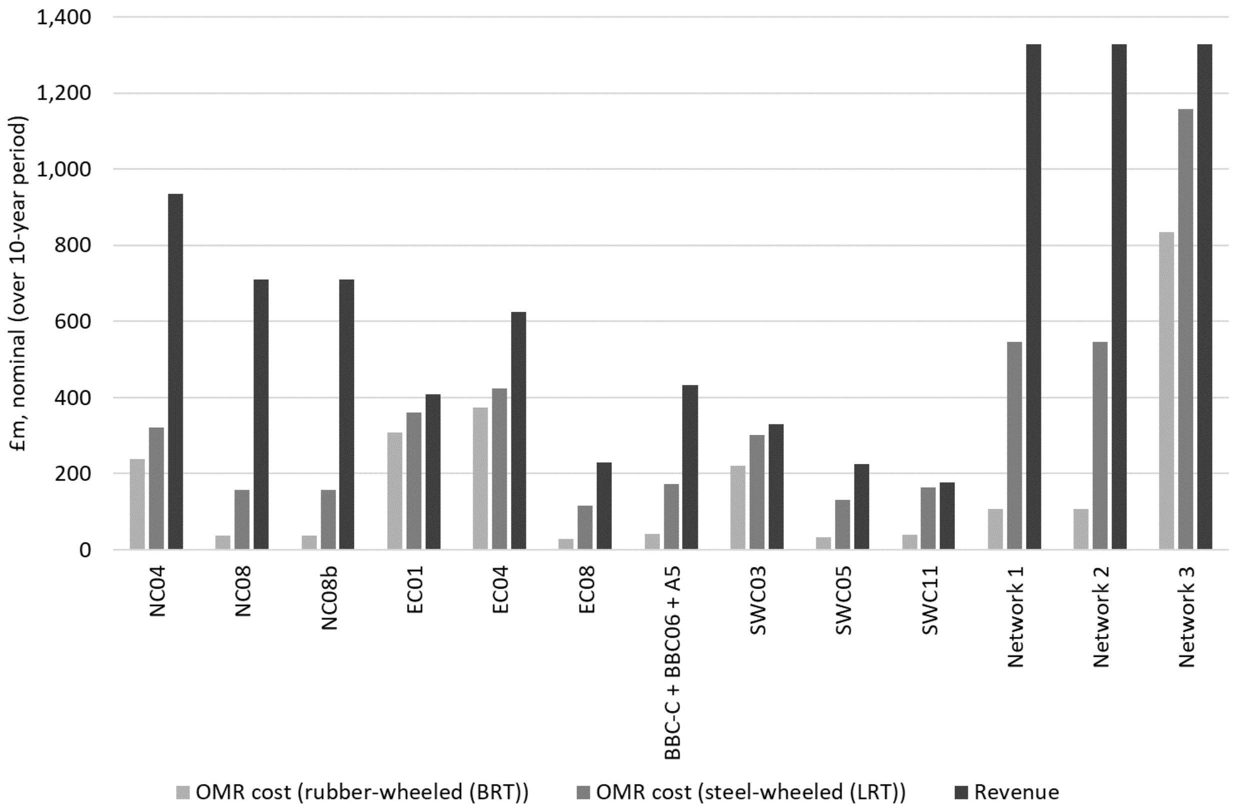
4.4.2. Table 4-6 shows the total farebox revenue generated by Mass Transit over the 60-year appraisal period. The revenue presented below is associated with the Mass Transit operation and does not include any impact on the wider public transport network.

Table 4-6 – Revenue (£m, nominal over 60-year appraisal period)

Option	Revenue over 60-year appraisal period (£m, nominal)
North Corridor	
NC04	11,307
NC08	8,568
NC08b	8,568
East Corridor	
EC01	4,926
EC04	7,553
EC08	2,761
Bristol – Bath Corridor	
BBC-C + BBC06 + A5	5,233
South-West Corridor	
SWC03	3,994
SWC05	2,713
SWC11	2,142
Networks	
Network 1	16,050
Network 2	16,045
Network 3	23,875

4.4.3. Comparing the operating costs and revenues provides an indication of the potential financial sustainability of the project once operational. Figure 4-1 shows a comparison of the OMR costs and revenue for each option over the first 10-years of scheme operation. It should be noted that at this stage of scheme development these have both been estimated proportionately. Although suitable for indicative purposes for the SOC, they are not based on detailed financial modelling and are subject to the simplifications and assumptions noted in this chapter and the Economic Dimension. Figure 4-1 shows that for options on the North and Bristol – Bath corridors and the network options the revenue generated could exceed the operating costs for both rubber and steel-wheeled solutions. For the East and South-West corridors the revenue generated exceeds the operating costs for some but not all options.

Figure 4-1 - Revenue and OMR cost comparison (over 10-year period)



4.5 Budgets and Funding Cover

4.5.1. At this early stage of scheme development there is not a clear position of how the Mass Transit system would be paid for and / or operated. The *Funding and Financing Strategy,* which includes examples of the funding and financing arrangements of other mass transit systems, states that it is likely that many of the funding and financing avenues that have been identified may be used for discrete elements of the programme but are unlikely to be able to deliver it in its entirety as there is no single pot of money and delivery solution that can deliver such a large, diverse, and technically complex programme.

4.5.2. This is particularly true for options involving significant tunnelled sections where the capital costs are considerably higher than the overground options. It will be necessary to consider all options, including grants from central Government, farebox revenue, s.106 / CIL contributions etc., and also considering the proposed development of local land and whether this will deliver housing or business parks etc., as well as local views on demand management measures that may inform different solutions, together with the potential for private sector investment / financing.

4.5.3. The approach to funding and financing will depend on a number of interlinked elements including, but not limited to:

- Phasing of the Mass Transit programme
- Modal solution identified
- Procurement route
- Availability of public finance
- Risk management
- Stakeholder and political environment
- Relationship with other infrastructure in the region

4.5.4. Table 4-7 below shows the funding and financing options that have been considered within the *Funding and Financing Strategy*; the strategy document should be referred to for more detail of the legal considerations and examples.

Table 4-7 – Funding and financing options appraisal

Funding or financing	Category	Description	Examples
Finance and funding	Grant	Variety of central Government funds that may be available to finance the delivery of the programme	Funding may be available from: ▪ DfT ▪ Department for Levelling Up, Homes and Communities ▪ National Highways
Finance	Public finance	Public sector loans are available from a number of sources with the key distinction from grants being that these are repayable	▪ UK Infrastructure Bank ▪ Public Works Loan Board ▪ Tax increment finance
Funding	Public sector funding streams	This category identifies potential routes to generate funding to meet the ongoing needs of the project	▪ Planning contributions (s106, CIL) ▪ Highways contributions (s38, s278) ▪ Workplace parking levy and other demand management solutions ▪ Use of existing assets ▪ Business rate supplement and retention ▪ Business improvement district, enterprise zones or

Funding or financing	Category	Description	Examples
			similar approaches to rate utilisation ▪ Road user charging and shadow tolling
Finance	Private finance	A variety of private sector investment options are relevant to be considered based on the overall financial model. This is particularly relevant where investors are keen to explore green investment which this scheme will support.	▪ Corporate finance ▪ Private borrowing ▪ Project finance (including demand / farebox revenue risk) ▪ Joint delivery with the private sector ▪ Next generation Public Finance Initiative ▪ Regulated asset base model ▪ Land value capture
Alternative	Partnership, alliancing and collaboration	There are other more collaborative models of delivery that may be available with stakeholders or other investors. These can be shaped to fit a project or any part of it depending on the interests of each party and their appetite for investment and risk.	Not applicable

4.6 Summary

4.6.1. There are significant costs associated with constructing and operating such a complex and extensive mass transit network, in particular for the capital costs for options requiring tunnelled sections. At this stage of scheme development there is not a clear position of how the Mass Transit system would be paid for and / or operated. The Funding and Financing Strategy identifies that it is likely that many of the funding and financing avenues may be required for discrete elements of the programme but are unlikely to be able to deliver it in its entirety as there is no single pot of money and delivery solution that can deliver such a large programme at one time. The Phasing Strategy, which is being developed to support the SOC, considers different ways in which the programme could be phased and delivered.

4.6.2. A comparison of high-level operating, maintenance and renewal costs and farebox revenue shows that for some corridors and networks the revenue generated could sustain the ongoing operation of the system. However, it is noted that these estimates are based on indicative operating cost estimates using benchmarks from similar schemes and revenue estimates from the catchment-based spreadsheet which is subject to the limitations discussed in the Economic Dimension.

4.6.3. As the programme develops, affordability and strategies for funding and financing will be considered in more detail as approaches to phasing are better understood, there is more detail of the options in terms of costs and revenues and the economic landscape becomes clearer in terms of potential inflation in the short to medium term.

5 Commercial Dimension

5.1 Introduction

5.1.1. This section outlines the approach taken to assess the feasibility and practicability of delivering the proposed Mass Transit programme.

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. The contents of this dimension are covered in Figure 5-1.

Figure 5-1 - Contents of the Commercial Dimension

- Output Based Specification: The requirement of the Mass Transit programme will be summarised in terms of outcomes and outputs
- Procurement Strategy: The procurement and purchasing options will be discussed – this includes the Routes to Market, Contracting Strategy and Contract Type
- Human Resources Issues: The personnel, people management and trade union implications for the Mass Transit programme will be discussed
- Summary: The Dimension will be summarised to bring it to a close

5.1.4. The Commercial Dimension is structured in line with the '*Transport Business Case: assessment and process procedures*' guidance from the DfT. It should be considered in conjunction with the *Phasing Strategy* and the *Funding and Financing Strategy*. The strategies are complementary, particularly with how the Combined Authority will align the procurement model to each phase or element of funding and financing.

5.1.5. The Construction Innovation Hub's *Value Toolkit* has been piloted on the Combined Authority Mass Transit programme as a framework for embedding value-based decision making in the development and delivery of the scheme. It has informed the scheme's outcome-based approach and supported the completion of a Client Profile, which begins to consider the optimum delivery model and ensure that appropriate risk allocation, pricing approaches and supporting payment mechanisms have been incorporated.

5.1.6. The toolkit has assisted in:

- Developing a coherent set of outcome statements to reflect the Combined Authority's approach to considering value through decision making. These outcome statements are mapped to the project's outputs in Table 5-1

- Once developed, prioritising and rationalising the outcome statements, which reflect both the Combined Authority and major stakeholders' aspirations towards value delivery, outlining how it approaches decision making in respect of the scheme
- Understanding what roles and responsibilities the Combined Authority can and will play in the Delivery Model for the programme
- Understanding of how to prioritise the carbon net zero, climate emergency, social value and other economic, environmental, and social decisions of each UA in respect of scheme designs, procurement and delivery

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, construction, and operational phases of the Mass Transit programme. At the OBC stage, this will be developed into a full specification with the programme developed under a variety of work packages.

5.2.2. The Mass Transit programme objectives were initially developed by the Combined Authority in 2019 in alignment with regional priority outcomes and policy aims. They have since been updated, with the process described in the *Objective Development Report*, and the objectives in the 2.8 of the Strategic Dimension.

5.2.3. Using the Value Toolkit, the objectives for the Mass Transit programme have been translated into a set of outcome statements that reflect the programmes value aspirations. The outcome statements outlined in Table 5-1 will drive decision-making throughout delivery of the Mass Transit programme. The themes between the objectives and the outcome statements are aligned in terms of what Mass Transit is seeking to achieve.

5.2.4. These outcome statements are differentiated by the phase in which they are expected to be achieved i.e. during the construction phase or once the Mass Transit programme has been commissioned and is in use. There is some minor duplication between outcomes statements arising during the design and construction phase. This is to be expected with metrics being developed to assess whether the outcome statements have been achieved across the different phases.

Table 5-1 – Output-based specification and desired scheme outcomes

Phase	Outputs	Outcome Statements
Design and Planning	▪ Detailed design for the Mass Transit 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	▪ Improve inter-urban connectivity ▪ Support sustainable economic growth ▪ Define an appropriate route hierarchy ▪ Deliver better environmental outcomes ▪ Incorporate the benefits of new technology to support efficient use of the network and enable behaviour change ▪ There is a high level of stakeholder engagement with the delivery team to support decision-making ▪ Maximise interim use of site for nature-based solutions during development
Construction	Construction of system wide infrastructure improvements and enhancements to facilitate the provision of a segregated Mass Transit system. Outputs may include: ▪ New stops and transport Hub Interchanges ▪ Depots and associated infrastructure ▪ Tunnels ▪ Overhead Line Equipment	▪ Increased community health and safety during construction ▪ Negative experiences of the project during delivery are minimised within the local area ▪ Provision of employment opportunities within the local region with a focus on people from disadvantaged and underrepresented backgrounds (BAME, gender, etc.) ▪ Provision of economic opportunities for local businesses (e.g. Small-to-Medium Enterprise's (SMEs) and Voluntary, Community and Social Enterprise (VCSEs) throughout construction ▪ Mass Transit drives increased investment in deprived local communities throughout construction ▪ Increases strength of relationships with local networks and supply chain

Phase	Outputs	Outcome Statements
	▪ Permanent Way infrastructure ▪ Utility diversions ▪ ITS installations and upgrades	▪ Supports economic growth by delivering operational income during construction programme ▪ Supports the development of new skills and levels of continuous learning within the region ▪ Asset with high use of recycled and renewable content in materials, products and systems ▪ Atmospheric air quality improves from existing site conditions during construction ▪ Mass Transit delivery achieves biodiversity net gain ▪ Low upfront carbon emissions during project delivery ▪ Low end of life carbon emissions ▪ A decreased risk of flooding from the existing site conditions as outlined in the Water Framework Directive ▪ The pace of build for Mass Transit is aligned with the industry standard benchmark ▪ Capital cost aligned with the industry standard benchmark ▪ Asset with high use of recycled and renewable content in materials, products and systems ▪ Maximise interim use of site for nature-based solutions during development ▪ An asset that is highly resilient to mitigate external threats and operational risks, which could impact during construction and in use
Operations and Maintenance Services	▪ New and enhanced public transport services within the West of England ▪ Vehicles ▪ Maintenance and operational staff ▪ Maintenance facilities – including vehicle	▪ Provision of employment opportunities within the local region with a focus on people from disadvantaged and underrepresented backgrounds (BAME, gender, etc.) ▪ Users feel secure when using the asset ▪ The solution provides a frequent, affordable and reliable service for all stakeholders across the network ▪ High levels of community satisfaction through a frequent and affordable public transport service

Phase	Outputs	Outcome Statements
	maintenance and staff welfare facilities	▪ An asset that is highly resilient to mitigate external threats and operational risks, which could impact during construction and in use ▪ Mass Transit drives increased investment in deprived local communities throughout use ▪ Connects the West of England region, thereby reducing deprivation ▪ Increases breadth and connectivity of local services across the network ▪ A transport system that provides integrated end-to-end journeys for users ▪ Increases strength of relationships with local networks and supply chain ▪ Mass Transit revenue payback period aligned with the industry standard benchmark. ▪ To improve reliability and frequency of services on the four corridors by prioritising public transport ▪ Atmospheric air quality improves from existing site conditions during use ▪ The solution minimises operational waste ▪ Improvement in health and wellbeing from design linking user with the surrounding natural environment (i.e. Biophylic design) ▪ Low operational carbon emissions during asset use. ▪ Mass Transit delivers modal shift from private car to public transport and active travel ▪ Mass Transit supports economic growth and return by making sustainable transport the preferred option for short to mid-distance journeys ▪ Supports the development of new skills and levels of continuous learning within the region ▪ Improve operation, resilience and reliability of the transport network

Programme Outputs

5.2.5. The Mass Transit programme will include the development of a transit system with one of the following technologies:

- Bus Rapid Transit
- Trackless Light Transit
- Light Rail Transit
- Very Light Rail

5.2.6. At the current stage, the project is mode-agnostic. This is to be considered in further detail as proposals are refined as part of the OBC. A large portion of the outputs of each technology type will be consistent at this stage, including the need for vehicles, stopping points, power sources and other infrastructure developments. These outputs will be driven by the need for each technology to follow the same high-level routes considered at this SOC stage. Details on the sifting process and how these modes were considered is covered under section 2.11.

5.3 Procurement Strategy

5.3.1. The proposed Mass Transit programme is a major, complex programme of works. It will be a significant undertaking in terms of strategic planning, preparation, resource requirements, design, procurement, construction delivery and operations. Due to the size and complexity of the Mass Transit programme, it is expected that the programme will be delivered with a phased approach – this is discussed further in the *Phasing Strategy*.

5.3.2. The Mass Transit programme will require a range of outsourced services to supplement the client organisation in its design, development, operation, and maintenance of the Mass Transit system. Individual work packages will likely include the following services:

- Programme management
- Business case development
- Planning/scheduling
- Risk management
- Cost management
- Design and systems integration
- Infrastructure and civil works
- Vehicles

5.3.3. These services can be clustered under three defined categories as below:

- **Design and preparation services** – services that support the Combined Authority in delivering the Mass Transit programme, including planning, design, business case development etc.
- **Construction (civil and infrastructure works)** – services required to construct both civil works and infrastructure enhancement and upgrades to support the Mass Transit

- **Operations and maintenance services** – provision of the Mass Transit service, including its operations and maintenance

Procurement Objectives

5.3.4. Table 5-2 provides a list of suggested procurement objectives relevant to the Combined Authority and the Mass Transit 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 – Mass Transit 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.

Procurement Approach

5.3.5. As noted previously, the services required to support the Combined Authority in delivering and implementing the Mass Transit system can be defined under the three categories:

- Design and preparation services
- Construction (civil and infrastructure works)
- Operations and maintenance services

5.3.6. Each category will require a specific procurement strategy that reflects the requirements associated with the provision of that service category and the risk/complexity involved.

5.3.7. The following sections outline a summary of each category of services and provide a high-level overview of the potential procurement route options available to the Combined Authority.

Design and Preparation Services

5.3.8. The Combined Authority have commissioned WSP to undertake the SOC stage of the Mass Transit programme. WSP were procured through the West of England Professional Services Framework (PSF) – a legally compliant OJEU framework.

5.3.9. The four-year framework commission is being delivered under an NEC4 Professional Services contract, which covers the Combined Authority, Bristol City Council, Bath and North East Somerset Council, North Somerset Council and South Gloucestershire Council. There are several different services available under the framework.

Construction (Civil & Infrastructure Works)

5.3.10. The Mass Transit programme will require the completion of a variety of civil and infrastructure works to ensure the appropriate infrastructure is in place in advance of the procurement of transport services. These works will potentially include the following activities:

- Carriageway widening and/or modification to accommodate the Mass Transit technology
- Associated tunnelling works
- Utility diversions
- Depot construction for stabling and maintaining vehicles
- Installation of technology routing (such as permanent way or other)
- Traffic signalisation
- Integrated Transport Systems to support the Mass Transit services including:
- Camera enforcement
- Traffic signals
- Real-time information signage
- On-street passenger information signage
- Enhanced stop information
- Transport hubs – including stops, stations, ticketing services and waiting areas

5.3.11. The procurement strategy for these services/assets will vary depending on the scope and package of the works being procured, the complexity of requirements, desired risk allocation between the Combined Authority and the supply chain and the overall funding/financing strategy. The Combined Authority will:

- Review the outcomes of each work package as it develops
- Review each work package against the criteria of complexity of requirements, risk allocation between the supply chain and the client, capability, and capacity of the client to deliver and manage the risks identified and use this analysis to select an appropriate procurement route
- Through desktop research and market engagement activities at the OBC stage, the Combined Authority will test its approach to risk allocation for the programme, the complexity of different work packages, procurement route and contracting model

- Establish the route to market and contracting strategy which most appropriately achieves the procurement objectives and addresses the key risks identified
- Manage the tender process
- Evaluate bid responses
- Award contracts based on a clear list of predefined criteria

Procurement Model Options

5.3.12. Table 5-3 outlines each of the public procurement model options that may be explored for Mass Transit work packages and the advantages and disadvantages of each type available. In terms of delivery planning, the interface between the Target Operating Model, Delivery Model and Client Model must be understood to inform the procurement model. Decisions made to inform each of these strategies or models, will have consequential impacts on the selection of an optimal procurement and contracting model because of the interdependence between all these models and strategies.

5.3.13. Considering that an incremental, phased, and programmatic approach will benefit the delivery of the Mass Transit programme and maximise the value of each investment, several public and private procurement models will be available to the Combined Authority.

5.3.14. At this stage, without a confirmed funding and financing strategy or the Target Operating Model, the procurement model options focus solely on the construction phase. While the private funded procurement model options will touch upon options for operations and maintenance, this will be looked at in greater detail at the OBC stage.

Table 5-3 – Mass Transit public procurement model options

Procurement Strategy	Advantages	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 lower a potentially reduced Client risk profile ▪ Stimulates innovation, reducing cost	▪ 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)

Procurement Strategy	Advantages	Disadvantages
	■ Price certainty can be obtained before commencement ■ Risks are identified and allocated during the procurement phase	■ 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
Construction Management The client appoints a design team and Construction Manager to oversee the delivery of the works. The works are then constructed	■ Time-saving due to overlap between design and construction ■ Contractors and trades can contribute to the design phase	■ 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

Procurement Strategy	Advantages	Disadvantages
by several different trade Contractors. The Construction Manager role is to manage, programme and coordinate the design and construction	▪ 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	▪ 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

5.3.15. While Table 5-3 considers the publicly funded options, Table 5-4 considers the advantages and disadvantages of private finance procurement model options.

Table 5-4 - Mass Transit privately funded procurement model options

Procurement Strategy	Advantages	Disadvantages
Public-Private Partnerships		
Public-Private Partnerships (PPP / PFI / DBO) A partnership between the public and private sector to deliver a project. This partnership may require private sector finance and involves a long term (25-30 year) contract which usually includes an element of operation or management. On occasion a single Contractor, perhaps a special purpose vehicle (SPV) funds, designs, constructs and operates an asset for a period.	▪ Infrastructure can be delivered at an initial low cost to the taxpayer ▪ The private sector assumes the risk of delivering and operating the asset ▪ Better value for money as a wider range of private sector skills can be utilised	▪ Can be a relatively expensive route compared to other options ▪ High tendering cost due to complexity of delivery vehicles and risk management ▪ The Contracting Authority is locked into a long-term contract, which rewards based on forecast usage only
Design, Build, Finance, Operate, Maintain (DBFOM) – transfer of all revenue risk [User-pays PPP] A partnership with the private sector where they design, build, finance, operate and maintain the asset under a long-term agreement. In this strategy, the PPP Contract transfers all revenue risks to the private sector. **These are also known as concession schemes**	▪ Contractor financed at their own risk ▪ The Contractor is responsible for design, construction, financing, operations, and maintenance ▪ The Contractor is responsible for all lifecycle costs ▪ Revenues can be used to fund the procurement of the infrastructure and its operations and maintenance ▪ User-pays PPP - Public Sector protected from the risk of lower than forecasted revenue returns	▪ Risk that revenue is over forecasted leading to operational funding issues for the private sector ▪ The private sector will factor in a premium to cover potential revenue risks, resulting in the client paying a premium for the risk ▪ The private sector will remain the economic owner of the asset during the life of the concession contract
Design, Build, Finance, Operate, Maintain (DBFOM) with limited or no transfer of revenue risk [Government-pays PPP]	▪ The Contractor is responsible for design, construction, financing, operations, and maintenance	▪ The public sector should factor in a contingency to cover potential revenue risks

Procurement Strategy	Advantages	Disadvantages
A partnership with the private sector where they design, build, finance, operate and maintain the asset under a long-term agreement. In this strategy, the PPP Contract retains all or most revenue risks with the public sector. **These are also known as a Private Finance (PFI) PPP**	▪ Contractor repays financing with government availability payments ▪ The Contractor is responsible for all lifecycle costs ▪ Options for government to contribute towards development costs through grant funding where forecasted revenues are unable to entirely fund the project	▪ Public sector charges the end-user for the use of the asset but is exposed to the risk that revenue is over forecasted
Design, Build, Finance, Maintain (DBFM) with separate arrangements for the operation of the system A partnership with the private sector where they design, build, finance and maintain the asset under a long-term agreement. In this strategy, the operations are carried out by a client organisation or a separate commission.	▪ Like a Design and Build contract the government is handed assets on completion ▪ Contractor finances at their own risk ▪ The Contractor is responsible for all maintenance costs throughout the asset's lifecycle ▪ Client control of operations ▪ Contractor payments are deferred until the commissioning stage and paid in fixed instalments over several years	▪ The private sector will factor in a premium to cover potential construction risks and deferred payment, resulting in the client paying a premium ▪ Financing is subject to construction risk only – no impact on performance risk. This may drive undesirable behaviours ▪ The Contractor may seek an increased pace of delivery over functionality and operational readiness
Design, Build, Operate, Maintain (DBOM) A partnership with the private sector where they design, build, operate and maintain the asset under a long-term agreement.	▪ The Contractor is paid against an agreed budget for their input enabling cost certainty ▪ Integrated Management Approach ▪ Public sector retains ownership ▪ Public sector finances and takes revenue risk	▪ Financed by public sector ▪ Risk of unexpected maintenance costs can only be transferred to the Contractor in a limited way ▪ The majority of maintenance risk sits with the public sector

Procurement Strategy	Advantages	Disadvantages
	▪ Maintenance work can be pre-contracted and paid by the public sector at an agreed price	▪ The Contractor may seek to reduce quality during construction to generate lower costs and increased margins

5.3.16. The preferred delivery model will vary depending on several factors, including the key programme governance decisions around the Target Operating Model, Delivery Model and the Client Model, as well as the type of technology, package being delivered, and the funding and financing strategy.

5.4 Route To Market Options

5.4.1. The size and complexity of the Mass Transit scheme 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 procurement exercise under the Public Contract Regulations 2020 to create a new framework to deliver the outputs of the Mass Transit 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
- A procurement exercise using existing frameworks to access pre-qualified contractors to deliver the scheme

5.4.2. The Combined Authority will consider how the operations and maintenance elements of the work are procured, particularly where a private funding mechanism is chosen.

5.4.3. The advantages and disadvantages of each of these routes are covered in Table 5-5.

Table 5-5 – Advantages and disadvantages of the routes to market available for the Mass Transit

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
A Combined Authority Mass Transit 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	▪ The Combined Authority will need to develop the scope and pipeline of works early in the programme to allow a contractor to tender competitively

Route to Market	Advantages	Disadvantages
	together to define the scope	
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 Contract Strategy

Contracting Model

5.5.1. 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.

5.5.2. 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.

5.5.3. A list of the available contracting models is seen in Table 5-6. 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 proposed Target Operating Model for the asset and the proposed delivery model for its development. The contracting model for the operations and maintenance phase can be selected once the Target Operating Model is known.

Table 5-6 – 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

Model and features	Advantage	Disadvantages	Considerations
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
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.	▪ 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.

Model and features	Advantage	Disadvantages	Considerations
▪ **Complexity or frontier in scale and in scope** ▪ **Client unable to manage and/or carry delivery risk**			▪ 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

5.5.4. 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 *Institution of Civil Engineers (ICE) Conditions of Contract*, which since August 2011 has been rebadged as the *Infrastructure Conditions of Contract* (ICC). 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

5.5.5. 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.

5.5.6. 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.

5.5.7. 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

5.5.8. The NEC suite of contracts is broken down into three areas Works, Service and Supply. For the Mass Transit programme, only the Works contracts are considered due to the design services being commissioned separately. Table 5-7 outlines the suite of NEC Works Contracts (with their associated abbreviation) and guidance on when to use each.

Table 5-7 – Types of NEC Works Contracts[70]

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.

[70] Adapted from NEC4 Establishing a procurement and Contract Strategy – Volume 1

NEC Works Contract	Abbreviation of the NEC Works Contract	When to use it
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.

5.5.9. 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 5-8.

Table 5-8 – NEC ECC Main Options[71]

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.

[71] Adapted from NEC4 Establishing a procurement and Contract Strategy – Volume 1

Main Option	When to use it
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.
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)

5.5.10. 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 5-9.

Table 5-9 – 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 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.

5.5.11. 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.

5.5.12. 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.

5.5.13. 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.

Bespoke Contract Form

5.5.14. Where there is a public-private partnership involved, it is likely that a bespoke and specific contract will be required as the main form of contract between the funder and contracting authority. This contract will underpin the terms of the private finance deal and terms which underpin the procurement model discussed in Table 5-4.

5.5.15. Once the main contract is in place, the contracting authority will likely be able to consider using either an NEC or ICC standard forms of contracts for the works and services within the supply chain.

5.6 Procurement Strategy Summary

5.6.1. At this stage, all options remain open to the Combined Authority from a procurement model, route to market, contracting model and contract type perspective. The drivers that support the Combined Authority make these decisions include:

- Defining the Target Operating Model for the Mass Transit asset pre-commencement of the OBC
- Undertaking a delivery model assessment building on the output of the Client Approach workstream of the Value Toolkit pre-commencement of the OBC
- Considering the most optimal Client Model for the Combined Authority to deliver the Mass Transit programme pre-commencement of the OBC

5.6.2. By undertaking these assessments, the Combined Authority will better understand the key governance and delivery planning constraints which will be placed on the procurement model.

5.6.3. The preferred model for each element of the Mass Transit programme will be considered in line with packaging, and a funding and financing strategy as key drivers for each package. The Combined Authority is unlikely to be able to complete one single procurement for all elements of the Mass Transit programme. Therefore, with a Target Operating Model, Delivery Model and Client Model, a considered approach will be needed to ensure the Mass Transit programme achieves value for money and the other procurement objectives of the programme.

5.6.4. The composition of each procurement package will determine the level of risk allocation between the Combined Authority and the supply chain and the complexity of each package's requirements.

5.6.5. The contracting model will depend on many factors, which will include the route to market, packaging strategy and the funding and financing strategy. With four technology types remaining and the details of the packaging to be determined, the optimal contracting model will be confirmed as part of the OBC.

5.7 Human Resource Issues

5.7.1. No significant human resources issues have been identified that could affect the deliverability of the scheme. No TUPE issues are expected.

5.7.2. More information on the governance and management of the project, including details of the people involved, is set out in the Management Dimension.

5.8 Summary of the Commercial Dimension

5.8.1. The Commercial Dimension acknowledges that all options remain valid for the procurement model, route to market, contracting model and contract type.

5.8.2. Before the commencement of the OBC, the Combined Authority expects to undertake the following tasks which are key to informing the procurement model:

- Define the Target Operating Model for the Mass Transit programme
- Undertake a Delivery Model Assessment building on the output of the Client Approach workstream of the Value Toolkit
- Consider the most optimal Client Model to deliver the Mass Transit programme

6 Management Dimension

6.1 Introduction

6.1.1. This dimension considers 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. It demonstrates the way in which the Mass Transit 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.

6.1.3. This dimension is structured in line with '*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 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 Evidence of Similar Projects

6.2.1. The delivery of the Mass Transit scheme is expected to build upon experience gained on several major schemes delivered by the Combined Authority and UAs. A selection thereof has been 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 to the Mass Transit scheme. Where possible, the lessons learned from these projects and programmes will be applied to the delivery of the Mass Transit scheme.

6.2.2. The proposed scheme is a major, complex programme of works. It 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. This has been discussed in the *Phasing Strategy*.

Table 6-1 - Evidence of similar projects

Contract	Scheme Description	Works Date	Approximate Value	Project Delivered Successfully
MetroWest	MetroWest is a Nationally Significant Infrastructure Project to transform rail services in Bristol and the surrounding West of England region. Following a successful decision on the Development Consent Order, MetroWest is reopening two lines and up to seven new stations between 2021 and 2026 to increase new rail journeys and frequency of services through central Bristol.	2021 - 2026	£200m	Ongoing
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 includes: ▪ 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	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 bus-way, new bus lanes and priority measures, new or improved stops and interchanges and parallel walking and cycling routes.	2014 - 2017	£63m	Complete
Metrobus – Cribbs Patchway Extension	The scheme aims to improve the public transport network by providing an alternative, fast and direct bus route between Parkway Station and The Mall at Cribbs Causeway. It will benefit communities in Stoke Gifford, Patchway and the forthcoming Cribbs Patchway New Neighbourhood on the former Filton Airfield. Metrobuses will travel in both directions along the route from Bristol Parkway Station via Hatchet Road, Gipsy Patch Lane, through the Horizon 38 Business Park site, across the A38, through	2019 - 2023	£57m	Ongoing

Contract	Scheme Description	Works Date	Approximate Value	Project Delivered Successfully
	the Cribbs Patchway New Neighbourhood site, San Andreas roundabout on Hayes Way, Highwood Road to The Mall bus station.			
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.	2015 - 2016	£48m	Complete
Bath Transportation Package	Significant upgrades of Bath's transport network has been taking place since 2012. The improvements, which include increased Park & Ride capacity, improving bus routes, improving traffic flows and creating a safer experience for pedestrians aim to tackle traffic congestion, improve air quality, and provide the infrastructure needed to support new homes and jobs for local people. The projects have been funded through a combination of Council and DfT investment.	2012-2015	£27m	Complete
Bristol Temple Meads Regeneration	Regeneration programme to transform Bristol Temple Meads station and its railway with new station accesses, new railway tracks and signalling in and around Bristol to increase network capacity and prepare for MetroWest's new services and stations.	2020-2023	£24m	Ongoing
Portway P&R Rail Station	BCC is delivering the sub-region's first new rail station since 1996. As a third party funded station, BCC set out the case for the project and secured the support of Network Rail and Great Western Railway. Funded by the Combined Authority, the DfT and BCC, the £5m project is delivering a single platform alongside the existing Park & Ride site which will form a new station on the Severn Beach line. Working in partnership with Network Rail and Great Western Railway, construction is now 75% complete. The construction programme has had to manage rail line blockades, interfaces with the operational P&R site and management of construction traffic including pre-fabricated concrete platform sections (126m). The project involves several interfacing elements such as the delivery of customer-focused infrastructure and station facilities within the car park, with a range of contractors. The station will be served by existing trains which have required re-timetabling by the operator to ensure capacity to call at the station.	2022	£5m	Ongoing

6.3 Governance, Organisational Structure and Roles

6.3.1. Appropriate levels of governance are critical to the successful delivery of the programme. Defining a clear governance structure with evident lines of communication will ensure decisions are made proactively for the benefit of the project.

6.3.2. In defining the governance, organisation structure and roles for the Mass Transit scheme, the Combined Authority are using *the Infrastructure and Project Authorities Routemap* to support the development of a Target Operating Model, which in turn informs the selection of an optimal Delivery Model, Client Model, and ultimate procurement strategy.

6.3.3. The use of Routemap supports the Combined Authority in taking a structured and robust approach to determining the best delivery approach for the scheme; it accounts for lessons learned from other major infrastructure projects, such as the construction of the Elizabeth Line, HS2 and Thames Tideway.

Delivery Model

6.3.4. A detailed delivery model assessment will be completed prior to the submission of an OBC, in line with the *Government Commercial Functions Delivery Model Assessment Guidance* note published in May 2021. This assessment will use an evidence-based and structured methodology to assess which service delivery model offers best value for money and will inform the development of the governance structure as the programme evolves.

Existing Governance Structure

6.3.5. The organisational and governance structure in Figure 6-1 shows the proposed lines of accountability and responsibility for the Mass Transit scheme, based on the existing operation of the Combined Authority. This reflects the Combined Authority's constitution and aligns to the organisation's approach to governance on major projects/programmes.

6.3.6. At the heart of the programme's governance framework will be the Programme Steering Group (currently Infrastructure Directors), which is accountable through the Combined Authority. This body is ultimately responsible for decision making and ensuring the programme is aligned to wider organisational aims and other concurrent projects and programmes.

6.3.7. As more detail on the relationship, procurement and interface with the supply chain is agreed, the Combined Authority will assess and validate their governance structure to reflect their chosen Delivery Model, Client Model and Procurement Model for the programme.

6.3.8. A Senior Responsible Officer (SRO) will be appointed who will be accountable to the Portfolio Review Meeting and will be responsible for the work of the Programme Steering Committee. Figure 6-1 also shows the role the Local Enterprise Partnership and stakeholders play in the governance structure. Table 6-2 and Table 6-3 outline the responsibilities of each party within the governance structure.

Figure 6-1 - Governance structure

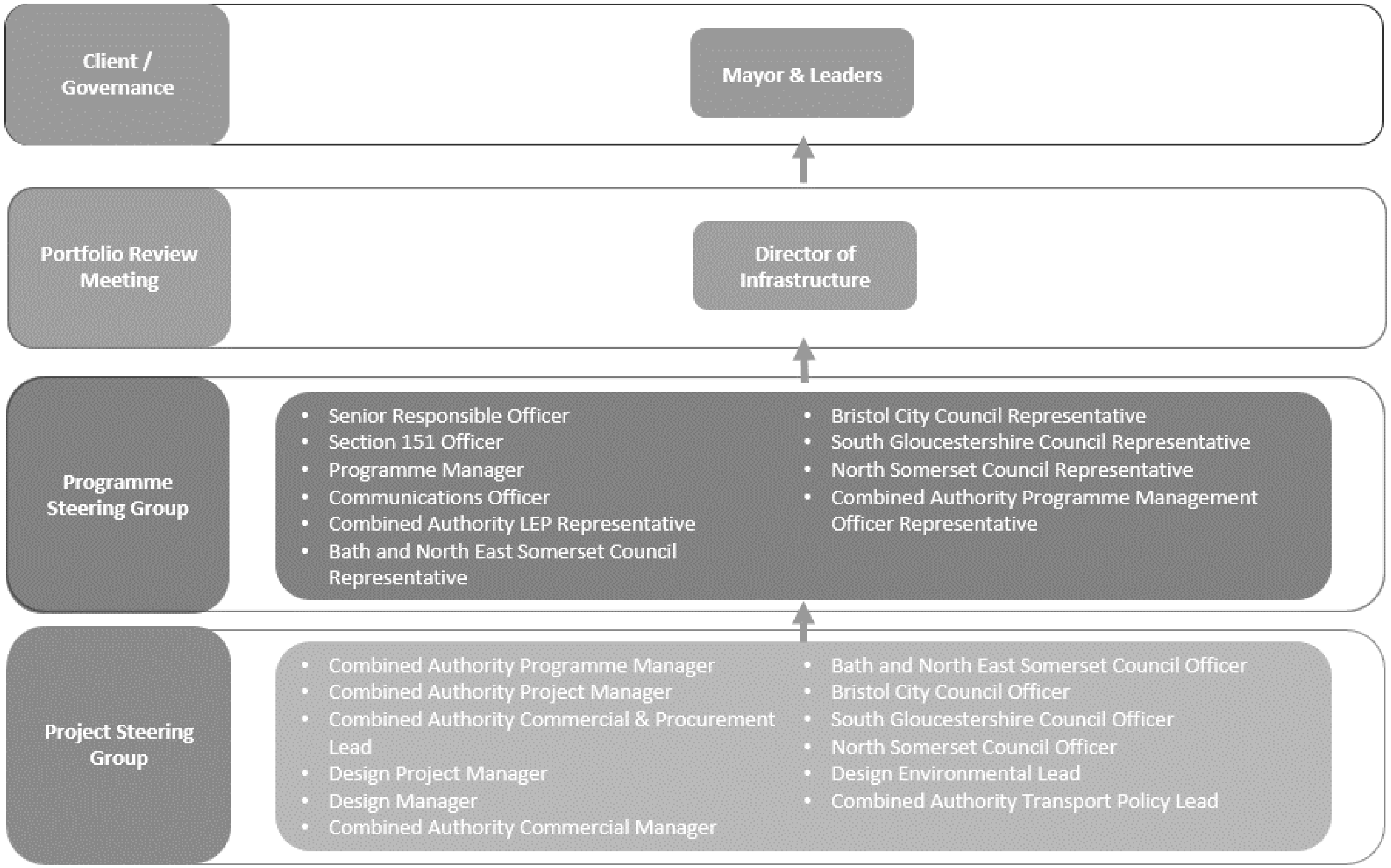


Table 6-2 – Key committees and boards within Mass Transit's governance structure

Committees and Boards	Responsibilities
Mayor and Leaders	Accountable for overall programme oversight, assurance, risk and approval of funding and benefits realisation
Portfolio Review Meeting	Chaired by the Director of Infrastructure and is accountable for escalation and oversight of the Mass Transit programme outcomes and legislative or policy decisions, new entries to portfolio, portfolio level benefits and funding decisions i.e. allocations, use of headroom.
Programme Steering Group	▪ The Programme Steering Group comprises the SRO and the Programme Manager from the Combined Authority, along with Directors from the Combined Authority and the UAs. 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
Project Steering Group	The Project Steering Group comprises the work stream leads and project managers from the Combined Authority, the UAs and design partner. This group will meet on a weekly basis and seeks to resolve issues between the various work streams and reporting and escalating matters to Programme Steering Group for key decisions. Some members of this Steering Group overlap with the Programme Steering Group to support efficient communication of information. The key tasks for the Project Steering Group are to: ▪ Prepare, review, and maintain the programme strategy documents ▪ Review programme schedule and obtain updates on outstanding actions

Committees and Boards	Responsibilities
	■ Review upcoming milestones ■ Resolve escalated issues / bottlenecks from Work Stream Groups; and recommend position statements ■ Ongoing management of the programme, team and scheme ■ Progressing technical designs in line with the agreed scope ■ Negotiating with key stakeholders and partners where the scheme impacts upon their assets and incorporating any feedback ■ Managing risk in line with an approved Risk Management Plan ■ Monthly progress reporting to the Programme Steering Group

Table 6-3 – Key roles within the Mass Transit governance structure

Key Roles	Responsibilities
Senior Responsible Owner	An SRO will be appointed, and a sponsor team established to support the SRO and represent the sponsoring organisation. They will primarily be accountable for the delivery of the Mass Transit scheme. 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 Mass Transit project team with leadership, decisions, and direction
Section 151 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.

Key Roles	Responsibilities
	▪ 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.

Future Governance Structure

6.3.10. Consideration of the optimal Client Model and funding and financing strategy will inform elements of the future governance structure for the Mass Transit programme. It is assumed that the existing governance structure will adapt to meet the needs of the programme during the OBC stage – including a Mass Transit Board.

6.3.11. The *Phasing Strategy* acknowledges that the Mass Transit programme will likely be delivered as a series of individual work packages. The programme's governance structure will need to reflect this. An overarching governance structure to manage the programme will result in additional governance at a work package or project level. A similar approach was taken by the Combined Authority on the MetroWest programme.

6.4 Assurance

6.4.1. The Mass Transit programme will follow the *Combined Authority's Assurance Framework*. The framework[72] sets out arrangements adopted by the Combined Authority in relation to:

- Governance and 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)
- A supporting appendix sets out the approach to assessing value for money (Appendix 6)

6.4.2. The Seven Principles of Public Life (the Nolan principles) underpin the Assurance Framework. In addition, the Mass Transit programme will follow applicable assurance and approval processes at both a national and local level.

6.4.3. In line with the Assurance Framework, the Combined Authority will monitor the programme through the Programme Steering Group. The Combined Authority Committee releases funding, where appropriate, based upon the completion of milestones to desired quality and cost.

6.4.4. Where funding is sought from Central Government, it would be ensured that the programme adhered to and aligned with relevant assurance requirements including the HM Treasury Green Book and any specific departmental specific guidance (i.e., DfT Transport Business Cases guidance, TAG, and Strength in numbers: the DfT analytical assurance framework[73]).

[72] West of England Investment Fund Assurance Framework, West of England Combined Authority, June 2018
[73] Strength in numbers: the DfT analytical assurance framework, Department for Transport, January 2022

Combined Authority Assurance Framework

6.4.5. 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.

6.4.6. 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 Mass Transit investment will be managed in accordance with the usual local authority checks and balances, including the financial duties and rules which require local authorities to act prudently in spending.

Unitary Authority Assurance

6.4.7. In addition to the Combined Authority's assurance processes, the programme will comply with the assurance requirements of the UAs. This will see each dimension of the business case reviewed by each authority as the programme progresses. The programme schedule will include sufficient durations, where needed, to allow the UAs to undertake these reviews.

Gateway Reviews

6.4.8. It is essential that large, complex, and long running programmes are monitored effectively. All major transport schemes must demonstrate that a system for monitoring progress is part of the management structure and plan. A gateway review process is a formal assessment of the progress of a project at key stages in its development. A gateway review process assesses 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.

6.4.9. At the OBC stage, the Combined Authority will confirm how a gateway review will feed down from the programme to individual projects to ensure each phase of work meets the overarching aims of the programme.

6.5 Programme Reporting

6.5.1. The scheme will be delivered in line with the Combined Authority's existing effective programme and project management procedures. The Programme Manager 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 programme.

6.5.2. As the *Phasing Strategy* develops, the drumbeat for the reporting for each project will be clarified. However, reporting will be a live process, which will be kept up to date over the lifecycle of the programme.

6.5.3. This reporting relates to progress, risks, and issues and will involve the following regular actions:

- The Programme 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 Mayor and Leaders, which has executive powers. Reports to Cabinet will be prepared if Mayor and Leaders consider these necessary to resolve a specific delivery matter. The SRO will provide regular updates to the responsible Cabinet Member(s). This ensures appropriate involvement of the elected members in this important project.
- The Programme 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.

6.5.4. Underpinning this reporting is the programme's delegation of authority. The change control process will ensure the Programme Manager can efficiently manage changes in scope, plan or budget while ensuring the Steering Group has sufficient oversight.

6.6 Programme Scope, Dependencies and Constraints

6.6.1. The scope of the Mass Transit scheme includes the planning, design, construction, operations and maintenance and the project management of a new mass transit scheme.

6.6.2. A single, preferred mass transit technology has yet to be decided, however, it is expected that it will require the creation of a new transport network, the design of new infrastructure and depot facilities. The programme is also expected to involve significant utility diversionary works, environmental mitigation work and wider active travel works.

6.6.3. Section 1.7 provides further detail of the scope of the scheme.

Programme Dependencies

6.6.4. Currently, there are two key themes of dependency apparent for the Mass Transit programme. Firstly, there are the statutory processes and secondly the interface with other projects/programmes within the region. Given the scale of the proposed Mass Transit network, dependencies will emerge, and the programme will capture and review these going forward. The Combined Authority maintains a *Dependency Register*, which is fed into by the UAs and is updated as the programme enters a new phase or at a minimum every six months.

6.6.5. Section 2.4 of the Strategic Dimension discusses the key programme interdependencies in more detail.

Programme Constraints

6.6.6. The programme constraints have been explored at length within the Constraints Register (contained within the OAR and outlined in section 2.11 of the Strategic Dimension. The key themes include:

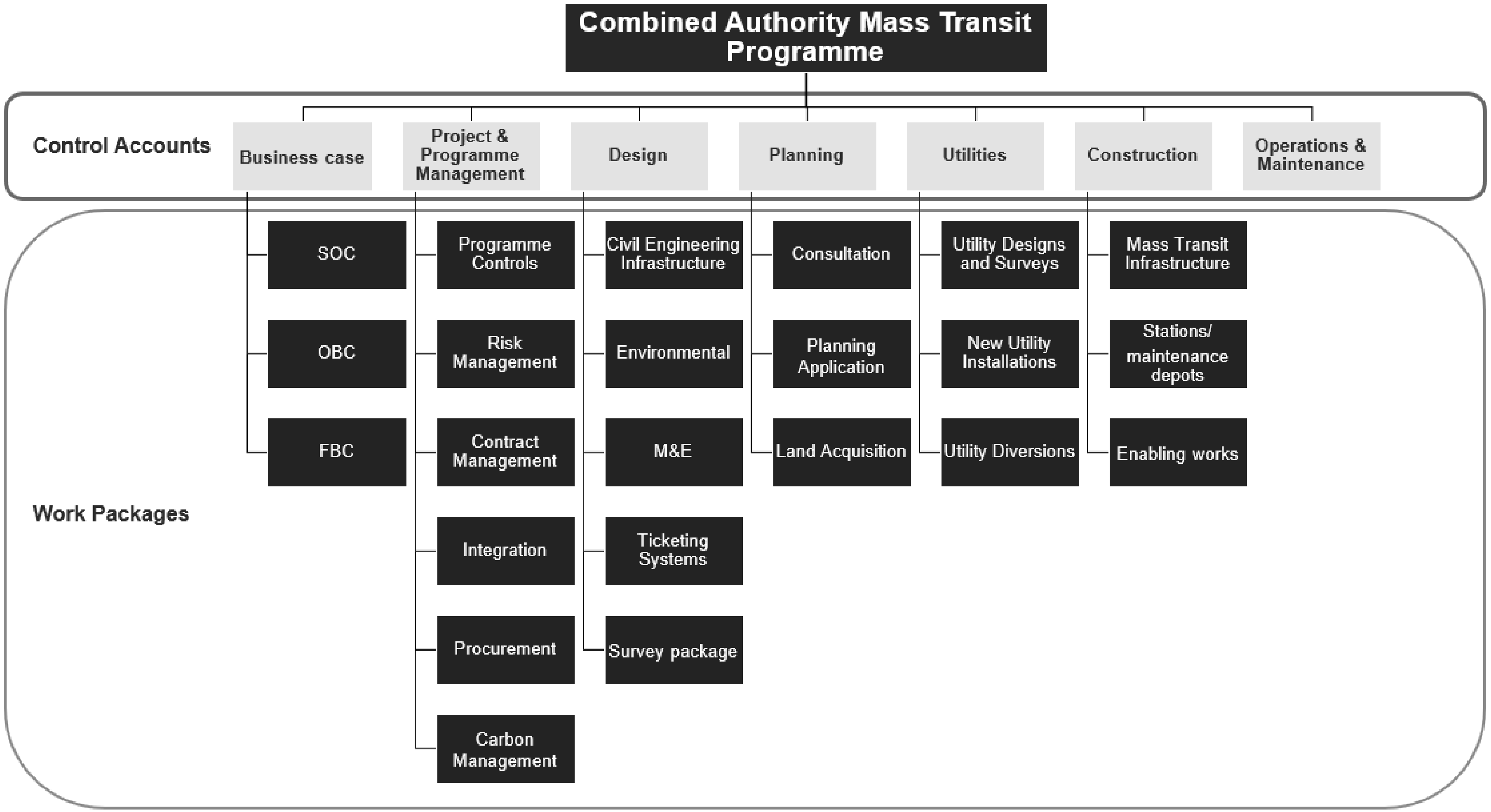
- Environmental
- Land
- Funding and financing
- Utilities
- Construction constraints – including space and existing asset constraints
- Legislation and legal constraints

6.6.7. The Constraints Register will continue to capture and assess the impact of the constraints on the delivery of the Mass Transit programme. Moving forward, designs and technology options will continue to be assessed against the constraints to ensure their feasibility.

6.7 Programme Implementation

6.7.1. The Mass Transit programme is broken down into a Work Breakdown Structure (WBS) outlined in Figure 6-2. This WBS will be developed further at the OBC stage. While this SOC reflects the Mass Transit programme, the *Phasing Strategy* and outcomes of the SOC will further refine this WBS, particularly the construction level work breakdown.

Figure 6-2 - Work Breakdown Structure



6.8 Programme Plan

6.8.1. As the programme develops, the programme plan will reflect the complex work breakdown structure seen in Figure 6-2. A detailed business case, procurement, enabling works and main construction works plan will be developed during the OBC stage.

6.8.2. The *Phasing Strategy* currently outlines several approaches to the delivery of Mass Transit. A key point is that the programme is expected to be phased. This will result in elements of the programme having different schedules. Once a baseline plan is in place, progress will be reported to the Programme Board.

6.8.3. One of the key strengths of this approach is that lessons learned across the work packages will be picked up and integrated with later phases.

6.9 Carbon Management Strategy

6.9.1. The carbon management standard PAS2080[74] 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".

6.9.2. The purpose of the carbon management process is to manage and reduce the GHG (carbon) emissions over the course of the project lifecycle. This can be achieved through taking actions that maximise whole-life emission reduction impacts (e.g. modal-shift) and minimising impacts that increase emissions (e.g. embodied carbon). These actions must be informed by carbon assessments that provide an understanding of the whole-life carbon impact.

6.9.3. As made clear in PAS2080 and acknowledged in the DfT's *Carbon Management Guidance* (November 2021), having a carbon management system in place is essential to deliver whole-life carbon emissions reduction. 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.

6.9.4. A *Carbon Management Strategy* has been prepared as part of the SOC. This supports the development and implementation of a carbon management process within the programme which promotes low carbon infrastructure planning and delivery.

6.9.5. This strategy sets out:

[74] PAS 2080 – Carbon management in infrastructure in 2016 (revision in 2022), British Standards Institute, 2016

- 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 Mass Transit programme

6.9.6. A Carbon Management Plan will build on the *Carbon Management Strategy* and will be developed post SOC submission in alignment with the principles of the following guidance:

- PAS2080 (2022)[75]
- DfT Carbon Management Guidance – Management Case (November 2021)[76]
- Institute of Environmental Management & Assessment Delivering Quality Development (2016)[77]
- Construction Playbook (2020)[78]
- Transport Analysis Guidance: Unit A3 environmental impact appraisal (2022)[79]

Carbon Management Strategy and Policy

6.9.7. The Combined Authority's carbon management objectives for the Mass Transit programme are as follows:

- To reduce carbon emissions during maintenance and operations of the assets
- 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

6.9.8. In addition, the Strategic Dimension highlights specific carbon related measures of success for the programme. The particular focus is to reduce overall carbon emissions in the region. The measures of success for this are captured in section 2.10 of the Strategic Dimension.

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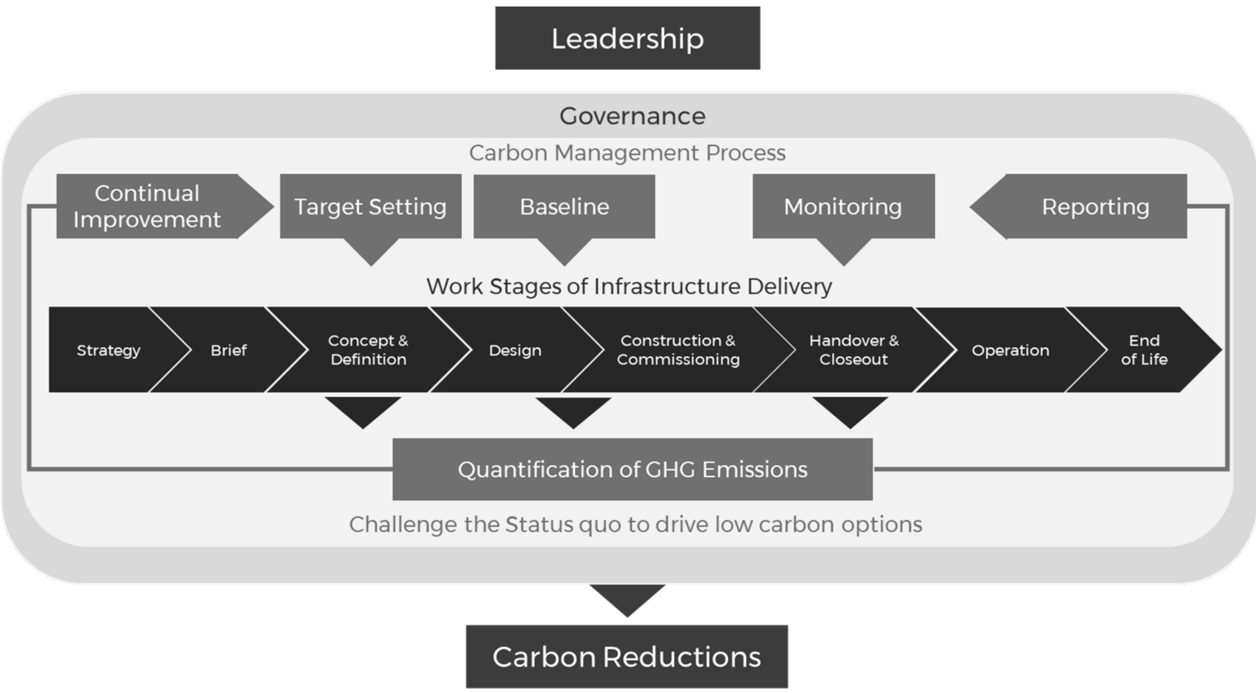
[75] PAS 2080 – Carbon management in infrastructure in 2016 (revision in 2022), British Standards Institute, 2016
[76] Carbon Management Guidance – Management Case, DfT, 2021
[77] Environmental Impact Assessment Guide to, Institute of Environmental Management & Assessment Delivering Quality Development, 2016
[78] The Construction Playbook, Cabinet Office, 2020
[79] TAG unit A3 environmental impact appraisal, DfT, 2022

Carbon Management Process

6.9.9. The Combined Authority will implement a PAS2080 carbon management process for the Mass Transit programme, 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 outline the frequency, methodology and process for measuring, quantifying, and reporting on the management of carbon throughout infrastructure planning and delivery.

6.9.10. 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 6-3 - PAS2080 Carbon Management Process



6.9.11. Table 6-4 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 6-4 - Carbon Management Process (Developed from PAS 2080:2016 guidance)

Activity	Description
Baseline and target setting	Setting 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.

Activity	Description
Monitoring	Robust monitoring will be completed at frequent intervals during infrastructure delivery to highlight progress of carbon reductions against set targets.
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 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

6.9.12. 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

6.9.13. 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.

6.9.14. The entire value chain for the Mass Transit programme will be required to complete carbon management training as outlined in Table 6-5.

Table 6-5 - 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

6.9.15. 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.

6.9.16. NEC Contracts 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.

Carbon Management Governance

Roles, Responsibilities and Accountabilities

6.9.17. The *Carbon Management Strategy* acknowledges that all members of the programme have a responsibility to support its delivery. In line with best practice, each UA and the Combined Authority will appoint a Carbon Coordinator.

6.9.18. In addition to the Carbon Coordinators and in line with PAS 2080, 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

6.9.19. The complete value chain will be required to undergo a PAS 2080 verification of supply chain exercise and the supply chain will be required to demonstrate PAS 2080 verification to ensure all those involved in the planning and delivery of the Mass Transit programme are compliant with the standard and that carbon management underpins the delivery of the asset or programme of work.

6.9.20. PAS 2080 defines the roles and responsibilities of the various parties involved in the carbon management process as outlined in Table 6-6.

Table 6-6 - Carbon Management Process roles and responsibilities (Developed from PAS 2080:2016 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
Mass Transit asset owner	■ In addition to roles and responsibilities outlined for all value chain members, the ultimate Mass Transit 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

Party	Roles and responsibilities
	▪ 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
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

6.9.21. 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.

6.9.22. The Programme Manager will be responsible for the project meeting its carbon management objectives, delivering the projected target carbon reduction outcomes.

6.9.23. The full value chain will be responsible for delivery of the required carbon emission reductions throughout the planning and delivery of the Mass Transit programme. 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 Mass Transit programme.

6.9.24. The Combined Authority will embed the carbon management process within the programme through the Carbon Coordinator and Programme Steering Group. This includes considering the appropriate forum for raising and discussing progress against the carbon management strategy.

Document Management

6.9.25. A *Carbon Management Strategy* has been developed as part of the SOC. Going forwards this document will be updated and maintained as circumstances of the Mass Transit scheme and its carbon management evolve. The strategy will further mature into a Carbon Management Plan.

6.9.26. A carbon management actions/opportunities log will be established and 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’.

6.10 Stakeholder and Communications

6.10.1. An engagement strategy that identifies stakeholders, describes the communication objectives and activities required to achieve them has been developed for the programme. This highlights the stakeholder engagement activities, key messaging, frequency of engagement and communication methods to be used when engaging with these groups regarding the proposed scheme.

6.10.2. Engagement has taken place on the programme with the aim of introducing the scheme with key stakeholder groups throughout the region. The outcomes of this engagement have fed into the SOC to support the development of the benefits and the optioneering exercise.

6.10.3. As of Autumn 2022, the Combined Authority has drafted a *Communications and Engagement Plan* to outline the engagement approach that will be taken with stakeholders and the community on future transport plans for the region, including the Mass Transit scheme. The Plan has been developed to ensure all actions are clear, thereby enabling meaningful engagement as the scheme progresses towards OBC.

6.10.4. This includes:

- An analysis of the strengths, weaknesses, opportunities and threats as related to engagement on the Mass Transit scheme
- An engagement approach for key stakeholders, tailored to specific stakeholder needs
- The mapping of different stakeholder groups, as well as a full list of stakeholders
- Tactics for the successful engagement of different stakeholder groups
- A breakdown of expected content and material to ensure effective engagement

6.10.5. It is expected that this Engagement Plan will be agreed and further developed as the scheme, and other external influences including Local Plan development, progress.

6.11 Risk and Issue Management

6.11.1. 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 the impact if they did. The Director Board'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.

6.11.2. 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 that 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.

6.11.3. 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.

6.11.4. Risk and issue management processes happen in conjunction to support the Programme and Project Steering Groups identify potential issues to the project while managing those issues that transpire.

Risk Management Process

6.11.5. Risk management is seen as a key process underpinning good programme governance and the achievement of scheme objectives in a cost-effective manner. During the SOC stage, programme risk assessments have been undertaken using the three-stage process, enabling the population of a risk register (see Appendix O. This three-stage process includes:

- Risk identification
- Risk quantification
- Risk management through response planning and risk mitigation

Risk Identification

6.11.6. 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 risks
- Risk to impact on the existing highway network

Delivery Environment and Complexity Analytic

6.11.7. The Delivery Environment and Complexity Analytic (DECA) is a tool created by the National Audit Office (NAO) in 2013 to help identify strategic risks associated with a project or programme.

6.11.8. The DECA considers several strategic factors which will give insight to some of the key challenges, complexities and risks that could be encountered. These factors include considering events which could impact the scheme achieving its benefits, the stakeholders and strategic outcomes.

6.11.9. During the SOC, the DECA was used to support risk identification exercises. The outputs of the DECA fed the programme strategic risk register which is updated on a regular basis by the Project Steering Group. A snapshot of the key DECA strategic risks and their risk ratings are captured in Table 6-7. To note, the risks with similar themes have been merged as part of the programme strategic risk register to reduce the number of risks, where possible.

Table 6-7 – DECA strategic risks

Risk No	Risk Description	Impact	Risk Rating
1	There may be a breakdown in collaboration between the Combined Authority and Unitary Authority partners involved in the development and delivery of the Mass Transit programme	Difficulty getting agreement and sign off on decisions throughout the governance framework	High
2	The Combined Authority may be unable to scale or develop the internal skills required to develop and deliver the Mass Transit programme.	Inefficiencies throughout the programme resulting in cost and time delays –	High

		which ultimately reduce the benefits being realised	
3	The Combined Authority may not evolve sufficiently from a governance perspective to deliver Mass Transit and allow it to sufficiently meet the outcomes and benefits of the intervention	Inefficiencies throughout the programme resulting in cost and time delays – which ultimately reduce the benefits being realised	High
4	The Combined Authority and the Unitary Authority partners may not have the capability and capacity to deliver a project of the complexity of Mass Transit	Inefficiencies throughout the programme resulting in cost and time delays – which ultimately reduce the benefits being realised	High
5	The Combined Authority may not sufficiently capture the needs/wants of key stakeholders that influence Mass Transit. This includes the key stakeholders and the ways in which they should be engaged on key decisions	Reduced confidence of the public in the Combined Authority's ability to deliver transformational schemes in the region	High
6	The environment in which the Mass Transit is delivering – economic, political, geopolitical – could change overtime resulting in uncertainties in areas difficult for the Combined Authority to control.	Inefficiencies throughout the programme resulting in cost and time delays – which ultimately reduce the benefits being realised	High
7	There is risk around communications with key local politicians	There may be reduced confidence from key stakeholders that the Combined Authority can deliver schemes which meet their needs in the region	High
8	Delays in the Mass Transit programme delivery may see underlying economic growth in the region missed due to the need of mass transit to unlock that underlying growth.	Reduction in the overall benefits of the Mass Transit programme	Medium
9	Developing untested options may introduce novel testing and operating requirements which the Combined Authority don't have the capability to undertake.	Prolonged or delayed commissioning of the scheme which may drive up the costs of the Mass Transit programme and reduce the confidence of the public in the Combined Authority's ability to deliver schemes	Medium

6.11.10. At this stage, a proportionate approach has been taken to the identification of corridor-level risks. The strategic risk register documents corridor-specific risks that may impact the overall delivery of the scheme. Constructability risks are documented in the Constraints Register (*appended to the OAR*), and were taken into account during the shortlisting process. Together these will form the basis of corridor-specific risk registers, which will be developed as design detail emerges as part of the OBC.

6.11.11. In addition to the list of threats seen in Table 6-7, there are key opportunities that the Mass Transit scheme could support realisation of. The Combined Authority has started to identify some of these key opportunities which could include:

- A review of the bus network could result greater public transport coverage in the region as supported services may not need to serve Mass Transit corridors and therefore could serve areas that currently have fewer bus routes
- There is an opportunity to locate new housing and development sites across the region along Mass Transit routes so that they are well served by public transport
- There are opportunities to align and minimise enabling and construction works disruption across the Mass Transit programme through integration with other projects and programmes planning to be delivered
- The Combined Authority and UAs have an opportunity to use Mass Transit routes to locate transport hubs and enhance the benefits of Mass Transit

6.11.12. Similarly to the management of risks, a number of approaches will be taken to manage these opportunities in line with best practice[80], including:

- 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

6.11.13. Opportunities will be explored further during the OBC.

Risk Quantification

6.11.14. During the assessment of the risks at the SOC stage, the identified risks are 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.

6.11.15. As the programme develops, this qualitative assessment will also translate 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 QRA to produce a risk-adjusted cost estimate. At the OBC stage a programme QRA methodology will be developed to allow a prediction of an ‘expected’ risk value for the programme. This will inform the OBC’s risk

[80] Hillson, D. (2001). Effective strategies for exploiting opportunities. Paper presented at Project Management Institute Annual Seminars & Symposium, Nashville, TN. Newtown Square, PA: Project Management Institute

adjusted cost estimate value. As detailed in the Financial Dimension, at this SOC stage the risk cost has been assumed as percentage uplift on the base costs.

Response Plans and Mitigation

6.11.16. Following the initial assessment of the programme risks, a systematic approach was adopted to respond to risks and allocate responsibility to the most appropriate party in line with the governance arrangements. One of the following four strategies was, and will continue to be, adopted for each risk 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

6.11.17. Following the implementation of these strategies, if a risk 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.

Issue Management Process

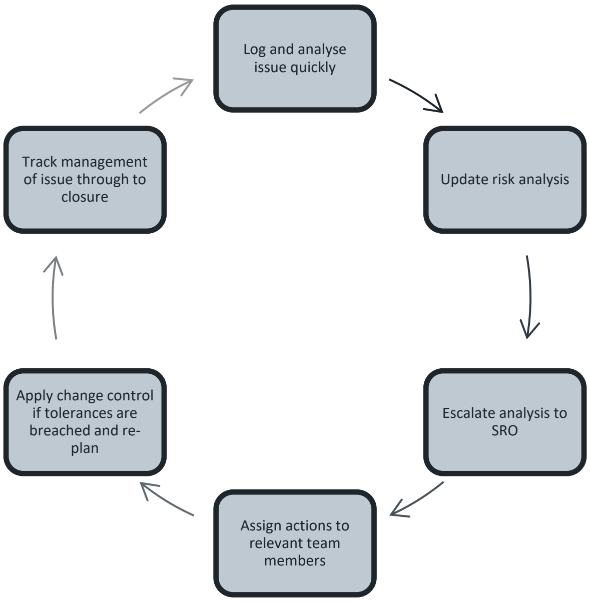
6.11.18. Issue management relates to the exceedance of agree tolerances for delegated work and requires regular and ongoing support from an SRO to resolve identified issues. Issues can relate to scope, quality, time, cost, or benefits and usually result in an actual or expected impact on the programme.

6.11.19. 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

6.11.20. Figure 6-4 outlines the key aspects of issue resolution as defined by the Association of Project Management. This process will be adopted by the Mass Transit programme as best practice in issue management and resolution.

Figure 6-4 - Issue Management Process



6.11.21. 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.

6.12 Lessons Learned Management

6.12.1. Lessons management is a key element of a 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 successes or failures is therefore paramount to the programme’s delivery.

6.12.2. Lessons should be captured, understood, and communicated to the wider project team to inform delivery based on current or previous experience. For the proposed programme, the development and implementation of a robust lessons management strategy will ensure that both positive and negative project experiences are shared, and appropriate responses are embedded within the scheme’s delivery.

6.12.3. The Combined Authority will establish a lessons management register and communication plan at the outset of the OBC. From this, the Programme Manager will be responsible for ensuring lessons are captured and communicated to the wider project team on a regular basis.

6.13 Benefits Management

6.13.1. The Strategic Dimension identifies the measures of success associated with each programme objective. These measures of success are captured in section 2.10.

6.13.2. A *Benefits Realisation Plan* will be prepared as part of the OBC. 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.

6.14 Data And Information Security

UK General Data Protection Regulation (UK GDPR)

6.14.1. *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.

6.14.2. 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.

6.14.3. The UK GDPR sets out seven key principles, which will guide the scheme's approach to processing personal data. These are outlined below in the context of actions the Mass Transit programme 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 Mass Transit programme will not ask for, retain, or give out more Personal Data than is required for a specified purpose
- Accuracy – The Mass Transit programme will ensure Personal Data is up to date and accurate
- Storage limitation – The Mass Transit programme 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 Mass Transit programme will ensure appropriate access controls, confidentiality, and IT security for Personal Data
- Accountability – The Mass Transit programme will appoint an individual to take responsibility for UK GDPR compliance

6.14.4. The Mass Transit scheme will adopt a 'data protection by design and default' approach as recommended by the UK Information Commissioner's Office. This will include its approach when adopting a level 2 BIM approach in line with PAS 1192-2 and PAS1192-3[81] 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.

6.15 Benefits Management and Evaluation

6.15.1. Robust monitoring and evaluation are key elements of the overall appraisal process. Therefore, the Mass Transit scheme will be subject to a monitoring and evaluation process in accordance with the Assurance Framework to identify the extent to which it has met the objectives and the anticipated outcomes.

6.15.2. A *Monitoring and Evaluation Plan* will be submitted for approval to the Combined Authority Grant Assurance Team as part of the OBC or before any data collection is programmed. This will ensure that the benefits realised can be understood, disseminated, and lessons taken forward into other schemes. This plan will outline how the programme and phases evaluate whether the objectives and outcomes have been met. This includes ensuring the key elements of the Equality Impact Assessment Strategy have been captured and the Mass Transit scheme complies with all elements of it.

6.15.3. A theory of change diagram is included within Appendix F, which maps the causal linkages and chains between objective, inputs, outputs, and outcomes with the anticipated impacts and how they will be measured captured in section 2.10.

6.16 Project Closure

6.16.1. Following completion of the delivery phase activities, the Combined Authority will commence the administrative closure of this element of the Mass Transit scheme. This will include the following steps for each project under the Mass Transit scheme:

- Completion of a delivery close out report, which includes a summary of the delivery phase and evidence that the programme 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 Mass Transit asset
- Register of outstanding or residual risks/issues that will transition into the operational phase of the Mass Transit system

[81] PAS1192-2 and PAS1192-3, British Standards institute, 2013/2014

- Stakeholder feedback and lessons learned will be captured and disseminated in line with the lessons management strategy outlined previously

6.16.2. A robust document archiving exercise will also be completed to ensure that programme documentation is available to the Mass Transit operations phase as required.

6.17 Summary

6.17.1. While the Combined Authority has delivered several high profile, multifaceted projects and programmes, the Mass Transit scheme will be a significant and complex undertaking. In response to this, the *Phasing Strategy* starts to consider the best possible approach to de-risking and reducing the complexity of delivering the programme of works.

6.17.2. An appropriate governance structure is essential to the delivery of the scheme. The Combined Authority will build on the existing working groups to formalise a Programme and Project Steering Group, which will be accountable to the Mayor and Leaders. This aligns with best practice programme management guidance and the constitution of the Combined Authority. However, it is acknowledged that the governance structure for the programme is likely to change as the Delivery Model, Client Model and Procurement Model evolve. The primary function of the governance framework will be to continue to support the Mass Transit programme deliver the programme.

6.17.3. The programme is expected to be taken forward in project phases. As a result, a staggered schedule for delivery is anticipated. The schedule will remain a live document, with progress being monitored monthly by the Programme Manager and the Programme Steering Group.

6.17.4. A *Carbon Management Strategy* has been prepared to support the development and implementation of a carbon management process on the Mass Transit programme. This strategy outlines how the programme will track and reduce emissions, govern the carbon management process, train and upskill personnel on legislation and finally ensure the programme complies with standards such as PAS2080. This Strategy will form the basis of the more detailed Carbon Management Plan as the programme develops.

6.17.5. Early stakeholder engagement has been undertaken to raise awareness and build support for the Mass Transit programme. The Combined Authority has drafted a Stakeholder and Engagement Plan and will continue to engage and consult with stakeholders going forwards. The programme constraints and dependencies are discussed in detail in the strategic dimension.

6.17.6. Risk, opportunity and issue management processes will follow best practice guidance throughout the programme lifecycle. A DECA has been conducted, which identifies the key challenges and threats to the 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 Programme Manager track and monitor the programme cost and schedule against the baseline.

6.17.7. 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*.

Appendix A

Transport Data

Walking Routes

- W01 Bath 1
- W02 Bath 2
- W03 Keynsham 1
- W04 Keynsham 2
- W05 Somer Valley 1
- W06 Somer Valley 2
- W07 Clifton Village and Whiteladies Road
- W08 Shirehampton
- W09 Westbury-on-Trym, Henleaze and Southmead
- W10 Gloucester Road
- W11 Knowle and Totterdown
- W12 Fishponds and Church Road
- W13 Bedminster and Southville
- W14 Hartcliffe and Hengrove Park
- W15 Clevedon 1
- W16 Clevedon 2
- W17 Yatton
- W18 Nailsea 1
- W19 Nailsea 2
- W20 Portishead
- W21 Weston-super-Mare 1
- W22 Weston-super-Mare 2
- W23 Bristol North Fringe
- W24 Bristol East Fringe 1
- W25 Bristol East Fringe 2
- W26 Yate and Chipping Sodbury
- W27 Thornbury

Cycling Routes

- C01 Bath 1
- C02 Bath 2
- C03 Bath 3
- C04 Keynsham
- C05 Somer Valley
- C06 Bristol 1
- C07 Bristol 2
- C08 Bristol 3
- C09 Bristol 4
- C10 Bristol 5
- C11 Bristol 6
- C12 Clevedon
- C13 Nailsea 1

- C14 Nailsea 2
- C15 Portishead
- C16 Weston-super-Mare 1
- C17 Weston-super-Mare 2
- C18 Weston-super-Mare 3
- C19 Bristol North Fringe 1
- C20 Bristol North Fringe 2
- C21 Bristol East Fringe
- C22 Yate and Chipping Sodbury 1
- C23 Yate and Chipping Sodbury 2
- C24 Thornbury

Traffic Flows

The following tables show traffic flows for each road within the study area, taken from the DfT traffic count website for the year 2019. Numbers highlighted red show the highest flows in each local authority area for both buses and coaches, and for all motor vehicles.

B&NES

Road name	Start Junction / Road	End Junction / Road	Buses and Coaches	All Motor Vehicles
A4	A4174/A4175	B3116	159	27,504
A4	B3116	A39	272	23,432
A4	A3604	A367	582	14,221
A4	A367	Broad St	51	7151
A4	A39	A36	340	27,141
A37	A362	A39	107	15,766
A431	Penn Hill Rd, Bath	LA boundary	54	7633
A4	A363	LA Boundary	120	10,689
A4	A431	A3604	675	21,881
A4	A3039	A36	276	18,110
A37	LA boundary	A362	73	14,622
A4174	A4	LA boundary	60	40,071
A4	LA boundary	A4174	275	35,095
A4	Northgate St	Saracen St	70	5,074
A4	A36	A4 principal	340	16,043
A4	Old Newbridge Hill	A431	377	17,808
A431	A4	Penn Hill Rd	83	7,510
A37	Staunton Lane	LA Boundary	101	17,806
A4	A46	A363	104	23,932

City of Bristol

Road name	Start Junction / Road	End Junction / Road	Buses and Coaches	All Motor Vehicles
A38	Parson St	A370 roundabout	399	10,515
A403	Kings Road Avenue	Unclassified Road	20	10,846
A420	Midland Rd	Trinity Rd	463	13,292
A4018	A38	A4176	801	22,998
A4174	Hartcliffe Way roundabout	A37	110	20,479
A3029	Bedminster Down Rd	Bedminster Rd	266	23,137
A420	Trinity Rd	Easton Way roundabout	525	18,341
A4	A3029	Hotwells Rd	365	17,958
A4018	A4162	A4162	219	17,468
A4	A37	A4320	484	23,011
A4	A4162	A4176	205	23,959
A3029	A38	A3029 Ashton Road/Winterstoke Underpass	44	23,849
A370	A3029/B3120	A38 roundabout	28	15,991
A420	A431	A4017	221	9,909
A432	A4320	B4469	323	9,448
A37	LA boundary	A4174	100	13,218
A4320	Lawrence Hill roundabout	A432	93	39,340
A4	Water Lane	A4174	419	26,320
M32	Junction 2 M32	LA Boundary	547	84,898
A3029	A4	A370	752	60,593
A37	A4174	B3122	281	15,789
A38	St James Barton	Muller Road	449	11,824
A38	A4044	A370	919	18,758
A420	A4320	B4467	465	19,898
A4018	A4176	B4056 Henleaze Rd	430	17,818
A4162	A4	Canford Rd	90	5,870
A4176	A4	A4018	85	18,321
A4174	A37	A4	86	17,235
A4017	A420	LA Boundary	50	5,401
A420	Clarence Rd	Stapleton Rd	403	11,827
A432	A420	A4320	353	5,708
A432	B4469	A4174	115	10,105
A4	A3029	A4 split	391	19,557
A4162	Canford Lane	A4018	16	8,131
A4	Emery Rd	LA Boundary	275	35,095
A4	A4176 Bridge Valley road	A3029 Brunel Way	250	35,320
A4044	A420	A4032	933	40,979

Road name	Start Junction / Road	End Junction / Road	Buses and Coaches	All Motor Vehicles
A38	Kings Head Lane roundabout	Bedminster Rd	182	11,686
A432	B4469	B4469	322	32,516
A3029	A4174	A38	135	17,109
A38	Bedminster Down Rd	A4174	180	20,177
A4	A370	A37	782	36,067
A37	B3122	A4	253	15,988
A4044	A38	A4/B4053 roundabout	591	8,923
A420	B4467	A431	322	18,149
A420	Old Market St	Stapleton Rd	426	9,438
A4018	A4176	A4162	61	14,379
A4320	A432	A4032/M32	101	37,737
A4	A4044	A370	1535	39,187
A3029	A3029 Brunel Way	A3029 Merchants Road	17	4,544
M32	A4320	2	804	82,895
A4	Merchants Rd	A38/A4108	536	15,356
A4044	A4/B4053 roundabout	A420	594	36,370
A4044	A4032	A38	1278	39,750
A4032	A4044	M32	789	51,994
A38	Bedminster Rd	A3029	130	16,007
A420	A4017	LA Boundary	232	11,899
A3029	A3029 Brunel Lock Road/McAdam Way	A4 midpoint	459	57,516
A4162	Canford Rd	A4018	156	5,915
A431	LA Boundary	A420	210	21,378
A432	A4017	LA Boundary	124	11,675
A4174	A432	LA Boundary	36	9,559
A38	Muller Rd	LA Boundary	156	17,931
A4018	A4162	LA Boundary	143	21,593
A369	A370/A3029 midpoint	LA Boundary	92	11,332
A370	LA Boundary	A369/A3029 midpoint	481	36,186
A38	LA Boundary	Cemetery roundabout	157	11,456
A370	A38	A4	120	9,756
A370	A38	A4	36	15,772
A420	A4044	A420 split	942	17,943
A38	A3029	A38 West street	186	20,430
A4	A4 Eagle Road	A4 Bristol Hill	190	15,052
A4	A4 Bath Road	A4 Bristol Hill	187	17,136
A3029	A369/A370 midpoint	A3029 Winterstoke Road	210	10,810
A3029	A369/A370 midpoint	A3029 Winterstoke Road	14	5,570
A370	A3029 Brunel Road	A370	30	22,360
A4032	M32	A4320	158	10,399

Road name	Start Junction / Road	End Junction / Road	Buses and Coaches	All Motor Vehicles
M32	A4032	A4230	631	41,595
M32	3	A4320	643	66,316
A4320	A4032	M32	161	16,579
A38	A4018	A38 Colston Avenue roundabout	1200	29,937
A38	A38 Colston Street roundabout	A38 St Johns Bridge	2699	16,325
A38	A38 St Johns Bridge	A4440	1718	18,295
A3029	A3029 Brunel Way	A3029 Merchants Road	248	2,433
A3029	A3029 Brunel Lock Road/McAdam Way	A4 Merchants Road	36	1,796
A4	A4 under Bristol Gate	A3029	74	7,351
A4	A4174	Emery Rd	277	35,446
A3029	A370	A369	640	67,506
A4	A4162	A403	202	21,903
A4	A4162	A403	214	23,299
A4174	B3130 Barrow Lane	LA Boundary	94	12,490
A4320	A4	A420	179	32,808
A4	A4320	Eagle Rd	361	25,639

North Somerset

Road name	Start Junction / Road	End Junction / Road	Buses and Coaches	All Motor Vehicles
A370	B3133 Smallways	Chelvey Rd, Backwell	171	15,082
A38	A371 Sidcot Lane	A38 Star	40	10,574
A369	B3124 Bristol Road	End of road	10	14,503
A38	Winscombe Hill	A371 Sidcot Lane	71	13,587
A370	Station Road Backwell	B3130	147	13,708
A38	LA Boundary	A368	41	12,645
A370	M5 j21	B3133	133	17,246
A3033	A370 Windwhistle Road	A370	59	14,123
A369	B3129	LA Boundary	92	11,332
A370	A3033 Devonshire Road	Carlton Street	59	11,700
A38	A368	B3130	81	16,036
A369	M5 J 19	B3129	111	18,036
A370	A370 Francis Fox Road	Walliscote Road	310	15,369
A370	A370 Beach Road	Walliscote Road	267	5,330
A370	A370 Beach Road	Walliscote Road	58	6,223
A370	Carlton street	Oxford St	94	5,659
A370	LA Boundary	Bleadon Hill	75	19,742
A370	A370 Station Road	B3440	268	16,428
A370	A370 Francis Fox Road	A3033	165	22,874
A370	Chelvey Rd	Station Road	145	13,470

A370	Bleadon Hill	A3033	100	18,134
A4174	B3130 Barrow Street	LA Boundary	71	22,278
A38	B3130 Barrow Lane	LA Boundary	260	20,416
A38	B3130 Barrow Lane	LA Boundary	157	11,456
A4174	B3130 Barrow Lane	LA Boundary	100	17,568
A370	B3130 Barrow Street	LA Boundary	125	17,120
A370	B3130 Barrow Street	LA Boundary	232	29,153
A370	A3033 Drove Road	A371	227	39,321
A370	A371 Locking Moor Road	M5 J 21	67	35,135

South Gloucestershire

Road name	Start Junction / Road	End Junction / Road	Buses and Coaches	All Motor Vehicles
A38	Old Aust Rd	B4427	148	22,703
A432	LA Boundary	A4017	124	11,675
A4175	B4465	A4017	144	8,894
A4174	LA Boundary	Cleeve Wood Road	36	9,559
A38	A4174	B4057	293	37,517
A46	M4	A420	18	12,197
A431	A4175	A4175	38	14,760
A4174	M32	Bromley Heath Roundabout	255	58,283
A420	A4175	A4175	149	10,525
A420	A46(T)	LA Boundary	25	7,477
A38	B4427	B4061	100	21,434
A403	B4055	M48	21	9,441
A4017	Cheltenham Road	B4465	135	11,573
A4017	A420	Cheltenham Road	56	6,214
A38	B4057	M5/Aztec West	199	32,316
A46	A432	A433	16	9,211
A420	A4175	Bath Road	21	13,454
A431	A4174	LA Boundary	210	21,378
A4174	A38	M32	227	36,505
A4175	A4175 Station Road Link	B4465 Broad St	89	11,098
A4174	Cleeve Wood Road	A32	96	13,059
A38	LA Boundary	A4174	156	17,931
A46	Sands Hill	M4 J18	73	29,783
A4017	B4465	A432	61	10,133
A4174	A4174	Cleeve Hill	56	14,239
A4175	A431	A420	82	9,494
A420	Bath Road	A46(T)	29	12,219
A432	B4060 Horse St, Chipping Sodbury	A46	37	10,719
A433	A46	LA Boundary	23	4,356

Road name	Start Junction / Road	End Junction / Road	Buses and Coaches	All Motor Vehicles
A4175	LA boundary	A431	97	15,949
A432	A4017	A4017	237	16,030
A46	LA boundary	A420	62	21,886
A431	LA boundary	A4175	54	7,633
A4017	LA Boundary	A4017 merge	50	5,401
M32	LA Boundary	1	409	79,187
A403	Unclassified Road	B4064	14	9,466
A38	B4509	LA Boundary	36	8,555
A46	A433	LA Boundary	7	5,020
A4174	Station Road Link	B4465	37	44,114
A4174	Station Road Link	A420	37	44,645
A4175	A4175 Station Rd	A4174 Avon Ring Rd	24	18,005
A4174	Emersons Way roundabout	B4465	146	33,937
A403	LA Boundary	Central Avenue	20	10,846
A38	M5	Old Aust Rd	140	22,574
A432	A4174	Station Rd	67	15,747
A432	Station Rd	Church Rd	111	13,629
A432	roundabout leading to Woodward Avenue	B4060	154	18,524
A432	B4060 Station Rd	B4060 Horse St	72	11,849
A420	A4017	A4174	229	14,185
A420	A4017	A4174	109	7,735
A470	A4017	A4174	53	6,942
A4018	LA Boundary	M5	355	34,147
A38	B4061	B4509	14	6,847
A420	LA Boundary	A4017	232	11,899
A4174	A4174	A432	156	37,095
A4174	A432	Emersons Way roundabout	178	41,437
A4174	A4174 spur	A420	167	50,694
A4174	A4	A4174 spur	60	40,071
A420	A4175	A4175	154	17,383
A432	Church Rd, Coalpit Heath	roundabout leading to Woodward Avenue, Yate	153	17,597
A432	A4017	A4174	148	10,171
M32	1	M4 (19)	362	84,107
A431	A4175	A4174	117	13,999
A4174	A431	A4174	21	11,915

Vehicle Delay and Speeds

The following table shows the average delay (flow-weighted) on locally managed 'A' roads in England, by local authority and road name: annual averages from 2017 (DfT).

Local Authority	Road Name	Average delay (spvpm)[1,2,3,4,5]		
		2017	2018	2019 [6]
Bath and North East Somerset	A3039	269.9	176.6	246.1
	A3062	74.6	74.7	69.9
	A36	82.7	115.3	81.2
	A362	38.3	37.2	35.5
	A363	17.5	21.5	16.2
	A367	34.5	36.5	31.2
	A368	17.7	19.0	17.2
	A37	23.9	26.7	21.7
	A39	28.1	32.7	22.7
	A4	42.3	47.8	36.7
	A4175	40.0	33.8	33.2
	A431	26.0	26.7	24.7
Bristol, City of	A3029	58.2	66.3	62.9
	A369	57.9	77.7	57.2
	A37	125.9	138.6	117.4
	A370	117.2	130.2	78.6
	A38	117.7	119.3	105.5
	A4	54.2	56.4	50.9
	A4018	90.1	96.3	87.3
	A403	52.0	53.7	57.1
	A4044	210.5	248.0	223.5
	A4162	49.5	60.1	55.7
	A4174	87.3	89.8	95.8
	A4176	73.5	75.7	69.4
	A420	101.5	112.5	99.5
	A431	50.6	58.1	53.8
	A432	130.6	142.5	137.5
	A4320	84.7	87.8	74.2
North Somerset	A3033	56.5	52.6	50.3
	A368	28.9	27.4	28.6
	A369	30.2	31.8	27.7
	A370	27.6	25.1	23.3
	A371	39.9	39.6	36.9
	A38	21.6	18.1	19.6
	A4174	..	34.2	..

Local Authority	Road Name	Average delay (spvpm)[1,2,3,4,5]		
		2017	2018	2019 [6]
South Gloucestershire	A38	40.2	39.0	37.4
	A4017	79.9	97.2	78.2
	A4018	41.5	44.5	37.5
	A403	15.6	20.4	21.6
	A4174	52.4	47.4	43.4
	A4175	28.9	43.4	28.2
	A420	30.4	36.3	32.1
	A431	54.9	53.1	48.7
	A432	36.2	33.1	32.5
	A433	13.1	16.7	15.7
	A46	16.3	15.1	14.1
	A470	..	..	109.8
AVG DELAY				59.74

The following table shows the average vehicle speeds (flow-weighted) on locally managed 'A' roads in England, by local authority and road name: annual averages from 2017 (mph) (DfT)

Local Authority	Road Name	2017	2018	2019 [5]
Bath and North East Somerset	A3039	7.5	9.7	7.7
	A3062	16.9	16.7	17.1
	A36	15.8	13.9	16.0
	A362	23.8	23.5	23.6
	A363	36.2	33.9	36.3
	A367	26.6	25.7	27.3
	A368	32.8	31.9	32.3
	A37	30.1	29.3	30.2
	A39	27.4	26.7	29.5
	A4	25.9	24.5	26.5
	A4175	26.0	27.1	25.9
	A431	25.7	25.7	26.0
Bristol	A3029	21.4	19.7	17.7
	A369	20.8	18.6	20.6
	A37	13.2	12.6	13.4
	A370	13.3	12.7	16.0
	A38	12.9	12.8	13.1
	A4	23.0	22.5	22.9
	A4018	15.1	14.6	15.1
	A403	23.6	23.3	22.5
	A4044	10.3	9.1	10.1
	A4162	20.4	19.4	19.8

Local Authority	Road Name	2017	2018	2019 [5]
	A4174	17.1	17.0	15.1
	A4176	16.8	16.6	16.9
	A420	13.9	13.0	13.5
	A431	19.2	18.2	18.6
	A432	12.6	11.9	11.8
	A4320	18.5	18.2	18.5
North Somerset	A3033	18.9	19.3	19.2
	A368	27.8	27.8	27.2
	A369	29.5	29.1	29.3
	A370	31.1	31.7	32.0
	A371	27.9	28.2	26.8
	A38	34.2	35.0	34.3
	A4174	..	28.9	..
South Gloucestershire	A38	26.2	26.3	26.2
	A4017	16.3	14.8	16.2
	A4018	26.5	26.0	27.2
	A403	41.1	39.1	37.2
	A4174	25.6	26.7	28.0
	A4175	25.3	22.2	25.0
	A420	27.5	26.1	27.6
	A431	18.9	19.1	19.6
	A432	25.0	26.1	25.9
	A433	42.6	40.7	40.5
	A46	40.2	40.6	40.5
	A470	..	..	12.5

Bus Services

Existing Bus Service Provision in the West of England Region

Bus Service	Route	Approximate daily frequency
1 / 2 / 2A	Cribbs Causeway – Broadmead – Broom Hill (1) Cribbs Causeway - Bristol Centre – Stockwood (2) Filton - Broadmead – Stockwood (2A)	20 - 40 minutes
3 / 4	Cribbs Causeway – Avonmouth – Stoke Bishop - Bristol	30 minutes
5	Bristol – Stapleton – Downend	30 minutes
U5	Bath Bus Station – Bath Spa University via Lower Bristol Road, Newbridge Road	Hourly
6/7	Bristol – Whitehall – Speedwell – Fishponds – Soundwell - Kingswood - Two Mile Hill - New Cheltenham – Staple Hill	30 minutes
8	Bath City Centre – Kingsway	30 minutes
17	Southmead Hospital – Keynsham (via Hanham)	30 minutes

Bus Service	**Route**	**Approximate daily frequency**
19	Bath - Kingswood - Downend – Cribbs Causeway	Hourly
24	Southmead Hospital – Lockleaze – Eastville – Broadmead – Bedminster – Ashton Gate	15 - 20 minutes
35	Bristol – Marshfield	1 hour 30 minutes
36	Bristol Centre – Brislington	30 minutes
39	Bath Bus Station – Bristol Bus Station via Keynsham	30 minutes
X39	Bath Bus Station – Bristol Bus Station via Keynsham Bypass	15 minutes
41x	Lawrence Hill – City Centre	15 minutes until 15:32 (last bus)
42	Odd Down P&R – Royal United Hospital	1 hour
42 / 43	City Centre - Bitton via Lawrence Hill, St. George, Kingswood, Oldland Common (42) City Centre - Cadbury Heath (43)	1 hour (42) 10 – 20 minutes (43)
44 / 45	Bristol Centre – St George – Cadbury Heath	20 – 30 minutes
48 / 48A	Broadmead – Fishponds – Emersons Green	20 minutes
49	Bristol Centre - Fishponds - Staple Hill – Emersons Green	20 minutes
Y5	Bristol – Yate – Chipping Sodbury	2x hourly
70 / 71	Hengrove Depot - Bristol Centre - Frenchay (70) Bristol Centre - UWE Frenchay Campus (71)	20 minutes
72/ 72A	Bristol Temple Meads Railway Station – UWE Frenchay Campus (72) Bristol Temple Meads - Redland - UWE Frenchay Campus (72A)	1 hour
73	Bristol Temple Meads Railway Station – Cribbs Causeway	15 - 20 minutes
75 / 76	Hengrove – Cribbs Causeway	15 minutes (75) 20 – 30 minutes (76)
90	City Centre – Bedminster – Filwood Park – Hengrove	20 minutes
91	Bristol Centre - Hartcliffe - Bristol Centre	1 hour 5 minutes
92	Bristol Temple Meads Railway Station – Totterdown – Knowle - Hengrove	30 minutes
96	Brislington – Knowle – Hengrove	2x hourly
178	Radstock – Keynsham – Bristol Bus Station (via Brislington and Temple Meads)	Hourly
349	Bristol Bus Station – Keynsham (via Temple Meads)	30 minutes
376	Bristol – Farrington Gurney	30 minutes
T1 / T1s	Bristol City Centre – Harry Stoke – Thornbury (T1) Thornbury - Bristol Centre (T1s)	30 minutes
T2	Bristol City Centre – Cribbs Causeway – Thornbury	2x hourly
X1	Bristol – Weston-super-Mare Weston-super-Mare – Bristol	20 minutes (peak) 30 minutes – 1 hour (off-peak)

Bus Service	Route	Approximate daily frequency
X2	Bristol – Congresbury - Yatton	Hourly
X4	Bristol – Pill – Sheepway – Portishead	30 minutes
X6	Bristol – Failand – Tickenham - Clevedon	Hourly
X7	Bristol – Nailsea – Clevedon	Hourly
X9	Bristol – Long Ashton – Wraxall - Nailsea	30 minutes
X39 (till 7pm)	Bath Bus Station – Bristol Bus Station via Keynsham Bypass	15 - 20 minutes
39 (post 7pm)	Bath Bus Station – Bristol Bus Station via Keynsham	30 minutes
Y1	Bristol – Chipping Sodbury	30 minutes
Y3	Bristol – M32 – Hambrock – Winterbourne – Yate	2 hourly
Y4	Bristol – Frenchay – Winterbourne – Coalpit Heath – Yate	1 hour 30 minutes
Y6	Southmead Hospital – Cribbs Causeway – Winterbourne – Yate – Chipping Sodbury	Hourly
P&R (Portway)	Portway – Bristol Centre	15 minutes
P&R (Brislington)	Brislington – Temple Meads – Broadmead	12-15 minutes
21	Newbridge Park and Ride – Bath City Centre	15 minutes
metrobus		
m1	Cribbs Causeway – Bristol Centre – Hengrove	15 minutes
m2	Long Ashton P&R to City Centre	20 minutes
m3x	Emersons Green to City Centre	20 minutes
Airport Services		
A1 Bristol Flyer	Bristol Airport – central Bristol	20 minutes
A3 Weston-Super-Mare	Bristol Airport – Weston-Super-Mare	Hourly
A4 Air Decker	Bath – Bristol Airport via Saltford, Keynsham and South Bristol.	Hourly

P&R Services, 2022

Service	Route	Approximate Daily Frequency
Brislington P&R		
349 (ABUS)	Bristol Bus Station – Keynsham Church (via Brislington)	30 minutes
178	Radstock – Bristol (via Midsomer Norton, Paulton, Marksbury, Keynsham)	1 hour
668	Peasedown – Timsbury – Keynsham – Bristol	Once a day (Mondays only)
Newbridge P&R		
21	Newbridge Park and Ride – Bath City Centre	15 minutes
X39	Bath Bus Station – Bristol Bus station via Keynsham Bypass	15 minutes
A4	Bath – Bristol Airport via Saltford, Keynsham and South Bristol.	Hourly
Long Ashton P&R		

Service	Route	Approximate Daily Frequency
m2	Long Ashton Park and Ride – Bristol City Centre	20 minutes
505	Long Ashton Park and Ride – Clifton, Bristol Zoo, and Southmead Hospital	20-40 minutes
Lyde Green P&R		
m3	Lyde Green Park and Ride – Bristol & Bath Science Park – UWE Frenchay – Cabot Circus – Bristol City Centre – Emersons Green	20 minutes
m3x	m3 route, without stops at UWE, Stoke Park, or Begbrook	20 minutes
49	Lyde Green Park and Ride - Emersons Green – Bristol City Centre	20 minutes
462	Mangotsfield - Bromley Heath - Bristol City Centre	30 minutes
86	Lyde Green Park and Ride – Yate – Courtney Road School – Kingswood	2 hours

Source: Travelwest Bus Operator Timetables – August 2022

Railway Stations

North Corridor

Bristol Parkway

Bristol Parkway railway station, on the South Wales Main Line, is in the Stoke Gifford area in the northern suburbs of Bristol. It provides an excellent national rail link with the Great Western Railway weekday service providing connections to London Paddington and Cardiff Central, Weston-super-Mare, and Westbury and Gloucester via Bristol Temple Meads. CrossCountry also operate trains from Bristol Parkway to Manchester Piccadilly, Plymouth, Bristol and Edinburgh Waverley via Leeds and Newcastle. The station is easily accessible for all users having step-free access provision, toilet facilities and waiting areas. A taxi waiting area and bus services are located outside the station.

Filton Abbey Wood

Filton Abbey Wood railway station is located in Filton, off Filton Avenue. The station is located next to the Ministry of Defence (MoD), a key employer in the region, for which it is a key rail connection. It provides links to Cardiff Central, Taunton, Portsmouth Harbour, and Weymouth. The station is accessible to all with ramps up to the platforms and offers both bicycle parking and storage. There is no taxi-rank at this station.

Patchway

Patchway railway station is located in the North- Bristol suburb of Little Stoke, accessible from the B4057. Facilities at this station are somewhat limited, with no ticket machine, bicycle storage, taxi rank, or toilet provision. Patchway Railway station provides key links to Taunton and Cardiff Central, on which line Bristol Temple Meads is located.

Montpelier

Montpelier railway station is located in the North Bristol suburb of Montpelier, accessible from Cromwell Road and Gloucester Road. The station offers bicycle parking, a taxi rank, and step-free access making it accessible to all. There is however no toilet provision or ticket machine. The station provides departures to Avonmouth, Bristol Temple Meads, and Severn Beach.

Redland

Redland railway station is located in the north of Redland, off of South Road in the North West of Bristol. Whilst the station offers Bicycle parking, Taxis, and Step -free access, it has no ticket machine or toilet provision. The station provides regular services to Avonmouth and Bristol Temple Meads, with a less frequent service to Severn Beach also.

East Corridor

Lawrence Hill

Lawrence Hill railway station is located off the A420 in Lawrence Hill, to the East of Bristol City Centre. The station does not offer step-free access and is therefore not accessible to all. There are no toilet provisions or ticket machines. There is however bicycle parking and a taxi rank. Services from Lawrence Hill provide links to other railway stations in Bristol including Bristol Parkway, Bristol Temple Meads and Filton Abbey Wood. It also provides services to Avonmouth and Severn Beach.

Stapleton Road

Stapleton Road railway station is located to the north of Saint Agnes, to the North East of Bristol City Centre. The station does not offer step-free access and is therefore not accessible to all. There are no toilet provisions or ticket machines. There is however bicycle parking and a taxi rank. Services from Stapleton Road provide links to Avonmouth, Bristol Temple Meads, Bristol Parkway, Weston-super-Mare, Weymouth, and Westbury.

South-West Corridor

Bedminster

Bedminster railway station is located in Bedminster, South of Bristol City Centre. The station does not offer step-free access and is therefore not accessible to all. There are no toilet provisions or ticket machines. There is however bicycle parking and taxis available. Bedminster Railway station offers services to Bristol Parkway and Filton Abbey Wood within Bristol, and Weston-super-Mare, Taunton, and Cardiff Central also.

Parson Street

Parson Street railway station is located to the South of Southville, on the A38/ A417 junction. The station does not offer step-free access and is therefore not accessible to all. There are no toilet provisions or ticket machines. There is however bicycle parking and a taxi rank. The station provides services to Bristol Parkway, Filton Abbey Wood, Taunton, Weston-super-Mare, and Cardiff Central.

Bristol – Bath Corridor

Bath Spa

Bath Spa railway station is located in central Bath, accessible from the A3039 (Dorchester Street). The station offers bicycle parking, a taxi rank, and step-free access making it accessible to all. There is also toilet provision and ticket machines. The station provides a national rail link with services to Bristol and Cardiff, Worcester and Portsmouth, and London.

Bristol Temple Meads

Bristol Temple Meads railway station is located approximately 300m from Bath Bridge Roundabout and is a key transport hub for the city. Bristol Temple Meads provides a national rail link with services to London, Bath, the South West, Cardiff and the North as well as local stopping services to Weston-super-Mare, Severn Beach and Gloucester. A taxi waiting area is located directly outside the front of the station and bus stops are nearby for onward travel.

Keynsham

Keynsham railway station is located in Keynsham Town Centre, between Bristol and Bath. Step-free access is available to all platforms, with access to Platform 2 being via the Car Park rather than an overbridge. The station does not offer toilet provision but does facilitate the collection and purchase of tickets. There is bicycle parking and storage available, with the availability of taxis also. Services run to Bristol Parkway, Weymouth, Warminster, Gloucester, and London Paddington.

Oldfield Park

Oldfield Park railway station is located to the west of Bath, off Brook Road. The station offers bicycle parking and ticket machines, There is no step-free access, nor toilet provision. Services from Oldfield Park provide links to Bristol and Cardiff, and Bath, Portsmouth, Weymouth, and London.

Railway Station Usage

The table below provides a summary of the levels of use at each railway station, using data from the Office of Rail and Road (ORR) to 2020.

Existing Railway station Usage (ORR, 2018-20)

Railway station	2019-20 Entries & Exits	2018-19 Entries & Exits	% change	2019-20 Inter-changes	Platforms	Parking	
						Cycles	Cars
North Corridor							
Bristol Parkway	2,371,812	2,208,904	7.4%	783,137	2	156	1140

Railway station	2019-20 Entries & Exits	2018-19 Entries & Exits	% change	2019-20 Inter-changes	Platforms	Parking	
						Cycles	Cars
Filton Abbey Wood	976,150	901,872	8.2%	-	3	18	54
Patchway	91,158	104,078	-12.4%	-	2	4	15
Montpelier	129,556	94,684	36.8%	-	1	8	0
Redland	120,642	88,338	36.6%	-	1	12	0
East Corridor							
Lawrence Hill	190,118	148,606	27.9%	-	2	30	-
Stapleton Road	205,224	168,674	21.7%	-	2	28	-
South-West Corridor							
Bedminster	104,050	95,466	9.0%	-	2	20	-
Parson Street	173,832	149,700	16.1%	-	2	16	-
Bristol-Bath Corridor							
Bath Spa	6,432,812	6,538,056	1.6%	198,424	2	103	78
Bristol Temple Meads	11,619,360	11,367,652	2.2%	1,631,569	13	444	374
Keynsham	532,966	511,642	4.2%	-	2	14	49
Oldfield Park	359,846	322,654	10.3%	-	2	14	-

Source: https://dataportal.orr.gov.uk/statistics/usage/estimates-of-station-usage - Table 1410

The table shows that the number of entries and exits at all railway stations in the corridors has increased between 2018 and 2020, apart from Patchway where there was a 12.4% decline in use.

The railway stations that have seen the most growth in use are Montpelier and Redland, followed by Lawrence Hill and Stapleton Road. This is because in 2019-20 there were improvements to the Sunday service to 11 trains per day, from 2 trains per day previously.

The railway stations with the highest annual use are Bristol Temple Meads (11.6 million), Bath Spa (6.5 million), and Bristol Parkway (2.3 million) between 2019 and 2020.

Service Provision

The table below shows the destinations served by each railway station in the corridors, along with their frequency. This information was collated using the Network Rail website in November 2020.

Origin	Destination	Frequency (mins)	Trains per hour
Bristol Temple Meads	Bath Spa	10	6
	Bristol Parkway	25	2
	Filton Abbey Wood	15	4
	Bedminster	60	1
	Keynsham	20	3
	Parson Street	60	1
	Lawrence Hill	20	3
	Montpelier	50	1
Bath Spa	Bristol Temple Meads	12	5
	Bristol Parkway	60	1
	Keynsham	20	3
	Filton Abbey Wood	20	3
Bristol Parkway	Bath Spa	60	1
	Bristol Temple Meads	10	6
	Keynsham	60	1
	Lawrence Hill	30	2
	Stapleton Road	20	3
	Filton Abbey Wood	25	2
Keynsham	Bristol Temple Meads	60	1
	Bath Spa	20	3
	Bristol Parkway	60	1
	Filton Abbey Wood	20	3
Bedminster	Bristol Temple Meads	60	1
	Parson Street	60	1
	Lawrence Hill	30	2
	Stapleton Road	60	1
	Filton Abbey Wood	60	1
Parson Street	Bedminster	60	1
	Bristol Temple Meads	60	1
	Lawrence Hill	30	2
	Stapleton Road	60	1
	Filton Abbey Wood	40	2
Lawrence Hill	Parson Street	60	1
	Bristol Temple Meads	20	3
	Bristol Parkway	60	1
	Bedminster	15	4
	Stapleton Road	20	3
	Montpelier	20	3
Stapleton Road	Bristol Temple Meads	30	2

Origin	Destination	Frequency (mins)	Trains per hour
	Bristol Parkway	60	1
	Bedminster	60	1
	Lawrence Hill	20	3
	Parson Street	60	1
	Filton Abbey Wood	20	3
	Montpelier	45	1
Filton Abbey Wood	Bath Spa	20	3
	Parson Street	40	2
	Bristol Parkway	60	1
	Bedminster	60	1
	Stapleton Road	25	2
	Patchway	35	2
Patchway	Filton Abbey Wood	35	2
Montpelier	Bristol Temple Meads	40	2
	Lawrence Hill	40	2
	Stapleton Road	35	2
Redland	Avonmouth	35	2
	Bristol Temple Meads	35	2
	Severn Beach	120	1

Appendix B

Policy Context

National policies and plans

Growth Plan (HM Treasury, 2022)

The Growth Plan 2022 prioritises growth as the Government's central economic mission, focusing on the supply side of the economy as well as tax cuts. It aims to unlock private investment across the UK in an effort to boost trend growth to 2.5% in GDP.

As part of its efforts to increase growth, the Government aims to make Britain a place for:

- Investment: creating the right conditions and removing barriers to the flow of private capital – whether taxes or regulation
- Skilled employment: helping the unemployed into work and those in jobs secure better paid work
- Infrastructure: accelerating the construction of vital infrastructure projects by liberalising the planning system and streamlining consultation and approval requirements
- Home ownership: getting the housing market moving
- Enterprise: cutting red tape and freeing business to grow and invest

Key to the development and improvement of infrastructure is the introduction of Investment Zones across the UK, which will benefit from tax incentives, planning reforms to accelerate development, and wider support for local growth. As part of the latter, Mayoral Combined Authorities hosting Investment Zones will receive a single local growth settlement in the next Spending Review period.

The Government is in early discussions with 38 Mayoral Combined Authorities and Upper Tier Local Authorities who have expressed an initial interest in hosting an Investment Zone within their locality. This includes the West of England Combined Authority.

The Growth Plan also sets out the infrastructure projects that the Government will prioritise for acceleration, which reflects those projects that have a high potential to move to the construction phase at a swift pace. Within the Combined Authority region, this includes the M32 Sustainable Transport Corridor and Hub, and the Bristol to Bath Sustainable Transport Corridor, both part of the City Region Sustainable Transport Settlement (CRSTS). While the West of England Mass Transit scheme has not been submitted to Government for consideration at the time of the Growth Plan's publication, it is notable that several Mass Transit schemes are listed for acceleration.

Levelling Up the United Kingdom (DfT, Department for Levelling Up, Housing and Communities, 2022)

The Government's publication of Levelling Up the United Kingdom sets out a new policy regime to address the unequal distribution of opportunity and socio-economic outcomes associated with where people live and work.

The paper sets out a broad and long-term programme to address geographical inequality, to transform underperforming places and boost local growth, so that people everywhere are living longer, healthier and more fulfilling lives.

Related to transport, people, places and the economy, Levelling Up will target the closing of the inequality gap between the highest and lowest performing areas of the UK by 2030 by:

- Boosting productivity, pay, jobs and living standards especially in those places where they are lagging
- Spread opportunities and improve public services, especially in those places where they are weakest
- Restore a sense of community, local pride and belonging, especially in those places where they have been lost

Improving transport infrastructure and services is expected to drive economic growth and boost productivity through improved market access. This is fundamental to successfully achieving the Levelling Up ambitions.

Efforts to reduce disparity and spread opportunity are fundamental to the Mass Transit scheme. The policy notes that the West of England is need of transport infrastructure upgrades and improvements in order to address the link between poor public transport connectivity and regional inequality. Mass Transit will support the core pillars of the paper by raising productivity and empowering communities through improved transport accessibility.

National Planning Policy Framework (Department for Levelling Up, Housing and Communities, updated 2021)

The National Planning Policy Framework (NPPF) contains the Government’s planning policies for England and how these are expected to be applied.

The NPPF advises that planning policies and decisions should play an active role in guiding development towards sustainable solutions and recognises three interlinked dimensions in achieving this: economic, social and environmental. The policies within the framework seek to improve health, social and cultural wellbeing for all, deliver adequate community and cultural facilities, provide services to meet the demand of local people, and create a good standard of amenity for all existing and future occupants of land and buildings. Development that takes place under the framework is expected to contribute to the conservation and enhancement of the natural and historic environments as well as prevent development that leads to unacceptable levels of pollution.

The NPPF emphasises good design, which is a key aspect of sustainable development and should contribute positively to making places better for people and should avoid significant adverse impacts that can affect health and quality of life.

The following objectives should be delivered through the preparation and implementation of plans, taking into account local circumstances and a presumption in favour of sustainable development:

- **Economic** – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support existing, planned and potential growth, innovation and improved productivity, and by identifying and coordinating the provision of infrastructure.
- **Social** – to support strong, vibrant, and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations, and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being.
- **Environmental** – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

The NPPF also sets out policies to promote sustainable transport, including the expectation that the environmental impacts of traffic and transport infrastructure are identified, assessed, and taken into account, and that appropriate opportunities are taken for avoiding and mitigating adverse effects and achieving net environmental gains.

Considering the objectives of the NPPF, the promotion of sustainable transport, particularly the inclusion of walking, cycling, and public transport use, is at the forefront of the framework. Accordingly, the Mass Transit scheme adheres to the planning policies set out in the framework and provides well-designed active travel networks, as well as large scale transport elements that mitigate against any adverse impacts on the environment.

Build Back Better: Our Plan for Growth (HM Treasury, 2021)

Build Back Better sets out the government's plans to support growth through significant investment in infrastructure, skills, and innovation.

It aims to address long-term problems to deliver growth that creates high-quality jobs across the UK and utilises the strengths of the Union. The 'plan for growth' is closely aligned the priorities of levelling up the whole of the UK, supporting the transition towards net zero, and supporting the vision for a global Britain.

The Mass Transit scheme unlocks access to core employment areas in Bristol and Bath city centres, as well as enterprise zones. A well-developed transport network will allow businesses in the region to grow and expand, enabling them to extend supply chains, deepen labour and product markets. This element of the scheme supports the Government's efforts regarding economic recovery.

Decarbonising Transport: A Better, Greener Britain (DfT, 2021)

The Transport Decarbonisation Plan (TDP) sets out the intentions of building back a better, greener Britain in response to a change in the way people travel and work.

Transport is the largest contributor to UK domestic greenhouse gas emissions. The TDP establishes the aim to deliver a step change in both the breadth and scale of the Government's ambitions on transport to reach net zero.

The plan aims to decarbonise all forms of transport through the following measures:

- Increasing cycling and walking
- Transitioning to zero emission buses, taxis and coaches
- Decarbonising our railways
- A zero-emission fleet of cars, vans, motorcycles and scooters
- Accelerating maritime decarbonisation
- Accelerating aviation decarbonisation

A second set of ambitions looks at multi-modal decarbonisation and key enablers:

- Delivering a zero-emission freight and logistics sector
- Delivering decarbonisation through places
- Maximising the benefits of sustainable low carbon fuels
- Hydrogen's role in a decarbonised transport system
- More choice and better efficiency in future transport
- Supporting UK research and development as a decarbonisation enabler

Measures used in the approach to decarbonisation will also seek to deliver wider benefits including to improve air quality, noise, health, reducing congestion and delivering high-quality jobs and growth for everyone across the UK.

Not only does Mass Transit align with the measures set out in the TDP to reach net zero, but the scheme also provides some of the key enablers to achieve the intentions set out in the plan. For instance, Mass Transit will reduce car dependency by providing increased choice of accessible and reliable sustainable modes.

Bus Back Better (DfT, 2021)

Bus Back Better sets the vision for the future of local bus services and is key to achieving two of the Government's wider priorities: net zero and levelling up.

The strategy aims to make buses greener, more frequent, more reliable, easier to understand and use, better coordinated and cheaper. It is linked with the Government's funding announcement prior to the pandemic of £3bn of new funding to improve local bus services across England.

The strategy provided a timeline for achieving a better-connected bus network, with an expectation that by October 2021 all LTAs would publish a local Bus Service Improvement

Plan (BSIP), detailing how they proposed to use their powers to improve services. Successful authorities were notified of their BSIP funding awards in April 2022.

Irrespective of the mode selected for the proposed Mass Transit scheme, of which bus rapid transit is one, an improved public transport network would improve the reliability of the existing bus network. A number of bus improvement schemes have been proposed under the West of England BSIP, which will be taken into account as the scheme progresses.

National Infrastructure Strategy (HM Treasury, 2020)

The National Infrastructure Strategy sets out the Government's plans to transform infrastructure across the UK by 2050 by focusing on four overarching subject matters:

- Levelling up – boosting growth and productivity by investing in rural areas, towns and cities
- Zero emissions by 2050 – transforming infrastructure to decarbonise the UK's power, heat and transport networks, and adapting to the risks posed by climate change
- Supporting private investment – providing clarity on Government plans to ensure confidence
- Accelerate and improve delivery – reforming the planning system, and improving the way projects are chosen, procured, and delivered

The National Infrastructure Strategy shares the National Infrastructure Commission's ambitions for levelling up cities outside of London. Improved transport links will allow cities to 'act as an anchor' for growth across a region, enabling the rebalancing of the economy through infrastructure. This priority area for Government has already been reflected in dedicated funding through the Levelling Up Fund, worth up to £4.8bn over the next four years to 2024-25.

The Strategy underscores the Government's commitment to creating rural communities with strong transport networks, thereby unlocking opportunity, and supporting local economies. Active and sustainable travel remains a priority, with future funding having been committed for cycling (through active travel funds referenced in Gear Change) and bus improvements.

Connectivity through sustainable infrastructure is central to the Mass Transit scheme, with its objectives including a reduction in overall carbon emissions and improving air quality and increasing connectivity and accessibility of services. Delivery of a Mass Transit public transport network will closely align to the strategic goals of the National Infrastructure Strategy, primarily through achieving a modal shift from the use of the car to public transport.

Gear Change: A Bold Vision for Cycling and Walking (DfT, 2020) / Local Transport Note (LTN) 1/20 Cycle Infrastructure Design (DfT, 2020)

Gear Change (DfT, 2020) sets out the Government's plan to create a step-change in cycling and walking and a target for half of all journeys in towns and cities to be cycled or walked by 2030. To facilitate this, actions are grouped into four central themes:

- Better streets for cycling and people: thousands of miles of safe, continuous, direct routes for cycling
- Cycling and walking at the heart of transport, place-making and health policy: significantly increasing dedicated cycling and walking funding to create a long-term cycling and walking programme and support delivery of local cycling and walking infrastructure plans
- Empowering and encouraging local authorities: by increasing funding but also ensuring that government funding is only granted to schemes that meet new standards.
- Enabling people to cycle and protecting them when they do: introducing new laws and safety standards.

A *One Year On* review has since been published (DfT, 2021), which updates government commitments, and provides a number of case studies on local cycling and walking schemes, as well as reflecting on low traffic neighbourhoods.

Gear Change was published alongside *Local Transport Note (LTN) 1/20*. LTN 1/20, provides the accompanying design guidance to support Gear Change and applies to all highways-based schemes. It reflects current best practice, and states that, for schemes to receive government funding there will be a presumption that they must deliver or improve cycle infrastructure to the standards set out in the LTN.

A new executive agency, Active Travel England, has been set up to manage the national active travel budget and inspect schemes to ensure they meet the new national standards.

While the Mass Transit scheme is likely to be a mix of transport types, it will be supported by an active network and green infrastructure that seeks to protect the environment and improve the health and wellbeing of communities. The incorporation of walking and cycling routes will address the current varying quality of active travel infrastructure in the region.

Ten Point Plan for a Green Industrial Revolution (Department for Business, Energy & Industrial Strategy, updated November 2020)

The ‘Ten Point Plan’ commits to mobilising £12bn of government investment as part of what has been termed Green Industrial Revolution. The ten points cover ways to decarbonise the UK across the sectors of across 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 plan relate to transport infrastructure (accelerating the shift to zero emissions vehicles and green public transport, cycling and walking), but the underlying objective is to reduce carbon from transport networks. This is supported by the ‘National Infrastructure Strategy’, which states infrastructure investment is fundamental to delivering the Carbon Net Zero targets.

The Mass Transit scheme aims to reduce the number of trips made in the private car, therefore reducing congestion, vehicle emissions, and creating a cleaner air environment. With the population forecasted to increase in the West of England, and more people consequently traveling, Mass Transit will provide a sustainable alternative to journeys currently made by car, and work towards to future-proofing the region.

The Green Book (HM Treasury, updated December 2020)

The Government's Green Book sets out HM Treasury's guidance on how to appraise and evaluate policies, projects and programmes. It supports the five-case model which is the Government's recommended framework for developing business cases, as set out in the DfT's guidance on Transport Business Cases.

The Green Book guidance was reviewed in 2020, along with current appraisal practice, to ensure that it properly reflected the Governments levelling up agenda. Key changes include:

- A greater emphasis on the strategic case in the business case, and correspondingly a lesser emphasis on the benefit-cost ratio (BCR)
- The increased importance of place-based analysis to help drive up the levelling-up agenda
- A review of the environmental social discount rate, in support of the drive towards net zero emissions

These changes mean that schemes which support the levelling up and decarbonisation agenda will be better able to secure government funding and approval.

Strategic fit is key to establishing a rationale for intervention and must be considered as part of the longlist appraisal. The Mass Transit scheme is aligned with national, regional and local policy and planning, contributing to the Government's goals of decarbonisation and levelling up pockets of regional deprivation.

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

The Future of Mobility: Urban Strategy (DfT, 2019) outlines the Government's approach to maximising the benefits from transport innovation in cities and towns. It sets out the principles that will guide the Government's response to emerging transport technologies and business models.

In facilitating innovation in urban mobility for freight, passengers, and services, the strategy sets out the benefits mobility innovation can deliver, the Government's approach and the principles by which to achieve them.

The scheme is fundamental to an efficient transport system across the West of England as high-capacity Mass Transit is essential for connecting people in and around dense urban centres such as Bristol and meeting increased demand on the network.

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

This Strategy sets out the Government's plans to make transport systems more inclusive, providing disabled people with the same access to transport as everyone else, and to be able to travel confidently, easily and without extra cost. By 2030, the Government aims to have equal access for disabled people using the transport system, with assistance if physical infrastructure remains a barrier.

While the Mass Transit scheme remains mode agnostic, the final option will improve the travelling experience for all people and will be compliant with modern accessibility standards. An inclusive public transport network has the potential to ensure that all passengers feel confident and empowered to travel.

Transport Investment Strategy (DfT, 2017)

The Transport Investment Strategy sets out how the Government plans to invest in transport infrastructure. The Strategy is seen as an enabler to help deliver the Industrial Strategy, which, by improving connections between communities and businesses, will help deliver planned growth across the country.

Investment decisions should focus on the main objectives set out in the Transport Investment Strategy. The objectives and policy include:

- Creating a more reliable, less congested, and better-connected transport network that works for the users who rely on it
- Building a stronger, more balanced economy by enhancing productivity and responding to local growth priorities
- Enhancing our global competitiveness by making Britain a more attractive place to trade and invest
- Supporting the creation of new housing

The Mass Transit scheme responds to the core objectives outlined in the Transport Investment Strategy by providing an opportunity to both safeguard the environment and drive economic growth. Investment in Mass Transit will support the expected 11% growth in population by 2030 in the West of England by ensuring communities are connected to housing, employment opportunities, education, and services.

Regional policies and plans

West of England Climate and Ecological Strategy and Action Plan (Combined Authority, 2022)

The West of England Climate and Ecological Strategy and Action Plan sets out five priority areas that are expected to deliver significant climate and ecological benefits, to the yar 2030. These are:

- Low Carbon Transport – to decarbonise the transport system, reduce car dependency, manage demand, increase cycling and walking and the use of public transport
- Low Carbon Buildings and Places – to increase the energy performance of buildings and develop low carbon standards in new developments

- Nature Recovery – to ensure that 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% by 2030
- Low Carbon Business – to help business and local people benefit from growth in the green economy; maximising government investment in the region and supporting our businesses to grow
- Renewable Energy – to work to decarbonise the energy system and increase local renewable energy

The strategy recognises that emissions from transport are among the largest contributors to greenhouse gas and CO2 emissions in the region, and that it is not reducing in line with other emissions. Indeed, population growth means that car trips are expected to increase by a further 8% up to 2030, which will worsen existing conditions.

Emerging findings from the West of England Transport Decarbonisation Study show that there is a considerable gap between forecast carbon emissions reductions and 2030 ambitions. Even considering planned activity and commitments such as the City Region Sustainable Transport Settlement and MetroWest, this will only reduce carbon emissions to around 25% of current levels by 2030.

In order to fill this gap, we need to substantially reduce the use of the private car mileage by 40%, reducing the number of trips and their length. A shift towards electric cars will not be enough. Infrastructure improvements to walking, cycling and public transport will need to go beyond existing plans to provide alternative journey options to the private car. A range of demand management measures will also be needed to help reduce the number of car trips within the region. This may include travel planning, marketing, parking policy, and a package of workplace parking levies and/or congestion charging areas.

The Mass Transit programme is fully aligned with the findings of both the West of England Climate and Ecological Strategy and Action Plan, and the Decarbonisation Strategy. In order to achieve carbon reduction targets by 2030, a transformational public transport scheme will need to be underway to facilitate behaviour change alongside demand management measures.

A Strategy for Homes – the West of England Housing Delivery Strategy (2020-30) (Combined Authority, 2021)

The Housing Delivery Strategy has been constructed to accelerate delivery in line with the region's housing requirement and sets the expectation that the funding delivers acceleration and additionality. There is urgent need for new homes in the West of England, with over 30,000 Affordable Homes required to meet the need across the region by 2036. The strategy is focused on delivering three main outcomes:

- Increased pace
- Affordable Homes
- Quality Homes

To achieve such ambitions, a programme of priority locations has been identified to receive investment from the £40m funding package from the Combined Authority Investment Fund. The Fund will accelerate the delivery of 6,621 homes to keep pace with the expected increase in population in the region.

The Mass Transit scheme supports the delivery of thousands of new homes in the region by integrating housing growth with walking, cycling and public transport developments. Increasing active travel to and from new housing developments, as well as providing accessible public transport links is key to unlocking housing growth in the West of England.

West of England Bus Service Improvement Plan (Combined Authority, 2021)

The West of England Bus Service Improvement Plan aligns with the wider strategic vision of the Combined Authority which is to ensure that public transport acts as an enabler to economic growth by improving access to employment, services, and education. As such, the BSIP aims to deliver the following ambitious targets by 2030:

- Reduce bus journey times by 10%
- Ensure 95% of services run on time
- Return to pre-pandemic patronage by 2025
- Increase passenger satisfaction
- All buses to be zero emissions

Delivering the initiatives outlined in the BSIP is best achieved by collaboration between local transport authorities and operators. Therefore, regardless of final technology mode, Mass Transit will form part of a coordinated and convenient public transport network that is able to integrate seamlessly with existing and future bus routes that offer reliable, frequent, and quicker journeys. Mass Transit is therefore a component of the long-term plan for supporting the delivery of the BSIP given the scheme’s commitment to increasing the number of journeys made by public transport.

West of England Local Plan: Joint Local Transport Plan 4 (2020-36) (Combined Authority, 2020)

The JLTP4 was published in March 2020. The Plan considers transport in the region up to 2036 and sets out aims to achieve a well-connected sustainable transport network that works for residents, businesses, and visitors across the region. It targets greater, realistic travel choices and making walking, cycling and public transport the natural way to travel. It has the following objectives, which have been integrated as part of the proposed Mass Transit scheme’s objectives:

- Act against climate change and address poor air quality
- Support sustainable and inclusive economic growth
- Enable equality and improve accessibility
- Contribute to better health, wellbeing, safety and security
- Create better places

Mass Transit is one of several major schemes are set out in the JLTP4 for the West of England region, stating that “mass transit will, wherever possible, be configured to complement metrobus routes and to integrate with the existing passenger rail network. New mass transit services could be introduced on some corridors by diverting through traffic onto other new or improved roads.”

The plan also states that wherever possible, road space should be reallocated to modes of transport that carry people more efficiently than the current provision, which the Mass Transit scheme seeks to do. This would reduce capacity for general traffic, making driving on congested corridors the least attractive transit option and encouraging private car users to switch to alternative, more sustainable modes.

West of England Bus Strategy (Combined Authority, 2020)

The West of England Bus Strategy looks at how bus services can help to tackle congestion and reduce carbon emissions at a regional level. Based on passenger research, the strategy aims to create a bus network that people want, and are able, to use by improving the quality and reliability of bus services. The strategy includes the following objectives:

- 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

The use of Bus Rapid Transit is one of the technology modes under consideration for Mass Transit. Irrespective of the final technology mode, Mass Transit will form an integrated service with the region’s bus networks, ensuring a holistic approach is achieved for public transport provision along key travel corridors in the region.

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

The LCWIP sets out WECA’s approach to support the DfT’s national policy aspiration to double cycling activity by 2025. It aims to ensure the West of England is a region where cycling and walking are the preferred choices for shorter trips and to access public transport.

£411m of investment is proposed by 2036, improving the environment for cyclists and pedestrians, focusing on 30 local high streets as well as improvements along 55 continuous cycle routes. There are 13 routes identified for improvement, covering the West of England region from Bristol City Centre to Kingswood and Bath Road.

Improving the walking and cycling environment in the region is expected to enable sustainable and active first and last mile travel to and from the Mass Transit network. This is key to achieving mode shift and creating a holistic and accessible network.

West of England Climate Emergency Action Plan (Combined Authority, 2020)

The Combined Authority produced a climate emergency action plan in September 2020, which sets out how the region aims to become carbon neutral by 2030. The action plan covers five themes:

- **Low carbon transport system:** work to decarbonise the transport system and increase cycling and walking and the use of public transport
- **Low carbon businesses:** help businesses and local people benefit from growth in the green economy; maximising government investment in the region and supporting businesses to build back better following the coronavirus pandemic
- **Renewable energy:** work to decarbonise the energy system and increase local renewable energy
- **The green environment:** protect and enhance the environment through a proactive approach to green infrastructure
- **Low carbon buildings and places:** increase the energy performance of buildings and develop low carbon standards in new developments

The Mass Transit scheme directly contributes to the over-arching goal of becoming carbon neutral by providing a step-change in public transport connectivity and facilitating a modal shift towards sustainable travel. It will therefore be a key contributor to tackling the climate emergency.

West of England Joint Green Infrastructure Strategy 2020-30 (Combined Authority, 2020)

The Joint Green Infrastructure Strategy has been produced and endorsed by the Combined Authority and Bath and North East Somerset, Bristol, North Somerset and South Gloucestershire Councils. Green infrastructure is strategically planned and managed network of natural and semi natural areas – green and blue delivering multiple benefits. The strategy sets out the importance of an integrated approach to green infrastructure and the benefits and values of an interconnected system of landscapes.

The strategic outcomes include:

- Supporting resilient ecosystems and biodiversity
- Mitigating and adapting the natural and built environment to climate change
- Conserving and enhancing a legible network of physical green spaces
- Reducing and managing flood risks and drought
- Improving mental and physical health, and the cohesion of local communities
- Maintaining and enhancing cultural heritage, landscapes and natural resources
- Promoting economic growth, employment and skills improvement

The Mass Transit system will be designed with Green Infrastructure in mind. By integrating green and blue infrastructure with Mass Transit, there is an opportunity to create a transport mode that encourages shorter journeys to be made by bicycle or foot. This will enable transit stops to be locate further apart, and therefore reduce the number of stops making journeys across urban areas faster and more direct.

As part of the preliminary works for Mass Transit, a *Green Infrastructure Enhancement Strategy* was produced. The outcomes of this will be integrated as the scheme progresses to OBC and detailed design.

West of England COVID-19 Recovery Plan (Combined Authority, 2020)

The West of England has developed an ambitious programme to build back better, greener, and stronger following the coronavirus pandemic. The plan aims to re-build back across five pillars with different outcomes. The outcomes of the plan are outlined as follows and include a £320m+ investment in the region's transport and housing by 2025:

- Rebuilding businesses
- Getting residents back into jobs
- Strengthening inclusion
- Supporting a green recovery
- Renewing places

The Mass Transit scheme is expected to contribute to the achievement of outlined recovery outcomes, with specific regard to that of supporting a green recovery and renewing places. Mass Transit is intended to be a sustainable means of improving accessibility and connectivity across the region, therefore helping to both rebuild businesses and get residents back into jobs. Improved accessibility will also strengthen inclusion, leading to a better, more equally connected region. Achieving these outcomes through sustainable modes, and encouraging a sustainable modal shift, is supportive of a green recovery.

Western Gateway Strategic Transport Plan (2020-25) (Western Gateway STB, 2019)

The Strategic Transport Plan considers all modes of transport within the context of strategic travel and provides a clear framework for future-decision making. Its aim is to deliver sustainable growth by ensuring the Western Gateway area is sustainably connected and provides high-quality and value for money travel opportunities for all businesses, residents, and visitors.

The following challenges have been identified to help achieve this aim:

- The legacy of coronavirus, which is likely to have a significant impact on traditional journey patterns
- The need to decarbonise the transport network with partner authorities declaring a climate emergency
- The importance of improving connectivity to support the delivery of sustainable growth

- The need to tackle rural accessibility gaps by working with partners to develop sustainable solutions to maintaining rural transport networks
- The need to reduce the regions productivity gap by removing travel constraints

The Mass Transit scheme objectives closely align with the vision of the Strategic Plan. Delivering an accessible and sustainable transport system for the region will help to deliver sustainable growth and recovery, tackle accessibility gaps, and reduce travel constraints, while helping to meet decarbonisation goals through mode shift.

West of England Local Industrial Strategy (Department for Business, Energy & Industrial Strategy, 2019)

The Local Industrial Strategy identifies the region's strengths and challenges and presents plans to solidify the foundations upon which the region will thrive. These are built around four key priorities:

- **Cross-sectoral innovation:** strengthening innovation and driving productivity by connecting researchers, businesses, and residents through a global centre of innovation excellence; and developing, testing, and preparing for market, user-centred products, and services through a new West of England Network of Living Labs
- **Inclusive growth:** introducing new measures to help all residents contribute to and benefit from the region's economic success
- **The productivity challenge:** providing businesses in the region with the space, networks, and skills they need to boost productivity, grow, and thrive
- **Innovation in infrastructure:** tackling climate change, addressing air quality, and ensuring quality of life for current and future residents including investing in infrastructure that reduces energy demand, lowers carbon emissions and is resilient to the impacts of climate change

The Mass Transit scheme aligns with the key priorities of the strategy by delivering a better connected, sustainable, and highly integrated transport network across the region. In turn, better connections will foster economic growth and increased productivity, and improved sustainability on the network will enable carbon reductions.

West of England Energy Strategy (Combined Authority, 2019)

The West of England Joint Committee agreed the basis for a West of England Energy Strategy in February 2019. The strategy sets out the direction towards a diverse, resilient, and affordable energy system that enables economic growth and reduces greenhouse gas emissions. It outlines five areas of activity:

- Improving businesses and industry energy efficiency
- Improving homes
- Accelerating the shift to low carbon transport
- Delivering clean, smart, and flexible power
- Leading in the public sector

The key area of relevance is a shift to low carbon transport. For this area, the West of England has the objective to reduce energy consumption in transport, and to create enabling conditions to increase new Ultra Low Emission Vehicle (ULEV) registrations for users of the strategic road network.

The Mass Transit scheme will therefore provide the infrastructure key to making public transport the preferred way to travel, thereby reducing the region's carbon emissions.

West of England Joint Transport Study (Combined Authority, 2017)

The Joint Transport Study (JTS) set out a programme of transport schemes and interventions for the West of England that address current challenges on the network and mitigate the impact of future developments to 2036 and beyond.

The planned programme of interventions aims to achieve mode shift away from the car and create a more efficient and resilient network through the following key four vision statements:

- A step change in the number of healthy, low carbon walking and cycling journeys
- Transforming connectivity by public transport
- Managing traffic demand and a more resilient road network
- Effective connectivity at the local, sub-regional, national and international scales

A Joint Spatial Plan was developed in parallel with the JTS. The proposed growth strategy within the Joint Spatial Plan was used to help shape the development of the long-term transport vision.

Mass Transit is referenced as a mode within the transport vision. It is proposed in stretches between Bristol and Bristol Airport, Bristol and the North Fringe, Bristol and the East Fringe, and Bristol and Bath. Delivery of such is therefore in line with the JTS.

West of England Strategic Economic Plan 2015-2030 (West of England Local Enterprise Partnership, 2015)

The Strategic Economic Plan was developed by the West of England LEP and covers a programme of interventions to promote local economic growth and make the West of England one of the fastest growing sub-regions in the country. It outlines goals to be achieved by 2030; Mass Transit is expected to contribute to the following:

- One of Europe's fastest growing and most prosperous sub regions, which has closed the gap between disadvantaged and other communities – driven by major developments in employment and government-backed infrastructure improvements in South Bristol and North Somerset
- A buoyant economy competing internationally, based on investment by innovative, knowledge- based businesses and a high level of graduate and vocational skills

- A rising quality of life for all, achieved by the promotion of healthy lifestyles, access to better quality healthcare, an upturn in the supply of affordable housing of all types and the development of sustainable communities
- Easier local, national and international travel, thanks to transport solutions that link communities to employment opportunities and local services, control and reduce congestion and improve strategic connections by road, rail and through Bristol Airport and Bristol Port
- Success secured in ways that are energy efficient, protect air quality, minimise and manage waste and protect and enhance the natural and built environment

With investments being targeted to key growth enablers such as infrastructures, people and skills, delivery of the Mass Transit scheme aligns with the priority growth focuses of the Strategic Plan.

Mass Transit will connect to major employment sites in the region, which will create better economic growth. It will also connect to Bristol Airport, both of which connections address the strategic aim to facilitate local, national, and international travel.

Local policies and plans

Bristol City

Bristol Local Plan (Emerging, 2024)

Bristol City Council is currently working to update its Local Plan, setting out development over the next 20 years. It is underscored by *Progressing Bristol's Development* – a statement published in October 2020 that explains BCC's current approach to making planning decisions.

This planning statement reiterates Bristol's commitment to addressing the region's climate and ecological emergency, and lists objectives, including:

- The delivery of new and affordable homes, and inclusive public spaces
- Promoting rapid economic recovery and future resilience
- Contributing to a digital and connected city
- Tackling the causes of climate change and responding to its challenges
- Promoting active lifestyles in its approach to development

The update of the Local Plan builds on this and aims to progress the city's development by:

- Setting out an approach to inclusive and sustainable growth and development, addressing the needs of everyone in all parts of the city
- Enabling of delivery of at least new 33,500 homes in Bristol by 2036 including affordable housing and homes to meet a range of needs
- Aiming to exceed our housing target where new infrastructure can unlock additional potential

- Enabling growth of our economy for everyone, with modern workplaces and digital infrastructure fit for the future.

As part of its vision for a well-connected city, the planning statement and draft Local Plan development strategy describe the need for major transport improvements, including a mass transit system, which will help meet Bristol's objectives of improving transport to meet increased demand from growth in housing, jobs, and regeneration, as well as minimising the negative impact of congestion.

This in turn will stimulate the business activity that comes from a growing population, and support the continued viability and growth of local services and facilities.

BCC aims to adopt the updated plan in Autumn 2024.

Bristol One City Economic Recovery Statement of Intent & Economic Recovery and Renewal Strategy (2020)

In June 2020, Bristol City Council published an ‘Economic Renewal Statement of Intent’ that set out the City’s roadmap to recovery from coronavirus, and how they intend to move forwards. The statement of intent was:

- A recognition of the way Bristol want to rebuild after the coronavirus pandemic
- A description how Bristol’s One City Economy Board work will contribute to wider recovery work and interact with existing governance structures
- A way for Bristol to communicate our local priorities to regional, national and international stakeholders

The ‘Bristol One City Economic Recovery and Renewal Strategy’ is the next step in developing Bristol’s response to the pandemic. The strategy is built around three pillars of recovery which align with the West of England recovery priorities:

- **People and labour markets** – protecting employment levels, building skills and improving pathways to work for young people and groups disadvantaged in the labour market, creating opportunities for better employment particularly in green industries
- **Business and investment** – supporting businesses to recover from the crisis, while promoting digital innovation, investment in low carbon technology and practices and attracting the location of new and established businesses into the region
- **Place** – enabling development to ensure provision for future homes, jobs and quality places, improving connectivity and the protection of green spaces, focusing on areas with communities experiencing long term deprivation

The Statement of Intent noted Temple Quarter as being a key initiative for the City. This capital programme will unlock the opportunity to create c22,000 jobs, a minimum of 10,000 homes and an economic boost of £1.6bn per annum.

Creating a reliable and regular mass transit system will better connect communities to work and education, thereby helping businesses to both grow and access a wider pool of talent.

This will also help businesses to recover from the pandemic and attract new business to the region.

Bristol Temple Quarter Enterprise Zone Spatial Framework (2016, updated 2021)

The Temple Quarter Spatial Framework is a non-statutory planning document setting out how the Temple Quarter Enterprise Zone could become a thriving new city quarter over the next 25 years, incorporating 17,000 new jobs and a 12,000-seat arena.

The two key aspects central to the development of the Spatial Framework are the urban structure and the public realm. The Spatial Framework proposes significant improvements in the public realm and movement including:

- **Pedestrian Route Improvements:** entailing enhancement of a number of existing routes, opening up pedestrian access to the area's waterfront and public access through Temple Meads Station complex to significantly increase station capacity and usability
- **Cycle Route Improvements:** significant improvements to the strategic cycling network in and around the enterprise zone
- **Public transport and station improvements:** the delivery of world-class railway hub with outstanding station facilities and the creation of a user-friendly, dispersed interchange zone with the station and Brunel Mile at its heart
- **Changes to highway access:** aimed at rebalancing the strategic highway network to improve access by walking, cycling and public transport without reducing traffic capacity (Temple Gate) and new vehicular access arrangements to both the arena and Temple Meads railway station
- **Wayfinding and information provision:** extending the Bristol Legible City Information System south and east of the station complex.

The Mass Transit scheme will further the policies of the spatial framework through facilitating movement to Bristol Temple Quarter Enterprise Zone and reducing levels of congestion. Increased connectivity to this key employment zone will also increase access to potential jobs, and therefore help to further economic growth in the region.

Bristol Transport Strategy (2019)

The Bristol Transport Strategy was adopted in 2019 and has a vision up to 2036 to 'tackle congestion and make Bristol a better place for all'. The strategy notes that congestion is an issue in Bristol, particularly at peak times, but increasingly throughout the day, making travel around the city slow and unreliable for many people. A focus is on moving the most people in the space available and to improve the reliability of sustainable transport. The key challenges in relation to transport include:

- High levels of congestion mean journeys made by all motorised modes can be unreliable
- Buses get caught up in traffic, causing buses to be late reducing the attractiveness of public transport

- Transport network is vulnerable, and incidents can cause the city to become severely congested

The strategy notes that with more people living and working in Bristol, leading to significant increases in motor traffic, it will become progressively important and challenging to reduce the overall carbon footprint. Promoting sustainable and healthy modes of transport is one of the main ways we can reduce transport emissions, along with the promotion of more efficient vehicles.

The Mass Transit scheme is expected to provide the necessary modal shift towards public transport in order to alleviate current levels of congestion. This is expected to enable future economic growth within Bristol and improve the resilience of the transport network for all users.

Bedminster Green Framework (2019)

The Bedminster Green Framework produced by BCC in 2019 sets out proposals for the future of the area noting that developments in the area should fund/deliver, as appropriate:

- Improvements to the A38 as a bus priority route alongside enhanced public realm and crossing facilities
- Safe cycle links to existing routes to the city centre and Temple Quarter Enterprise Zone and to Malago Greenway and Filwood Quietway
- Improved access to Bedminster Station
- Electric vehicle charging points
- Effective offsite mitigation to ensure that limited parking provision within the developments does not lead to overspill parking on surrounding streets that would impact negatively upon the neighbouring community
- Flood risk and drainage provision, including opening up of the culvert and channelled sections of the River Malago, subject to feasibility
- Enhanced Green, environment and high-quality public realm
- Whitehouse Lane enhancements, subject to the findings of the Strategic Joint Transport Assessment

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These improvements will impact the mass transit Bristol Airport corridor and their integration should therefore be considered in its development.

Bristol City Centre Framework (2018)

The Bristol City Centre Framework is a strategy for improving movement, public realm, and the approach to regeneration and development in the heart of Bristol. The framework notes a need to be flexible and adaptable in the response to economic, environmental, social, and technological changes, and ensure that the success of the city centre if shared and inclusive to all people across the whole city.

The framework outlines four key objectives of:

- Creating a liveable, vibrant, safe and inclusive city centre for the benefit of people of all ages to live, work, learn and enjoy, both during the day and night
- Tackling traffic congestion and improving air quality; making the city centre better connected, accessible and healthier
- Supporting the city centre as the core retail, leisure, and cultural heart of the region by enabling regeneration, diversifying uses and promoting the offer
- Ensuring the sustainable development of new homes, employment space, enhancement of heritage assets, streets and public open spaces; contributing to a carbon neutral and climate resilient city

Facilitating a better connected and more accessible mass transport option for people living and working in Bristol is expected to encourage a modal shift towards public transport. Congestion levels will be significantly reduced, thereby improving air quality through a reduction in greenhouse gas emissions. The Mass Transit scheme is also expected to provide connections to future developments of employment and housing.

Bath and North East Somerset

Bath and North East Somerset Local Plan Update (Emerging, 2023)

B&NES is currently in the process of updating its Local Plan, establishing the planning framework for the district up to 2042. This document will contain a vision, strategy and associated policies to guide and manage how the district grows and changes during that period, as well as how planning application for new development are decided.

In October 2022, B&NES released its launch document for consultation. It lists the central policy aims for the emerging Local Plan as:

- Responding to the challenge of the climate emergency and facilitating the goal of net zero carbon by 2030
- Establishing a transformational approach to protecting and enhancing nature
- Maximising the delivery of affordable housing to respond to the district's demographic, social and economic needs
- Creating opportunities for sustainable economic development, the types of jobs that are needed in our communities, and the right type of space available for businesses to grow

The Local Plan is expected to focus on the following priorities:

- Maintaining a 5-year housing land supply and facilitating delivery of the necessary type and scale of new homes to respond to the district's social and economic needs, including homes for older people, students, key workers, gypsies, travellers, and boat dwellers, supported accommodation for residents with health and social care needs, and provision of self-build dwellings
- Delivering high-quality development that supports vibrant, healthy, successful communities, and addresses inequalities

- Ensuring new development is aligned with the necessary infrastructure, including community facilities and green infrastructure
- Protecting and enhancing the beauty of our environment
- Setting an approach to sustainable transport and movement which facilitates behavioural change and the 15-minute neighbourhood concept
- Increasing renewable energy generation
- Setting a positive strategy for the conservation and enjoyment of the historic environment
- Creating vibrant town and city centres

B&NES plans to consult on the draft Plan in June 2024, with formal adoption in September 2025.

Journey to Net Zero (2022)

Journey to Net Zero: Reducing the Environmental Impact of Transport in Bath sets out a plan to tackle a number of significant environmental challenges:

- Combating climate change
- Improving air quality
- Improving health and wellbeing
- Tackling congestion

The document acknowledges that current travel patterns within B&NES will not achieve carbon neutrality by 2030, and sets out the changes needed to the transport system to create better places to live and work.

This will involve reducing the dominance of the private car, while maintaining access for those whose needs cannot easily be met by more sustainable modes of transport. This plan focuses primarily on the City of Bath, but also recognises the importance of the travel corridors between the city and the wider district.

The plan considered projects in three groupings, based on their current level of development: current projects, projects in development, and future projects; as well as their delivery timescale: short, medium and long-term.

Mass Transit is recognised as a better public transport option within Journey to Net Zero, noting that B&NES wants to deliver an attractive, high-quality transport solution that offers seamless journeys for everyone. Route options are being developed that have the potential to connect the highest volumes of people, city and town centres, as well as employment hubs. It suggests that, with the right combination of measures, the potential scale of carbon impact could be high.

Bath and North East Somerset Ecological Emergency (2020)

An ecological emergency has been declared by B&NES Council in response to the ongoing threat to wildlife and ecosystems. The declaration recognises the essential role nature plays in society and the economy and provides a statement of intent to protect wildlife and habitats, enabling residents to benefit from a green, nature rich environment.

Development of the Mass Transit will encourage a modal shift towards the use of public transport, and active travel also. Reduced levels of congestion will not only reduce levels of greenhouse gas emissions but also reduce the negative effects on surrounding eco-systems, aligning to the priorities of the Ecological Emergency declaration.

Bath and North East Somerset Climate Emergency Action Plan (2019)

The B&NES Climate Emergency Action Plan notes the following priority areas for action:

- Energy efficiency improvement of the majority of existing buildings and zero carbon new build
- Transport: a major shift to mass transport, walking and cycling to reduce transport emissions
- A rapid and large-scale increase in local renewable energy generation

The following areas are priorities for transport and active travel in the short-term:

- Continue to expand the walking and cycling networks across the district and promote active travel, investing an additional £150k
- To deliver cycling and walking infrastructure across B&NES
- Commence the delivery of Low Traffic Neighbourhoods to prioritise pedestrians and cyclists in residential areas
- Clean air zone (CAZ) project implemented in accordance with agreed programme
- Pilot a last mile delivery service to reduce supplier journeys into Bath
- Ensure the community infrastructure levy (CIL) funding helps to improve sustainable transport infrastructure
- Review of the use of the council's passenger transport fleet to maximise utilisation
- Ongoing reductions in council grey fleet mileage and grow pool car uptake
- Continue to promote flexible staff working and homeworking to reduce travel and promote sustainable transport options, as well as our salary sacrifice schemes for electric vehicles and bicycles

The objectives of the Mass Transit scheme align to the policies of the Climate Emergency Action Plan, namely through the facilitation of a modal shift towards mass transit and the use of public transport. This will reduce congestion, which will in turn reduce levels of carbon emissions, contributing to the goals of Net-Zero.

Bath and North East Somerset Local Plan (2016-36)

The Local Plan Partial update is due to be published in 2024, with consultation to commence this year. The current Local Plan (2018) references several Strategic Development Location (SDLs), which are of relevance to the corridor, as shown as follows. These include Whitchurch and Keynsham.

- The Whitchurch SDL was identified as part of the JSP as being an appropriate location for delivering in the region of 2,000 new homes including affordable housing, with 1,600 of these homes built during the plan period

- The Keynsham SDL is a development at North Keynsham of 1,500 new homes (1,400 within the Plan period) including affordable housing provision, 50,000 sqm of employment floorspace, a new school, a local centre and potential for a new marina

The development at North Keynsham will require the delivery of key transport infrastructure before new homes are completed, including the North Keynsham multi-modal Link Road from Avon Mill Lane to the A4, Keynsham railway station improvements and a metrobus (or high-quality public transport) route from Bristol to Keynsham in the A4 corridor. Other transport requirements include pedestrian and cycle connections (including to the Bristol to Bath Railway Path), a high frequency local bus service through the site, and off-site junction improvements.

Delivery of these SDLs will place pressure on the transport network through increases in trips made. This mass transit study will help to unlock SDL developments, and provides an opportunity to make sustainable connections through exploring options to provide the high-quality public transport link between Bristol and Bath.

The Mass Transit scheme will provide the necessary infrastructure to help enable development opportunities in North Keynsham, by improving connectivity and accessibility. Mass Transit will integrate into the active travel network to enable sustainable journeys. The scheme will also help to alleviate additional pressure on the transport network associated with new developments.

Bath and North East Somerset Economic Strategy (2014-2030)

The provision of an affordable, low carbon, accessible, integrated and reliable transport network that allows people to get around is essential to support economic growth in B&NES. A key component to supporting economic growth, and the development of sustainable connected communities, is accessibility to major employment locations. Ensuring that accessibility to major employment sites is improved will allow businesses to draw from a wider labour catchment area and residents to exercise sustainable transport options.

The implementation of a mass transit system between Bristol and Bath will help to meet the desire for improved connectivity to better connect to key employment sites. The Mass Transit scheme will provide increased connectivity and provide employers with access to a larger pool of skilled workers and help attract new business investment.

In addition, the scheme will enable improved connections and accessibility to education, work and training through a sustainable mode, which is essential to support the economic growth outlined in the Economic Strategy.

Getting Around Bath – A Transport Strategy for Bath (2014)

A key strand of Bath's transport strategy is to reduce the impact of vehicle movements. The strategy aims to achieve this reduction through a combination of measures, including better traffic management, comprehensive parking controls, expansion of P&R and enabling people to walk, cycle and use trains and buses. The following policies emphasise the need for a mass transit system and sustainable links into and out of Bath:

- Policy GABP4: Vehicle movement should be better managed to reduce traffic impact and emissions, particularly in the city centre where there is less space available
- Policy GABP6: The Enterprise Area is developed as part of an integrated approach with strong sustainable transport links to the city centre and rail stations. The development will focus initially on office and related development at the eastern end of the site and have limited car parking
- Policy GABP9: Improved bus services, with ticketing and other improvements and measures to improve reliability, will provide alternative travel options to car use, promoted through travel plans and comprehensive marketing

The Mass Transit scheme aligns to the policies outlined in the Bath Transport Strategy by enabling people to shift from single use cars to public transport and active travel. The proposed routes traverse the city centre to stop at Newbridge P&R and Bath Spa, enabling onward travel to and from destinations outside of the West of England. Bus Rapid Transit is one of the core technology modes being taken forward to the OBC stage of the scheme.

South Gloucestershire

Climate Emergency Strategy (2020-30)

South Gloucestershire declared a climate emergency in 2019 and pledged to provide the leadership to enable South Gloucestershire to become carbon neutral by 2030. In addition, the council signed up to the UK100 pledge to enable communities in the region to achieve 100% renewable energy across all sectors. The vision is for ‘a climate resilient South Gloucestershire with a thriving low carbon economy and lifestyle reflected in travel, homes, businesses, and communities, where nature can flourish.’ In order to achieve this vision, the strategic aims are as follows:

- For South Gloucestershire to become Carbon Neutral by 2030
- To maximise the generation of renewable energy from installations located within South Gloucestershire
- To ensure South Gloucestershire is prepared for the local impacts of a changing climate
- To ensure that nature in our local area is more protected connected and health and that biodiversity is increased
- To plant trees across South Gloucestershire by 2030 to double canopy cover

As part of the preparatory works for the design of the Mass Transit scheme, the Combined Authority is putting into place a biodiversity net gain strategy that will guide the scheme’s development.

In addition, the Mass Transit scheme is expected to enable sustainable journeys across South Gloucestershire, thereby contributing to the reduction in levels of congestion and levels of greenhouse gas emissions. As a result, it would contribute to the achievement of the strategic aims required to achieve the vision of becoming a low carbon economy using 100% renewable energy.

South Gloucestershire Local Plan: Policies, Sites and Places Plan (Adopted 2017)

The Policies, Sites and Places Plan forms part of the South Gloucestershire Local Plan. It is comprised of Development Management policies will be considered when considering the delivery of Mass Transit through South Gloucestershire.

Policies outlined cover the following themes:

- Responding to Climate Change and High-Quality Design
- Managing Future Development
- Tackling Congestion and Improving Accessibility
- Managing the Environment and Heritage
- Maintaining Economic Prosperity
- Providing Housing and Community Infrastructure

The policies covered in the Local Plan highlight a need for effective public transport connections in South Gloucestershire. Accordingly, the Mass Transit scheme will sustainably link under served, rural communities to major centres and destinations where employment opportunities, retail, education and community, health and education facilities are available. This will enhance economic prosperity and resilience in South Gloucestershire.

South Gloucestershire Health and Well-being Strategy (2017-21)

The Joint Health and Well-being Strategy sets out key areas of focus and actions, which members of the Health and Wellbeing Board will work together on to reduce health inequalities and improve the health and well-being of people living and working in South Gloucestershire. It details the following areas for action:

- Improve educational attainment of children and young people and promote their wellbeing and aspirations
- Promote and enable positive mental health and wellbeing for all
- Promote and enable good nutrition, physical activity and a healthy weight for all
- Maximise the potential of our built and natural environment to enable healthy lifestyles and prevent disease

The Mass Transit scheme will provide a reliable and efficient means of transport. Its integration into the active travel network will enable first and last mile active travel, contributing to better mental and physical health for all.

South Gloucestershire Economic and Skills Strategy (2016-20)

The Economic and Skills Strategy is underpinned by the Economic Development Plan, the Skills Employability Plan, and the Education Plan. The South Gloucestershire Local Strategic Partnership has outlined priorities for developing the economy within its

Sustainable Community Strategy 'South Gloucestershire 2036 – a great place to live and work.' The vision is for all in South Gloucestershire to access first-class education and prosper through a balanced economy, a well-trained workforce and sustainable jobs.

The priorities to achieve this vision are set out below:

- Support local business growth
- Support major businesses to stay in the area
- Help new businesses to form
- Promote South Gloucestershire to inward investors
- Improve training, skills, and workforce development
- Share the benefits of economic growth
- Improve education in schools

The Mass Transit scheme will help to support the priorities of the South Gloucestershire Economic and Skills Strategy through providing reliable and efficient transport services for employees to access work, education, and training. The resulting skilled workforce will enable businesses to form and grow in the area, while the improved resilience of the transport network will improve freight services.

South Gloucestershire Local Plan (2006-27)

The local plan for SGC is currently being revised due to the withdrawal of the JSP. The current over-arching aim of SGC's local plan is to ensure that in the future, the development and change of use of land in South Gloucestershire is consistent with the principles of sustainable development. A summary of the existing local plan is presented below which is subject to change.

The over-arching aim of SGC's local plan is to ensure that in future, the development and change of use of land in South Gloucestershire is consistent with the principles of sustainable development. The plan emphasises the need for public transport and aims to promote safe and sustainable transport with minimum environmental impact.

Within the plan there are a number of policies and objectives which are of relevance to the Mass Transit scheme, including:

- **Policy CS7 - Strategic Transport Infrastructure:** states that priority will be given to the implementation of strategic infrastructure proposals that reduce congestion and improve accessibility by means other than private car. The major scheme programme includes for a series of Rapid Transit Routes. It is currently envisaged that it will be a bus-based system but could provide the opportunity to upgrade to a Light Rapid Transit (tram) based system in the future. This segregated route will provide significant improvements in public transport delivery in South Gloucestershire, thereby forming the primary element of the strategy to reduce congestion.
- **Policy CS8 - Improving Accessibility** - reinforces the desire to provide a wide range of travel options as alternatives to private car for new development sites. It states that all

new development proposals will be encouraged to reduce greenhouse gas emissions by providing integrated walking, cycling and public transport infrastructure and contributions to bus services, and other initiatives such as commuter and car clubs and community transport projects.

South Gloucestershire Council identified their most highly-ranked priorities as ‘enabling and facilitating a modal shift from private car to public transport’ and ‘linking other forms of transport’. The proposed Mass Transit scheme is expected to achieve both goals, with modal shift and an interconnected transport network being strategic outcomes.

North Somerset

North Somerset Local Plan 2038 (Emerging, 2023)

North Somerset consulted on its emerging Local Plan in 2020, seeking views on the key challenges facing the district (July 2020) and on high-level approaches for delivering the growth required within the context of those challenges (November 2020).

As of August 2022, North Somerset has released its Preferred Options draft. This document identifies where development can and cannot take place in North Somerset and is intended to guide investment and funding to the year 2038. It is based around the following vision:

By 2038 there will be a transformation in the way we live which reflects a more responsible attitude to climate change and the use of resources. New homes, buildings and communities will be highly sustainable, accessible and attractive places with higher quality standards. There will be more diversity in terms of the form and type of new development to increase variety and choice to better meet the needs of all, create jobs and to tackle inequality. Regeneration will transform and breathe new life into existing towns and valued areas will be protected. People’s well-being, a strong sense of community, opportunity and fairness will be at the heart of all development in North Somerset.

A number of strategic priorities build on this vision, including the following, which are closely related to the provision of Mass Transit:

- To promote sustainable development and address the climate emergency.
- To increase the number and range of job opportunities across the district, particularly at the towns to give people the opportunity to work near to where they live
- To reduce car use, encourage walking and cycling, and high quality and effective public transport
- To deliver essential new strategic transport infrastructure to support new development and enable more sustainable travel options.
- To deliver higher residential densities through good design, particularly at town centres, transport hubs and on brownfield sites.
- To provide essential infrastructure in step with development, both transport infrastructure and community infrastructure such as schools, healthcare facilities and community centres.

Strategic Policy 10 (SP10), which focuses on transport, sets out that transport schemes must be developed in line with the following hierarchy:

- Delivery of attractive, safe, and inclusive routes for walking and cycling which are well integrated into existing networks and provide access to effective and frequent public transport
- Delivery of better local bus, rail and rapid transit services and infrastructure supporting uptake in public transport use within and between towns in North Somerset and further afield including, first and last mile provision, reallocation of highway space and new or improved bus stops
- Delivery of infrastructure to facilitate the use of electric vehicles
- Improvement of safety on the transport network for all users

New transport infrastructure will be considered where it also supports active travel and public transport, benefits community connectivity, public realm or provides safety improvements or is required to support economic development.

Mass Transit is directly referenced in reference to Locational Policy 2 (LP2), which focuses on the strategic location at Yanley Lane (Woodspring golf course). This new, mixed-use growth location is proposed to accommodate around 2,500 houses, including 875 affordable homes, a local centre, a new secondary school, and three 420-place primary schools. It is noted that the development must comply with a number of development principles, including that a segregated mass transit route will pass through the development, linked to the local centre, and provide the opportunity for fast, frequent access to Bristol.

Appropriate surface access improvements, including Mass Transit, are also needed to mitigate the adverse impact of airport traffic on local communities and the highway network, and facilitate a sustained modal shift to public transit.

The Local Plan timescale assumes adoption in December 2023.

North Somerset Economic Plan (2020)

In light of coronavirus, the North Somerset Economic Plan replaces the existing economic plan, which was due to run until 2036. It has two core drivers: helping those suffering economic hardships and building on the opportunities the crisis has revealed. The council is prioritising economic renewal activity around three key pillars:

- Providing inclusive growth and wellbeing for North Somerset people
- Delivering digital access for all
- Supporting green business and low carbon activities

Objectives of the Mass Transit are closely aligned to the key pillars of North Somerset's Economic Plan, and development of the scheme will therefore enable the achievement of these pillars. The Mass Transit system is expected to provide better access to employment and education facilities, contributing to the provision of inclusive growth. As a sustainable transport infrastructure, it will also contribute to the fostering of low carbon activities.

North Somerset Climate Emergency Strategy (2019)

The North Somerset Climate Emergency Strategy is a live document that outlines seven key principles for how NSC will address the causes and consequences of climate change, with the aim to be carbon neutral by 2030. The seven key principles are:

- Adapting to climate change
- Reduce emissions from transport
- Replenish our carbon stores
- Repair, reuse, reduce and recycle
- Renewable energy generation
- An energy efficient built environment
- Become a net zero carbon council

The Mass Transit system will help North Somerset to meet the majority of the seven key principles outlined in the Climate Emergency Strategy through not only delivering a sustainable transport initiative, but also encouraging a modal shift from the private car to the use of sustainable public transport. Achievement of such modal shift will also reduce the amount of greenhouse gas emissions from transport and facilitate the council's ambition of achieving net zero.

North Somerset Local Plan / Core Strategy (2017)

North Somerset Council's Local Plan has a vision for sustainable, inclusive, safe, healthy, prosperous communities thriving in a quality environment. Since the withdrawal of the JSP in 2019, the council is starting the process of preparing a local plan to shape investment and infrastructure funding to support new homes, workplaces and local facilities.

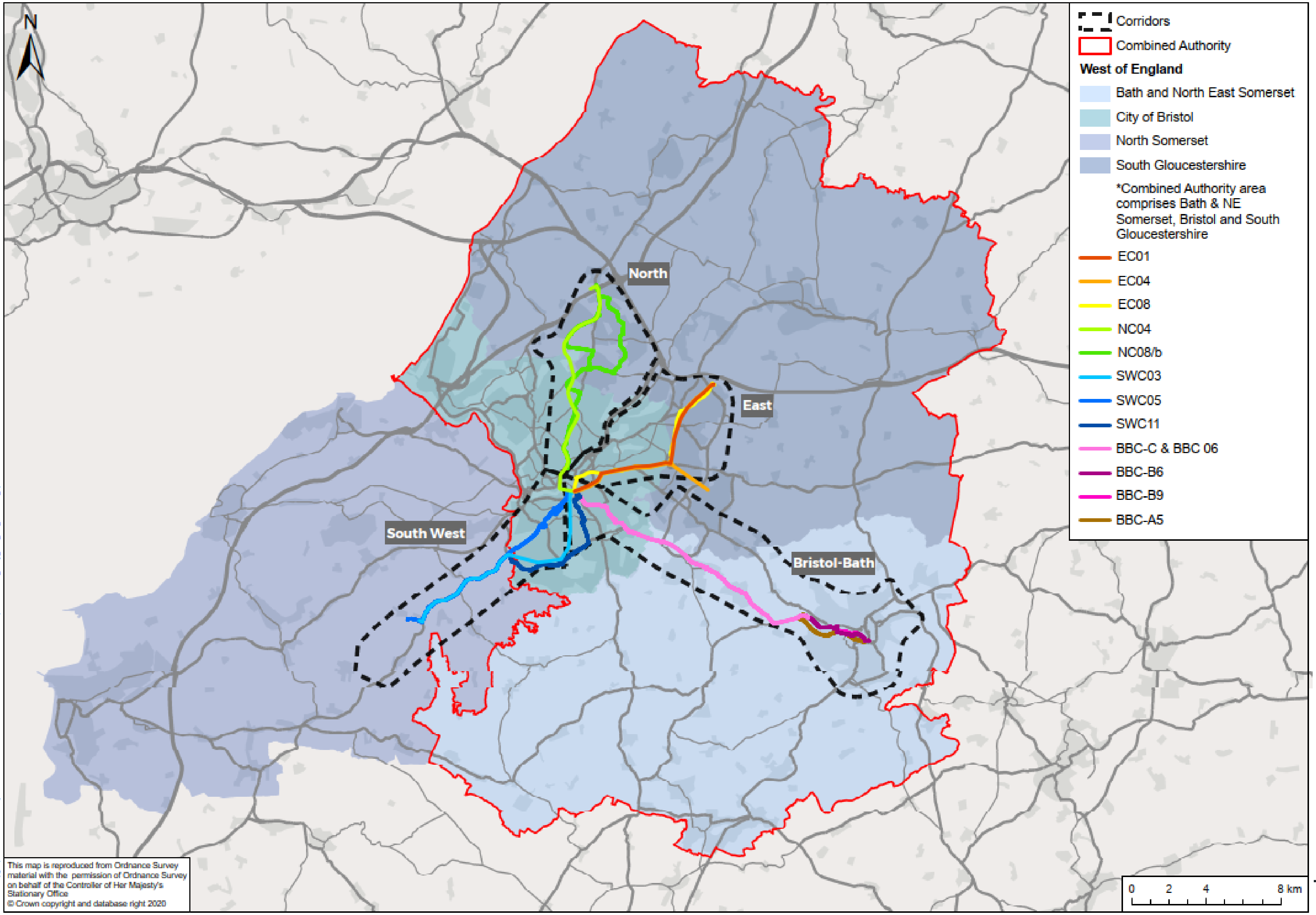
North Somerset's priorities are:

- Tackling disadvantage and promoting equality of opportunity
- Developing strong inclusive communities
- Ensuring safer communities
- Improving health and wellbeing
- Developing a prosperous economy and enterprising community
- Living within environmental limits

It is recognised that different parts of the West of England have differing levels of opportunity and deprivation. The Mass Transit scheme aims to reach into deprived areas, enabling better links between residential areas and employment and education. It is expected that these improved links will not only improve economic productivity, but also the health and wellbeing of North Somerset's communities.

Appendix C

Geographical Corridor Map


N
Corridors
Combined Authority
West of England
Bath and North East Somerset
City of Bristol
North Somerset
South Gloucestershire
*Combined Authority area comprises Bath & NE Somerset, Bristol and South Gloucestershire
EC01
EC04
EC08
NC04
NC08/b
SWC03
SWC05
SWC11
BBC-C & BBC 06
BBC-B6
BBC-B9
BBC-A5
North
East
South West
Bristol-Bath
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0 2 4 8 km

Appendix D

Combined Authority Core Strategic Functions

The following sets out the functions and responsibilities of the West of England Combined Authority as set out in the West of England Combined Authority Order 2017.

Core Strategic Functions

West of England Combined Authority Objectives

- Contribute to providing strong collective leadership and strategic direction to realise the full economic potential of the West of England
- Support the development and delivery of key strategies to improve the economic conditions across the West of England area
- Contribute to the formulation and expression of joint views (of the West of England Mayor and the local authorities) to central government and other bodies and organisations in respect of legislation, proposed legislation and other matters of concern, interest or relevance to the West of England economy with a particular focus on removing barriers to growth and the delegation of additional powers and funding
- Actively support the coordination of joint local authority activity across the West of England, including the activities of the Local Enterprise Partnership Business Board
- Work with appropriate agencies and bodies both within and beyond the West of England in order to achieve any shared economic objectives
- Ensure arrangements are in place to report the proposals and activities of the Combined Authority to the constituent councils
- Take any decisions required to deliver the West of England Devolution Deal(s) and the relevant Strategic Plans including additional funding, freedoms and flexibilities
- Provide a formal and accountable forum for decision making relating to all relevant West of England Combined Authority functions

Transport

The West of England Mayoral functions

- Devolved and consolidated local transport budget (including maintenance funding)
- Identify a Key Route Network
- Prepare a Local Transport Plan including:
  - Strategic infrastructure delivery plan
  - Bus strategy, including all quality partnership arrangement and Bus Services Bill Powers, for example franchising
  - Key Route Network (management and maintenance principles)

The West of England Combined Authority functions

- Power to deliver Grants to the UAs for the exercise of highway functions
- Integrated Transport Authority (ITA) powers:
  - Concessionary fares
  - Provision of local bus information

- Community Transport

- MoU with National Highways and Network Rail

The West of England Mayoral functions

- Designation of a Clean Air Zone (with consent from the constituent council)

West of England Combined Authority and Unitary Authority Joint functions

- Subsidised services - Socially necessary bus services

Planning and Housing

The West of England Mayoral functions

- Combined Authority (Mayoral) Spatial Plan (from May 2018)
- Strategic planning powers
  - Power to ‘call-in’ cross boundary, linear infrastructure (as identified in the Combined Authority (Mayoral) Spatial Strategy) planning applications
  - Compulsory purchase powers (CPO) (with consent from the constituent council)
  - Power to create Mayoral Development Corporations (with consent from the constituent council)

The West of England Combined Authority functions

- Promote the establishment of a Joint Assets Board for the West of England

Skills

The West of England Combined Authority functions

- Responsibility for 19+ Adult Education Budget (commissioning from 17/18, budget from 18/19)
- Apprenticeship Grant for Employers (AGE) (to 31 July 2017)

The West of England Combined Authority functions held concurrently with unitary authorities (can be exercised independently by the CA and the UAs)

- Provision of education and training for persons over compulsory school age
- Power to provide for additional Nursery Schools
- Power to provide for suitable education and training to meet the reasonable needs of persons who are— (i) over compulsory school age but under 19, and (ii) subject to youth detention in their area
- Power to provide for boarding accommodation for persons with learning difficulties
- Power to provide for securing and encouraging work experience

Employment

The West of England Combined Authority functions

- Co-design and co-commission of the new work and health programme
- An assessment of economic conditions of the Combined Authority area (held concurrently with unitary authorities and so can be exercised independently by the CA and the unitary authorities)
- Support the West of England Growth Hub
- Support Invest Bristol & Bath

Finance

The West of England Mayoral functions

- Mayoral Budget of the Combined Authority
- Power to raise supplementary business rates to fund infrastructure (subject to the agreement of business and up to 2p per pound of rateable value)

The West of England Combined Authority functions

- Creation and administration of the Single Investment Fund
- Approval of its borrowing limits
- Treasury management strategy, including reserves, investment strategy, borrowing and budget of the Combined Authority including the amount of any expenses, including a levy, to be met by the constituent Councils

Governance and Other Administration

The West of England Combined Authority functions

- Approval of the Combined Authority's Constitution and Standing Orders
- Exercise the General Power of Competence to the extent that those functions are exercisable for the purpose of economic development and regeneration
- Power to encourage visitors and provide conference and other facilities
- Power to place staff at the disposal of other local authorities
- Power to arrange for publication of information etc. relating to the functions of the authority
- Power to prosecute and defend legal proceedings
- Powers to research and collect information

Appendix E

CRSTS Delivery Plan

CRSTS Delivery Plan

The following schemes are part of the Combined Authority's delivery plan for the £540m City Region Sustainable Transport Settlement. The delivery plan includes an additional reserve list of schemes as part on an approach to overprogramming. The Combined Authority has flexibility to manage their programme in line with the approach to change control, but remains responsible for sourcing any additional funding required to deliver the agreed schemes.

Those schemes that are expected to interlink directly with the proposed Mass Transit scheme are highlighted. Other schemes are expected to have an impact on the wider transport network as they progress.

Name of Scheme	Description	Location
Bristol City Centre Sustainable Transport Corridor	Improving the appeal and effectiveness of public transport offer in Bristol City Centre, this project includes upgrading cycling and walking infrastructure, implementing Bus Priority and creating effective transport hubs/interchange across the city centre. This will deliver significant multi-modal transport benefits across the city.	Bristol
Long Ashton metrobus Improvements	Network improvements to the metrobus service to Long Ashton. These include changes to infrastructure at Bedminster Bridges roundabout, Bedminster Parade and Redcliff Hill to enable a more reliable service.	Bristol
Bath City Centre Sustainable Transport Corridor	Improving the appeal and effectiveness of public transport offer in Bath City Centre, this project includes upgrading cycling and walking infrastructure, improvements to the Bus Station and links across the river. This will deliver significant multi-modal transport benefits across the city.	Bath City Centre
Bristol to Bath Sustainable Transport Corridor - Bristol to Emery Road	Improving public transport services along the A4 Strategic Corridor from Bristol Temple Meads to the existing Park and Ride at Emery Road (5km). This already popular public transport service is hampered by a lack of continuous bus priority. This project would address much of the challenges to enable a more reliable and faster service. Walking and cycling infrastructure along the route is also being significantly improved.	A4 Corridor
Bristol to Bath Sustainable Transport Corridor - Keynsham to Bath	There is no bus priority at present along this 12.5km route that connects Bath to its largest town - Keynsham. Therefore, improving public transport offer along this section of the A4 is a priority. Walking and cycling infrastructure along the route is also being significantly improved.	A4 Corridor

Bristol to Bath Sustainable Transport Corridor - Transport Hub	The existing Park and Ride at Emery Road is near to capacity. Relocation to the A4/A4174 (ring road) junction would not only resolve the capacity issue, but would also reduce the amount of travel between the ring road and the existing park and ride. This would reduce air quality issues and trip generation.	A4 Corridor
M32 Sustainable Transport Corridor and Hub*	Providing a new transport hub, improvements to bus priority and improved active travel offer. This scheme removes substantial traffic entering the centre of Bristol that at present is generated from the M4. It includes a new junction off the M32, a new transport hub and parking, improvements to bus priority into the centre of Bristol and walking and cycling connections. *Scheme retained by DfT and subject to business case approval by HMG	Bristol (M32 is in Bristol)
Portway Sustainable Transport Corridor and Hub	Focused on enhancing the corridor between central Bristol, employment sites in Avonmouth and connections to the M5. These initiatives consist of upgrading the existing P&R site, bus segregation measures and improved cycling infrastructure.	Bristol
Stockwood to Cribbs Causeway Sustainable Transport Corridor	These are a number of activities related to infrastructure improvement regarding public transport offer in the A37/A4018 corridor. These upgrades include the provision of bus priority measures, road design and enhancement of cycling and walking routes across the covered area.	Bristol city
Thornbury to North Bristol Sustainable Transport Corridor	This is about a series of interventions focused on improving transport links and public transport services along the A38 connections from Thornbury to the M32.	A38 Thornbury to M32
Bristol to Hengrove metrobus extension	This consist of a series of upgrades to the existing metrobus route to Hengrove, in combination with bus stop upgrades and bus priority measures throughout the corridor.	Thornbury and Charfield (Bristol and South Gloucestershire)
Somer Valley to Bath Sustainable Transport Corridor	This activity is focused on improving links from the Somer Valley to Bath, including connections to rural communities. Interventions include better bus priority measures, creation of transport hubs and provision of new cycling infrastructure to connect those rural communities with Bath.	Somer Valley to Bath

Chipping Sodbury to Hambrook Sustainable Transport Corridor	These are a number of interventions focused on improving Active Travel links and public transport services in from University of the West of England (Frenchay) to Yate and Chipping Sodbury. Activities include enhancement of cycling infrastructure, creation of new transport hubs and road design.	Frenchay, Yate, Chipping Sodbury
Regional Station Accessibility	This activity aims to bring Lawrence Hill railway station up to a MetroWest standard regarding accessibility. Enhancements include full step free access, and where required improvements to wayfinding, easy walking and cycling access, improvements to security, CCTV and lighting.	Lawrence Hill
Charfield Railway Station*	This activity is focused on the construction of a new station at Charfield, between Gloucester and Yate. This will enable additional development and sustainable transport for new and existing residents of the village, including a transport hub. *Scheme retained by DfT and subject to business case approval by HMG	Charfield
B&NES – Bath & Midsomer Norton Walking and Cycling Packages	We will invest in walking and cycling facilities across Bath and Midsomer Norton area to improve the attractiveness of active travel, including new modes. The facilities include increased provision of cycle parking spaces and off-road and segregated walking and cycling routes.	B&NES – Bath & Midsomer Norton
Bristol to Bath Railway Path improvements	This activity aims to deliver enhancement to the Bristol Bath Railway Path in the South Gloucestershire area. Upgrading of lighting and access to the path is required. To achieve year-round model shift improved lighting and access is essential. This will enable commuters to access employment sites in Bristol, Bath and north fringe sustainably year-round.	South Glos
Bath and North East Somerset Liveable Neighbourhoods	Proposed liveable neighbourhood scheme in Bath which will engage with local residents and business through the 'co-design' process to understand the barriers to walking, cycling, public transport and wider 'liveability'. The project will see improvements to 5 Local Cycling and Walking Improvement Plan (LCWIP) routes and 5 Core Walking Zones alongside enhancements to local connections, and ecological assets (e.g. Sustainable Drainage Systems, tree planting and parklets)	B&NES

Bristol City Liveable Neighbourhoods	Proposed liveable neighbourhood scheme in Bristol focused on delivering 4 LCWIP routes and one Core Walking Zone alongside enhancements to local connections and ecological assets (e.g. SUDS, Tree planting and Parklets). The scheme will interface with the regeneration of the Temple Quarter Enterprise Zone, St Phillips Marsh and Temple Meads.	Central Bristol
South Gloucestershire Liveable Neighbourhoods	This is one of the liveable neighbourhood proposed schemes. It is focused on the delivery of Liveable Neighbourhood Strategy and policy across South Gloucestershire.	Yate & Thornbury
Integrated Smart Ticketing	Development of new and simplified bus ticketing options across all buses in the West of England Combined Authority and North Somerset Council. It will deliver tap-on, tap-off contactless ticketing. It will allow the introduction of fare capping, faster boarding processes and the removal of the need for prior network knowledge across users.	West of England and North Somerset
Regional Transport Branding	This activity is focused on the delivery of a Regional Transport Branding. This aims to drive higher patronage across public transport and active travel modes in the West of England.	Regional
Maintenance - ITB/Maintenance Funding	The Combined Authority (CA) will dedicate a section of the highway maintenance funding to cater for as yet unidentified localised safety and highway management improvements at locations which are outside the main proposals in the submission. This portion of funding will allow the CA to address any safety or traffic management issues which arise, in a timely fashion.	Regional
Maintenance Challenge Fund	The Combined Authority (CA) will dedicate a section of the highway maintenance funding to cater for as yet unidentified localised safety and highway management improvements at locations which are outside the main proposals in the submission. This portion of funding will allow the CA to address any safety or traffic management issues which arise, in a timely fashion.	Regional
Non-highways Maintenance	The Combined Authority (CA) will dedicate a section of the highway maintenance funding to cater for yet unidentified localised safety and highway management improvements at locations which are outside the main proposals in the submission. This portion of funding will allow the CA to address any safety or traffic management issues which arise, in a timely fashion.	Regional

Overprogramming - Sustainable Transport Corridor Additional Value pot	This is the opportunity for all strategic corridors to enhance their existing offer through further walking and cycling provision, enhancing connections to rural communities, first and last mile journey improvements and transport hubs	Regional
Overprogramming - Liveable Neighbourhoods Additional Value pot	This is the opportunity to enhance the liveable neighbourhood programme once trials are completed.	Regional
Overprogramming - Bus stop upgrades outside of Sustainable Transport Corridor routes	Further bus stops outside of the CRSTS sustainable transport corridors also require upgrade and standardisation.	Regional
Overprogramming - Bath City Centre sustainable transport corridor enhancements	This is the opportunity to enhance the Bath City Centre Sustainable Transport Corridor offer including further walking and cycling provision and further improvement for buses accessing the bus station.	Bath
Overprogramming - Concorde Way/ Dovercourt Depot	Off-road extension to walking and cycling strategic cycle route in North Bristol section, replacing current on-road section from Muller Road to Constable Road with high-quality walking and cycling path.	Lockleaze, Bristol
Overprogramming - Filton to MoD	Improvements to walking and cycling routes alongside the A4174 Ring Road in Filton, from Great Stoke Way (GSW) roundabout to the Ministry of Defence facility.	Filton, North Fringe
Overprogramming - Keynsham Road	Creation of a high-quality protected cycle and walking route between Bitton Station on the BBRP and Keynsham Station, along the Keynsham Road.	Bitton, SGC and Keynsham, B&NES
Overprogramming - Grovesend to Gillingstool	Stage 2 of the Thornbury Link, providing a segregated cycle route linking Thornbury to the A38 SC.	Thornbury

Appendix F

Theory of Change

Current / Future Situation

- Within the SGC and NSC areas, almost 70% of commuting journeys are by car
- Within B&NES and BCC areas 50% and 42% respectively of commuting trips are by car
- Two of every five of these journeys are less than 5km in distance
- 78% of all commuting trips between the different UAs are by car, with public transport trips representing only 6% and active travel 7%
- Significant gap between journey time in trips made by car vs journey made by public transport
- Population growth means that car trips are expected to increase by a further 8% by 2030

Drivers for Change: Dependence on private car

- Region ranks the lowest of all regions at £49.76 per £1,000 of GVA spent on transport
- 3,386 accidents recorded between 2017 and 2019 in the study area, 977 involved cyclist and 642 involved pedestrians. Concentrated in areas of congestion
- Capacity constraints on existing rail lines
- Over half of the responses to the draft JLTP4 felt that local bus services are not reliable nor good value for money, 55% of respondents felt that currently it is difficult to plan and make journeys by bus
- More than 50% of responses to draft JLTP4 agreed connectivity needed to be improved for neighbourhood trips within the region
- Inbound bus speeds in the AM peak on the A38(N), A38(S) and A420 were 6mph, and 8-11mph on the A4

Drivers for Change: Low public transport and active travel use

- Across the four corridors the average delay on A-roads is 72 seconds per vehicle mile, considerably higher than the UK average along A-roads of 25 seconds per vehicle mile
- Average speeds within study area are 23mph, compared to a 46mph UK average
- Average delay on A432, A420 and A38, of over 100 seconds of delay per vehicle mile
- Bristol is third most congested city in the UK
- 67 hours lost to congestion in 2021, a 90% increase on 2020 data
- £300m annual cost of congestion for the region
- Based on forecast growth and the current level of car dependence, journey times could increase by 9% by 2036, and time spent queuing in traffic could increase by 74%

Drivers for Change: Congestion, Delay and Journey Time Reliability

- Hot-spots on each corridor ranked in the top 5% of most deprived locations
- 68% correlation between household deprivation rank and the lack of access to a vehicle
- Areas such as Lockleaze, St. Pauls and Easton are not only some of the most deprived areas within the four corridors but are also among the most congested
- Life expectancy varies significantly between most and least deprived areas
- Across the West of England in 2017, 6.6% of 16- and 17-years olds were Not in Education, Employment or Training (NEET), above the national average of 6.0%

Drivers for Change: Regional inequality and deprivation

- Transport responsible for 32% of carbon emissions in the region, and has only fallen by 5% across the area since 2005
- Climate emergency declared by every authority in the region
- 106 Noise Important Aireas along the corridors
- To reach their 2030 Net Zero target, a 40% reduction must be made in private car mileage

Drivers for Change: Climate emergency

- Baseline growth projects 65,000 jobs and 2.6% GVA growth in the region
- Mismatch between skills provision and employment opportunities in growth sectors
- Average of 6,000 homes per year needed, including 30,000 affordable homes

Drivers for Change: Enabling regeneration and economic growth

Operational Objectives

- A transport system that provides integrated end-to-end journeys for users
- Increased capacity on the public transport network
- Frequent, affordable and reliable services
- An accessible, inclusive, safe and secure solution

Specific Objectives

- To improve user experience of public transport and active travel
- To reduce overall carbon emissions and improve air quality in the region
- To increase connectivity of services across the network
- To improve reliability and frequency of services on the four corridors by prioritising public transport
- To reduce journey times and congestion across the region
- To increase accessibility across the region for all
- To enhance the natural and built environment
- To deliver modal shift from private car to public transport and active travel

Strategic Outcomes

Delivering a world-class, transformational, public transport system, that:

- Connects the West of England region, thereby reducing deprivation and inequality, and contributing to the levelling up agenda
- Supports sustainable, economic growth and enables regeneration
- Contributes to delivering Carbon Net Zero
- Improves local environmental conditions and air quality
- Makes sustainable transport the preferred option for short to mid-distance journeys

Appendix G

BBSC Proposals


BRISTOL TO BATH STRATEGIC CORRIDOR - STRATEGIC OUTLINE CASE
MEDIUM 2 INTERVENTION
Key
New additional bus lane
New reallocated bus lane
Existing bus lane
Traffic significantly reduced from current flows due to bus gates & re-routing
Cycle path*
New transport hub and P&R
New transport interchange along bypass connecting to active travel links
Juntion improvements
* Only fully segregated cycle paths shown, other cycling improvements including where space does not allow for full segregation
P&R relocated from Brislington to Hicks Gate Transport Hub (and potentially expanded).
Option 6A and 6H
Additional bus lane in one direction.
Option 9/ Package E
Existing City Centre Loop
Section 1
Section 2
Section 3
Section 4
Section 5
Section 6
Three Lamps Junction
ARNO'S VALE
BRISLINGTON
KNOWLE
HENGROVE
Emery Road
Hicks Gate Roundabout
Keynsham
Broadmead Roundabout
Saltford
Kelston
Corston
A4/A36 Junction
Windsor Bridge
UPPER WESTON
WALCOT
BATHWICK
TWERTON
Bath
Bath Spa
Bath Spa University Newton Park Campus
Bath City Farm
Charlcombe
Bath Racecourse
Avon Valley Adventure & Wildlife Park
Knowle Golf Club
Stockwood Vale Golf Club
Whitehall Garden Centre
Queen Charlton
Chewton Keynsham
Burnett
Compton Dando
Publow
Pensford
Belluton
Norton Hawkfield
Norton Malreward
Stanton Drew
Stanton Prior
Wilmington
Marksbury
Hunstrete
Englishcombe
Conham River Park
HANHAM
BARRS COURT
Longwell Green
Willsbridge
Bitton
Upton Cheyney
Swineford
Beach
River Avon
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Appendix H

MCAF Criteria

Confidential

Table H-1 – Suitability criteria and sub-criteria

"To what extent does the option contribute to…?"

Criteria	Sub-criteria
Vision	To drive a step change in public transport connectivity and usage in the West of England, connecting us to a greener future and facilitating opportunities to unlock our potential for significant inclusive housing and employment growth in the region
Objective #1	Provide a step change in public transport connectivity, capacity and passenger journey experience across the sub-region to further reduce car dependency and with strong links to other modes of transport including rail, bus and air transport hubs
Objective #2	Complement the existing and proposed rail network and services and maximise interchange opportunities
Objective #3	Maximise opportunities for better health through increased physical activity, improved safety, improved air quality and implementation of green infrastructure
Objective #4	Reduce inequality in the region, ensuring access to the system is affordable for all and ensure user experience is front and centre to ensure the mass transit option is attractive to all
Objective #5	Identify opportunities for regeneration and growth, and how the mass transit solution can enable this (working with the unitary authorities to identify those locations) and the priorities within the Local Industrial Strategy, with an understanding of the extent to which different options might affect the scale of the opportunity – see section 9.3.8 regarding future development sites
Objective #6	Deliver mode shift to sustainable transport modes, from private car, to help tackle the climate emergency and move people more efficiently around our sub region

Table H-2 – Feasibility criteria

"What is the impact of…on the feasibility of the option?"

Criteria	Sub-criteria
Deliverability	Maturity of construction and operational technology Extent of physical and environmental constraints Extent of external dependencies beyond the scope and control of the scheme
Viability	Outturn cost and availability of funding Requirement for powers, consents Capability and capacity of delivery agent
Support	Alignment with local and regional policy

	Likely level of local political and stakeholder support Likely level of public support
Future Proofing	The extent to which the technology remains flexible to future uncertainty

Table H-3 – Acceptability criteria and sub-criteria

"To what extent does the option contribute to…?"

Criteria	Sub-criteria
Economic	Improving connectivity between businesses and their suppliers and markets Increasing labour market catchments (improving connectivity between economic centres and residential areas) Unlocking employment growth Unlocking housing growth Improving journey time reliability
Social	Improving access to employment, health, education, retail and social facilities Realising health benefits through the promotion of active travel Improving safety and wellbeing through improved quality of place Improving mobility by providing an accessible and seamless transport offer (including physical access, interchange, integration with the wider network and affordability) Addressing accessibility barriers for those in areas of deprivations or members of protected groups
Environmental	Minimising the contribution of transport to climate change through reducing whole-life carbon emissions Improving local air quality Protecting and enhancing the natural capital (biodiversity, habitat) Protecting and enhancing surface and groundwater quality, reducing and managing flood risk Protecting and enhancing the built environment (heritage, townscape)

Appendix I

MCAF Outputs

Table I-1 – North Corridor longlist assessment outcomes

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
NC01	MB	N	MB	SB	SA	SB	▪ Direct route and serves Southmead Hospital, Patchway, Filton and residential areas to the south ▪ Does not serve Cribbs Causeway ▪ Partial tunnelled / overground sections to overcome pinch points / constraints whilst balancing overall cost
NC02	MB	N	LB	MB	MA	SB	▪ Serves Southmead, Cribbs Causeway, Bradley Stoke, Bristol Parkway railway station, Redland railway station, University of West of England (UWE). ▪ Significant cost of tunnelling with two routes to the south ▪ NF03 serves a similar area but with one tunnelled section to the south
NC03	MB	N	LB	MB	MA	SB	▪ Serves Southmead Hospital, Cribbs Causeway, Patchway, Bradley Stoke, Bristol Parkway railway station, Filton Abbey Wood railway station, UWE, residential areas along A38 ▪ Partial tunnelled / overground sections to overcome pinch points / constraints whilst balancing overall cost ▪ Further work is required to understand the feasibility of serving Bradley Stoke in terms of demand and cost
NC04	MB	N	LB	MB	MA	SB	▪ Direct route and serves Southmead Hospital, Cribbs Causeway, Patchway, Filton and residential areas to the south

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
							▪ Partial tunnelled / overground sections to overcome pinch points / constraints whilst balancing overall cost ▪ Similar route to NF01 except serves Cribbs Causeway
NC05	SB	N	MB	MB	SA	N	▪ Capacity constraints on the existing line limit additional frequency of service ▪ This is not seen as the 'step change' sought by mass transit ▪ Would require Network Rail approvals, complicating feasibility
NC06 – bus / BRT	SB	N	SB	MB	N	SB	▪ Direct overground route and serves Southmead Hospital, Patchway, Filton and residential areas to the south ▪ Does not serve Cribbs Causeway ▪ Resultant impact of access restrictions on A38
NC06 – tram-train	SB	N	SB	MB	SA	N	
NC07	MB	N	MB	MB	SA	SB	▪ Serves Cribbs Causeway, Patchway, Bradley Stoke, Ministry of Defence (MOD), Bristol Parkway railway station, Filton and residential areas to the south ▪ Does not serve Southmead Hospital ▪ Resultant impact of access restrictions on A38 ▪ NF08 is a similar route, which does serve Southmead Hospital
NC08	MB	N	MB	MB	SA	SB	▪ Serves Southmead Hospital, Cribbs Causeway, Patchway, Bradley Stoke, MOD, Bristol Parkway railway station, Filton and residential areas to the south

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
							▪ Further detail required to understand potential for priority / segregation on A38 ▪ Resultant impact of access restrictions on A38
NC09	SB	N	MB	MB	SA	SB	▪ Serves Eastgate Retail Park, Filton, Cribbs Causeway, MOD, Stoke Gifford and Bradley Stoke ▪ Does not serve Southmead Hospital or residential areas to the south of Filton ▪ Does not serve attractions along the A38 ▪ Use of M32 would limit impact on A38
NC10	MB	N	MB	MB	SA	SB	▪ Serves Eastgate Retail Park, Lockleaze, Filton, Cribbs Causeway, MOD, Stoke Gifford and Bradley Stoke ▪ Does not serve Southmead Hospital or residential areas to the south of Filton ▪ Does not serve attractions along the A38 ▪ Use of M32 would limit impact on A38
NC11	SB	N	SB	SB	SA	N	▪ Serves Eastgate Retail Park, UWE, Filton, Cribbs Causeway, MOD ▪ Does not serve Southmead Hospital, residential areas to the south of Filton or residential areas to east of A38 ▪ Does not serve attractions along the A38 ▪ Use of M32 would limit impact on A38
NC12	MB	SA	LB	SB	MA	N	▪ Serves Southmead, Cribbs Causeway, Bradley Stoke, Bristol Parkway railway station, Redland railway station, UWE

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
							■ Significant cost of tunnelling with two routes to the south, other options serve area with single tunnel ■ Significant adverse impact on Purdown / Stoke Park Estate, stakeholder / public response could risk deliverability ■ NF03 serves a similar area but with one tunnelled section to the south

Table I-2 – East Corridor longlist assessment outcomes

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
EC01	MB	N	MB	MB	SA	SB	■ Serves Lawrence Hill railway station, St George, Kingswood, Staple Hill, Downend, Emersons Green and Bristol & Bath Science Park ■ A fully tunnelled option will provide full segregation and reliable journey times ■ High cost of fully tunnelled route
EC02	SB	SA	MB	SB	SA	N	■ Serves Lawrence Hill railway station, St George, Kingswood and Warmley ■ Does not serve the Bristol & Bath Science Park ■ Does not serve residential areas along A432 ■ Serves less areas of deprivation

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
							■ A tunnelled option will provide full segregation and reliable journey times ■ High cost of fully tunnelled route
EC03	MB	SA	LB	MB	MA	SB	■ Serves Lawrence Hill railway station, St George, Kingswood, Warmley, Cadbury Heath, Staple Hill, Downend, Emersons Green, Bristol & Bath Science Park and Lyde Green P&R ■ A tunnelled option will provide full segregation and reliable journey times ■ Very high cost of tunnelling on multiple sections of the route ■ Overground section between Lyde Green and Warmley would be on greenfield land (through golf club) which could have adverse response from stakeholders and could risk delivery
EC04	MB	N	MB	MB	SA	SB	■ As per EF03 but does not have north-south connection between Warmley and Lyde Green ■ Tunnelled option will provide full segregation and reliable journey times ■ Very high cost of tunnelling on multiple sections of the route
EC05	SB	SA	MB	MB	MA	N	■ As per EF03 but does not have north-south connection between Kingswood and Emersons Green ■ Does not serve Staple Hill, Downend and Emersons Green to the west of the A4174 ■ Overground section between Lyde Green and Warmley would be on greenfield land (through golf club) which could have adverse response from stakeholders and could risk delivery

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
EC06	MB	SA	LB	MB	MA	SB	▪ Serves Easton, Stapleton Road railway station, Fishponds, Lawrence Hill railway station, St George, Kingswood, Warmley, Cadbury Heath, Staple Hill, south of Downend, Emersons Green, Bristol & Bath Science Park and Lyde Green P&R ▪ Very high cost of tunnelling on two long sections of the route risks feasibility ▪ Overground section between Lyde Green and Warmley would be on A4174 which may be better received by stakeholders than greenfield options
EC07	MB	SA	MB	MB	SA	SB	▪ Most direct route between Bristol and Bristol & Bath Science Park via Lawrence Hill railway station, Staple Hill, south of Downend, Emersons Green ▪ Does not serve Lyde Green P&R ▪ Tunnelled option will provide full segregation and reliable journey times ▪ High cost of fully tunnelled route, but most direct route considered ▪ Could detrimentally impact on existing metrobus routes
EC08	MB	SB	MB	MB	N	SB	▪ Serves Lawrence Hill railway station, St George, Kingswood, Staple Hill, Downend, Emersons Green and Bristol & Bath Science Park ▪ Similar route to EF01, but an overground option ▪ Resultant impact on general traffic ▪ Further detail required to understand potential for priority / segregation on the route

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
EC09	SB	N	SB	SB	N	SB	▪ Serves Lawrence Hill railway station, St George, Kingswood, Warmley and Cadbury Heath ▪ Does not serve the Bristol & Bath Science Park ▪ Does not serve residential areas along A432 ▪ Serves less areas of deprivation
EC10	SB	SA	SB	MB	N	N	▪ Serves Lawrence Hill railway station, St George, Kingswood, Warmley, Cadbury Heath, Staple Hill, Downend, Emersons Green, Bristol & Bath Science Park and Lyde Green P&R ▪ Length of route may impact on journey times and attractiveness of system ▪ Resultant impact on general traffic given scale of option and number of roads that would potentially require restrictions, this is likely to be unacceptable by stakeholders ▪ Overground section between Lyde Green and Warmley would be on A4174 which may be better received by stakeholders than greenfield options
EC11 – bus / BRT	SB	SA	MB	N	SA	N	▪ Serves Lawrence Hill, parts of Easton, Fishponds, Staple Hill (indirectly), Emersons Green and Bristol & Bath Science Park ▪ Does not serve Lyde Green P&R ▪ Does not serve residential areas along the A420 ▪ Compromises the Bristol to Bath Railway Path with significant environmental impacts, lack of stakeholder support could impact on deliverability
EC11 – Tram-Train	SB	SA	MB	N	SA	N	

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
EC12	SB	SA	MB	MB	N	SB	▪ Serves Easton, Stapleton Road railway station, Fishponds, Lawrence Hill railway station, St George, Kingswood, Warmley, Cadbury Heath, Downend, Emersons Green, Bristol & Bath Science Park and Lyde Green P&R ▪ Length of route may impact on journey times and attractiveness of system ▪ Resultant impact on general traffic given scale of option and number of roads that would potentially require restrictions, this is likely to be unacceptable by stakeholders
EC13	SB	SA	SB	MB	N	SB	▪ Serves Easton, Stapleton Road railway station, Fishponds, Staple Hill, Lawrence Hill railway station, St George, Kingswood, Warmley, Cadbury Heath, Downend, Emersons Green ▪ Does not serve Bristol & Bath Science Park and Lyde Green P&R ▪ Length of route may impact on journey times and attractiveness of system ▪ Resultant impact on general traffic given scale of option and number of roads that would potentially require restrictions, this is likely to be unacceptable by stakeholders
EC14	MB	N	SB	MB	N	SB	▪ Most direct route between Bristol and Bristol & Bath Science Park via Stapleton Road railway station, Easton, Fishponds, Downend and Bromley Heath ▪ Does not serve Lyde Green P&R ▪ Does not serve residential areas along A420 ▪ Resultant impact on general traffic

<table>
<tr><th rowspan="3">Route No</th><th colspan="6">Overall Score</th><th rowspan="3">Comments</th></tr>
<tr><th rowspan="2">Suitability</th><th rowspan="2">Feasibility</th><th colspan="3">Acceptability</th><th rowspan="2">Overall</th></tr>
<tr><th>Economy</th><th>Social</th><th>Environment</th></tr>
<tr><td>EC15 – bus / BRT</td><td>SB</td><td>SA</td><td>SB</td><td>MB</td><td>N</td><td>N</td><td rowspan="2">▪ Route follows M32 from Bristol City Centre to Bristol & Bath Science Park
▪ Does not serve dense residential areas within the corridor
▪ Contradicts political aspirations to downgrade M32
▪ Requires Highways England (HE) approvals, complicating feasibility
▪ Could detrimentally impact on existing metrobus routes</td></tr>
<tr><td>EC15 – Tram-Train</td><td>SB</td><td>SA</td><td>SB</td><td>MB</td><td>SA</td><td>N</td></tr>
<tr><td>EC16 – bus / BRT</td><td>SB</td><td>SA</td><td>SB</td><td>MB</td><td>SA</td><td>N</td><td rowspan="2">▪ Route follows M32 from Bristol City Centre to Bristol & Bath Science Park
▪ Does not serve dense residential areas within the corridor
▪ Additional cost and deliverability risk of providing ‘double deck’ on M32, additional environmental implications
▪ Contradicts political aspirations to downgrade M32
▪ Requires HE approvals, complicating feasibility
▪ Could detrimentally impact on existing metrobus routes</td></tr>
<tr><td>EC16 - Tram-Train</td><td>SB</td><td>SA</td><td>SB</td><td>MB</td><td>SA</td><td>N</td></tr>
<tr><td>EC17</td><td>SB</td><td>SA</td><td>MB</td><td>MB</td><td>SA</td><td>N</td><td>▪ Follows existing rail line between Bristol Temple Meads, Lawrence Hill and Stapleton Road, potential frequency, and therefore step change, likely to be limited by capacity constraints
▪ Route follows M32 from Stapleton Road to Bristol & Bath Science Park
▪ Does not serve dense residential areas within the northern section of the corridor
▪ Additional cost and deliverability risk of providing ‘double deck’ on M32, additional environmental implications
▪ Contradicts political aspirations to downgrade M32
▪ Requires HE and Network Rail approvals, complicating feasibility</td></tr>
</table>

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
							▪ Could detrimentally impact on existing metrobus routes

Table I-3 – Bristol – Bath Corridor longlist assessment outcomes (end-to-end options [BBC01 to BBC05, BBC13])

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
BBC01	MB	N	MB	SB	SA	SB	▪ Direct route and serves Brislington, Keynsham and Saltford ▪ Tunnelled option will provide full segregation and reliable journey times ▪ High cost, significant physical constraints, environmental considerations ▪ BBC03 offers similar route but partial tunnelled / overground
BBC02	MB	N	MB	MB	SA	SB	▪ Serves Knowle, Longwell Green, Keynsham and Saltford, additional route length will impact substantially on journey times and costs ▪ Serves areas of deprivation ▪ Tunnelled option will provide full segregation and reliable journey times ▪ High cost and significant physical constraints of tunnelled option
BBC03	MB	N	MB	SB	SA	SB	▪ Direct route and serves Brislington, Keynsham and Saltford

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
							▪ Partially tunnelled / overground sections to overcome pinch points / constraints whilst balancing overall cost
BBC04	SB	SA	MB	SA	MA	N	▪ Does not serve Keynsham or Saltford ▪ Route length will impact on journey times compared to existing services ▪ Compromises the Bristol to Bath Railway Path with significant environmental impacts, lack of stakeholder support could impact on deliverability
BBC05	SB	N	MB	SB	SA	SB	▪ Capacity constraints on the existing line limit additional frequency of service ▪ This is not seen as the 'step change' sought by mass transit ▪ Would require Network Rail approvals, complicating feasibility
BBC13	MB	SA	MB	SB	MA	N	▪ This route is the same as BBC03 with the exception of a bypass of Saltford ▪ Stakeholder response to the bypass is likely to result in significant risk to deliverability ▪ Environmental impact of the bypass including that on natural capital ▪ Political support could be limited due to 'road building'

Table I-4 – Bristol – Bath Corridor longlist assessment outcomes (Bristol City Centre – A4 / A4174 junction [BBC-A to BBC-E])

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
BBC-A	SB	N	SB	MB	N	N	▪ Does not serve Bristol Temple Meads or Totterdown ▪ Could impact on existing A4 services ▪ Serves areas of deprivation
BBC-B	MB	N	MB	MB	N	SB	▪ Serves Bristol Temple Meads, but does not serve Totterdown ▪ Could impact on existing A4 services ▪ Significant constraints to east of Bristol Temple Meads incl. Cattle Market Road, rail underbridges
BBC-C	MB	SB	MB	MB	N	SB	▪ Most direct route, serves dense residential areas and Bristol Temple Meads ▪ Constraints on the A4 would need to be considered in more detail incl. residential / commercial property access and potential for segregation
BBC-D	MB	N	SB	MB	N	SB	▪ Serves Bristol Temple Meads and dense residential areas at Totterdown and Knowle ▪ Route length could impact journey times ▪ The impact on existing routes would likely leave areas along the A4 and A37 without services
BBC-E	MB	SB	MB	MB	N	SB	▪ Serves dense residential areas and Bristol Temple Meads ▪ Offers alternative to congested A4 ▪ Reliant on delivery of Callington Road Link, which is considered independent to the Mass Transit project

Table I-5 – Bristol – Bath Corridor longlist assessment outcomes (A4 / A4174 junction – Newbridge P&R [BBC06 to BBC12, BBC14])

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
BBC06	MB	SB	MB	SB	N	SB	▪ Most direct route and serves Brislington, Keynsham and Saltford ▪ Further detail required to understand potential for priority / segregation
BBC07	MB	SB	SB	MB	N	SB	▪ Serves Brislington, Keynsham Town Centre and Saltford ▪ Balance of impact on journey times and reliability through Keynsham Town Centre with additional demand ▪ Significant constraints likely in Keynsham Town Centre
BBC08	SB	N	SB	MB	N	N	▪ Does not serve Saltford, does serve west Keynsham and the railway station ▪ Route length could impact journey times, with potential for a worse offer than existing services therefore not a 'step change'
BBC09	N	SA	SB	SB	N	N	▪ Does not serve Keynsham or Saltford, does serve Longwell Green ▪ Route length could impact journey times to a greater extent than other options. The offer is likely to be worse than existing services and not a 'step change'

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
BBC10 – bus / BRT	N	SA	SB	N	SA	N	▪ Does not serve Saltford, does serve west Keynsham and the railway station ▪ Route length will impact on journey times compared to existing services ▪ Compromises the Bristol to Bath Railway Path with significant environmental impacts, lack of stakeholder support could impact on deliverability
BBC10 – Tram-Train	N	SA	SB	N	MA	N	
BBC11 – bus / BRT	MB	SA	MB	MB	SA	N	▪ This route is the same as BBC06 with the exception of a bypass of Saltford ▪ Stakeholder response to the bypass is likely to result in significant risk to deliverability ▪ Environmental impact of the bypass including that on natural capital ▪ Political support could be limited due to 'road building'
BBC11 – Tram-Train	MB	SA	MB	SB	SA	N	
BBC12 – bus / BRT	SB	N	MB	MB	N	SB	▪ Serves Keynsham, Longwell Green, Saltford and Keynsham railway station ▪ Additional route length will impact on journey times and costs ▪ The impact on journey times and costs of diversion to Longwell Green is deemed unacceptable. This link could be explored at a later stage.
BBC12 – Tram-Train	SB	N	MB	MB	SA	N	

Route No	Overall Score						Comments
	Suitability	Feasibility	Acceptability			Overall	
			Economy	Social	Environment		
BBC14	MB	SB	SB	MB	SA	SB	■ This route is the same as BBC07 with the exception that it would serve the north Keynsham potential development location ■ Given *SDS* programme, future development sites are not being considered at this stage of assessment therefore this option performs the same as BBC07.

Appendix J

Appraisal Output Tables

Confidential

Economic Efficiency of the Transport System (TEE)

Non-business: Commuting	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs	Passengers	Passengers	
Travel time	86,296		-	-	86,296	-
Vehicle operating costs	-		-			-
User charges	-			-	-	
During Construction & Maintenance	-					
NET NON-BUSINESS BENEFITS: COMMUTING	86,296	(1a)	- -	-	86,296	-

Non-business: Other	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs	Passengers	Passengers	
Travel time	- 315,220		- 626,897	-	311,678	-
Vehicle operating costs	- 47,930		- 47,930			-
User charges	-			-	-	
During Construction & Maintenance	-					
NET NON-BUSINESS BENEFITS: OTHER	- 363,150	(1b)	- 674,828	-	311,678	

Business

User benefits			Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers	
Travel time	- 359,277		- 38,667	- 340,723	-		20,113	
Vehicle operating costs	- 43,941		- 11,730	- 32,211				
User charges	-				-		-	
During Construction & Maintenance	-							
Subtotal	- 403,218	(2)	- 50,397	- 372,934	-	-	20,113	

Private sector provider impacts				Freight	Passengers	
Revenue	130,326		- 657,977		788,303	
Operating costs	- 130,266		- 130,266			
Investment costs	-		-			
Grant/subsidy	-					
Subtotal	60	(3)				

Other business impacts						
Developer contributions	-	(4)				
NET BUSINESS IMPACT	- 403,158	(5) = (2) + (3) + (4)				

TOTAL		
Present Value of Transport Economic Efficiency Benefits (TEE)	- 680,012	(6) = (1a) + (1b) + (5)

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.

All entries are discounted present values, in 2010 prices and values

Public Accounts (PA) Table

	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	**TOTAL**		**INFRASTRUCTURE**			
Revenue	-					-
Operating Costs	833		833			-
Investment Costs	-					-
Developer and Other Contributions	-					
Grant/Subsidy Payments	-					
NET IMPACT	**833**	***(7)***				
Central Government Funding: Transport						
Revenue	-					-
Operating costs	-					-
Investment Costs	558,532					558,532
Developer and Other Contributions	-					
Grant/Subsidy Payments	-					
NET IMPACT	**558,532**	***(8)***				
Central Government Funding: Non-Transport						
Indirect Tax Revenues	- 2,315	*(9)*	21,510			- 23,825
TOTALS						
Broad Transport Budget	559,366	*(10) = (7) + (8)*				
Wider Public Finances	- 2,315	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values in 2010 prices and values.

Analysis of Monetised Costs and Benefits (£000s)

Noise	- 3,716	*(12)*
Local Air Quality	- 6,501	*(13)*
Greenhouse Gases	- 14,846	*(14)*
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	- 55,737	*(17)*
Economic Efficiency: Consumer Users (Commuting)	86,296	*(1a)*
Economic Efficiency: Consumer Users (Other)	- 363,150	*(1b)*
Economic Efficiency: Business Users and Providers	- 403,158	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	2,315	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	- 763,126	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	559,366	*(10)*
Present Value of Costs (see notes) (PVC)	559,366	*(PVC) = (10)*

OVERALL IMPACTS

Net Present Value (NPV)	- 1,322,492	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	-	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Economic Efficiency of the Transport System (TEE)

Non-business: Commuting	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs	Passengers	Passengers	
Travel time	84,156		-	-	84,156	-
Vehicle operating costs	-		-			-
User charges	-			-	-	
During Construction & Maintenance	-					
NET NON-BUSINESS BENEFITS: COMMUTING	84,156	*(1a)*	- -	-	84,156	-

Non-business: Other	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs	Passengers	Passengers	
Travel time	- 391,689		- 692,907	-	301,218	-
Vehicle operating costs	- 42,703		- 42,703			-
User charges	-			-	-	
During Construction & Maintenance	-					
NET NON-BUSINESS BENEFITS: OTHER	- 434,392	*(1b)*	- 735,610	-	301,218	

Business

User benefits			Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers	
Travel time	- 376,084		- 35,895	- 360,215	-		20,026	
Vehicle operating costs	- 42,613		- 10,694	- 31,919				
User charges	-				-		-	
During Construction & Maintenance	-							
Subtotal	- 418,697	*(2)*	- 46,589	- 392,134	-	-	20,026	
Private sector provider impacts						Freight	Passengers	
Revenue	132,668				- 655,405		788,073	
Operating costs	- 130,266				- 130,266			
Investment costs	-				-			
Grant/subsidy	-							
Subtotal	2,402	*(3)*						
Other business impacts								
Developer contributions	-	*(4)*						
NET BUSINESS IMPACT	- 416,296	*(5) = (2) + (3) + (4)*						
TOTAL								
Present Value of Transport Economic Efficiency Benefits (TEE)	- 766,532	*(6) = (1a) + (1b) + (5)*						

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.

All entries are discounted present values, in 2010 prices and values

Public Accounts (PA) Table

	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	**TOTAL**		**INFRASTRUCTURE**			
Revenue	-					-
Operating Costs	558		558			-
Investment Costs	-					-
Developer and Other Contributions	-					
Grant/Subsidy Payments	-					
NET IMPACT	**558**	***(7)***				
Central Government Funding: Transport						
Revenue	-					-
Operating costs	-					-
Investment Costs	544,646					544,646
Developer and Other Contributions	-					
Grant/Subsidy Payments	-					
NET IMPACT	**544,646**	***(8)***				
Central Government Funding: Non-Transport						
Indirect Tax Revenues	- 4,299	*(9)*	19,954			- 24,253
TOTALS						
Broad Transport Budget	545,204	*(10) = (7) + (8)*				
Wider Public Finances	- 4,299	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values in 2010 prices and values.

Analysis of Monetised Costs and Benefits (£000s)

Noise	- 2,486	*(12)*
Local Air Quality	- 4,350	*(13)*
Greenhouse Gases	- 12,431	*(14)*
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	- 37,293	*(17)*
Economic Efficiency: Consumer Users (Commuting)	84,156	*(1a)*
Economic Efficiency: Consumer Users (Other)	- 434,392	*(1b)*
Economic Efficiency: Business Users and Providers	- 416,296	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	4,299	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	- 827,392	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	545,204	*(10)*
Present Value of Costs (see notes) (PVC)	545,204	*(PVC) = (10)*

OVERALL IMPACTS

Net Present Value (NPV)	- 1,372,595	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	-	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Economic Efficiency of the Transport System (TEE)

Non-business: Commuting	ALL MODES		ROAD		BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs		Passengers	Passengers	
Travel time	253,683		-		-	253,683	-
Vehicle operating costs	-		-				-
User charges	-				-	-	
During Construction & Maintenance	-						
NET NON-BUSINESS BENEFITS: COMMUTING	253,683	*(1a)*	-	-	-	253,683	-

Non-business: Other	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs	Passengers	Passengers	
Travel time	844,055		12,953	-	831,102	-
Vehicle operating costs	1,497		1,497			-
User charges	-			-	-	
During Construction & Maintenance	-					
NET NON-BUSINESS BENEFITS: OTHER	845,552	*(1b)*	14,450	-	831,102	

Business

User benefits			Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers	
Travel time	85,359		1,445	7,546	-		76,369	
Vehicle operating costs	1,595		459	1,136				
User charges	-				-		-	
During Construction & Maintenance	-							
Subtotal	86,955	*(2)*	1,904	8,682	-	-	76,369	
Private sector provider impacts						Freight	Passengers	
Revenue	550,170				- 622,478		1,172,648	
Operating costs	- 787,471				- 787,471			
Investment costs	-				-			
Grant/subsidy	-							
Subtotal	- 237,301	*(3)*						
Other business impacts								
Developer contributions	-	*(4)*						
NET BUSINESS IMPACT	- 150,347	*(5) = (2) + (3) + (4)*						

TOTAL		
Present Value of Transport Economic Efficiency Benefits (TEE)	948,888	*(6) = (1a) + (1b) + (5)*

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.

All entries are discounted present values, in 2010 prices and values

Public Accounts (PA) Table

	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	**TOTAL**		**INFRASTRUCTURE**			
Revenue	-					-
Operating Costs	- 1,485		- 1,485			-
Investment Costs	-					-
Developer and Other Contributions	-					
Grant/Subsidy Payments	-					
NET IMPACT	**- 1,485**	***(7)***				
Central Government Funding: Transport						
Revenue	-					-
Operating costs	-					-
Investment Costs	5,372,658					5,372,658
Developer and Other Contributions	-					
Grant/Subsidy Payments	-					
NET IMPACT	**5,372,658**	***(8)***				
Central Government Funding: Non-Transport						
Indirect Tax Revenues	- 117,085	*(9)*	- 16,508			- 100,577
TOTALS						
Broad Transport Budget	5,371,172	*(10) = (7) + (8)*				
Wider Public Finances	- 117,085	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values in 2010 prices and values.

Analysis of Monetised Costs and Benefits (£000s)

Noise	6,621	*(12)*
Local Air Quality	11,584	*(13)*
Greenhouse Gases	- 6,477	*(14)*
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	99,315	*(17)*
Economic Efficiency: Consumer Users (Commuting)	253,683	*(1a)*
Economic Efficiency: Consumer Users (Other)	845,552	*(1b)*
Economic Efficiency: Business Users and Providers	- 150,347	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	117,085	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	942,846	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	5,371,172	*(10)*
Present Value of Costs (see notes) (PVC)	5,371,172	*(PVC) = (10)*

OVERALL IMPACTS

Net Present Value (NPV)	- 4,428,326	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	0.2	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Economic Efficiency of the Transport System (TEE)

Non-business: Commuting	**ALL MODES**		**ROAD**	**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**	**Passengers**	**Passengers**	
Travel time	86,296		-	-	86,296	-
Vehicle operating costs	-		-			-
User charges	-			-	-	
During Construction & Maintenance	-					
NET NON-BUSINESS BENEFITS: COMMUTING	86,296	*(1a)*	- -	-	86,296	-

Non-business: Other	**ALL MODES**		**ROAD**	**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**	**Passengers**	**Passengers**	
Travel time	- 315,220		- 626,897	-	311,678	-
Vehicle operating costs	- 47,930		- 47,930			-
User charges	-			-	-	
During Construction & Maintenance	-					
NET NON-BUSINESS BENEFITS: OTHER	- 363,150	*(1b)*	- 674,828	-	311,678	

Business

User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time	- 359,277		- 38,667	- 340,723	-		20,113	
Vehicle operating costs	- 43,941		- 11,730	- 32,211				
User charges	-				-		-	
During Construction & Maintenance	-							
Subtotal	- 403,218	*(2)*	- 50,397	- 372,934	-	-	20,113	
Private sector provider impacts						**Freight**	**Passengers**	
Revenue	130,326				- 657,977		788,303	
Operating costs	- 572,915				- 572,915			
Investment costs	-				-			
Grant/subsidy	-							
Subtotal	- 442,589	*(3)*						
Other business impacts								
Developer contributions	-	*(4)*						
NET BUSINESS IMPACT	- 845,807	*(5) = (2) + (3) + (4)*						
TOTAL								
Present Value of Transport Economic Efficiency Benefits (TEE)	- 1,122,661	*(6) = (1a) + (1b) + (5)*						

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.

All entries are discounted present values, in 2010 prices and values

Public Accounts (PA) Table

	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	**TOTAL**		**INFRASTRUCTURE**			
Revenue	-					-
Operating Costs	833		833			-
Investment Costs	-					-
Developer and Other Contributions	-					
Grant/Subsidy Payments	-					
NET IMPACT	**833**	***(7)***				
Central Government Funding: Transport						
Revenue	-					-
Operating costs	-					-
Investment Costs	638,275					638,275
Developer and Other Contributions	-					
Grant/Subsidy Payments	-					
NET IMPACT	**638,275**	***(8)***				
Central Government Funding: Non-Transport						
Indirect Tax Revenues	- 2,315	*(9)*	21,510			- 23,825
TOTALS						
Broad Transport Budget	639,109	*(10) = (7) + (8)*				
Wider Public Finances	- 2,315	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values in 2010 prices and values.

Analysis of Monetised Costs and Benefits (£000s)

Noise	- 3,716	*(12)*
Local Air Quality	- 6,501	*(13)*
Greenhouse Gases	- 19,893	*(14)*
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	- 55,737	*(17)*
Economic Efficiency: Consumer Users (Commuting)	86,296	*(1a)*
Economic Efficiency: Consumer Users (Other)	- 363,150	*(1b)*
Economic Efficiency: Business Users and Providers	- 845,807	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	2,315	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	- 1,210,823	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	639,109	*(10)*
Present Value of Costs (see notes) (PVC)	639,109	*(PVC) = (10)*

OVERALL IMPACTS

Net Present Value (NPV)	- 1,849,932	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	-	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Economic Efficiency of the Transport System (TEE)

Non-business: Commuting	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs	Passengers	Passengers	
Travel time	84,156		-	-	84,156	-
Vehicle operating costs	-		-			-
User charges	-			-	-	
During Construction & Maintenance	-					
NET NON-BUSINESS BENEFITS: COMMUTING	84,156	*(1a)*	- -	-	84,156	-

Non-business: Other	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs	Passengers	Passengers	
Travel time	- 391,689		- 692,907	-	301,218	-
Vehicle operating costs	- 42,703		- 42,703			-
User charges	-			-	-	
During Construction & Maintenance	-					
NET NON-BUSINESS BENEFITS: OTHER	- 434,392	*(1b)*	- 735,610	-	301,218	

Business

User benefits			Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers	
Travel time	- 376,084		- 35,895	- 360,215	-		20,026	
Vehicle operating costs	- 42,613		- 10,694	- 31,919				
User charges	-				-		-	
During Construction & Maintenance	-							
Subtotal	- 418,697	*(2)*	- 46,589	- 392,134	-	-	20,026	
Private sector provider impacts						Freight	Passengers	
Revenue	132,668				- 655,405		788,073	
Operating costs	- 572,915				- 572,915			
Investment costs	-				-			
Grant/subsidy	-							
Subtotal	- 440,247	*(3)*						
Other business impacts								
Developer contributions	-	*(4)*						
NET BUSINESS IMPACT	- 858,945	*(5) = (2) + (3) + (4)*						
TOTAL								
Present Value of Transport Economic Efficiency Benefits (TEE)	- 1,209,181	*(6) = (1a) + (1b) + (5)*						

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.

All entries are discounted present values, in 2010 prices and values

Public Accounts (PA) Table

	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	**TOTAL**		**INFRASTRUCTURE**			
Revenue	-					-
Operating Costs	558		558			-
Investment Costs	-					-
Developer and Other Contributions	-					
Grant/Subsidy Payments	-					
NET IMPACT	**558**	***(7)***				
Central Government Funding: Transport						
Revenue	-					-
Operating costs	-					-
Investment Costs	623,631					623,631
Developer and Other Contributions	-					
Grant/Subsidy Payments	-					
NET IMPACT	**623,631**	***(8)***				
Central Government Funding: Non-Transport						
Indirect Tax Revenues	- 4,299	*(9)*	19,954			- 24,253
TOTALS						
Broad Transport Budget	624,188	*(10) = (7) + (8)*				
Wider Public Finances	- 4,299	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values in 2010 prices and values.

Analysis of Monetised Costs and Benefits (£000s)

Noise	- 2,486	*(12)*
Local Air Quality	- 4,350	*(13)*
Greenhouse Gases	- 17,344	*(14)*
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	- 37,293	*(17)*
Economic Efficiency: Consumer Users (Commuting)	84,156	*(1a)*
Economic Efficiency: Consumer Users (Other)	- 434,392	*(1b)*
Economic Efficiency: Business Users and Providers	- 858,945	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	4,299	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	- 1,274,953	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	624,188	*(10)*
Present Value of Costs (see notes) (PVC)	624,188	*(PVC) = (10)*

OVERALL IMPACTS

Net Present Value (NPV)	- 1,899,142	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	-	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Economic Efficiency of the Transport System (TEE)

Non-business: Commuting	ALL MODES		ROAD		BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs		Passengers	Passengers	
Travel time	253,683		-		-	253,683	-
Vehicle operating costs	-		-				-
User charges	-				-	-	
During Construction & Maintenance	-						
NET NON-BUSINESS BENEFITS: COMMUTING	253,683	*(1a)*	-	-	-	253,683	-

Non-business: Other	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
User benefits	TOTAL		Private Cars and LGVs	Passengers	Passengers	
Travel time	844,055		12,953	-	831,102	-
Vehicle operating costs	1,497		1,497			-
User charges	-			-	-	
During Construction & Maintenance	-					
NET NON-BUSINESS BENEFITS: OTHER	845,552	*(1b)*	14,450	-	831,102	

Business

User benefits			Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers	
Travel time	85,359		1,445	7,546	-		76,369	
Vehicle operating costs	1,595		459	1,136				
User charges	-				-		-	
During Construction & Maintenance	-							
Subtotal	86,955	*(2)*	1,904	8,682	-	-	76,369	
Private sector provider impacts						Freight	Passengers	
Revenue	550,170				- 622,478		1,172,648	
Operating costs	- 1,107,458				- 1,107,458			
Investment costs	-				-			
Grant/subsidy	-							
Subtotal	- 557,289	*(3)*						
Other business impacts								
Developer contributions	-	*(4)*						
NET BUSINESS IMPACT	- 470,334	*(5) = (2) + (3) + (4)*						
TOTAL								
Present Value of Transport Economic Efficiency Benefits (TEE)	628,901	*(6) = (1a) + (1b) + (5)*						

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.

All entries are discounted present values, in 2010 prices and values

Public Accounts (PA) Table

	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	**TOTAL**		**INFRASTRUCTURE**			
Revenue	-					-
Operating Costs	- 1,485		- 1,485			-
Investment Costs	-					-
Developer and Other Contributions	-					
Grant/Subsidy Payments	-					
NET IMPACT	**- 1,485**	***(7)***				
Central Government Funding: Transport						
Revenue	-					-
Operating costs	-					-
Investment Costs	6,336,641					6,336,641
Developer and Other Contributions	-					
Grant/Subsidy Payments	-					
NET IMPACT	**6,336,641**	***(8)***				
Central Government Funding: Non-Transport						
Indirect Tax Revenues	- 117,085	*(9)*	- 16,508			- 100,577
TOTALS						
Broad Transport Budget	6,335,156	*(10) = (7) + (8)*				
Wider Public Finances	- 117,085	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values in 2010 prices and values.

Analysis of Monetised Costs and Benefits (£000s)

Noise	6,621	*(12)*
Local Air Quality	11,584	*(13)*
Greenhouse Gases	- 11,794	*(14)*
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	99,315	*(17)*
Economic Efficiency: Consumer Users (Commuting)	253,683	*(1a)*
Economic Efficiency: Consumer Users (Other)	845,552	*(1b)*
Economic Efficiency: Business Users and Providers	- 470,334	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	117,085	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	617,542	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	6,335,156	*(10)*
Present Value of Costs (see notes) (PVC)	6,335,156	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	- 5,717,614	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	0.1	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Appraisal Summary Table

Date produced:	04.08.2023

Contact:	
Name	
Organisation	West of England Combined Authority
Role	Promoter/Official

Name of scheme:	West of England Mass Transit
Description of scheme:	The West of England Mass Transit scheme consists of improved transport measures across the West of England area. Three network options across four travel corridors (North, East, South West, and Bristol-Bath) have been appraised: Overground network 1 (OG1), Overground network 2 (OG2) and Underground network 1 (UG1). Four modes have been considered within the appraisal: Bus Rapid Transit (BRT), Trackless Light Transit (TLT), Light Rail Transit (LRT) and Very Light Rail (VLR). This Appraisal Summary Table refers to the appraisal results of all three network options, assuming all three will consist of BRT improvements.

Impacts		Summary of key impacts	Assessment: Quantitative	Assessment: Qualitative	Assessment: Monetary £(NPV)	Assessment: Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	The Mass Transit scheme will provide seamless travel across the region, improving connectivity from more rural areas into employment centres seen in areas such as Bristol city centre. The scheme will generate benefits to business users travelling via public transport by improving the existing congestion problem faced particularly in the outskirts and into Bristol city centre. Highway users will experience a disbenefit for the overground options, as a lack of segregation between bus and car users may worsen travel for those in private cars.	Value of journey time changes(£) Net journey time changes (£) 0 to 2min / 2 to 5min / > 5min	N/A	OG1: -£358.3m OG2: -£376.1m UG1: £85.4m	
	Reliability impact on Business users	The scheme will provide a fully segregated mass transit system in the West of England, allowing it to bypass existing traffic entirely in the form of either overground or underground routes. This will significantly improve the reliability offered by public transport and improve network resilience. The integration of Mass Transit with the wider transport network will improve reliability of end-to-end journeys with seamless interchange within Bristol City Centre and at interchange hubs across the network.	Not quantified at this stage	Beneficial	Not quantified at this stage	
	Regeneration	Not assessed	Not quantified at this stage	N/A	Not quantified at this stage	
	Wider Impacts	The scheme is expected to increase economic output and productivity through increased efficiency of the network connectivity. There are anticipated to be benefits in term of agglomeration and labour supply impacts, and output change in imperfectly competitive markets. The Economic Narrative sets out the anticipated wider impacts of the scheme in more detail. At this stage, a high-level assessment of wider impacts has been undertaken which includes an uplift on user benefits for agglomeration, and an uplift on business user benefits for output change.	N/A	N/A	OG1: -£272.4m OG2: -£301.0m UG1: £245.2m	
Environmental	Noise	The scheme proposals are expected to encourage modal shift thereby reducing the amount of vehicle movements along all four corridors. The overground networks may result in some additional ground traffic noise, particularly associated with the diversion of general traffic along routes anticipated to be largely residential in nature. The underground option is not expected to result in increased noise levels once operational.	N/A	N/A	OG1: -£3.7m OG2: -£2.5m UG1: £6.6m	
	Air Quality	It is anticipated that the scheme will improve air quality by encouraging modal shift and reducing the amount of vehicle movements along all four corridors. Available traffic data shows that all networks may produce a significant reduction in traffic flow along the A38 between Bond Street and Ashley Down Road where the Mass Transit route is closed to general traffic; this will reduce emissions of NO2 and PM and would benefit the AQMA. The overground networks are anticipated to increase traffic along dispersal routes taken by general traffic, this will disbenefit the air quality at the sensitive receptors along largely residential streets, and within the vicinity of the section of the Mass Transit route, where closed to general traffic.	N/A	N/A	OG1: -£6.5m OG2: -£4.3m UG1: £11.6m	
	Greenhouse gases	The reduction in highway kilometres as a result of modal shift will lead to a net decrease in user greenhouse gas emissions. Likewise, the scheme may adversely impact greenhouse gases as a result of increased vehicular traffic along dispersal routes.	Change in non-traded carbon over 60y (CO2e): OG1: 178,422 tonnes; OG2: 142,864 tonnes; UG1: -7,881 tonnes Change in traded carbon over 60y (CO2e):	N/A	OG1: -£14.8m OG2: -£12.4m UG1: -£6.5m	
	Landscape and Townscape	It is assumed the setting for the proposed new Mass Transit infrastructure would be in line with the character of the existing local area. The closure of lanes to general traffic may have potential beneficial effects on the streetscape, encouraging active travel and benefitting commercial and residential areas. Potential effects on visual amenity could arise as a result of introducing new transport modes and associated infrastructure and increased traffic flows on diversionary routes for a number of sensitive receptors (residential properties, cycle routes etc). The underground network could affect the landscape/townscape character of the local area as a result of the introduction of permanent infrastructure such as station access points and ventilation shafts. Above ground infrastructure would be sensitively designed in the character of the local townscape. Potential effects on visual amenity could arise as a result of introducing new transport infrastructure in view of sensitive receptors.	N/A	Moderate Adverse	N/A	
	Historic Environment	It is predicted that the networks (both overground and underground) have the potential for high impacts to the setting of several heritage assets during operation. There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure, however the design process would account for, and protect, these assets.	N/A	Moderate Adverse	N/A	
	Biodiversity	Where the route uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. Overhead electrification infrastructure if required for the Mass Transit route, could impact protected species through collision of species with cabling and vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes. It is anticipated that protected species may potentially be affected by direct impacts, from injury through to mortality of species and indirect disturbance impacts such as from noise and lighting if not suitably mitigated as a result of the operation of the overground networks. It is not anticipated that there will be a significant adverse impact on ecological receptors during operation of the underground sections of the scheme. There is the potential for the Mass Transit network to have an impact on designated sites, further ecological assessment work in relation to these sites would be carried out as the scheme progresses, as appropriate.	N/A	Slight Adverse	N/A	
	Water Environment	All networks will involve infrastructure that passes through areas of surface water associated with the headwaters of small streams where there is the potential for adverse impacts on flood risk. Parts of the route may be at risk of groundwater flooding, due to the presence of groundwater flow barriers. For below ground structures, if they are below the water table, new drainage requirements may be needed. The overground network involves increased risk of spillage / runoff and creating pollutant pathways to groundwater depending on drainage design.	N/A	Slight Adverse	N/A	
Social	Commuting and Other users	The Mass Transit scheme will provide seamless travel across the region, improving connectivity from more rural areas into employment centres seen in areas such as Bristol city centre. The scheme will generate benefits to commuters and other public transport users by improving the existing congestion problem faced particularly in the outskirts and into Bristol city centre. Highway users will experience a disbenefit for the overground options, as a lack of segregation between bus and car users may worsen travel for those in private cars.	Value of journey time changes(£) Net journey time changes (£) 0 to 2min / 2 to 5min / > 5min	N/A	OG1: -£228.9m OG2: -£307.5m UG1: £1,097.8m	
	Reliability impact on Commuting and Other users	The scheme will provide a fully segregated mass transit system in the West of England, allowing it to bypass existing traffic entirely in the form of either overground or underground routes. This will significantly improve the reliability offered by public transport and improve network resilience. The integration of Mass Transit with the wider transport network will improve reliability of end-to-end journeys with seamless interchange within Bristol City Centre and at interchange hubs across the network.	Not quantified at this stage	Beneficial	Not quantified at this stage	
	Physical activity	As part of the proposed Mass Transit system there is provision for walking and cycling infrastructure as part of each of the options. This seeks to encourage an increase in sustainable journeys which could have beneficial effects on physical activity and associated health benefits. Further, the use of public transport encourages first mile / last mile trips by active modes to access the network. Therefore, the Mass Transit system is anticipated to encourage the use of active travel through access, egress and the infrastructure provided as part of the scheme, resulting in benefits in terms of physical activity.	Not quantified at this stage	Beneficial	Not quantified at this stage	
	Journey quality	The Mass Transit scheme will provide a high-quality, modern public transport system equipped with a high standard of passenger facilities. To further improve journey qulity, the scheme will include useful on-board and off-board information and will offer frequent services to avoid issues such as overcrowding. The segregation of Mass Transit from general traffic, and impacts of this on operation, will reduce the stress / frustration of travelling in the region. This will improve overall journey quality.	N/A	Large Beneficial	N/A	
	Accidents	The reduction in traffic as a result of the scheme, particularly within Bristol city centre where the potential for collisions is high, should improve safety for those living and working in the four corridors. A wider network of safer routes should encourage more walking, cycling and public transport trips within the region.	A high level quantification and monetisation of accident impacts has been udnertaken using the Marginal External Costs (MECs) approach based on the change in highway kilometres travelled as a result of the scheme at this stage.	N/A	OG1: -£55.7m OG2: -£37.3m UG1: £99.3m	
	Security	The Mass Transit system will increase the actual and perceived security of passengers by creating well-lit and visible stop locations and operating secure vehicles which are fitted with CCTV.	N/A	Large Beneficial	N/A	
	Access to services	The introduction of the scheme will provide access to key destinations, including employment and leisure facilities within the four corridors. In particular this will provide connections between locations which are currently not well linked by public transport services. The scheme will have a positive impact on the avilability and physical accessibility of transport with the vehicles meeting accessibility standards and improving the quality of travel for passengers.	N/A	Beneficial	N/A	
	Affordability	Within the appraisal, it has been assumed that fares are consistent between current public transport costs and Mass Transit fares. Therefore, for public transport passengers who switch to Mass Transit there are not considered to be affordability impacts. Where travellers switch to Mass Transit from car there may be a change in user cost as a result of paying fares, however it is assumed within the model where a decision is made to switch modes this is based on the balance of costs and journey times.	N/A	Neutral	N/A	
	Severance	To assess the impact of the scheme on severance the Do Minimum and Do Something level of severance has been compared. Based on the descriptions above it is anticipated that the scheme will result in areas of moderate severance reducing to slight. This is considered a conservative assessment but reflects the scale of the area covered by the Mass Transit network, and the different pedestrian movements included within this. Where traffic redistributes to other routes as a result of the scheme (i.e. largely for overground options / sections of options where there may be one-way systems or road closures), there is the potential for an adverse impact on severance on these routes. This will be considered further as the modelling framework develops and captures modal shift and wider network impacts of the options in more detail.	N/A	Slight Beneficial	N/A	
	Option and non-use values	The scheme will provide a step change in transport service compared to existing transport provision in the West of England. It will provide a segregated, reliable service that will connect communities in and around the West of England. It is noted however, there is likely to be a rationalisation of bus services on some of the corridors which may impact on the public transport availability to wider areas. It is anticipated that as part of consideration of first mile / last mile solutions end to end journeys will be provided for, mitigating some of the impacts on bus services.	N/A	Neutral	N/A	
Public Accounts	Cost to Broad Transport Budget	The Broad Transport Budget which captures the public sector cost of the scheme (Capital and Operational costs) has been estimated in line with TAG.	N/A	N/A	OG1: -£559.4m OG2: -£545.2m UG1: -£5,371.2m	
	Indirect Tax Revenues	The scheme will result in increased indirect tax revenues as a result of greater spending on public transport fares and fuel spends.	N/A	N/A	OG1: -£2.3m OG2: -£4.3m UG1: -£117.1m	

Appraisal Summary Table

Date produced:	04.08.2023	**Contact:**	
Name of scheme:	West of England Mass Transit	**Name**	
Description of scheme:	The West of England Mass Transit scheme consists of improved transport measures across the West of England area. Three network options across four travel corridors (North, East, South West, and Bristol-Bath) have been appraised: Overground network 1 (OG1), Overground network 2 (OG2) and Underground network 1 (UG1). Four modes have been considered within the appraisal: Bus Rapid Transit (BRT), Trackless Light Transit (TLT), Light Rail Transit (LRT) and Very Light Rail (VLR). This Appraisal Summary Table refers to the appraisal results of all three network options, assuming all three will consist of LRT improvements.	**Organisation**	West of England Combined Authority
		Role	Promoter/Official

	Impacts	Summary of key impacts	Assessment: Quantitative	Assessment: Qualitative	Assessment: Monetary £(NPV)	Assessment: Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	The Mass Transit scheme will provide seamless travel across the region, improving connectivity from more rural areas into employment centres seen in areas such as Bristol city centre. The scheme will generate benefits to business users travelling via public transport by improving the existing congestion problem faced particularly in the outskirts and into Bristol city centre. Highway users will experience a disbenefit for the overground options, as a lack of segregation between bus and car users may worsen travel for those in private cars.	Value of journey time changes(£) Net journey time changes (£) 0 to 2min / 2 to 5min / > 5min	N/A	OG1: -£359.3m OG2: -£376.1m UG1: £85.4m	
Economy	Reliability impact on Business users	The scheme will provide a fully segregated mass transit system in the West of England, allowing it to bypass existing traffic entirely in the form of either overground or underground routes. This will significantly improve the reliability offered by public transport and improve network resilience. The integration of Mass Transit with the wider transport network will improve reliability of end-to-end journeys with seamless interchange within Bristol City Centre and at interchange hubs across the network.	Not quantified at this stage	Beneficial	Not quantified at this stage	
Economy	Regeneration	Not assessed	Not quantified at this stage	N/A	Not quantified at this stage	
Economy	Wider Impacts	The scheme is expected to increase economic output and productivity through increased efficiency of the network connectivity. There are anticipated to be benefits in term of agglomeration and labour supply impacts, and output change in imperfectly competitive markets. The Economic Narrative sets out the anticipated wider impacts of the scheme in more detail. At this stage, a high-level assessment of wider impacts has been undertaken which includes an uplift on user benefits for agglomeration, and an uplift on business user benefits for output change.	N/A	N/A	OG1: -£272.4m OG2: -£301.0m UG1: £245.2m	
Environmental	Noise	The scheme proposals are expected to encourage modal shift thereby reducing the amount of vehicle movements along all four corridors. The overground networks may result in some additional ground traffic noise, particularly associated with the diversion of general traffic along routes anticipated to be largely residential in nature. The underground option is not expected to result in increased noise levels once operational.	N/A	N/A	OG1: -£3.7m OG2: -£2.5m UG1: £6.6m	
Environmental	Air Quality	It is anticipated that the scheme will improve air quality by encouraging modal shift and reducing the amount of vehicle movements along all four corridors. Available traffic data shows that all networks may produce a significant reduction in traffic flow along the A38 between Bond Street and Ashley Down Road where the Mass Transit route is closed to general traffic; this will reduce emissions of NO2 and PM and would benefit the AQMA. The overground networks are anticipated to increase traffic along dispersal routes taken by general traffic, this will disbenefit the air quality at the sensitive receptors along largely residential streets, and within the vicinity of the section of the Mass Transit route, where closed to general traffic.	N/A	N/A	OG1: -£6.5m OG2: -£4.3m UG1: £11.6m	
Environmental	Greenhouse gases	The reduction in highway kilometres as a result of modal shift will lead to a net decrease in user greenhouse gas emissions. Likewise, the scheme may adversely impact greenhouse gases as a result of increased vehicular traffic along dispersal routes.	Change in non-traded carbon over 60y (CO2e): OG1: 178,422 tonnes OG2: 142,864 tonnes UG1: -7,881 tonnes Change in traded carbon over 60y (CO2e):	N/A	OG1: -£19.9m OG2: -£17.3m UG1: -£11.8m	
Environmental	Landscape and Townscape	It is assumed the setting for the proposed new Mass Transit infrastructure would be in line with the character of the existing local area. The closure of lanes to general traffic may have potential beneficial effects on the streetscape, encouraging active travel and benefitting commercial and residential areas. Potential effects on visual amenity could arise as a result of introducing new transport modes and associated infrastructure and increased traffic flows on diversionary routes for a number of sensitive receptors (residential properties, cycle routes etc). The underground network could affect the landscape/townscape character of the local area as a result of the introduction of permanent infrastructure such as station access points and ventilation shafts. Above ground infrastructure would be sensitively designed in the character of the local townscape. Potential effects on visual amenity could arise as a result of introducing new transport infrastructure in view of sensitive receptors.	N/A	Moderate Adverse	N/A	
Environmental	Historic Environment	It is predicted that the networks (both overground and underground) have the potential for high impacts to the setting of several heritage assets during operation. There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure, however the design process would account for, and protect, these assets.	N/A	Moderate Adverse	N/A	
Environmental	Biodiversity	Where the route uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. Overhead electrification infrastructure if required for the Mass Transit route, could impact protected species through collision of species with cabling and vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes. It is anticipated that protected species may potentially be affected by direct impacts, from injury through to mortality of species and indirect disturbance impacts such as from noise and lighting if not suitably mitigated as a result of the operation of the overground networks. It is not anticipated that there will be a significant adverse impact on ecological receptors during operation of the underground sections of the scheme. There is the potential for the Mass Transit network to have an impact on designated sites, further ecological assessment work in relation to these sites would be carried out as the scheme progresses, as appropriate.	N/A	Slight Adverse	N/A	
Environmental	Water Environment	All networks will involve infrastructure that passes through areas of surface water associated with the headwaters of small streams where there is the potential for adverse impacts on flood risk. Parts of the route may be at risk of groundwater flooding, due to the presence of groundwater flow barriers. For below ground structures, if they are below the water table, new drainage requirements may be needed. The overground network involves increased risk of spillage / runoff and creating pollutant pathways to groundwater depending on drainage design.	N/A	Slight Adverse	N/A	
Social	Commuting and Other users	The Mass Transit scheme will provide seamless travel across the region, improving connectivity from more rural areas into employment centres seen in areas such as Bristol city centre. The scheme will generate benefits to commuters and other public transport users by improving the existing congestion problem faced particularly in the outskirts and into Bristol city centre. Highway users will experience a disbenefit for the overground options, as a lack of segregation between bus and car users may worsen travel for those in private cars.	Value of journey time changes(£) Net journey time changes (£) 0 to 2min / 2 to 5min / > 5min	N/A	OG1: -£228.9m OG2: -£307.5m UG1: £1,097.7m	
Social	Reliability impact on Commuting and Other users	The scheme will provide a fully segregated mass transit system in the West of England, allowing it to bypass existing traffic entirely in the form of either overground or underground routes. This will significantly improve the reliability offered by public transport and improve network resilience. The integration of Mass Transit with the wider transport network will improve reliability of end-to-end journeys with seamless interchange within Bristol City Centre and at interchange hubs across the network.	Not quantified at this stage	Beneficial	Not quantified at this stage	
Social	Physical activity	As part of the proposed Mass Transit system there is provision for walking and cycling infrastructure as part of each of the options. This seeks to encourage an increase in sustainable journeys which could have beneficial effects on physical activity and associated health benefits. Further, the use of public transport encourages first mile / last mile trips by active modes to access the network. Therefore, the Mass Transit system is anticipated to encourage the use of active travel through access, egress and the infrastructure provided as part of the scheme, resulting in benefits in terms of physical activity.	Not quantified at this stage	Beneficial	Not quantified at this stage	
Social	Journey quality	The Mass Transit scheme will provide a high-quality, modern public transport system equipped with a high standard of passenger facilities. To further improve journey qulity, the scheme will include useful on-board and off-board information and will offer frequent services to avoid issues such as overcrowding. The segregation of Mass Transit from general traffic, and impacts of this on operation, will reduce the stress / frustration of travelling in the region. This will improve overall journey quality.	N/A	Large Beneficial	N/A	
Social	Accidents	The reduction in traffic as a result of the scheme, particularly within Bristol city centre where the potential for collisions is high, should improve safety for those living and working in the four corridors. A wider network of safer routes should encourage more walking, cycling and public transport trips within the region.	A high level quantification and monetisation of accident impacts has been udnertaken using the Marginal External Costs (MECs) approach based on the change in highway kilometres travelled as a result of the scheme at this stage.	N/A	OG1: -£55.7m OG2: -£37.3m UG1: £99.3m	
Social	Security	The Mass Transit system will increase the actual and perceived security of passengers by creating well-lit and visible stop locations and operating secure vehicles which are fitted with CCTV.	N/A	Large Beneficial	N/A	
Social	Access to services	The introduction of the scheme will provide access to key destinations, including employment and leisure facilities within the four corridors. In particular this will provide connections between locations which are currently not well linked by public transport services. The scheme will have a positive impact on the avilability and physical accessibility of transport with the vehicles meeting accessibility standards and improving the quality of travel for passengers.	N/A	Beneficial	N/A	
Social	Affordability	Within the appraisal, it has been assumed that fares are consistent between current public transport costs and Mass Transit fares. Therefore, for public transport passengers who switch to Mass Transit there are not considered to be affordability impacts. Where travellers switch to Mass Transit from car there may be a change in user cost as a result of paying fares, however it is assumed within the model where a decision is made to switch modes this is based on the balance of costs and journey times.	N/A	Neutral	N/A	
Social	Severance	To assess the impact of the scheme on severance the Do Minimum and Do Something level of severance has been compared. Based on the descriptions above it is anticipated that the scheme will result in areas of moderate severance reducing to slight. This is considered a conservative assessment but reflects the scale of the area covered by the Mass Transit network, and the different pedestrian movements included within this. Where traffic redistributes to other routes as a result of the scheme (i.e. largely for overground options / sections of options where there may be one-way systems or road closures), there is the potential for an adverse impact on severance on these routes. This will be considered further as the modelling framework develops and captures modal shift and wider network impacts of the options in more detail.	N/A	Slight Beneficial	N/A	
Social	Option and non-use values	The scheme will provide a step change in transport service compared to existing transport provision in the West of England. It will provide a segregated, reliable service that will connect communities in and around the West of England. It is noted however, there is likely to be a rationalisation of bus services on some of the corridors which may impact on the public transport availability to wider areas. It is anticipated that as part of consideration of first mile / last mile solutions end to end journeys will be provided for, mitigating some of the impacts on bus services.	N/A	Neutral	N/A	
Public Accounts	Cost to Broad Transport Budget	The Broad Transport Budget which captures the public sector cost of the scheme (Capital and Operational costs) has been estimated in line with TAG.	N/A	N/A	OG1: -£639.1m OG2: -£624.2m UG1: -£6,336.6m	
Public Accounts	Indirect Tax Revenues	The scheme will result in increased indirect tax revenues as a result of greater spending on public transport fares and fuel spends.	N/A	N/A	OG1: -£2.3m OG2: -£4.3m UG1: -£117.1m	

Appendix K

Adjusted BCRs

Confidential

Table K-1 - Corridor option adjusted BCR

(£m, 2010 PV)	NC04	NC08	NC08b	EC01	EC04	EC08	BBC	SWC03	SWC05	SWC11
Rubber-wheeled (BRT)										
Adjusted PVB	637	-86	-63	184	380	-413	-583	108	6	-212
PVC	1,672	195	193	1,649	2,078	77	122	1,496	128	155
Adjusted BCR	**0.4:1**	**VP VfM**	**VP VfM**	**0.1:1**	**0.2:1**	**VP VfM**	**VP VfM**	**0.1:1**	**0.0:1**	**VP VfM**
Steel-wheeled (LRT)										
Adjusted PVB	554	-208	-185	132	330	-502	-696	29	-92	-338
PVC	1,972	219	217	1,949	2,456	91	142	1,764	146	175
Adjusted BCR	**0.3:1**	**VP VfM**	**VP VfM**	**0.1:1**	**0.1:1**	**VP VfM**	**VP VfM**	**0.0:1**	**VP VfM**	**VP VfM**

Table K-2 - Network option adjusted BCR

Adjusted Appraisal Results (£m, 2010 PV)	Network 1	Network 2	Network 3
Rubber-wheeled (BRT)			
Adjusted PVB	-1,036	-1,128	1,188
PVC	559	545	5,371
Adjusted BCR	VP VfM	VP VfM	0.2:1
Steel-wheeled (LRT)			
Adjusted PVB	-1, 483	-1,576	863
PVC	639	624	6,335
Adjusted BCR	VP VfM	VP VfM	0.1:1

Appendix L

Environmental Appraisal Tables

Options Assessment Table - Overground Network 1 - NC08b, EC08, SWC11, BBC-C+BBC-06+BBC-A5, Option B

Option Ref		**NC08b**
Option Summary		**Option description (and baseline) as per NF08 other than Ch550 to 3000 -** Width constraints require all general through traffic to be removed; traffic would still be permitted to cross the route. General traffic would be re-routed along existing A and B classification routes, possible using the M32 for longer, end to end journeys**.** • MT route baselines are as per the NF08 assessment in the table above and this are not repeated below. • No diversionary routes have been identified at this time for assessment but it is considered that similar impacts and effects would be anticipated to those envisaged with respect to NC08.
Noise and Vibration	Baseline - key aspects and importance / significance	The route passes through 12 road NIAs: • 297 runs (in part) north from St James Barton roundabout to the Arley Hull/Bath Buildings junction on the A38 Cheltenham Road/Stokes Croft; • 296 runs along the A38 Cheltenham Road/Gloucester Road from the junction with Winsley Road to just before the junction with Bolton Road; • 295 runs along the A38 Gloucester Road from just after the junction with Brynland Avenue to the junction with Dongola Avenue; • 294 runs along the A38 Gloucester Road from just before the junction with Tortworth Road to the junction with Beaufort Road; • 293 runs along the A38 Gloucester Road from the junction with Court Road to just before the junction with Highbury Road; • 292 runs along the A38 Filton Road from the junction with Doone Road to just after the junction with Montreal Avenue; • 314 runs along the A38 Gloucester Road from just after the Filton Roundabout to Filton College South; • 289 runs along the A4174 Station Road from the junction with Shellard Road to the junction with Emma-Chris Way; • 290 runs along the A4174 Station Road and New Road from the junction between New Road and Pilkington Close to just before the junction between the A4174 Station Road and New Road; • 288 runs along the A38 Gloucester Road from just after the junction with the B4057 Gipsy Patch Lane to just past where the A38 Gloucester Road crosses the railway line; • 287 runs along the A38 Gloucester Road from just before Sandhurst Close to the junction with Hempton Lane; and • 286 runs along the A38 Gloucester Road from the ends of Manor Grove and Oaktree Crescent. There are around 12000 properties along the MT route out of which more than 7600 are residential and more than 4600 are non-residential. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[1], baseline daytime noise levels are generally above $L_{Aeq,16h}$ 55dB (free-field) at the nearest houses along the A38 and Filton Road. Noise levels are generally below $L_{Aeq,16h}$ 55dB (free-field) at houses away from the main roads.
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors. However, it is anticipated that adverse impacts associated with above ground construction works including from plant and waste (spoil) haulage are likely. Noise and vibration impacts could be a particular issue for local residents along the cut and cover section between Ch3000 and 3700**.**
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that overall the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs. However, some additional above ground traffic noise is expected, particularly associated with the diversion of general traffic along A and B classification routes, anticipated to be largely residential in nature. A quantitative assessment should be undertaken at the appropriate stage in accordance with DMRB LA111 to verify benefits in noise levels as a result of modal shift.
	Impact Assessment (operation)	**Slight Beneficial**
Air Quality	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. Air quality impacts could be a particular issue for local residents along the cut and cover section between Ch3000 and 3700. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. Available traffic data shows that there will be significant reduction in traffic flow along the A38 between Bond Street and Ashley Down Road where the MT route is closed to general traffic; this will reduce emissions of nitrogen dioxide (NO2) and particulate matter (PM) and would benefit the AQMA. It is anticipated that there will be an increase in traffic along dispersal routes taken by general traffic, this will disbenefit the air quality at the sensitive receptors along largely residential streets, such as Muller Road, Kellaway Avenue and Coldharbour Road, and within the vicinity of the section of the MT route where closed to general traffic.
	Impact Assessment	**Slight – Moderate Beneficial**

[1] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		NC08b
Landscape/Townscape	Likely Effects – Construction	Significant adverse effects could arise as a result of construction infrastructure including temporary compounds, storage and construction parking in residential / commercial townscape character areas across the route. There would be potentially large adverse effects on townscape particularly for the cut and cover section of the route, given the traffic disruption and position within a residential and commercial location on Gloucester Road.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed the landscape setting for the proposed new MT infrastructure would be in keeping with the existing local character. The option would require new infrastructure to be constructed across a former airfield, although it is assumed this would be in keeping with the proposed Brabazon development (i.e. coordinated with Brabazon layout). The closure of both lanes of general traffic along Cheltenham Road/Gloucester Road may have potential beneficial effects on the streetscape (assuming carriageway is re-designed with quality public realm, including green blue infrastructure, to promote pedestrian priority and facilitate cyclists), encouraging active travel and benefitting the commercial and residential area. Potential effects on visual amenity could arise as a result of introducing new transport modes and associated infrastructure for a number of sensitive receptors (residential properties, cycle routes etc). There may be potential adverse effects on the landscape/townscape character of the local vicinity, and in particular the proposed diversionary route, from increased traffic flows along more residential carriageways and through associated character areas.
	Impact Assessment (operation)	**Slight Adverse**
Historic Resources	Likely Effects – Construction	**Please note that a Gazetteer for this option is provided in Annex A of this report.** It is anticipated that construction techniques adopted, including cut and cover approach to underground section, would seek to avoid physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area. Construction of the route (and presence of associated construction infrastructure) may impact the significance of heritage assets through temporary changes in their settings. It is predicted that there is the potential for high impact to seven heritage assets (potential for damage to an asset given their immediate proximity to the route) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that operational impacts associated with noise and vibration along the MT route would be reduced although may be slightly increased along dispersal routes created by the closure of the section of the Cheltenham Road/Gloucester Road to two way general traffic . There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. Improvements in the existing streetscape and public realm which might be delivered via closure of the section of the Cheltenham Road/Gloucester Road to two way general traffic may present opportunities for enhancement of heritage assets through trails, signage and improved visitation. It is predicted that there is the potential for high impact to the setting of seven heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**
Biodiversity	Likely Effects – Construction	**Please note that additional baseline summary information for this route is provided in Annex B of this report.** Within Filton Airfield, there will be a direct loss of habitats and this may also result in fragmentation of the habitats present (and which may also adversely affect the species that rely on these habitats) assuming that the MT infrastructure is delivered ahead of the wider Brabazon development. It is anticipated that the option will otherwise be contained within the existing carriageway such that loss of habitats and vegetation clearance within the Three Brooks LNR, two SINCs, HPI woodland can be avoided although there is potential for loss of scrub, hedgerows and trees in roadside verges. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area. Increased levels of dust emissions and pollutants may result in temporary degradation of surrounding habitats if not suitably mitigated. In the absence of targeted species and habitat surveys, a moderate adverse effect has been scored, this is on account of the habitat loss within the former Filton Airfield predominantly comprising grassland and hardstanding habitats, with no hedgerows, woodland or scrub habitats identified on aerial imagery.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	Where the route uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. Where the route crosses the former Filton Airfield, it is anticipated that the operational phase has the potential to result in direct impacts on protected species through collision with vehicles and indirect disturbance on habitats through noise, lighting and pollution from vehicles. Overhead electrification infrastructure if required for the MT route, could impact protected species through collision of species with cabling and vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes for bats.
	Impact Assessment (operation)	**Slight Adverse (excluding species impacts)**
Water	Likely Effects – Construction	• Any loss of fluvial floodplain during the construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water and groundwater quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • Flood risk may increase temporarily. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures. • Dewatering activities may be required where penetration of the groundwater table is expected for earthworks. Impact on local/regional groundwater abstractions affecting groundwater level, flow and quality. This could result in impacts to groundwater receptors. • Changes to groundwater flow paths due to below ground structures extending below groundwater table and forming groundwater flow barriers that may increase pore water pressures and elevate the risk of groundwater flooding. • Excavation or construction of new roads could lead to increased pollution risk to groundwater receptors.

Option Ref		**NC08b**
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	• New infrastructure passes through areas of surface water flood risk associated with the headwaters of small streams where there is the potential for adverse impacts on flood risk. • Parts of the route may be at risk of fluvial flooding, awareness of constraints to the operational impacts should be considered. The frequency and severity of flooding will increase with the impacts of climate change. • Increased risk of spillage / runoff and creating pollutant pathways to groundwater depending on drainage design. • Parts of the route may be at risk of groundwater flooding (due to presence of groundwater flow barriers), awareness of constraints to the operational impacts should be considered. If below ground structure is below the water table, new drainage requirements may be needed.
	Impact Assessment (operation)	**Slight Adverse**

Option Ref		**EC08**
Noise	Baseline - key aspects and importance / significance	The route passes through eight road NIAs and one rail NIA: • 281 runs eastwards from Old Market roundabout to Lawrence Hill roundabout and along the A420 Lawford Street/Lamb Street/Lawfords Gate from the junction with the A420 Old Market Street to just after the junction with Pennywell Road; • 305 runs east from Lawrence Hill Roundabout along the A420 Lawrence Hill/Church Road until the junction with the A431 Summerhill Road. The NIA runs east from here along the A431 Summerhill Road/Air Balloon Road/Nags Head Hill until just after the junction with Kingsway; • RI_46 is located on the railway line just south of Lawrence Hill station; • 262 runs along the A420 Clouds Hill Road from just beyond the junction with Holmes Hill Road to just beyond the junction with Whiteway Road; • 261 runs the A420 Two Mile Hill Road/Regent Street/High Street from the Charlton Road junction to just beyond the junction with Two Mile Court; • 283 runs the A420 Two Mile Hill Road from just after the junction with Broadfield Avenue to just beyond the junction with Church Road; • 282 includes 4 residential properties at the A4017 Soundwell Road/Downend Road junction; • 249 includes residential and commercial properties at the A4017 Soundwell Road/Victoria Street, the A4174 Broad Street and the B4465 High Street junction; and • 246 runs along the A432 Badminton Road from the roundabout with the A432 Downend Road and the A4017 North Street to just before the junction with the A4174 Cleeve Hill and Cleeve Road. Diversionary and one-way system routes: • The one-way system along the A420 Lawford Street/Lamb Street/Lawfords Gate intersect with NIA 218 at the A420 Old Market Street to just after the junction with Pennywell Road; • The A431 Diversion route intersects with NIA 305 at the Chalk Road A420 junction and along the Summerhill Road between the A420 Church Road junction and to The Avenue junction; and • The A420 Diversion (Light Vehicles) route intersects with NIA 283 at the A420 Cloud Hill Road and Soundwell Road junction. There are more than 12000 properties along the MT and diversionary routes out of around 7600 are residential and more than 4500 are non-residential. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[2], baseline daytime noise levels are generally above LAeq,16h 60dB (free-field) at the nearest houses along the A420 and Soundwell Road. Noise levels are generally below LAeq,16h 55dB (free-field) at houses away from the main roads.
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors. However, it is anticipated that adverse impacts associated with above ground construction works including from plant and waste (spoil) haulage are likely. Therefore, a quantitative assessment should be undertaken at the appropriate stage to determine the potential for ground-borne noise and vibration impact.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs. However, some additional above ground traffic noise is expected particularly associated with the A420 and A431 diversion route which are predominately located through residential areas.
	Impact Assessment (operation)	**Neutral**
Air Quality	Baseline - key aspects and importance / significance	The route passes through: • Bristol AQMA at its western extent which includes the one-way system (along the A420 Lawford Street/Lamb Street/Lawfords Gate) and A431 Diversion Route, between St Philips and St George; • Kingswood – Warmley AQMA at its south-eastern extent, which is associated with the A420 Regent Street/High Street and extends from the junction with Blackhorse Road to the junction with Lansdown View; and • Staple Hill AQMA at its north-eastern extent which includes the B4465/Pendennis Road junction of the A420 Diversion (Light Vehicles) Route, which is associated with the A4017 Victoria Street/Soundwell Road and the A4175 High Street/ Broad Street crossroads.

[2] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		EC08
		There are numerous sensitive receptors such as residential, nursery, primary and secondary schools, pharmacy's, dentists, GP practices, a hospital and care homes within the study area. The Bristol's monitoring data shows that there are exceedances in annual mean NO2 concentrations at the monitoring sites in the vicinity of the Site between 2015 and 2019. Monitoring site at Church Road exceeded the AQS objective for annual mean NO2 of 40µg/m^3 in 2019.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. The initial traffic data shown that there will be significant reduction in flow along the A420 and the A431; this will reduce emissions of nitrogen dioxide (NO2) and particulate matter (PM) and subsequently improve roadside air quality and would benefit the AQMA. Currently available traffic data shows that there will be an increase in flow along the diversion routes, this will disbenefit the air quality at the sensitive receptors namely along A4174 at Emersons Green and A432 Westerleigh Road, Fishpond Road and Stapleton Road, and B4465 High Street at Staple Hill.
	Impact Assessment (operation)	**Slight Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The route follows the existing road network (A420/A4017/Westerleigh Road) and passes through mainly commercial and residential townscape characters. The route intersects the National Sustrans Cycleway twice, once at its western extent and once again close to Staple Hill. The route crosses the Regional Sustrans Cycleway at the northern extent and several Local Routes. The option does not pass adjacent to any designated landscapes. Local, regional and national Sustrans Cycleways cross and follow portions of the route. Within the 1.5km landscape study area there is one Registered Park and Garden, three LNR, four areas of ancient woodland, one country park and portions of the Bristol to Bath Green Belt. The A431 diversion route intersects the National Sustrans Cycleway near the City Academy Bristol. All the diversionary and one-way system routes have predominately residential townscape characters.
	Likely Effects – Construction	Potential large adverse effects could arise from construction infrastructure including temporary compounds, storage and construction parking in residential / commercial townscape character areas.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	There may be potential adverse effects on the landscape/townscape character of the MT route as a result of the introduction of transportation modes not currently present within the carriageway and associated MT infrastructure. This will be of particular note between Ch5900 to 9300 where the MT route operates in parallel along largely residential streets and where public transport modes are not currently present. Diverted general traffic flows along largely residential streets is also likely to adversely impact associated character areas. The closure of both lanes of general traffic along the A420 through Lawrence Hill / St George may have beneficial effects on the streetscape (assuming carriageway is re-designed with quality public realm, including green blue infrastructure, to promote pedestrian priority and facilitate cyclists), encouraging active travel and benefitting the commercial and residential area.
	Impact Assessment (operation)	**Moderate Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** The MT route would run near four Grade II* Listed Buildings, 67 Grade II Listed Buildings and four Conservation Areas within a 200m buffer. Most of the assets are centred around the Temple Meads, Redfield, St George and Kingswood areas. The A431 traffic diversion has six Grade II Listed buildings and one Conservation Area within a 100m buffer.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area. Construction activities along the route (and presence associated construction infrastructure) may impact the significance of heritage assets through temporary changes in their settings. It is predicted that there is the potential for high impact to 13 heritage assets (potential for damage to an asset given their immediate proximity to the route) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that operational impacts associated with traffic noise and vibration would be reduced along the MT route although may be increased along diversionary routes. There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. Improvements in the existing streetscape and public realm which might be delivered via closure of the Lawrence Hill / St George section of the A420 to two way general traffic may present opportunities for enhancement of the heritage assets through trails, signage and improved visitation. It is predicted that there is the potential for a high impact to setting of 13 heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this route is provided in Annex B of this report.** The MT route would run above Easton-Staple Hill Disused Railway SNCI near Lawrence Hill roundabout and would also run adjacent to the Folly Brook SNCI.at the northern extent. The route also passes adjacent to numerous important open spaces (IOS). The A431 diversion route along Beaufort Road runs adjacent to Blackswarth Road Wood SNCI, Crew's Hole Woodland SNCI and Troopers Hill SNCI. The A420 Diversion route (Light Vehicles) runs adjacent to an un-named SNCI adjacent to Acacia Road.

Option Ref		EC08
		The cycle diversion runs directly through St George's Park IOS. The route and some diversionary routes would run adjacent to or within the ZoI (200m buffer from the route) of the following habitats: • Habitats of Principal Importance (HPI); deciduous woodland; • UK BAP Priority habitat: wood pasture and parkland; and • Grassland, individual trees, areas of woodland and scrub. It is anticipated that the habitats present will support a range of protected and notable species associated with the habitats present.
	Likely Effects – Construction	It is anticipated that the option will be contained within the existing carriageway such that loss of habitats and vegetation clearance within the Feeder Side SNCI, Folly Brook SNCI, HPI woodlands and UKBAP wood pasture and parkland can be avoided. The cycle diversion may result in habitat loss through St George's Park, which includes amenity grassland and individual trees. This may adversely affect the species that rely on these habitats. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area. Increased levels of dust emissions and pollutants may result in temporary degradation of surrounding habitats if not suitably mitigated.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	As the MT route and diversionary general traffic routes use the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. However, if overhead electrification infrastructure is required for the MT route, this could impact protected species through collision of species with cabling and vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes for bats, however existing baseline conditions of the roads within the route may already reduce the suitability of the roads for bats. If the diversionary cycle path requires additional lighting through St George's Park, this has the potential to result in indirect disturbance on protected species and habitats through lighting if not suitably mitigated.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**
Water	Baseline - key aspects and importance / significance	**Surface Water** The MT route runs along the existing road network following from the A420 for approximately 5 km, through Flood Zone 1 (Low risk) and then north along the A4017 for 3 km, also through Flood Zone 1 (Low risk). The MT route then turns north-easterly along Westerleigh Road to Emersons Green, intersecting with an unnamed tributary of the River Frome (Ordinary Watercourse) along Westerleigh Avenue (Ch. 1350). Along this section, the MT route passes through Flood Zones 2 (Medium risk) & 3 (High risk), associated with the Folly Brook at Emersons Green; Flood Zone 2 along Jenner Boulevard at the northern extent of the route, and Flood Zone 3 at the north-west area of the Westerleigh Road/Jenner Boulevard roundabout. The A431 diversion route runs along the existing road network along Easton Road (B4465) before continuing in an easterly direction along Whitehall Road (B4465). The diversion route then turns south along Chalks Road and Blackswarth Road, then turns east along Beaufort Road and The Avenue, before turning west along Summerhill Road to re-join the MT route at the A420/Summerhill junction. The diversion route passes through Flood Zone 1 (Low risk). The cycle diversion turns off the A420 at the A420/Victoria Parade, before turning east along Mary Street and then north along Albert Parade. The diversion then turns east along the B4465 and Foxcroft Road, through St George's Park and then continues along the existing road network along Hudds Vale Road, Whiteway Road and Ingleside Road. Along Ingleside Road it turns south to re-join the MT route next to the A420/Soundwell Road junction. The cycle diversion passes through Flood Zone 1 (Low risk). The A420 diversion runs north parallel to the A4017 MT route from Lodge Road to Shrubbery Road, it then turns easterly along Downend Road (A432) where it then re-joins the MT route at the Downend Road (A432)/ North Street (A4017) roundabout. The A420 diversion passes through Flood Zone 1 (Low risk). The majority of the route is at Low risk of surface water flooding. However, there is ponding shown on five occasions along Westerleigh Road during the 1 in 30-year event surface water flood event; between Buckingham Place junction and Peache Road junction (Ch. 9350 to 9500), between Westbourne Road junction and Elmtree Avenue junction (Ch.10300 to 10450), between Dibden Road junction and Blackhorse Road junction (Ch. 10550 to 10700), just east of the Westerleigh Road/Emerson Way roundabout (Ch. 11100) and along Jenner Boulevard at the northern extent of the route. However, there is not a significant amount of high surface water flood risk across the route. **Groundwater** There are no superficial deposits present throughout the entire route. The route transects multiple formations of variable lithology (sandstone, mudstone, coal measures) as it progresses east towards Emersons Green (far north of the route). The dominant bedrock geologies are the Mercia Mudstone Group, South Wales Coal Measures Group and Pennant Sandstone Formation. Multiple faults exist and the location of these faults may allow deep groundwater circulation and is believed to be the pathway for deep thermal waters supplying the Bath and Bristol hot springs. Where the route transects the South Wales Coal Measures, the Coal Authority Interactive Map designates this a High Risk Development Area with multiple mine entry points identified. Depending on how the mines were worked and groundwater managed during operation, groundwater rebound i.e. to shallow levels below the ground surface may exist for the area. There may also be a risk of potential mine gas for this location as well. The SFRA identifies that groundwater can get within 1-2m of the ground surface. Groundwater flooding has been reported at locations throughout Bristol but this has tended to be in isolated basements, rather than groundwater rising above the ground surface. British Geological Survey (BGS) borehole ST57SE287 (near Temple Meads) indicates a rest water level (RWL) of approximately 3 mbgl (7 mAOD). BGS borehole ST67SW45 (near Lawrence Hill Station) indicates a RWL of 13 mbgl (7 mAOD). BGS borehole ST67NE90, situated near the Bristol Bath Science Park, indicates a rest water level of approximately 2 mbgl (49 mAOD). Groundwater is expected to be at shallow depth along the scheme. At the Old Market Roundabout to St George and along the A420, the scheme is mostly located within a high Groundwater Vulnerability Zone (GWVZ), which is associated with the Mercia Mudstone Group (Sandstone). Travelling north towards Staple Hill the route is within a Medium GWVZ, which is associated with the Coal Measures. The section of the route from Staple Hill north towards Emerson Green, is within a High GWVZ associated with the Pennant Sandstone Formation. Considering the environment, groundwater flood risk is considered to be low or manageable. The entire option is located upon Secondary A aquifers and no SPZ are identified along or within 1.0km of the scheme.
	Likely Effects – Construction	• Any loss of fluvial floodplain during construction may require temporary floodplain compensation.

Option Ref		EC08
		• The construction works may expose construction workers to flood risk. • There may be temporary adverse effects on groundwater quality as a result of earthworks particularly in fractured aquifers. • Potential localised impacts to groundwater quantity (level and flow) due to groundwater control measures.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	• The option may be at risk of fluvial and tidal flooding. The frequency and severity of flooding will increase with the impacts of climate change. • Increased risk of spillage / runoff and creating pollutant pathways to groundwater depending on drainage design.
	Impact Assessment (operation)	**Slight Adverse**

Topic / Option Ref		SWC11
Noise	Baseline - key aspects and importance / significance	The route passes through seven road NIAs: • 14353 runs along the A4 Temple Gate between the junction with Station Approach to just after the junction with Chatterton Square; • 12784 runs along the A38 Bridgewater Road from the junction with Winford Terrace to just before the junction with Dundry Lane; • 3992 includes a residential property on the A38 Bridgewater Road, just before the junction with Filter Cottages; • 3991 includes commercial property on the A38 Bridgewater Road just before the junction with Hoobs Lane and Barrow Lane; • 13851 runs along the A38 Bridgewater Road from just before the junction with Naish Lane to before the junction with Dial Lane; and • 12785 runs along the A38 Potter Hill from just after the junction with Currells Lane to just after the junction with School Lane. The route passes adjacent to one road NIA: • 264 runs along the A370 York Road from Langton Street Bridge to just beyond the junction with Spring Street. Diversionary Route The diversion passes through two road NIAs: • 267 runs along the A4 Bath Road from just passed the junction with Angers Road until the junction where the A37 merges onto the A4. This NIA also runs along the A37 Wells Road from the junction with Broadfield Road until the junction where the A37 merges onto the A4 Bath Road; and • 266 runs along the A37 Wells Road from the junction with Ponsford Road until the A37/ A4174 Airport Road junction. There are more than 4200 properties along the MT and diversionary routes of which more than 2900 are residential and more than 1200 are non-residential. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[3], baseline daytime noise levels are generally above $L_{Aeq,16h}$ 65dB (free-field) at the nearest houses along the A38, A4174, A37 and Redcliffe Way. Noise levels are generally below $L_{Aeq,16h}$ 55dB (free-field) at houses away from the main roads.
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors. However, it is anticipated that adverse impacts associated with above ground construction works including from plant and waste (spoil) haulage are likely.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs. However, some additional above ground traffic noise is expected associated with dispersal routes including the A4174. Benefits in noise levels due to modal shift will need to be verified during the quantitative assessment undertaken in accordance with DMRB LA111 at the appropriate stage.
	Impact Assessment (operation)	**Slight Beneficial**
Air Quality	Baseline - key aspects and importance / significance	The route passes through the Bristol AQMA at its northern extent, from Bristol Temple Meads to Bedminster and Knowle and to the north of Hengrove. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices, a hospital and care homes along the proposed scheme. The Bristol's monitoring data shows that there are exceedances in annual mean NO2 concentrations at the monitoring sites in the vicinity of the Site between 2015 and 2019. Monitoring sites at Bath Road, West Street, Bedminster Road and Bedminster Down Road exceeded the AQS objective for annual mean NO2 of 40µg/m^3 in 2019.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. The efficacy of the mitigation measures will be dependent on an appropriate monitoring regime. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**

[3] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Topic / Option Ref		**SWC11**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. The initial traffic data shown that there will be reduction in flow along the B3122 Saint John's Lane, Redcatch Road / Salcombe Road; this will reduce emissions of nitrogen dioxide (NO2) and particulate matter (PM) and improve roadside air quality and would benefit the AQMA. There could be an increase in general traffic flow along the dispersal routes including the A4174, this could disbenefit the air quality at the sensitive receptors along nearby residential roads.
	Impact Assessment (operation)	**Slight Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The route largely follows the existing A38 and A371 road networks and passes through more residential roads within Knowle and Hengrove. The route crosses through mainly residential and city centre landscape characters in Bristol and across the Bristol and Bath Green Belt to the Airport. Where the route leaves the A371 at Hengrove, it passes through Knowle using a combination of quiet residential roads and an existing bus route. The route reconnects with the A4 south of the Bathbridge roundabout by constructing a new road in a currently pedestrianised area. The route lies adjacent to one Local Nature Reserve. There are several Public Rights of Way and Sustrans Local Cycleways that cross and follow sections of the route, and two Sustrans National Cycleways cross the route. Additionally within the 1.5km landscape study area, there are two SSSIs, two LNRs, three registered Parks and Gardens and 10 areas of Ancient Woodland.
	Likely Effects – Construction	Potential significant effects could arise as a result of construction infrastructure including temporary compounds, storage and construction parking in residential / commercial townscape character areas. There would be potentially moderate adverse effects on townscape given the extent of traffic disruption from construction works within a residential and commercial locations.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed the landscape setting for the proposed new MT infrastructure would be in keeping with the existing local character. There may be potential adverse effects on the landscape/townscape character as a result of transportation modes not currently present within the carriageway and their associated infrastructure. There may be potential adverse effects on the landscape/townscape character of the local vicinity, and in particular along the proposed MT and general traffic diversionary route along residential roads and associated character areas.
	Impact Assessment (operation)	**Moderate Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** The MT route is entirely above ground and would run near one Grade I Listed Building, two Grade II* Listed Buildings, 13 Grade II Listed Buildings and three Conservation Areas. Most of the assets are within the Bristol City Centre, Temple Meads and Knowle area.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction activities along the route (and presence of associated construction infrastructure) may impact the significance of heritage assets through temporary changes in their settings. It is predicted that there is the potential for high impact to four heritage assets (potential for damage to an asset given its immediate proximity to the route) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that operational impacts associated with traffic noise and vibration would be reduced along the MT route although may be increased along diversionary routes for general traffic. There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. It is predicted that there is the potential for a high impact to the setting of four heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this route is provided in Annex B of this report.** The route would pass over or adjacent to: • Felton Common Local Nature Reserve (LNR); • Sites of Nature Conservation Interest (SNCI)[4]: River Avon, Wetmore Vale, Hengrove Park, Crox Bottom, Highridge Common; and • North Somerset Council Wildlife Sites[5]: Barrow Tanks, Fields East of Barrow Tanks. The route would pass over, adjacent to or within 200m of the following habitats: • HPI: Mudflats, good quality semi-improved grassland, lowland dry acid grassland and deciduous woodland; • UK Biodiversity Action Plan (BAP) Priority habitat[6]: Wood pasture and parkland; and • Non-HPI habitat: Floating Harbour, River Avon, the Barrow Gurney Reservoirs, Colliter's Brook, arable and grassland fields, reservoirs, hedgerows, trees, amenity grassland, and areas of woodland. It is anticipated that the habitats present will support a range of protected and notable species associated with the habitats present.

[4] https://maps.bristol.gov.uk/policies/
[5] http://map.n-somerset.gov.uk/PoliciesMap.html
[6] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

Topic / Option Ref		SWC11
	Likely Effects – Construction	It is anticipated that the existing road network will largely be used for this option, therefore it is anticipated that the majority of habitat loss will be limited to discrete areas of habitat associated with the road verge. If any road widening of the network is required this may adversely affect the habitats, including HPI and UK BAP Priority habitat and designated sites, as well as the species which rely on these habitats. The habitats to be lost is likely to be limited to discrete areas, as such a precautionary approach has been adopted. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	As the option uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. If overhead electrification infrastructure is required, this could impact protected species through collision of species with cabling in addition to vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes for bats.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**
Water	Baseline - key aspects and importance / significance	**Surface Water** The MT route runs along the existing road network following from Temple Gate (A4), by Bristol Temple Meads Station. Along Temple Gate (A4), at the Bath Bridge roundabout, the MT route intersects the River Avon (Ch. 2700) where it is classified as a fluvial Flood Zone 3 (High risk) area associated with the flood extents from the tidal River Avon. The route then turns west along Mead Street and then turns south to follow along St Luke's Road, continuing in a general southerly direction through Knowle until it reaches the Airport Road (A4174)/Salcombe Road junction (Ch. 5700) where it turns west. From the Bath Road (A4)/Mead Road junction to the Airport Road (A4174)/Salcombe Road junction, the route is entirely within Flood Zone 1 (Low risk), except for at the Airport Road (A4174)/Salcombe Road junction itself. The general traffic diversion also runs along the existing road network, continuing along Bath Road (A4) whilst the MT route turns west to Mead Street. The diversion turns west further on, along St John's Lane, before turning south along Redcatch Road (B3122) and then east along the same road name. It then turns south along Wells Road (A37) until it reaches the Airport Road (A4174)/Wells Road (A37) junction. Along this stretch described, the Traffic Diversion is entirely within Flood Zone 1 (Low risk). The diversion then turns west along Airport Road, until it meets up with the MT route after approximately 750 m, at the Airport Road (A4174)/Salcombe Road junction. Along this stretch, the diversion is entirely within Flood Zone 2 (Medium risk) and is within Flood Zone 3 (High risk) for the majority of the 750 m stretch. This is associated with the flood extents from the Brislington Brook, intersecting the Brook at two locations along this stretch. After the diversion re-joins the MT route at the Airport Road (A4174)/Salcombe Road junction, the MT route continues along in a westerly direction along the A4174, where it passes through areas of Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk) at several locations. The first location is from the Airport Road (A4174)/Salcombe Road (A37) junction (Ch. 5700) to approximately 130 m west for Flood Zone 3 (High risk) (Ch. 5700 to Ch. 5800) and approximately 160 m west for Flood Zone 2 (Medium risk) (Ch. 5700 to Ch. 5850). This is associated with the flood extents from the Brislington Brook, the route intersects the Brook along this location (Ch. 5800). The MT route along the A4174 also passes through an area of Flood Zone 3 (High risk), along Hengrove Way, for approximately 50 m (Ch. 8100 to Ch. 8150), in association with the flood extents of the Pigeonhouse Stream. The route intersects the Pigeonhouse Stream along Hengrove Way (Ch 8100). The route along the A4174 also passes through an area of Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk) along Anton Bantock Way and King Georges Road, in association with the flood extents of the River Malago (Ch. 9500). The area of Flood Zone 2 (Medium risk) stretches for approximately 50 m (Ch. 9450 to Ch. 9500), with two small stretches of Flood Zone 3 (High risk). The route then turns from the A4174 to along Bridgewater Road (A38) in a south-westerly direction at the Lime Kiln roundabout (Ch. 10950). It continues for approximately 6.25 km towards Bristol Airport along the A38, crossing between the two Barrow Gurney reservoirs. It then turns off west to the North Side Road at the A38/North Side Road roundabout (Ch. 17300), until it reaches the south-western extent of the option. This stretch of the route, is entirely within Flood Zone 1 (Low risk). The majority of the option is at Low risk of surface water flooding. Ponding is shown in several locations during a 1 in 30-year event (High risk). These locations are along St Luke's Road (Ch. 3300), St John's Lane, Ravenhill Road (Ch. 4000), Airport Road (A4174) (Ch. 6100 to Ch. 6200), Hengrove Way (A4174) (Ch. 8450) and across multiple locations across Bridgewater Road (A38) at the Bridgewater Road (A38)/Colliter's Way (Ch. 11000) and across the A38 stretch to the Bristol Airport (Ch. 11600 to Ch. 11700, Ch. 12350 to Ch. 13100, and Ch. 16900 to Ch. 17200). However, across the entire route, there is not a significant amount. The majority of the route is not located within a Source Protection Zone, except for at the south-western extent where it passes through the Outer Zone (Source Protection Zone 2) when it turns west along North Side Road for approximately 570 m. The Outer Zone (Source Protection Zone 2) is defined as *'the zone is 400 day travel time of pollutant to source. This has a 250 or 500 m minimum radius around the source depending on the amount of water taken'.* **Groundwater** Superficial Tidal Flat Deposits, comprising clay and silt, are present at the northern most extent of the route and are confined to the location of the River Avon. The bedrock geology from Temple Meads (north) to Bristol International Airport (south west) comprises the Mercia Mudstone Group (sandstone, mudstone), Lias Group (limestone, mudstone, siltstone) and Pembroke Limestone Group (limestone, mudstone) respectively. The route intercepts Secondary A, Secondary B, Secondary (undifferentiated) and Principal aquifers. The Principal aquifers are associated with the Pembroke Limestone Group in the south west close to Bristol International Airport. The route is predominantly located within a High Groundwater Vulnerability Zone (GWVZ) with soluble rock risk. There are two SPZ at Bristol International Airport, SPZ Inner Protection Zone 1 and Outer Protection Zone 2. No details have been provided on the groundwater abstractions but based on the geology of the area they will be targeting the Pembroke Limestone Group for supply. The Coal Authority Interactive Map does not identify any mine entry points throughout the route. SFRA for Bristol identifies a generally low groundwater flood risk . The SFRA also identifies that groundwater can get within 1-2m of the ground surface. Groundwater flooding has been reported at locations throughout Bristol city but this has tended to be in isolated basements, rather than groundwater rising above the ground surface.
	Likely Effects – Construction	• Any loss of fluvial floodplain during the construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk.

Topic / Option Ref		SWC11
		• The works could be impacted by/ exacerbate existing flooding. • There may be temporary adverse effects on groundwater quality particularly in fractured aquifers. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	• Parts of the option may be at risk of fluvial and tidal flooding, awareness of constraints to the operational impacts should be considered. The frequency and severity of flooding will increase with the impacts of climate change. • Increased risk of spillage / runoff and creating pollutant pathways to groundwater depending on drainage design.
	Impact Assessment (operation)	**Slight Adverse**

Option Ref		BBC-C
Noise	Baseline - key aspects and importance / significance	The route passes through four road NIAs: • NIA ID 14353 is on the A4 Temple Gate from just after the junction with Station Approach to just after the junction with Chatterton Square and includes the commercial properties to the east of the A4 Temple Gate; • NIA ID 267 runs along the A4 Bath Road from just before to just after the junction with the A37 Wells Road. The NIA also runs south from this junction along the A37 Wells Road until just after the junction with Broadfield Road; • NIA ID 299 runs along the A4 Bath Road from just before the junction with Summer Hill to just after the junction with Chatsworth Road; and • NIA ID 268 runs along the A4 Bath Road/Eagle Road/Bristol Hill/Brislington Hill from the junction with Sandy Park Road to the junction with the A4174 Callington Road. This NIA also includes the section of the A4174 from the A4 Brislington Hill to the roundabout with West Town Lane. There are around 2677 properties along the MT route out of which 1705 are residential and 972 are non-residential. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[7], baseline daytime noise levels at the nearest houses are generally above $L_{Aeq,16h}$ 65dB. (free-field).
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors but there is potential for some adverse impacts associated with construction works including plant.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs. Benefits in noise levels due to modal shift will need to be verified during the quantitative assessment undertaken in accordance with DMRB LA111 at the appropriate stage.
	Impact Assessment (operation)	**Slight Beneficial**
Air Quality	Baseline - key aspects and importance / significance	The option lies within the Bristol AQMA, which extends as far as Brislington at its eastern extent. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices, a hospital and care homes within the study area. Bristol's monitoring data show that there are exceedances in annual mean NO_2 concentrations at the monitoring sites in the vicinity of the western section of the corridor between 2015 and 2019. Monitoring sites at A4 Bath Road exceeded the AQS objective for annual mean NO2 in 2019.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. The initial traffic model shows a reduction in traffic in the Bristol City Centre as a result of the option; this will reduce emissions of nitrogen dioxide (NO2) and particulate matter; and subsequently improve roadside air quality and could benefit the Bristol AQMAs.
	Impact Assessment (operation)	**Slight Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The route follows the existing road network and passes through mainly residential and city centre landscape characters. The option lies adjacent to one Registered Park and Garden. There are several Sustrans Local Cycleways and one Sustrans National Cycleways crossing adjacent to Arno's Court park on the A4 and following sections of the route. Within the 1.5km landscape study area, there are two Local Nature Reserve (LNR), two ancient woodland areas and two Registered Park and Garden.

[7] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		BBC-C
	Likely Effects – Construction	Potential significant adverse effects could arise as a result of construction of MT infrastructure and associated temporary compounds, storage and construction parking in residential / commercial townscape character areas There would be potentially large adverse effects on townscape given the extent of traffic disruption within residential / commercial locations and alterations to the existing cycle route to connect with Sustrans National Route 3.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed the landscape setting for the proposed new MT infrastructure would be in keeping with the existing local character. There may be potential adverse effects on the landscape/townscape character as a result of transportation modes not currently present within the carriageway and their associated MT infrastructure. The route also diverts cyclists off the carriageway and on to the Sustrans National Route 3 (existing infrastructure diverts to north side of River Avon). This diversion is longer and assumes existing infrastructure can accommodate number of cyclists; however, this may have beneficial effects (i.e. more scenic route and off-carriageway may encourage active travel).
	Impact Assessment (operation)	**Moderate Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** The MT route is entirely above ground and would run near two Grade I Listed Buildings, ten Grade II* Listed Buildings, 43 Grade II Listed Buildings, one Grade II Registered Park and Garden, and three Conservation Areas. Most of the assets are within Totterdown and Brislington.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction activities along the route (and presence of associated construction infrastructure) may impact the significance of heritage assets through temporary changes in their settings. It is predicted that there is the potential for high impact to six heritage assets (potential for damage to an asset given their immediate proximity to the route) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that operational impacts associated with noise and vibration would be reduced along the MT route. There may be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. It is predicted that there is the potential for high impact to the setting of six heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this route is provided in Annex B of this report.** The route and its ZoI (200m buffer from the route) passes adjacent to three SNCIs: River Avon, Arno's Vale Cemetery and Brislington Meadows. The route uses an existing bridge to cross the Floating Harbour and the River Avon, both of which feed into the Severn Estuary (approximately 8.5km downstream), which is designated nationally and internationally as a SSSI, SAC, SPA and a Ramsar site. The route and its buffer passes through or adjacent to the following habitats: • HPI: deciduous woodland. • Other habitats along the scheme include woodland, scrub, scattered and lines of trees and amenity grassland. It is anticipated that the habitats present will support a range of protected and notable species.
	Likely Effects – Construction	It is anticipated that the existing road network will be used for the MT route and cycleway diversion, therefore it is anticipated that the majority of habitat loss will be limited to discrete areas of habitat associated with the road verge. If any road widening is required this may adversely affect the habitats, including HPI and designated sites, as well as the species which rely on these habitats. The habitats to be lost is likely to be limited to discrete areas, as such a precautionary approach has been adopted. The increased levels of noise and vibration, lighting and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area.
	Impact Assessment (construction)	**Slight to Moderate Adverse**
	Likely Effects – Operation	As the route uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. If overhead electrification infrastructure is required for the option, this could impact protected species through collision of species with cabling and vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes for bats, however existing baseline conditions of the road may already reduce the suitability of the roads for bats.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**

Option Ref		BBC-C
Water	Baseline - key aspects and importance / significance	**Surface Water** The route runs along the existing road network following from the Redcliffe Way (A4044)/Temple Gate (A4) junction, near to Bristol Temple Meads railway station. It continues along the A4, through Totterdown in a south-easterly direction, before turning south and continuing to follow the A4 until it reaches Brislington at the Bath Road (A4)/Callington Road (A4174) junction. The route is a total length of approximately 3.63 km. The route passes through areas of Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk) on two occasions; the first location is at the Bath Bridge roundabout (Ch. 2050), associated with the River Avon floodplain and the second location is at Bath Road (A4) (Ch. 5300), associated with the Brislington Brook.

Option Ref		BBC-C
		The Off-Road Cycle Link (NCN 3) diverts from the main MT route from the Bath Road (A4)/Russet Lane junction (Ch. 2900), then runs along the River Avon, before turning south along A4320 and Bloomfield Road, re-joining the main MT route at the Bath Road (A4)/Bloomfield Road junction (Ch. 3850). The majority of the Off-Road Cycle Link (NCN-3) is within Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk), for approximately 1.1 km. There are no significant areas of the BBC-C option affected by 1 in 30 year surface water flood events. **Groundwater** The route from Temple Meads towards Totterdown / Brislington is located within a High GWVZ with soluble rock risk associated to the Lias Group. The majority of the route from Temple Meads to Totterdown is located within a Medium and High GWVZ. The GWVZ is associated to the Mercia Mudstone Group. The entire route is located upon a Secondary A aquifer. No SPZ are identified along the route.
	Likely Effects – Construction	• Any loss of fluvial floodplain during construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • Flood risk may increase temporarily, this should be quantified and mitigated. • There may be temporary adverse effects on groundwater quality particularly in fractured aquifers. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	• The option may be at risk of fluvial and tidal flooding. • The frequency and severity of flooding will increase with the impacts of climate change.
	Impact Assessment (operation)	**Slight Adverse**

Option Ref		BBC-06
Noise	Baseline - key aspects and importance / significance	The option passes through six road NIAs: • NIA ID 268 runs along the A4 Bath Road/Eagle Road/Bristol Hill/Brislington Hill from the junction with Sandy Park Road to the junction with the A4174 Callington Road. This NIA also includes the section of the A4174 from the A4 Brislington Hill to the roundabout with West Town Lane; • NIA ID 5515 includes a residential property on the A4 Bath Road; • NIA ID 12801 includes a residential property on Hicks Gate, adjacent to the A4 Bath Road; • NIA ID 12804 encompasses properties along The Avenue, Abbey Park, The Park, Station Road, Old Vicarage Green, Pool Barton, Bristol Road and the High Street in Keynsham; • NIA ID 3698 starts just beyond the bridge over Avon Mill Lane and runs along the A4 Bath Road until just beyond the junction with The Glen; and • NIA ID 4003 is located on the A4 Bath Road between the junction with Bristol Road and just beyond the junction with Corston Lane. There are around 1289 properties along the MT route out of which 445 are residential properties and 844 are non-residential properties. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[8], baseline daytime noise levels at the nearest houses are generally above $L_{Aeq,16h}$ 65dB. (free-field).
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors but there is potential for some temporary adverse impacts associated with construction works including plant.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs although the benefits would be reduced since MT will operate within the soon to be implemented Bristol Bath Strategic Corridor (BBSC) which it is anticipated will already have benefited NIAs. Benefits in noise levels due to modal shift will need to be verified during the quantitative assessment undertaken in accordance with DMRB LA111 at the appropriate stage.
	Impact Assessment (Operation only)	**Slight Beneficial**
Air Quality	Baseline - key aspects and importance / significance	The route lies partially within the Bristol AQMA at its westernmost extent at Brislington. The route runs adjacent to the Keynsham AQMA at its western extent, which includes Station Road, Bristol Road between St Old Vicarage Green junction to Keynsham Library, Bath Hill from Bristol Road to the junction with Back Lane and Charlton Road from Bristol Road to just before the junction with Cranmore Avenue. The route also passes through Saltford AQMA at its eastern extent, which is located on the A4 Bath Road from the Manor Road/Beech Road junction to just beyond the junction with The Glen. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices, care homes and places of worship within the study area, predominately associated with south-east Bristol, Keynsham, Saltford and Corston.

[8] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		BBC-06
		The Bristol and B&NES monitoring data show that there are exceedances in annual mean NO2 concentrations at the monitoring sites in the vicinity of the route between 2015 and 2019. Monitoring sites at the A4 Bath Road exceeded the AQS objective for annual mean NO2 in 2019.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. This will reduce emissions of nitrogen dioxide (NO2) and particulate matter, and subsequently improve roadside air quality and benefit the AQMAs at Bristol, Keynsham and Saltford. However, it is anticipated that the benefit of the scheme is likely to be insignificant and overshadowed by the traffic reduction with the BBSC. There is the potential for disbenefits due to increased congestion with reduced/altered road space, although this will reduce over time as the effects of modal shift increase.
	Impact Assessment (operation)	**Slight Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The MT route follows the existing road network (and future BBSC route) and passes from the residential areas of Brislington, through Keynsham and Saltford; interspersed by the Bristol and Bath Greenbelt, either side of Keynsham. The eastern extent of the route runs adjacent to Newbridge Park and Ride on the edge of Bath World Heritage Site (WHS). The Local Sustrans Cycleway crosses and follows sections of the route and the National Avon Cycleway crosses the route to the east of Saltford. The route also runs adjacent to two Registered Parks and Gardens, one SSSI close to Newbridge and the Cotswold AONB close to Newbridge. Within the 1.5km landscape study area, there are three Registered Park and Garden, four Local Nature Reserve (LNR), seven ancient woodland, four SSSI sites and areas of the Bristol to Bath Green Belt.
	Likely Effects – Construction	It is assumed that construction impacts will be minimised by the use of the BBSC carriageway by MT for a large section of the route. There would be potentially slight adverse effects given the extent of traffic disruption within residential / commercial locations associated with construction of any additional associated MT infrastructure.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	There may be potential adverse effects on the landscape/townscape character of the MT route as a result of the introduction of transportation modes not currently present within the future BBSC carriageway (e.g. if steel wheeled transport modes are introduced) and any additional associated MT infrastructure.
	Impact Assessment (operation)	**Slight Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** The MT route is entirely above ground and would run near two Grade I Listed Buildings, four Grade II* Listed Buildings, 51 Grade II Listed Buildings, two Grade II* Registered Park and Garden, three Scheduled Monuments, two WHSs and five Conservation Areas. Most of the assets are within Keynsham and Saltford.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction activities along the route (and presence of associated construction infrastructure) may impact the significance of heritage assets through temporary changes in their settings. It is predicted that there is the potential for high impact to nine heritage assets (potential for damage to an asset given their immediate proximity to the works) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. It is predicted that there is the potential for high impact to the setting of nine heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this route is provided in Annex B of this report.** The route and its ZoI (200m buffer from the route) runs adjacent to Newton St Loe SSSI, which is designated for its geological assets and five SNCIs:, Brislington Meadows, East Wood and Keynsham Humpy Tumps complex, Charlton Bottom and Queen Charlton Watercourse, River Chew and Bitton to Bath railway track. The route and its buffer passes through or adjacent to the following habitats: • Habitat of Principal Importance (HPI)[9]: deciduous woodland, lowland calcareous grassland, traditional orchard, coastal and floodplain grazing marsh. • Biodiversity Action Plan (BAP) priority habitat[10] wood pasture and parkland. • Other habitats along the scheme include line of trees, hedgerows, grassland field and agricultural fields. It is anticipated that the habitats present will support a range of protected and notable species.
	Likely Effects – Construction	It is anticipated that the route would use the existing and future road network including any upgraded carriageways associated with the proposed BBSC, therefore it is anticipated that the majority of habitat loss will be limited to discrete areas of habitat associated with the road verge. Construction works may result in removal of verge vegetation including scrub,

[9] Protected under the Natural Environment and Rural Communities (NERC) Act 2006

[10] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

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		hedgerows and trees. Any widening of the road around the Bristol Road/Newbridge Road junction could adversely affect the geological features of Newton St Loe SSSI. The habitats to be lost is likely to be limited to discrete areas, as such a precautionary approach has been adopted. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	As the route uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. If overhead electrification infrastructure is required for the option, this could impact protected species through collision of species with cabling and vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes for bats, however existing baseline conditions of the road may already reduce the suitability of the roads for bats.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**

Option Ref		BBC-06
Water	Baseline - key aspects and importance / significance	**Surface Water** The option follows along the existing road network from the Bath Road (A4)/Callington Road (A4174) junction (Ch. 5500), in a south-easterly direction along the A4 until it reaches Newbridge Road (A4), by the River Avon (Ch. 17200). It is approximately 11.5 km in length in total. The majority of the route is within Flood Zone 1 (Low risk), but there are a few instances when the route passes through Flood Zone 3 (High risk) and Flood Zone 2 (Medium risk). The first location is located west of the Hicks Gate roundabout, passing through approximately 250 m of Flood Zone 3 (High risk) and Flood Zone 2 (Medium risk) (Ch. 7350 to Ch. 7600), associated with the Scotland Bottom watercourse, a tributary of the River Avon which it also intersects (Ch. 7350). Additionally, at the eastern section of the Bath Road (A4)/Broadmead Lane roundabout, the route intersects the Broadmead watercourse, a tributary of the River Avon (Ch. 10500) and a small area of Flood Zone 2 (Medium risk). The eastern-most extent of the route (Ch. 17150 to Ch. 17200) also falls within a Flood Zone 2 (Medium risk) area, associated with the River Avon floodplain. The majority of the option is at Low risk of surface water flooding. Ponding is shown in several locations during 1 in 30-year events (High risk). These locations are: at Hicks Gate roundabout (Ch. 7600), west of the River Chew (Ch. 9300 to Ch. 9400), at Bath Road (A4)/Broadmead Lane roundabout (Ch. 10300 to Ch. 10500), in close approximation to the Bath Road (A4)/Grange Road junction to the Bath Road (A4)/Norman Road junction (Ch. 11800 to Ch. 12200), near Bath Road (A4)/Uplands Road junction (Ch. 12800 to Ch. 13100), at Bath Road (A4)/Glen junction (Ch. 13450) and east of the Bristol Road (A4)/Wells Road (A39) roundabout (Ch. 15400 to Ch. 15500). However, over the whole scheme, there is not a significant amount. **Groundwater** The dominant geology for this routing comprises the Mercia Mudstone Group (sandstones and subordinate siltstone) and Lias Group (Limestone and Mudstone) from west (Brislington) to east (Lower Weston) respectively. The route will intercept Secondary A, Secondary B and Secondary (undifferentiated) aquifers. The majority of the route will intercept Secondary A aquifers. A SPZ Outer Protection Zone 2 is present at Somerdale Pavilion approximately 0.2km north east of the route. No details are currently available on yield, target or purpose of this abstraction.
	Likely Effects – Construction	• Any loss of fluvial floodplain during construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • Flood risk may increase temporarily, this should be quantified and mitigated. • There may be temporary adverse effects on groundwater quality particularly in fractured aquifers. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures.
	Impact Assessment (construction only)	**Slight Adverse**
	Likely Effects – Operation	• Parts of the route may be at risk of fluvial and tidal flooding. • The frequency and severity of flooding will increase with the impacts of climate change. • Use of existing road network with assumed no changes to ground level reduces the likelihood of pollution risk to groundwater receptors.
	Impact Assessment (operation only)	**Slight Adverse**

Option Ref		BBC-A5
Noise	Baseline - key aspects and importance / significance	The MT route passes through three road and one railway NIAs: • NIA ID RI_1333 is located along the railway line just west of Oldfield park station; • NIA ID 14682 runs along the A36 Lower Bristol Road from the Felding Road/Jews Lane junction to Pines Way, the A36 one-way system; • NIA ID 3700 runs along the A36 lower Bristol Road from St James's Cemetery entrance until the Westmoreland Road junction; and • NIA ID 12814 runs along the A36 Lower Bristol Road from just after The Square junction until the junction at Wood Street. The diversion route intersects with NIA 14682 at the A3604/ A36 junction. In addition the diversion passes through three road NIAs: • NIA 3697 runs along the A4 Newbridge Road from old Newbridge Hill /Brassmill Lane junction until just past Yomede Park junction; • NIA 12816 runs along the A4 Newbridge Road/Upper Bristol Road from just passed Lyme Gardens junction to just passed Cork Street junction; and

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		• NIA 12817 runs along the A4 Upper Bristol Road from just past Sterling House junction to just past Little Stanhope Street. There are around 2732 properties along the MT and diversionary routes of which 876 are residential and 1856 are non-residential. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[11], baseline daytime noise levels at the nearest houses to the scheme and the diversion route are generally above $L_{Aeq,16h}$ 65dB (free-field).
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors but there is potential for some adverse impacts associated with construction works including plant.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs. However, some additional above ground traffic noise is expected particularly associated with the diversion of general inbound traffic along the A4 Newbridge Road/ Upper Bristol Road which are predominately located through residential areas.
	Impact Assessment (Operation only)	**Neutral**
Air Quality	Baseline - key aspects and importance / significance	The MT route and inbound diversionary route lies partially within the Bath AQMA at its eastern extent, which is located largely along the A36 and A4 starting at the Fieldings Road/Jews Lane junction on the A36 and Roselyn Road junction along the A4 until Churchill Bridge Roundabout. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices, care homes and places of worship along the proposed scheme, predominately associated with Twerton, Oldfield Park and Bath city centre. The B&NES monitoring data show that there are exceedance in annual mean NO2 concentrations at the monitoring sites in the vicinity of the corridor between 2015 and 2019. Monitoring sites at Wells Road, Dorchester Street, Lower Bristol Road and Upper Bristol Road exceeded the AQS objective in 2019 for annual mean NO2.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. The initial traffic model shows a reduction in traffic in the Bath City Centre with the scheme. This will reduce emissions of nitrogen dioxide (NO2) and particulate matter; and subsequently improve roadside air quality and could benefit the Bath City Centre AQMA. There is the potential for disbenefits due to increased congestion with reduced/altered road space and increase in general traffic along the A4 Upper Bristol Road diversion route, which will disbenefit the air quality at the sensitive receptors although this will reduce over time as the effects of modal shift increase.
	Impact Assessment (operation)	**Slight Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The route follows the existing A4/A36 road network and initially passing through open space of the Bristol and Bath Greenbelt at the westernmost extent and then mainly through residential and city centre landscape characters including Bath WHS. The route crosses the National Sustrans Cycleway once at the eastern extent and once again at Fieldings Road/Jews Lane junction on the A36. The western extent of the route runs adjacent to the Cotswold AONB and Newton St. Loe SSSI near Newbridge Park and Ride and Carrs Woodland LNR located between Carrswood View junction and just before Connection Road junction along the A36. Additionally within the 1.5km landscape study area, there are three areas of Ancient Woodland and 11 registered Parks and Gardens. The diversionary route runs adjacent to the Cotswold AONB at Newbridge park and ride and follows the A4 Newbridge Road and Upper Bristol Road, and onto the A357 as well as crossing the River Avon along the A3604 to join the A36 midway along the scheme. The diversionary route also runs adjacent to Royal Victoria Park Registered Park and Garden.
	Likely Effects – Construction	Potential significant effects could arise from construction of MT infrastructure including temporary compounds, storage and construction parking in residential / commercial townscape character areas. There would be potentially large adverse effects on townscape given the extent of traffic disruption within residential / commercial locations particularly in Bath WHS, and alterations to the existing cycle route (i.e. off A36).
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	There may be potential moderate adverse effects on the landscape/townscape character of the MT route as a result of the introduction of transportation modes not currently present within the carriageway and associated MT infrastructure. Diverted general traffic flows along residential / commercial area along the A4 Upper Bristol Road is also likely to adversely impact associated character areas. The route also diverts cyclists off a section of the A36 into more residential character areas; whilst this may be more enjoyable (i.e. off main road), there are alternative safety considerations (i.e. more pedestrians and reversing cars in residential streets). It is assumed the effects on the landscape/townscape character and visual amenity will be more adverse if the option utilised is not bus transport (i.e. LRT, VLR), as this would introduce additional infrastructure and a new transport mode within a sensitive heritage character area (i.e. Bath WHS). It is assumed the route would follow the existing road network (i.e. assumed remains within current carriageway boundaries).

[11] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		BBC-A5
	Impact Assessment (operation)	**Moderate Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** This MT route is entirely above ground and would run near two Grade I Listed Buildings, 12 Grade II* Listed Buildings, 146 Grade II Listed Buildings, two Scheduled Monuments, one Conservation Area and two WHSs. Most of the assets are centred around Locksbrook, Twerton and Bath. A traffic diversion route along the A4 before crossing to the south and following the A36 has three Grade I Listed buildings, six Grade II* Listed Buildings, 76 Grade II Listed Buildings, one Scheduled Monument, one Conservation Area and two WHSs within a 100m buffer of the route.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction activities along the route (and presence of associated construction infrastructure) may impact the significance of heritage assets through temporary changes in their settings. It is predicted that there is the potential for high impact to five heritage assets (potential for damage to an asset given their immediate proximity to the route) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that operational impacts associated with traffic noise and vibration would be reduced along the MT route although may be increased along diversionary routes. There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. It is predicted that there is the potential for high impact to the setting of five heritage assets during operation.
	Impact Assessment (operation)	**Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this scheme is provided in Annex B of this report.** The MT route and its zone of influence (200m buffer from the route) runs adjacent to Newton St Loe SSSI, which is designated for its geological assets, Carrs Woodland LNR, and four SNCIs: River Avon, Bitton to Bath railway track, Newton Brook, Carrs Wood. The general traffic diversionary route and its buffer runs adjacent to Locksbrook Cemetery SNCI and River Avon SNCI The MT route, diversionary route and it's buffer passes through or adjacent to the following habitats: • Habitat of Principal Importance (HPI)[12]: deciduous woodland. • Biodiversity Action Plan (BAP) priority habitat[13] wood pasture and parkland. • Other habitats along the scheme include scattered and lines of trees, hedgerows, amenity grassland. It is anticipated that the habitats present will support a range of protected and notable species.
	Likely Effects – Construction	It is anticipated that the existing road network will used for the MT and diversionary route, therefore it is anticipated that the majority of habitat loss will be limited to discrete areas of habitat associated with the road verge. Construction works may result in removal of verge vegetation including scrub, hedgerows and trees, this may adversely affect the species which rely on these habitats. Any widening of the road around the Bristol Road/Newbridge Road junction could adversely affect the geological features of Newton St Loe SSSI. The habitats to be lost is likely to be limited to discrete areas, as such a precautionary approach has been adopted. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	As the route uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. If overhead electrification infrastructure is required for the option, this could impact protected species through collision of species with cabling. The overhead infrastructure may also disrupt foraging and commuting routes for bats, however existing baseline conditions of the road may already reduce the suitability of the roads for bats.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**
Water	Baseline - key aspects and importance / significance	**Surface Water** The option follows the existing road network following from the Newbridge Road (A4)/Lower Bristol Road (A36), separating into two separate spurs for the MT route (southern spur) and diversionary route (northern spur): • The MT route runs along Lower Bristol Road (A36), intersecting with the general traffic diversion route at the Lower Bristol Road (A36)/Windsor Bridge Road (A3604) junction. This part of the route passes through large areas of Flood Zone 2 (Medium risk) and small areas of Flood Zone 3 (High risk). Flood Zone 2 (Medium risk) is present along Lower Bridge Road (A36) at multiple locations, in association with the River Avon and the Newton Brook floodplains (Ch. 800 to Ch. 950, Ch. 1300 to Ch. 2300 and Ch. 2650 to Ch. 3000). The only Flood Zone 3 (High risk) area is located where the route intersects Brislington Brook (Ch. 900).

[12] Protected under the Natural Environment and Rural Communities (NERC) Act 2006

[13] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

Option Ref		BBC-A5
		• The northern spur runs along Newbridge Road (A4) . It turns south along Windsor Bridge Road (A3604) to link with the MT route at the Lower Bristol Road (A36)/Windsor Bridge Road (A3604). This part of the route passes through areas of Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk). Flood Zone 2 (Medium risk) areas are located along Newbridge Road (A4), for approximately 300 m, in association with the River Avon floodplain. Also, there are small sections of Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk) areas located along Upper Bristol Road (A4), by the Upper Bristol Road (A4)/Windsor Bridge Road (A3604) junction, and for approximately 90 m. Additionally, there is a stretch of Flood Zone 2 (Medium risk), along Windsor Bridge Road (A3604), for approximately 150 m. From the Windsor Bridge roundabout junctions, the two spurs continue easterly, largely parallel to each other: • The southern MT route continues along Lower Bristol Road in an easterly direction, until it reaches Churchill Bridge roundabout. It is almost entirely within Flood Zone 2 (Medium risk) (Ch. 3000 to Ch. 3200, Ch. 3350 to Ch. 3400 and Ch. 4500 to Ch. 4700), and Flood Zone 3 (High risk) (Ch. 3200 to Ch. 3350 and Ch. 3400 to Ch. 4500) (approximately 1.6 km). • The northern diversion route continues along Upper Bristol Road, which is entirely within Flood Zone 1 (Low risk). It then turns south and follows Green Park Road (A367) and Corn Street (A367), before turning south to reach Churchill Bridge roundabout and the main scheme route. Along the majority from the junction Green Park Road to Churchill Bridge roundabout, the diversion is almost entirely within Flood Zone 2 (approximately 875 m). It is also briefly within Flood Zone 3 (High risk) for approximately 125 m, along Corn Street (A367). Large sections of the route are within Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk). Large sections of this route are affected by 1 in 30 year surface water flood events. Along the northern spur from the Newbridge Road (A4)/Bristol Road (A36) junction to Churchill Bridge roundabout, the main high risk areas of surface water flooding are located along Newbridge Road (A4) by the Aspley Road junction and by the Hungerford Road junction. Additionally, 1 in 30 year surface water food events are located along Upper Bristol Road (A4) by Marlborough Lane junction and along Corn Street (A367). A 1 in 30 year surface water flood event would affect large swathes of the southern spur between the Newbridge (A4)/Bristol Road (A36) to Churchill Bridge roundabout. These areas stretch along Lower Bristol Road (A36) for approximately 500 m (Ch. 1800 to Ch. 2300) and almost entirely from approximately Waterside Court to the Churchill Bridge roundabout, approximately 1.8 km (Ch. 2700 to Ch. 4500) in total. **Groundwater** A combination of head deposits, Alluvium and River Terrace deposits are present along most of this route, where these superficial deposits are associated with the River Avon. The dominant geology for this route comprises the Mercia Mudstone Group (sandstones and subordinate siltstone), Lias Group (Limestone and Mudstone) and the Charmouth Mudstone Formation (Mudstone and some limestone) from west (Newbridge) to east (Bath Spa) respectively. The route will overly Secondary A, Secondary B and Secondary (undifferentiated) aquifers. The majority of the route will overly Secondary A aquifers. The route will use the existing road network and no changes to ground level are expected thus reducing any risk to groundwater receptors identified.
	Likely Effects – Construction	• Any loss of fluvial floodplain during construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • Flood risk may increase temporarily, this should be quantified and mitigated. • There may be temporary adverse effects on groundwater quality particularly in fractured aquifers. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures.
	Impact Assessment (construction only)	**Slight Adverse**
	Likely Effects – Operation	• Parts of the scheme may be at risk of fluvial and tidal flooding. • The frequency and severity of flooding will increase with the impacts of climate change. • Use of existing road network with assumed no changes to ground level reduces the likelihood of pollution risk to groundwater receptors.
	Impact Assessment (operation only)	**Slight Adverse**

Option Ref	Option B
Option Summary	**General Description –** Providing segregated MT routes connecting the key destinations through and around the city centre and connecting into corridor options. **Options B and G -** Utilising some of the existing A4044 and A38 around the city centre, the infrastructure changes required to accommodate city centre options B and G largely involve the reallocation of all traffic lanes into Mass Transit lanes to provide full segregation, except for at some pinch points. The option passes from Bristol TM through the centre of Bristol via Victoria Street, Bristol Bridge and Baldwin Street where alternative arrangements to limit access to general traffic are required to provide appropriate segregation for all road users. Thereafter, MT follows existing bus routes along A4044 and A4032 to bottom of Old Market linking up corridor hubs. Refer to drawing 70069287-WSP-BCC-DG-HW-0402. \\uk.wspgroup.com\central data\Projects\700692xx\70069287 - WECA MRT\04 Record of Issue\Task 6\2022 06 15 City centre Env drawings City Centre option descriptions - \\uk.wspgroup.com\central data\Projects\700692xx\70069287 - WECA MRT\04 Record of Issue\Task 6\2022 07 07 City Centre Descriptions **Option B:** • Route 1: East to South-West service, providing direct access from both corridors to Old Market, Cabot Circus, the Hospital, the Centre, and Temple Meads. The service would also serve Victoria and Bedminster • Route 2: North to Bristol – Bath corridor service, providing direct access from both corridors to the Hospital, the Centre, and Temple Meads. The service would also serve Victoria

Option Ref		Option B
Noise and Vibration	Baseline - key aspects and importance / significance	**Option B** The option passes through four road NIAs: • 297 runs along the A38 the Haymarket/ Moon Street passes through St James Barton roundabout and continue to A4044 Bond Street, A4032 Newfoundland Street. The NIA also includes Dale Street, Houlton Street, Clement Street; • 280 runs along the A38 Bridewell Street/Silver Street to the junction with Union Street; • 279 runs along the A38 Rupert Street/Quay Street/Small Street/ Colston Avenue from the junction with Christmas Street to just before the junction with St Augustine's Parade; and • 281 runs along the A4044 temple way/ Bond Street South, A420 St Philips from the Old market roundabout close to just before the Lawrence Hill roundabout. Three road NIAs fall within 300m of the option: • 298 runs along the A4018 St Augustine's Park Street/College Green and continues to run along the A4 Canons Road and joins A38; • 14353 runs along the A4 Temple Gate just before the Bath Bridge Roundabout and Bristol Temple Meads Railway station approach road to the junction with A4044; and • 265 runs along the A38 Bedminster Parade Road just before the Junction with the A370 Commercial Road. There are approximately 8900 properties along the route out of which more than 4700 are residential properties and more than 4200 are non-residential properties. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[14], baseline daytime noise levels are generally above $L_{Aeq,16h}$ 65dB (free-field) at the nearest houses along the A38, A4, A420, A4044 and A4032. Noise levels are generally below $L_{Aeq,16h}$ 55dB (free-field) at houses away from the main roads.
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors. However, it is anticipated that adverse impacts associated with above ground construction works including from plant and waste (spoil) haulage are likely. Therefore, a quantitative assessment should be undertaken at the appropriate stage to determine the potential for ground-borne noise and vibration impact.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs. A quantitative assessment should be undertaken at the appropriate stage in accordance with DMRB LA111 to ascertain the number of sensitive receptors adversely or beneficially impacted by the scheme. In the interim a neutral score has been attributed.
	Impact Assessment (operation)	**Neutral**
Air Quality	Baseline - key aspects and importance / significance	The route falls within the Bristol AQMA. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, a university, pharmacies, dentists, GP practices, hospitals and care homes along the proposed scheme. The Bristol's monitoring data shows that there are exceedances in annual mean NO2 concentrations at the monitoring sites in the vicinity if the Site between 2015 and 2019. Monitoring sites at Anchor Road, Rupert Street, The Haymarket, Bond Street and The Horsefair exceeded the AQS objective in 2019 for NO2.
	Likely Effects – Construction	It is anticipated that construction techniques adopted, and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works / material handlings and construction traffic and plant and waste (spoil) haulage cannot be ruled out. The efficacy of the mitigation measures will be dependent on a rigorous monitoring and enforcement regime. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. The segregation for Mass Transit would encourage modal shift and reducing the congestion; and this will reduce emissions of nitrogen dioxide (NO2) and particulate matter and subsequently improve roadside air quality and benefit the Bristol AQMA. There is the potential for disbenefits due to increased congestion with reduced/altered road space at the corridor connections, although this will reduce over time as the effects of modal shift increase.
	Impact Assessment	**Slight to Moderate Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The route follows the existing road network and passes through the historic and largely commercial Bristol city centre townscape character area. Local Sustrans route follow sections of the route near the St James Barton roundabout, and National Sustrans cross the route close to the junction of the High Street and Victoria Street. The route is directly connected with seven PROWs. No designated sites are present within 1.5km of the scheme.
	Likely Effects – Construction	Significant adverse effects could arise as a result of construction infrastructure including temporary compounds, storage and construction parking in the Bristol city centre townscape character. There would be potentially large adverse effects given the likely extent of traffic disruption during the construction works.

[14] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		Option B
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	There may be potential moderate adverse effects on the townscape character of the MT route as a result of transportation modes not currently present within the carriageways and their associated MT infrastructure (i.e. introducing permanent infrastructure within commercial character areas), increased traffic flows along more residential carriageways and through associated character area. Potential effects on visual amenity could arise as a result of introducing new transport modes and associated infrastructure for a number of sensitive receptors (i.e. recreational, residential, commercial, transport).
	Impact Assessment (operation)	**Moderate Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Option B** The MT route is entirely above ground and would run near 21 Grade I Listed Buildings, 57 Grade II* Listed Buildings, 335 Grade II Listed Buildings, nine Scheduled Monuments and 11 Conservation Areas. Most of the assets are within the High Street, Temple Street, Victoria Street, St Nicholas Street, St Stephen's Street and Christmas Steps areas of Bristol.
	Likely Effects – Construction	**Option B** It is anticipated that construction techniques adopted would seek to avoid physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction of the route (and associated construction infrastructure) may impact the significance of heritage assets through changes in their settings. It is predicted that there is the potential for high (direct) impact to two heritage assets and low to medium impact to other.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	**Option B** It is assumed that while operational impacts associated with noise and vibration along the MT route would be reduced, there may be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. It is predicted that there is the potential for a high impact to the setting of two heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	The route would pass over the Floating Harbour and River Avon SNCI which eventually leads into the Severn Estuary SAC, SPA, SSSI and Ramsar site The route would pass over, adjacent to or within 200m of the following habitats: • HPI: mudflats; and • Non-HPI habitat: Floating Harbour, River Avon, trees, amenity grassland. It is anticipated that the habitats present will support a range of protected and notable species.
	Likely Effects – Construction	It has been assumed that the scheme will be accommodated within the existing highway as present at the time that the MT scheme is constructed. It is anticipated that any habitat loss will be minimal. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	As the option uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. If overhead electrification infrastructure is required for the option this could impact protected species through collision of species with cabling and vehicles on the lines. Any overhead infrastructure may also disrupt foraging and commuting routes for bats.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**

Option Ref		Option B
Water	Baseline - key aspects and importance / significance	**Surface Water** Bristol City Centre option B route runs along the existing road network, circling around Bristol City Centre. From the A4044/Redcliffe Way roundabout, continuing west for approximately 390 m, passing through Flood Zone 2 (Medium risk) for the majority of this stretch. The route then turns north-west along Temple Gate and then Victoria Street for approximately 800 m, passing through Flood Zone 2 (Medium risk) for the majority of this stretch, and Flood Zone 3 (High risk) for only approximately 50 m at the end of this stretch. The route then turns west along Baldwin Street and then turns north-east along St Augustine's Parade, until it reaches St James Barton roundabout, passing through Flood Zone 2 (Medium risk) for the majority of the stretch. Following from St James Barton roundabout and continuing east for around 400 m to Bond Street (A4044)/Bond Street South (A4044) junction, passing through an area of Flood Zone 2 (Medium risk) for approximately 160 m. The route then turns south, continuing along A4044 until it reaches Old Market roundabout, passing through an area of Flood Zone 2 (Medium risk) for approximately 200 m. The majority of the City Centre is a Low risk of surface water flooding. Ponding is shown in at one location during a 1 in 30-year event (High risk), this is along Victoria Street (B4053) where it intersects the Bristol Channel. **Groundwater** Superficial Tidal Flat Deposits, comprising clay and silt, are present across most of the route. The majority of the route is situated within the Redcliffe Sandstone Member (fine to medium grained sandstone), which forms part of the Mercia Mudstone Group. A small section of the route on the A38 is situated within the Quartzitic Sandstone Formation (hard quartzitic sandstone with mudstones). The route intercepts a combination of Secondary A and Secondary B Aquifers. The route is not located in or close to (within 1km) a Source Protection Zone (SPZ). At this stage, no information is available on private water supplies that may be directly or indirectly impacted by the option. The option is located within a medium to high Groundwater Vulnerability Zone (GWV). The SFRA identifies that groundwater can get within 1-2m of the ground surface. Groundwater flooding has been reported at locations throughout the city but this has tended to be in isolated basements, rather than groundwater rising above the ground surface.
	Likely Effects – Construction	• Any loss of fluvial floodplain during the construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water and groundwater quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • The works could be impacted by/exacerbate existing flooding.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	• New infrastructure passes through areas of surface water flood risk associated with the headwaters of small streams where there is the potential for adverse impacts on flood risk. • Parts of the scheme may be at risk of fluvial and tidal flooding, awareness of constraints to the operational impacts should be considered. The frequency and severity of flooding will increase with the impacts of climate change.
	Impact Assessment (operation)	**Slight Adverse**

Overall average scores

TAG Environmental Topic	Impact Assessment (construction) score	Average (construction) score (Total/7)	Impact Assessment (operation) score	Average (operation) score (Total/7)
Noise	-14	-2	4	0.6
Air Quality	0	0	8	1.1
Landscape/Townscape	-18	-2.6	-12	-1.7
Historic Resources	-21	-3	-11	-1.6
Biodiversity	-8.5	-1.2*	-1	-0.1*
Water	-8	-1.1	-7	-1

*Note: Excluding potential impacts to species

Summary paragraphs

Construction

The potential impact on Historic Resources during construction is considered Large Adverse as there is the potential for high impact to several heritage assets. This is because construction activities and infrastructure along the route may impact the significance of heritage assets through temporary changes in their settings. Sensitive receptors relevant to Landscape/Townscape, such as residential properties and commercial premises, also have the potential to experience Large Adverse impacts during construction. It is anticipated that above ground construction works, including plant operation and waste (spoil) haulage handling, could cause a Moderate Adverse impact on Noise. It is anticipated that Biodiversity (excluding species) and Water could experience Slight Adverse impacts due to a number of reasons including temporary increases in levels of noise and vibration, lighting and human activity disturbing ecological receptors, and potential runoff from earthworks and materials storage affecting surface water and groundwater quality. With regards to Air Quality, it is considered that the residual impacts of dust and PM10 generated by construction activities following the application of mitigation measures and good site practice would be Neutral.

Operation

The potential impact on Landscape/Townscape is considered Moderate Adverse mainly due to the introduction of new transport modes causing adverse effects to landscape/townscape character and visual amenity. The impact on Historic Resources is also anticipated to be Moderate Adverse due to potential physical impacts to above ground cultural heritage assets and Conservation Areas. There may also be impacts to the significance of assets due to changes in their setting. Slight Adverse has been allocated to Water due to new infrastructure introducing or exacerbating flood risk, and the impact of climate change increasing the frequency and severity of flooding. The impacts on Biodiversity (excluding potential impacts on species) are anticipated to be Neutral, largely due to the route using the existing road network, and thus having limited effects on ecological receptors. The potential impact on Air Quality and Noise during operation is considered Slight Beneficial. This is because the MT routes are likely to encourage modal shift, reducing the amount of surface road traffic and associated emissions of nitrogen dioxide (NO2) and particulate matter. This would improve roadside air quality and noise levels, benefiting nearby AQMAs and NIAs respectively.

Options Assessment Table - Overground Network 2 - NC08b, EC08, SWC11, BBC-C+BBC-06+BBC-A5, Option E

<table>
<tr><td colspan="2">Option Ref</td><td>NC08b</td></tr>
<tr><td colspan="2">Option Summary</td><td>Option description (and baseline) as per NF08 other than Ch550 to 3000 - Width constraints require all general through traffic to be removed; traffic would still be permitted to cross the route. General traffic would be re-routed along existing A and B classification routes, possible using the M32 for longer, end to end journeys.
• MT route baselines are as per the NF08 assessment in the table above and this are not repeated below.
• No diversionary routes have been identified at this time for assessment but it is considered that similar impacts and effects would be anticipated to those envisaged with respect to NC08.</td></tr>
<tr><td rowspan="5">Noise and Vibration</td><td>Baseline - key aspects and importance / significance</td><td>The route passes through 12 road NIAs:
• 297 runs (in part) north from St James Barton roundabout to the Arley Hull/Bath Buildings junction on the A38 Cheltenham Road/Stokes Croft;
• 296 runs along the A38 Cheltenham Road/Gloucester Road from the junction with Winsley Road to just before the junction with Bolton Road;
• 295 runs along the A38 Gloucester Road from just after the junction with Brynland Avenue to the junction with Dongola Avenue;
• 294 runs along the A38 Gloucester Road from just before the junction with Tortworth Road to the junction with Beaufort Road;
• 293 runs along the A38 Gloucester Road from the junction with Court Road to just before the junction with Highbury Road;
• 292 runs along the A38 Filton Road from the junction with Doone Road to just after the junction with Montreal Avenue;
• 314 runs along the A38 Gloucester Road from just after the Filton Roundabout to Filton College South;
• 289 runs along the A4174 Station Road from the junction with Shellard Road to the junction with Emma-Chris Way;
• 290 runs along the A4174 Station Road and New Road from the junction between New Road and Pilkington Close to just before the junction between the A4174 Station Road and New Road;
• 288 runs along the A38 Gloucester Road from just after the junction with the B4057 Gipsy Patch Lane to just past where the A38 Gloucester Road crosses the railway line;
• 287 runs along the A38 Gloucester Road from just before Sandhurst Close to the junction with Hempton Lane; and
• 286 runs along the A38 Gloucester Road from the ends of Manor Grove and Oaktree Crescent.

There are around 12000 properties along the MT route out of which more than 7600 are residential and more than 4600 are non-residential.

According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[1], baseline daytime noise levels are generally above $L_{Aeq,16h}$ 55dB (free-field) at the nearest houses along the A38 and Filton Road. Noise levels are generally below $L_{Aeq,16h}$ 55dB (free-field) at houses away from the main roads.</td></tr>
<tr><td>Likely Effects – Construction</td><td>It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors. However, it is anticipated that adverse impacts associated with above ground construction works including from plant and waste (spoil) haulage are likely. Noise and vibration impacts could be a particular issue for local residents along the cut and cover section between Ch3000 and 3700.</td></tr>
<tr><td>Impact Assessment (construction)</td><td>Moderate Adverse</td></tr>
<tr><td>Likely Effects – Operation</td><td>It is assumed that overall the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs. However, some additional above ground traffic noise is expected, particularly associated with the diversion of general traffic along A and B classification routes, anticipated to be largely residential in nature. A quantitative assessment should be undertaken at the appropriate stage in accordance with DMRB LA111 to verify benefits in noise levels as a result of modal shift.</td></tr>
<tr><td>Impact Assessment (operation)</td><td>Slight Beneficial</td></tr>
<tr><td rowspan="4">Air Quality</td><td>Likely Effects – Construction</td><td>It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. Air quality impacts could be a particular issue for local residents along the cut and cover section between Ch3000 and 3700.
Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.</td></tr>
<tr><td>Impact Assessment (construction)</td><td>Neutral</td></tr>
<tr><td>Likely Effects – Operation</td><td>It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. Available traffic data shows that there will be significant reduction in traffic flow along the A38 between Bond Street and Ashley Down Road where the MT route is closed to general traffic; this will reduce emissions of nitrogen dioxide (NO2) and particulate matter (PM) and would benefit the AQMA. It is anticipated that there will be an increase in traffic along dispersal routes taken by general traffic, this will disbenefit the air quality at the sensitive receptors along largely residential streets, such as Muller Road, Kellaway Avenue and Coldharbour Road, and within the vicinity of the section of the MT route where closed to general traffic.</td></tr>
<tr><td>Impact Assessment</td><td>Slight – Moderate Beneficial</td></tr>
</table>

[1] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		NC08b
Landscape/Townscape	Likely Effects – Construction	Significant adverse effects could arise as a result of construction infrastructure including temporary compounds, storage and construction parking in residential / commercial townscape character areas across the route. There would be potentially large adverse effects on townscape particularly for the cut and cover section of the route, given the traffic disruption and position within a residential and commercial location on Gloucester Road.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed the landscape setting for the proposed new MT infrastructure would be in keeping with the existing local character. The option would require new infrastructure to be constructed across a former airfield, although it is assumed this would be in keeping with the proposed Brabazon development (i.e. coordinated with Brabazon layout). The closure of both lanes of general traffic along Cheltenham Road/Gloucester Road may have potential beneficial effects on the streetscape (assuming carriageway is re-designed with quality public realm, including green blue infrastructure, to promote pedestrian priority and facilitate cyclists), encouraging active travel and benefitting the commercial and residential area. Potential effects on visual amenity could arise as a result of introducing new transport modes and associated infrastructure for a number of sensitive receptors (residential properties, cycle routes etc). There may be potential adverse effects on the landscape/townscape character of the local vicinity, and in particular the proposed diversionary route, from increased traffic flows along more residential carriageways and through associated character areas.
	Impact Assessment (operation)	**Slight Adverse**
Historic Resources	Likely Effects – Construction	**Please note that a Gazetteer for this option is provided in Annex A of this report.** It is anticipated that construction techniques adopted, including cut and cover approach to underground section, would seek to avoid physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area. Construction of the route (and presence of associated construction infrastructure) may impact the significance of heritage assets through temporary changes in their settings. It is predicted that there is the potential for high impact to seven heritage assets (potential for damage to an asset given their immediate proximity to the route) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that operational impacts associated with noise and vibration along the MT route would be reduced although may be slightly increased along dispersal routes created by the closure of the section of the Cheltenham Road/Gloucester Road to two way general traffic . There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. Improvements in the existing streetscape and public realm which might be delivered via closure of the section of the Cheltenham Road/Gloucester Road to two way general traffic may present opportunities for enhancement of heritage assets through trails, signage and improved visitation. It is predicted that there is the potential for high impact to the setting of seven heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**
Biodiversity	Likely Effects – Construction	**Please note that additional baseline summary information for this route is provided in Annex B of this report.** Within Filton Airfield, there will be a direct loss of habitats and this may also result in fragmentation of the habitats present (and which may also adversely affect the species that rely on these habitats) assuming that the MT infrastructure is delivered ahead of the wider Brabazon development. It is anticipated that the option will otherwise be contained within the existing carriageway such that loss of habitats and vegetation clearance within the Three Brooks LNR, two SINCs, HPI woodland can be avoided although there is potential for loss of scrub, hedgerows and trees in roadside verges. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area. Increased levels of dust emissions and pollutants may result in temporary degradation of surrounding habitats if not suitably mitigated. In the absence of targeted species and habitat surveys, a moderate adverse effect has been scored, this is on account of the habitat loss within the former Filton Airfield predominantly comprising grassland and hardstanding habitats, with no hedgerows, woodland or scrub habitats identified on aerial imagery.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	Where the route uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. Where the route crosses the former Filton Airfield, it is anticipated that the operational phase has the potential to result in direct impacts on protected species through collision with vehicles and indirect disturbance on habitats through noise, lighting and pollution from vehicles. Overhead electrification infrastructure if required for the MT route, could impact protected species through collision of species with cabling and vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes for bats.
	Impact Assessment (operation)	**Slight Adverse (excluding species impacts)**
Water	Likely Effects – Construction	• Any loss of fluvial floodplain during the construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water and groundwater quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • Flood risk may increase temporarily. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures. • Dewatering activities may be required where penetration of the groundwater table is expected for earthworks. Impact on local/regional groundwater abstractions affecting groundwater level, flow and quality. This could result in impacts to groundwater receptors. • Changes to groundwater flow paths due to below ground structures extending below groundwater table and forming groundwater flow barriers that may increase pore water pressures and elevate the risk of groundwater flooding. • Excavation or construction of new roads could lead to increased pollution risk to groundwater receptors.

Option Ref		**NC08b**
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	• New infrastructure passes through areas of surface water flood risk associated with the headwaters of small streams where there is the potential for adverse impacts on flood risk. • Parts of the route may be at risk of fluvial flooding, awareness of constraints to the operational impacts should be considered. The frequency and severity of flooding will increase with the impacts of climate change. • Increased risk of spillage / runoff and creating pollutant pathways to groundwater depending on drainage design. • Parts of the route may be at risk of groundwater flooding (due to presence of groundwater flow barriers), awareness of constraints to the operational impacts should be considered. If below ground structure is below the water table, new drainage requirements may be needed.
	Impact Assessment (operation)	**Slight Adverse**

Option Ref		**EC08**
Noise	Baseline - key aspects and importance / significance	The route passes through eight road NIAs and one rail NIA: • 281 runs eastwards from Old Market roundabout to Lawrence Hill roundabout and along the A420 Lawford Street/Lamb Street/Lawfords Gate from the junction with the A420 Old Market Street to just after the junction with Pennywell Road; • 305 runs east from Lawrence Hill Roundabout along the A420 Lawrence Hill/Church Road until the junction with the A431 Summerhill Road. The NIA runs east from here along the A431 Summerhill Road/Air Balloon Road/Nags Head Hill until just after the junction with Kingsway; • RI_46 is located on the railway line just south of Lawrence Hill station; • 262 runs along the A420 Clouds Hill Road from just beyond the junction with Holmes Hill Road to just beyond the junction with Whiteway Road; • 261 runs the A420 Two Mile Hill Road/Regent Street/High Street from the Charlton Road junction to just beyond the junction with Two Mile Court; • 283 runs the A420 Two Mile Hill Road from just after the junction with Broadfield Avenue to just beyond the junction with Church Road; • 282 includes 4 residential properties at the A4017 Soundwell Road/Downend Road junction; • 249 includes residential and commercial properties at the A4017 Soundwell Road/Victoria Street, the A4174 Broad Street and the B4465 High Street junction; and • 246 runs along the A432 Badminton Road from the roundabout with the A432 Downend Road and the A4017 North Street to just before the junction with the A4174 Cleeve Hill and Cleeve Road. Diversionary and one-way system routes: • The one-way system along the A420 Lawford Street/Lamb Street/Lawfords Gate intersect with NIA 218 at the A420 Old Market Street to just after the junction with Pennywell Road; • The A431 Diversion route intersects with NIA 305 at the Chalk Road A420 junction and along the Summerhill Road between the A420 Church Road junction and to The Avenue junction; and • The A420 Diversion (Light Vehicles) route intersects with NIA 283 at the A420 Cloud Hill Road and Soundwell Road junction. There are more than 12000 properties along the MT and diversionary routes out of around 7600 are residential and more than 4500 are non-residential. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra2, baseline daytime noise levels are generally above LAeq,16h 60dB (free-field) at the nearest houses along the A420 and Soundwell Road. Noise levels are generally below LAeq,16h 55dB (free-field) at houses away from the main roads.
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors. However, it is anticipated that adverse impacts associated with above ground construction works including from plant and waste (spoil) haulage are likely. Therefore, a quantitative assessment should be undertaken at the appropriate stage to determine the potential for ground-borne noise and vibration impact.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs. However, some additional above ground traffic noise is expected particularly associated with the A420 and A431 diversion route which are predominately located through residential areas.
	Impact Assessment (operation)	**Neutral**
Air Quality	Baseline - key aspects and importance / significance	The route passes through: • Bristol AQMA at its western extent which includes the one-way system (along the A420 Lawford Street/Lamb Street/Lawfords Gate) and A431 Diversion Route, between St Philips and St George; • Kingswood – Warmley AQMA at its south-eastern extent, which is associated with the A420 Regent Street/High Street and extends from the junction with Blackhorse Road to the junction with Lansdown View; and • Staple Hill AQMA at its north-eastern extent which includes the B4465/Pendennis Road junction of the A420 Diversion (Light Vehicles) Route, which is associated with the A4017 Victoria Street/Soundwell Road and the A4175 High Street/ Broad Street crossroads. There are numerous sensitive receptors such as residential, nursery, primary and secondary schools, pharmacy's, dentists, GP practices, a hospital and care homes within the study area.

[2] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		**EC08**
		The Bristol's monitoring data shows that there are exceedances in annual mean NO2 concentrations at the monitoring sites in the vicinity of the Site between 2015 and 2019. Monitoring site at Church Road exceeded the AQS objective for annual mean NO2 of 40µg/m^3 in 2019.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. The initial traffic data shown that there will be significant reduction in flow along the A420 and the A431; this will reduce emissions of nitrogen dioxide (NO2) and particulate matter (PM) and subsequently improve roadside air quality and would benefit the AQMA. Currently available traffic data shows that there will be an increase in flow along the diversion routes, this will disbenefit the air quality at the sensitive receptors namely along A4174 at Emersons Green and A432 Westerleigh Road, Fishpond Road and Stapleton Road, and B4465 High Street at Staple Hill.
	Impact Assessment (operation)	**Slight Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The route follows the existing road network (A420/A4017/Westerleigh Road) and passes through mainly commercial and residential townscape characters. The route intersects the National Sustrans Cycleway twice, once at its western extent and once again close to Staple Hill. The route crosses the Regional Sustrans Cycleway at the northern extent and several Local Routes. The option does not pass adjacent to any designated landscapes. Local, regional and national Sustrans Cycleways cross and follow portions of the route. Within the 1.5km landscape study area there is one Registered Park and Garden, three LNR, four areas of ancient woodland, one country park and portions of the Bristol to Bath Green Belt. The A431 diversion route intersects the National Sustrans Cycleway near the City Academy Bristol. All the diversionary and one-way system routes have predominately residential townscape characters.
	Likely Effects – Construction	Potential large adverse effects could arise from construction infrastructure including temporary compounds, storage and construction parking in residential / commercial townscape character areas.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	There may be potential adverse effects on the landscape/townscape character of the MT route as a result of the introduction of transportation modes not currently present within the carriageway and associated MT infrastructure. This will be of particular note between Ch5900 to 9300 where the MT route operates in parallel along largely residential streets and where public transport modes are not currently present. Diverted general traffic flows along largely residential streets is also likely to adversely impact associated character areas. The closure of both lanes of general traffic along the A420 through Lawrence Hill / St George may have beneficial effects on the streetscape (assuming carriageway is re-designed with quality public realm, including green blue infrastructure, to promote pedestrian priority and facilitate cyclists), encouraging active travel and benefitting the commercial and residential area.
	Impact Assessment (operation)	**Moderate Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** The MT route would run near four Grade II* Listed Buildings, 67 Grade II Listed Buildings and four Conservation Areas within a 200m buffer. Most of the assets are centred around the Temple Meads, Redfield, St George and Kingswood areas. The A431 traffic diversion has six Grade II Listed buildings and one Conservation Area within a 100m buffer.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area. Construction activities along the route (and presence associated construction infrastructure) may impact the significance of heritage assets through temporary changes in their settings. It is predicted that there is the potential for high impact to 13 heritage assets (potential for damage to an asset given their immediate proximity to the route) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that operational impacts associated with traffic noise and vibration would be reduced along the MT route although may be increased along diversionary routes. There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. Improvements in the existing streetscape and public realm which might be delivered via closure of the Lawrence Hill / St George section of the A420 to two way general traffic may present opportunities for enhancement of the heritage assets through trails, signage and improved visitation. It is predicted that there is the potential for a high impact to setting of 13 heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this route is provided in Annex B of this report.** The MT route would run above Easton-Staple Hill Disused Railway SNCI near Lawrence Hill roundabout and would also run adjacent to the Folly Brook SNCI.at the northern extent. The route also passes adjacent to numerous important open spaces (IOS). The A431 diversion route along Beaufort Road runs adjacent to Blackswarth Road Wood SNCI, Crew's Hole Woodland SNCI and Troopers Hill SNCI. The A420 Diversion route (Light Vehicles) runs adjacent to an un-named SNCI adjacent to Acacia Road. The cycle diversion runs directly through St George's Park IOS. The route and some diversionary routes would run adjacent to or within the ZoI (200m buffer from the route) of the following habitats:

Option Ref		EC08
		• Habitats of Principal Importance (HPI); deciduous woodland; • UK BAP Priority habitat: wood pasture and parkland; and • Grassland, individual trees, areas of woodland and scrub. It is anticipated that the habitats present will support a range of protected and notable species associated with the habitats present.
	Likely Effects – Construction	It is anticipated that the option will be contained within the existing carriageway such that loss of habitats and vegetation clearance within the Feeder Side SNCI, Folly Brook SNCI, HPI woodlands and UKBAP wood pasture and parkland can be avoided. The cycle diversion may result in habitat loss through St George's Park, which includes amenity grassland and individual trees. This may adversely affect the species that rely on these habitats. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area. Increased levels of dust emissions and pollutants may result in temporary degradation of surrounding habitats if not suitably mitigated.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	As the MT route and diversionary general traffic routes use the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. However, if overhead electrification infrastructure is required for the MT route, this could impact protected species through collision of species with cabling and vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes for bats, however existing baseline conditions of the roads within the route may already reduce the suitability of the roads for bats. If the diversionary cycle path requires additional lighting through St George's Park, this has the potential to result in indirect disturbance on protected species and habitats through lighting if not suitably mitigated.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**
Water	Baseline - key aspects and importance / significance	**Surface Water** The MT route runs along the existing road network following from the A420 for approximately 5 km, through Flood Zone 1 (Low risk) and then north along the A4017 for 3 km, also through Flood Zone 1 (Low risk). The MT route then turns north-easterly along Westerleigh Road to Emersons Green, intersecting with an unnamed tributary of the River Frome (Ordinary Watercourse) along Westerleigh Avenue (Ch. 1350). Along this section, the MT route passes through Flood Zones 2 (Medium risk) & 3 (High risk), associated with the Folly Brook at Emersons Green; Flood Zone 2 along Jenner Boulevard at the northern extent of the route, and Flood Zone 3 at the north-west area of the Westerleigh Road/Jenner Boulevard roundabout. The A431 diversion route runs along the existing road network along Easton Road (B4465) before continuing in an easterly direction along Whitehall Road (B4465). The diversion route then turns south along Chalks Road and Blackswarth Road, then turns east along Beaufort Road and The Avenue, before turning west along Summerhill Road to re-join the MT route at the A420/Summerhill junction. The diversion route passes through Flood Zone 1 (Low risk). The cycle diversion turns off the A420 at the A420/Victoria Parade, before turning east along Mary Street and then north along Albert Parade. The diversion then turns east along the B4465 and Foxcroft Road, through St George's Park and then continues along the existing road network along Hudds Vale Road, Whiteway Road and Ingleside Road. Along Ingleside Road it turns south to re-join the MT route next to the A420/Soundwell Road junction. The cycle diversion passes through Flood Zone 1 (Low risk). The A420 diversion runs north parallel to the A4017 MT route from Lodge Road to Shrubbery Road, it then turns easterly along Downend Road (A432) where it then re-joins the MT route at the Downend Road (A432)/ North Street (A4017) roundabout. The A420 diversion passes through Flood Zone 1 (Low risk). The majority of the route is at Low risk of surface water flooding. However, there is ponding shown on five occasions along Westerleigh Road during the 1 in 30-year event surface water flood event; between Buckingham Place junction and Peache Road junction (Ch. 9350 to 9500), between Westbourne Road junction and Elmtree Avenue junction (Ch.10300 to 10450), between Dibden Road junction and Blackhorse Road junction (Ch. 10550 to 10700), just east of the Westerleigh Road/Emerson Way roundabout (Ch. 11100) and along Jenner Boulevard at the northern extent of the route. However, there is not a significant amount of high surface water flood risk across the route. **Groundwater** There are no superficial deposits present throughout the entire route. The route transects multiple formations of variable lithology (sandstone, mudstone, coal measures) as it progresses east towards Emersons Green (far north of the route). The dominant bedrock geologies are the Mercia Mudstone Group, South Wales Coal Measures Group and Pennant Sandstone Formation. Multiple faults exist and the location of these faults may allow deep groundwater circulation and is believed to be the pathway for deep thermal waters supplying the Bath and Bristol hot springs. Where the route transects the South Wales Coal Measures, the Coal Authority Interactive Map designates this a High Risk Development Area with multiple mine entry points identified. Depending on how the mines were worked and groundwater managed during operation, groundwater rebound i.e. to shallow levels below the ground surface may exist for the area. There may also be a risk of potential mine gas for this location as well. The SFRA identifies that groundwater can get within 1-2m of the ground surface. Groundwater flooding has been reported at locations throughout Bristol but this has tended to be in isolated basements, rather than groundwater rising above the ground surface. British Geological Survey (BGS) borehole ST57SE287 (near Temple Meads) indicates a rest water level (RWL) of approximately 3 mbgl (7 mAOD). BGS borehole ST67SW45 (near Lawrence Hill Station) indicates a RWL of 13 mbgl (7 mAOD). BGS borehole ST67NE90, situated near the Bristol Bath Science Park, indicates a rest water level of approximately 2 mbgl (49 mAOD). Groundwater is expected to be at shallow depth along the scheme. At the Old Market Roundabout to St George and along the A420, the scheme is mostly located within a high Groundwater Vulnerability Zone (GWVZ), which is associated with the Mercia Mudstone Group (Sandstone). Travelling north towards Staple Hill the route is within a Medium GWVZ, which is associated with the Coal Measures. The section of the route from Staple Hill north towards Emerson Green, is within a High GWVZ associated with the Pennant Sandstone Formation. Considering the environment, groundwater flood risk is considered to be low or manageable. The entire option is located upon Secondary A aquifers and no SPZ are identified along or within 1.0km of the scheme.
	Likely Effects – Construction	• Any loss of fluvial floodplain during construction may require temporary floodplain compensation. • The construction works may expose construction workers to flood risk. • There may be temporary adverse effects on groundwater quality as a result of earthworks particularly in fractured aquifers. • Potential localised impacts to groundwater quantity (level and flow) due to groundwater control measures.

Option Ref		EC08
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	• The option may be at risk of fluvial and tidal flooding. The frequency and severity of flooding will increase with the impacts of climate change. • Increased risk of spillage / runoff and creating pollutant pathways to groundwater depending on drainage design.
	Impact Assessment (operation)	**Slight Adverse**

Topic / Option Ref		SWC11
Noise	Baseline - key aspects and importance / significance	The route passes through seven road NIAs: • 14353 runs along the A4 Temple Gate between the junction with Station Approach to just after the junction with Chatterton Square; • 12784 runs along the A38 Bridgewater Road from the junction with Winford Terrace to just before the junction with Dundry Lane; • 3992 includes a residential property on the A38 Bridgewater Road, just before the junction with Filter Cottages; • 3991 includes commercial property on the A38 Bridgewater Road just before the junction with Hoobs Lane and Barrow Lane; • 13851 runs along the A38 Bridgewater Road from just before the junction with Naish Lane to before the junction with Dial Lane; and • 12785 runs along the A38 Potter Hill from just after the junction with Currells Lane to just after the junction with School Lane. The route passes adjacent to one road NIA: • 264 runs along the A370 York Road from Langton Street Bridge to just beyond the junction with Spring Street. Diversionary Route The diversion passes through two road NIAs: • 267 runs along the A4 Bath Road from just passed the junction with Angers Road until the junction where the A37 merges onto the A4. This NIA also runs along the A37 Wells Road from the junction with Broadfield Road until the junction where the A37 merges onto the A4 Bath Road; and • 266 runs along the A37 Wells Road from the junction with Ponsford Road until the A37/ A4174 Airport Road junction. There are more than 4200 properties along the MT and diversionary routes of which more than 2900 are residential and more than 1200 are non-residential. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[3], baseline daytime noise levels are generally above $L_{Aeq,16h}$ 65dB (free-field) at the nearest houses along the A38, A4174, A37 and Redcliffe Way. Noise levels are generally below $L_{Aeq,16h}$ 55dB (free-field) at houses away from the main roads.
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors. However, it is anticipated that adverse impacts associated with above ground construction works including from plant and waste (spoil) haulage are likely.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs. However, some additional above ground traffic noise is expected associated with dispersal routes including the A4174. Benefits in noise levels due to modal shift will need to be verified during the quantitative assessment undertaken in accordance with DMRB LA111 at the appropriate stage.
	Impact Assessment (operation)	**Slight Beneficial**
Air Quality	Baseline - key aspects and importance / significance	The route passes through the Bristol AQMA at its northern extent, from Bristol Temple Meads to Bedminster and Knowle and to the north of Hengrove. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices, a hospital and care homes along the proposed scheme. The Bristol's monitoring data shows that there are exceedances in annual mean NO2 concentrations at the monitoring sites in the vicinity of the Site between 2015 and 2019. Monitoring sites at Bath Road, West Street, Bedminster Road and Bedminster Down Road exceeded the AQS objective for annual mean NO2 of 40µg/m^3 in 2019.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. The efficacy of the mitigation measures will be dependent on an appropriate monitoring regime. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. The initial traffic data shown that there will be reduction in flow along the B3122 Saint John's Lane, Redcatch Road / Salcombe Road; this will reduce emissions of nitrogen dioxide (NO2) and particulate matter (PM) and improve roadside air quality and would benefit the AQMA. There could be an increase in general traffic flow along the dispersal routes including the A4174, this could disbenefit the air quality at the sensitive receptors along nearby residential roads.

[3] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Topic / Option Ref		SWC11
	Impact Assessment (operation)	**Slight Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The route largely follows the existing A38 and A371 road networks and passes through more residential roads within Knowle and Hengrove. The route crosses through mainly residential and city centre landscape characters in Bristol and across the Bristol and Bath Green Belt to the Airport. Where the route leaves the A371 at Hengrove, it passes through Knowle using a combination of quiet residential roads and an existing bus route. The route reconnects with the A4 south of the Bathbridge roundabout by constructing a new road in a currently pedestrianised area. The route lies adjacent to one Local Nature Reserve. There are several Public Rights of Way and Sustrans Local Cycleways that cross and follow sections of the route, and two Sustrans National Cycleways cross the route. Additionally within the 1.5km landscape study area, there are two SSSIs, two LNRs, three registered Parks and Gardens and 10 areas of Ancient Woodland.
	Likely Effects – Construction	Potential significant effects could arise as a result of construction infrastructure including temporary compounds, storage and construction parking in residential / commercial townscape character areas. There would be potentially moderate adverse effects on townscape given the extent of traffic disruption from construction works within a residential and commercial locations.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed the landscape setting for the proposed new MT infrastructure would be in keeping with the existing local character. There may be potential adverse effects on the landscape/townscape character as a result of transportation modes not currently present within the carriageway and their associated infrastructure. There may be potential adverse effects on the landscape/townscape character of the local vicinity, and in particular along the proposed MT and general traffic diversionary route along residential roads and associated character areas.
	Impact Assessment (operation)	**Moderate Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** The MT route is entirely above ground and would run near one Grade I Listed Building, two Grade II* Listed Buildings, 13 Grade II Listed Buildings and three Conservation Areas. Most of the assets are within the Bristol City Centre, Temple Meads and Knowle area.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction activities along the route (and presence of associated construction infrastructure) may impact the significance of heritage assets through temporary changes in their settings. It is predicted that there is the potential for high impact to four heritage assets (potential for damage to an asset given its immediate proximity to the route) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that operational impacts associated with traffic noise and vibration would be reduced along the MT route although may be increased along diversionary routes for general traffic. There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. It is predicted that there is the potential for a high impact to the setting of four heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this route is provided in Annex B of this report.** The route would pass over or adjacent to: • Felton Common Local Nature Reserve (LNR); • Sites of Nature Conservation Interest (SNCI)[4]: River Avon, Wetmore Vale, Hengrove Park, Crox Bottom, Highridge Common; and • North Somerset Council Wildlife Sites[5]: Barrow Tanks, Fields East of Barrow Tanks. The route would pass over, adjacent to or within 200m of the following habitats: • HPI: Mudflats, good quality semi-improved grassland, lowland dry acid grassland and deciduous woodland; • UK Biodiversity Action Plan (BAP) Priority habitat[6]: Wood pasture and parkland; and • Non-HPI habitat: Floating Harbour, River Avon, the Barrow Gurney Reservoirs, Colliter's Brook, arable and grassland fields, reservoirs, hedgerows, trees, amenity grassland, and areas of woodland. It is anticipated that the habitats present will support a range of protected and notable species associated with the habitats present.
	Likely Effects – Construction	It is anticipated that the existing road network will largely be used for this option, therefore it is anticipated that the majority of habitat loss will be limited to discrete areas of habitat associated with the road verge. If any road widening of the network is required this may adversely affect the habitats, including HPI and UK BAP Priority habitat and designated sites, as well as the species which rely on these habitats. The habitats to be lost is likely to be limited to discrete areas, as such a precautionary approach has been adopted. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area.

[4] https://maps.bristol.gov.uk/policies/
[5] http://map.n-somerset.gov.uk/PoliciesMap.html
[6] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

Topic / Option Ref		SWC11
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	As the option uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. If overhead electrification infrastructure is required, this could impact protected species through collision of species with cabling in addition to vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes for bats.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**
Water	Baseline - key aspects and importance / significance	**Surface Water** The MT route runs along the existing road network following from Temple Gate (A4), by Bristol Temple Meads Station. Along Temple Gate (A4), at the Bath Bridge roundabout, the MT route intersects the River Avon (Ch. 2700) where it is classified as a fluvial Flood Zone 3 (High risk) area associated with the flood extents from the tidal River Avon. The route then turns west along Mead Street and then turns south to follow along St Luke's Road, continuing in a general southerly direction through Knowle until it reaches the Airport Road (A4174)/Salcombe Road junction (Ch. 5700) where it turns west. From the Bath Road (A4)/Mead Road junction to the Airport Road (A4174)/Salcombe Road junction, the route is entirely within Flood Zone 1 (Low risk), except for at the Airport Road (A4174)/Salcombe Road junction itself. The general traffic diversion also runs along the existing road network, continuing along Bath Road (A4) whilst the MT route turns west to Mead Street. The diversion turns west further on, along St John's Lane, before turning south along Redcatch Road (B3122) and then east along the same road name. It then turns south along Wells Road (A37) until it reaches the Airport Road (A4174)/Wells Road (A37) junction. Along this stretch described, the Traffic Diversion is entirely within Flood Zone 1 (Low risk). The diversion then turns west along Airport Road, until it meets up with the MT route after approximately 750 m, at the Airport Road (A4174)/Salcombe Road junction. Along this stretch, the diversion is entirely within Flood Zone 2 (Medium risk) and is within Flood Zone 3 (High risk) for the majority of the 750 m stretch. This is associated with the flood extents from the Brislington Brook, intersecting the Brook at two locations along this stretch. After the diversion re-joins the MT route at the Airport Road (A4174)/Salcombe Road junction, the MT route continues along in a westerly direction along the A4174, where it passes through areas of Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk) at several locations. The first location is from the Airport Road (A4174)/Salcombe Road (A37) junction (Ch. 5700) to approximately 130 m west for Flood Zone 3 (High risk) (Ch. 5700 to Ch. 5800) and approximately 160 m west for Flood Zone 2 (Medium risk) (Ch. 5700 to Ch. 5850). This is associated with the flood extents from the Brislington Brook, the route intersects the Brook along this location (Ch. 5800). The MT route along the A4174 also passes through an area of Flood Zone 3 (High risk), along Hengrove Way, for approximately 50 m (Ch. 8100 to Ch. 8150), in association with the flood extents of the Pigeonhouse Stream. The route intersects the Pigeonhouse Stream along Hengrove Way (Ch 8100). The route along the A4174 also passes through an area of Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk) along Anton Bantock Way and King Georges Road, in association with the flood extents of the River Malago (Ch. 9500). The area of Flood Zone 2 (Medium risk) stretches for approximately 50 m (Ch. 9450 to Ch. 9500), with two small stretches of Flood Zone 3 (High risk). The route then turns from the A4174 to along Bridgewater Road (A38) in a south-westerly direction at the Lime Kiln roundabout (Ch. 10950). It continues for approximately 6.25 km towards Bristol Airport along the A38, crossing between the two Barrow Gurney reservoirs. It then turns off west to the North Side Road at the A38/North Side Road roundabout (Ch. 17300), until it reaches the south-western extent of the option. This stretch of the route, is entirely within Flood Zone 1 (Low risk). The majority of the option is at Low risk of surface water flooding. Ponding is shown in several locations during a 1 in 30-year event (High risk). These locations are along St Luke's Road (Ch. 3300), St John's Lane, Ravenhill Road (Ch. 4000), Airport Road (A4174) (Ch. 6100 to Ch. 6200), Hengrove Way (A4174) (Ch. 8450) and across multiple locations across Bridgewater Road (A38) at the Bridgewater Road (A38)/Colliter's Way (Ch. 11000) and across the A38 stretch to the Bristol Airport (Ch. 11600 to Ch. 11700, Ch. 12350 to Ch. 13100, and Ch. 16900 to Ch. 17200). However, across the entire route, there is not a significant amount. The majority of the route is not located within a Source Protection Zone, except for at the south-western extent where it passes through the Outer Zone (Source Protection Zone 2) when it turns west along North Side Road for approximately 570 m. The Outer Zone (Source Protection Zone 2) is defined as *'the zone is 400 day travel time of pollutant to source. This has a 250 or 500 m minimum radius around the source depending on the amount of water taken'.* **Groundwater** Superficial Tidal Flat Deposits, comprising clay and silt, are present at the northern most extent of the route and are confined to the location of the River Avon. The bedrock geology from Temple Meads (north) to Bristol International Airport (south west) comprises the Mercia Mudstone Group (sandstone, mudstone), Lias Group (limestone, mudstone, siltstone) and Pembroke Limestone Group (limestone, mudstone) respectively. The route intercepts Secondary A, Secondary B, Secondary (undifferentiated) and Principal aquifers. The Principal aquifers are associated with the Pembroke Limestone Group in the south west close to Bristol International Airport. The route is predominantly located within a High Groundwater Vulnerability Zone (GWVZ) with soluble rock risk. There are two SPZ at Bristol International Airport, SPZ Inner Protection Zone 1 and Outer Protection Zone 2. No details have been provided on the groundwater abstractions but based on the geology of the area they will be targeting the Pembroke Limestone Group for supply. The Coal Authority Interactive Map does not identify any mine entry points throughout the route. SFRA for Bristol identifies a generally low groundwater flood risk . The SFRA also identifies that groundwater can get within 1-2m of the ground surface. Groundwater flooding has been reported at locations throughout Bristol city but this has tended to be in isolated basements, rather than groundwater rising above the ground surface.
	Likely Effects – Construction	• Any loss of fluvial floodplain during the construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • The works could be impacted by/ exacerbate existing flooding. • There may be temporary adverse effects on groundwater quality particularly in fractured aquifers. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures.
	Impact Assessment (construction)	**Slight Adverse**

Topic / Option Ref		SWC11
	Likely Effects – Operation	• Parts of the option may be at risk of fluvial and tidal flooding, awareness of constraints to the operational impacts should be considered. The frequency and severity of flooding will increase with the impacts of climate change. • Increased risk of spillage / runoff and creating pollutant pathways to groundwater depending on drainage design.
	Impact Assessment (operation)	**Slight Adverse**

Option Ref		BBC-C
Noise	Baseline - key aspects and importance / significance	The route passes through four road NIAs: • NIA ID 14353 is on the A4 Temple Gate from just after the junction with Station Approach to just after the junction with Chatterton Square and includes the commercial properties to the east of the A4 Temple Gate; • NIA ID 267 runs along the A4 Bath Road from just before to just after the junction with the A37 Wells Road. The NIA also runs south from this junction along the A37 Wells Road until just after the junction with Broadfield Road; • NIA ID 299 runs along the A4 Bath Road from just before the junction with Summer Hill to just after the junction with Chatsworth Road; and • NIA ID 268 runs along the A4 Bath Road/Eagle Road/Bristol Hill/Brislington Hill from the junction with Sandy Park Road to the junction with the A4174 Callington Road. This NIA also includes the section of the A4174 from the A4 Brislington Hill to the roundabout with West Town Lane. There are around 2677 properties along the MT route out of which 1705 are residential and 972 are non-residential. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[7], baseline daytime noise levels at the nearest houses are generally above $L_{Aeq,16h}$ 65dB. (free-field).
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors but there is potential for some adverse impacts associated with construction works including plant.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs. Benefits in noise levels due to modal shift will need to be verified during the quantitative assessment undertaken in accordance with DMRB LA111 at the appropriate stage.
	Impact Assessment (operation)	**Slight Beneficial**
Air Quality	Baseline - key aspects and importance / significance	The option lies within the Bristol AQMA, which extends as far as Brislington at its eastern extent. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices, a hospital and care homes within the study area. Bristol's monitoring data show that there are exceedances in annual mean NO_2 concentrations at the monitoring sites in the vicinity of the western section of the corridor between 2015 and 2019. Monitoring sites at A4 Bath Road exceeded the AQS objective for annual mean NO2 in 2019.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. The initial traffic model shows a reduction in traffic in the Bristol City Centre as a result of the option; this will reduce emissions of nitrogen dioxide (NO2) and particulate matter; and subsequently improve roadside air quality and could benefit the Bristol AQMAs.
	Impact Assessment (operation)	**Slight Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The route follows the existing road network and passes through mainly residential and city centre landscape characters. The option lies adjacent to one Registered Park and Garden. There are several Sustrans Local Cycleways and one Sustrans National Cycleways crossing adjacent to Arno's Court park on the A4 and following sections of the route. Within the 1.5km landscape study area, there are two Local Nature Reserve (LNR), two ancient woodland areas and two Registered Park and Garden.
	Likely Effects – Construction	Potential significant adverse effects could arise as a result of construction of MT infrastructure and associated temporary compounds, storage and construction parking in residential / commercial townscape character areas There would be potentially large adverse effects on townscape given the extent of traffic disruption within residential / commercial locations and alterations to the existing cycle route to connect with Sustrans National Route 3.
	Impact Assessment (construction)	**Large Adverse**

[7] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		BBC-C
	Likely Effects – Operation	It is assumed the landscape setting for the proposed new MT infrastructure would be in keeping with the existing local character. There may be potential adverse effects on the landscape/townscape character as a result of transportation modes not currently present within the carriageway and their associated MT infrastructure. The route also diverts cyclists off the carriageway and on to the Sustrans National Route 3 (existing infrastructure diverts to north side of River Avon). This diversion is longer and assumes existing infrastructure can accommodate number of cyclists; however, this may have beneficial effects (i.e. more scenic route and off-carriageway may encourage active travel).
	Impact Assessment (operation)	**Moderate Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** The MT route is entirely above ground and would run near two Grade I Listed Buildings, ten Grade II* Listed Buildings, 43 Grade II Listed Buildings, one Grade II Registered Park and Garden, and three Conservation Areas. Most of the assets are within Totterdown and Brislington.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction activities along the route (and presence of associated construction infrastructure) may impact the significance of heritage assets through temporary changes in their settings. It is predicted that there is the potential for high impact to six heritage assets (potential for damage to an asset given their immediate proximity to the route) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that operational impacts associated with noise and vibration would be reduced along the MT route. There may be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. It is predicted that there is the potential for high impact to the setting of six heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this route is provided in Annex B of this report.** The route and its ZoI (200m buffer from the route) passes adjacent to three SNCIs: River Avon, Arno's Vale Cemetery and Brislington Meadows. The route uses an existing bridge to cross the Floating Harbour and the River Avon, both of which feed into the Severn Estuary (approximately 8.5km downstream), which is designated nationally and internationally as a SSSI, SAC, SPA and a Ramsar site. The route and its buffer passes through or adjacent to the following habitats: • HPI: deciduous woodland. • Other habitats along the scheme include woodland, scrub, scattered and lines of trees and amenity grassland. It is anticipated that the habitats present will support a range of protected and notable species.
	Likely Effects – Construction	It is anticipated that the existing road network will be used for the MT route and cycleway diversion, therefore it is anticipated that the majority of habitat loss will be limited to discrete areas of habitat associated with the road verge. If any road widening is required this may adversely affect the habitats, including HPI and designated sites, as well as the species which rely on these habitats. The habitats to be lost is likely to be limited to discrete areas, as such a precautionary approach has been adopted. The increased levels of noise and vibration, lighting and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area.
	Impact Assessment (construction)	**Slight to Moderate Adverse**
	Likely Effects – Operation	As the route uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. If overhead electrification infrastructure is required for the option, this could impact protected species through collision of species with cabling and vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes for bats, however existing baseline conditions of the road may already reduce the suitability of the roads for bats.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**

Option Ref		BBC-C
Water	Baseline - key aspects and importance / significance	**Surface Water** The route runs along the existing road network following from the Redcliffe Way (A4044)/Temple Gate (A4) junction, near to Bristol Temple Meads railway station. It continues along the A4, through Totterdown in a south-easterly direction, before turning south and continuing to follow the A4 until it reaches Brislington at the Bath Road (A4)/Callington Road (A4174) junction. The route is a total length of approximately 3.63 km. The route passes through areas of Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk) on two occasions; the first location is at the Bath Bridge roundabout (Ch. 2050), associated with the River Avon floodplain and the second location is at Bath Road (A4) (Ch. 5300), associated with the Brislington Brook. The Off-Road Cycle Link (NCN 3) diverts from the main MT route from the Bath Road (A4)/Russet Lane junction (Ch. 2900), then runs along the River Avon, before turning south along A4320 and Bloomfield Road, re-joining the main MT route at the Bath Road (A4)/Bloomfield Road junction (Ch. 3850). The majority of the Off-Road Cycle Link (NCN-3) is within Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk), for approximately 1.1 km. There are no significant areas of the BBC-C option affected by 1 in 30 year surface water flood events. **Groundwater** The route from Temple Meads towards Totterdown / Brislington is located within a High GWVZ with soluble rock risk associated to the Lias Group. The majority of the route from Temple Meads to Totterdown is located within a Medium and High GWVZ. The GWVZ is associated to the Mercia Mudstone Group. The entire route is located upon a Secondary A aquifer. No SPZ are identified along the route.

Option Ref		BBC-C
	Likely Effects – Construction	• Any loss of fluvial floodplain during construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • Flood risk may increase temporarily, this should be quantified and mitigated. • There may be temporary adverse effects on groundwater quality particularly in fractured aquifers. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	• The option may be at risk of fluvial and tidal flooding. • The frequency and severity of flooding will increase with the impacts of climate change.
	Impact Assessment (operation)	**Slight Adverse**

Option Ref		BBC-06
Noise	Baseline - key aspects and importance / significance	The option passes through six road NIAs: • NIA ID 268 runs along the A4 Bath Road/Eagle Road/Bristol Hill/Brislington Hill from the junction with Sandy Park Road to the junction with the A4174 Callington Road. This NIA also includes the section of the A4174 from the A4 Brislington Hill to the roundabout with West Town Lane; • NIA ID 5515 includes a residential property on the A4 Bath Road; • NIA ID 12801 includes a residential property on Hicks Gate, adjacent to the A4 Bath Road; • NIA ID 12804 encompasses properties along The Avenue, Abbey Park, The Park, Station Road, Old Vicarage Green, Pool Barton, Bristol Road and the High Street in Keynsham; • NIA ID 3698 starts just beyond the bridge over Avon Mill Lane and runs along the A4 Bath Road until just beyond the junction with The Glen; and • NIA ID 4003 is located on the A4 Bath Road between the junction with Bristol Road and just beyond the junction with Corston Lane. There are around 1289 properties along the MT route out of which 445 are residential properties and 844 are non-residential properties. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[8], baseline daytime noise levels at the nearest houses are generally above $L_{Aeq,16h}$ 65dB. (free-field).
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors but there is potential for some temporary adverse impacts associated with construction works including plant.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs although the benefits would be reduced since MT will operate within the soon to be implemented Bristol Bath Strategic Corridor (BBSC) which it is anticipated will already have benefited NIAs. Benefits in noise levels due to modal shift will need to be verified during the quantitative assessment undertaken in accordance with DMRB LA111 at the appropriate stage.
	Impact Assessment (Operation only)	**Slight Beneficial**
Air Quality	Baseline - key aspects and importance / significance	The route lies partially within the Bristol AQMA at its westernmost extent at Brislington. The route runs adjacent to the Keynsham AQMA at its western extent, which includes Station Road, Bristol Road between St Old Vicarage Green junction to Keynsham Library, Bath Hill from Bristol Road to the junction with Back Lane and Charlton Road from Bristol Road to just before the junction with Cranmore Avenue. The route also passes through Saltford AQMA at its eastern extent, which is located on the A4 Bath Road from the Manor Road/Beech Road junction to just beyond the junction with The Glen. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices, care homes and places of worship within the study area, predominately associated with south-east Bristol, Keynsham, Saltford and Corston. The Bristol and B&NES monitoring data show that there are exceedances in annual mean NO2 concentrations at the monitoring sites in the vicinity of the route between 2015 and 2019. Monitoring sites at the A4 Bath Road exceeded the AQS objective for annual mean NO2 in 2019.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**

[8] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		BBC-06
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. This will reduce emissions of nitrogen dioxide (NO2) and particulate matter, and subsequently improve roadside air quality and benefit the AQMAs at Bristol, Keynsham and Saltford. However, it is anticipated that the benefit of the scheme is likely to be insignificant and overshadowed by the traffic reduction with the BBSC. There is the potential for disbenefits due to increased congestion with reduced/altered road space, although this will reduce over time as the effects of modal shift increase.
	Impact Assessment (operation)	**Slight Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The MT route follows the existing road network (and future BBSC route) and passes from the residential areas of Brislington, through Keynsham and Saltford; interspersed by the Bristol and Bath Greenbelt, either side of Keynsham. The eastern extent of the route runs adjacent to Newbridge Park and Ride on the edge of Bath World Heritage Site (WHS). The Local Sustrans Cycleway crosses and follows sections of the route and the National Avon Cycleway crosses the route to the east of Saltford. The route also runs adjacent to two Registered Parks and Gardens, one SSSI close to Newbridge and the Cotswold AONB close to Newbridge. Within the 1.5km landscape study area, there are three Registered Park and Garden, four Local Nature Reserve (LNR), seven ancient woodland, four SSSI sites and areas of the Bristol to Bath Green Belt.
	Likely Effects – Construction	It is assumed that construction impacts will be minimised by the use of the BBSC carriageway by MT for a large section of the route. There would be potentially slight adverse effects given the extent of traffic disruption within residential / commercial locations associated with construction of any additional associated MT infrastructure.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	There may be potential adverse effects on the landscape/townscape character of the MT route as a result of the introduction of transportation modes not currently present within the future BBSC carriageway (e.g. if steel wheeled transport modes are introduced) and any additional associated MT infrastructure.
	Impact Assessment (operation)	**Slight Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** The MT route is entirely above ground and would run near two Grade I Listed Buildings, four Grade II* Listed Buildings, 51 Grade II Listed Buildings, two Grade II* Registered Park and Garden, three Scheduled Monuments, two WHSs and five Conservation Areas. Most of the assets are within Keynsham and Saltford.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction activities along the route (and presence of associated construction infrastructure) may impact the significance of heritage assets through temporary changes in their settings. It is predicted that there is the potential for high impact to nine heritage assets (potential for damage to an asset given their immediate proximity to the works) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. It is predicted that there is the potential for high impact to the setting of nine heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this route is provided in Annex B of this report.** The route and its ZoI (200m buffer from the route) runs adjacent to Newton St Loe SSSI, which is designated for its geological assets and five SNCIs:, Brislington Meadows, East Wood and Keynsham Humpy Tumps complex, Charlton Bottom and Queen Charlton Watercourse, River Chew and Bitton to Bath railway track. The route and its buffer passes through or adjacent to the following habitats: • Habitat of Principal Importance (HPI)[9]: deciduous woodland, lowland calcareous grassland, traditional orchard, coastal and floodplain grazing marsh. • Biodiversity Action Plan (BAP) priority habitat[10] wood pasture and parkland. • Other habitats along the scheme include line of trees, hedgerows, grassland field and agricultural fields. It is anticipated that the habitats present will support a range of protected and notable species.
	Likely Effects – Construction	It is anticipated that the route would use the existing and future road network including any upgraded carriageways associated with the proposed BBSC, therefore it is anticipated that the majority of habitat loss will be limited to discrete areas of habitat associated with the road verge. Construction works may result in removal of verge vegetation including scrub, hedgerows and trees. Any widening of the road around the Bristol Road/Newbridge Road junction could adversely affect the geological features of Newton St Loe SSSI. The habitats to be lost is likely to be limited to discrete areas, as such a precautionary approach has been adopted. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	As the route uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. If overhead electrification infrastructure is required for the option, this could impact protected species through collision of species with cabling and vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes for bats, however existing baseline conditions of the road may already reduce the suitability of the roads for bats.

[9] Protected under the Natural Environment and Rural Communities (NERC) Act 2006

[10] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

Option Ref		BBC-06
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**

Option Ref		BBC-06
Water	Baseline - key aspects and importance / significance	**Surface Water** The option follows along the existing road network from the Bath Road (A4)/Callington Road (A4174) junction (Ch. 5500), in a south-easterly direction along the A4 until it reaches Newbridge Road (A4), by the River Avon (Ch. 17200). It is approximately 11.5 km in length in total. The majority of the route is within Flood Zone 1 (Low risk), but there are a few instances when the route passes through Flood Zone 3 (High risk) and Flood Zone 2 (Medium risk). The first location is located west of the Hicks Gate roundabout, passing through approximately 250 m of Flood Zone 3 (High risk) and Flood Zone 2 (Medium risk) (Ch. 7350 to Ch. 7600), associated with the Scotland Bottom watercourse, a tributary of the River Avon which it also intersects (Ch. 7350). Additionally, at the eastern section of the Bath Road (A4)/Broadmead Lane roundabout, the route intersects the Broadmead watercourse, a tributary of the River Avon (Ch. 10500) and a small area of Flood Zone 2 (Medium risk). The eastern-most extent of the route (Ch. 17150 to Ch. 17200) also falls within a Flood Zone 2 (Medium risk) area, associated with the River Avon floodplain. The majority of the option is at Low risk of surface water flooding. Ponding is shown in several locations during 1 in 30-year events (High risk). These locations are: at Hicks Gate roundabout (Ch. 7600), west of the River Chew (Ch. 9300 to Ch. 9400), at Bath Road (A4)/Broadmead Lane roundabout (Ch. 10300 to Ch. 10500), in close approximation to the Bath Road (A4)/Grange Road junction to the Bath Road (A4)/Norman Road junction (Ch. 11800 to Ch. 12200), near Bath Road (A4)/Uplands Road junction (Ch. 12800 to Ch. 13100), at Bath Road (A4)/Glen junction (Ch. 13450) and east of the Bristol Road (A4)/Wells Road (A39) roundabout (Ch. 15400 to Ch. 15500). However, over the whole scheme, there is not a significant amount. **Groundwater** The dominant geology for this routing comprises the Mercia Mudstone Group (sandstones and subordinate siltstone) and Lias Group (Limestone and Mudstone) from west (Brislington) to east (Lower Weston) respectively. The route will intercept Secondary A, Secondary B and Secondary (undifferentiated) aquifers. The majority of the route will intercept Secondary A aquifers. A SPZ Outer Protection Zone 2 is present at Somerdale Pavilion approximately 0.2km north east of the route. No details are currently available on yield, target or purpose of this abstraction.
	Likely Effects – Construction	• Any loss of fluvial floodplain during construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • Flood risk may increase temporarily, this should be quantified and mitigated. • There may be temporary adverse effects on groundwater quality particularly in fractured aquifers. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures.
	Impact Assessment (construction only)	**Slight Adverse**
	Likely Effects – Operation	• Parts of the route may be at risk of fluvial and tidal flooding. • The frequency and severity of flooding will increase with the impacts of climate change. • Use of existing road network with assumed no changes to ground level reduces the likelihood of pollution risk to groundwater receptors.
	Impact Assessment (operation only)	**Slight Adverse**

Option Ref		BBC-A5
Noise	Baseline - key aspects and importance / significance	The MT route passes through three road and one railway NIAs: • NIA ID RI_1333 is located along the railway line just west of Oldfield park station; • NIA ID 14682 runs along the A36 Lower Bristol Road from the Felding Road/Jews Lane junction to Pines Way, the A36 one-way system; • NIA ID 3700 runs along the A36 lower Bristol Road from St James's Cemetery entrance until the Westmoreland Road junction; and • NIA ID 12814 runs along the A36 Lower Bristol Road from just after The Square junction until the junction at Wood Street. The diversion route intersects with NIA 14682 at the A3604/ A36 junction. In addition the diversion passes through three road NIAs: • NIA 3697 runs along the A4 Newbridge Road from old Newbridge Hill /Brassmill Lane junction until just past Yomede Park junction; • NIA 12816 runs along the A4 Newbridge Road/Upper Bristol Road from just passed Lyme Gardens junction to just passed Cork Street junction; and • NIA 12817 runs along the A4 Upper Bristol Road from just past Sterling House junction to just past Little Stanhope Street. There are around 2732 properties along the MT and diversionary routes of which 876 are residential and 1856 are non-residential. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[11], baseline daytime noise levels at the nearest houses to the scheme and the diversion route are generally above $L_{Aeq,16h}$ 65dB (free-field).

[11] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		BBC-A5
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors but there is potential for some adverse impacts associated with construction works including plant.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs. However, some additional above ground traffic noise is expected particularly associated with the diversion of general inbound traffic along the A4 Newbridge Road/ Upper Bristol Road which are predominately located through residential areas.
	Impact Assessment (Operation only)	**Neutral**
Air Quality	Baseline - key aspects and importance / significance	The MT route and inbound diversionary route lies partially within the Bath AQMA at its eastern extent, which is located largely along the A36 and A4 starting at the Fieldings Road/Jews Lane junction on the A36 and Roselyn Road junction along the A4 until Churchill Bridge Roundabout. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices, care homes and places of worship along the proposed scheme, predominately associated with Twerton, Oldfield Park and Bath city centre. The B&NES monitoring data show that there are exceedance in annual mean NO2 concentrations at the monitoring sites in the vicinity of the corridor between 2015 and 2019. Monitoring sites at Wells Road, Dorchester Street, Lower Bristol Road and Upper Bristol Road exceeded the AQS objective in 2019 for annual mean NO2.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. The initial traffic model shows a reduction in traffic in the Bath City Centre with the scheme. This will reduce emissions of nitrogen dioxide (NO2) and particulate matter; and subsequently improve roadside air quality and could benefit the Bath City Centre AQMA. There is the potential for disbenefits due to increased congestion with reduced/altered road space and increase in general traffic along the A4 Upper Bristol Road diversion route, which will disbenefit the air quality at the sensitive receptors although this will reduce over time as the effects of modal shift increase.
	Impact Assessment (operation)	**Slight Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The route follows the existing A4/A36 road network and initially passing through open space of the Bristol and Bath Greenbelt at the westernmost extent and then mainly through residential and city centre landscape characters including Bath WHS. The route crosses the National Sustrans Cycleway once at the eastern extent and once again at Fieldings Road/Jews Lane junction on the A36. The western extent of the route runs adjacent to the Cotswold AONB and Newton St. Loe SSSI near Newbridge Park and Ride and Carrs Woodland LNR located between Carrswood View junction and just before Connection Road junction along the A36. Additionally within the 1.5km landscape study area, there are three areas of Ancient Woodland and 11 registered Parks and Gardens. The diversionary route runs adjacent to the Cotswold AONB at Newbridge park and ride and follows the A4 Newbridge Road and Upper Bristol Road, and onto the A357 as well as crossing the River Avon along the A3604 to join the A36 midway along the scheme. The diversionary route also runs adjacent to Royal Victoria Park Registered Park and Garden.
	Likely Effects – Construction	Potential significant effects could arise from construction of MT infrastructure including temporary compounds, storage and construction parking in residential / commercial townscape character areas. There would be potentially large adverse effects on townscape given the extent of traffic disruption within residential / commercial locations particularly in Bath WHS, and alterations to the existing cycle route (i.e. off A36).
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	There may be potential moderate adverse effects on the landscape/townscape character of the MT route as a result of the introduction of transportation modes not currently present within the carriageway and associated MT infrastructure. Diverted general traffic flows along residential / commercial area along the A4 Upper Bristol Road is also likely to adversely impact associated character areas. The route also diverts cyclists off a section of the A36 into more residential character areas; whilst this may be more enjoyable (i.e. off main road), there are alternative safety considerations (i.e. more pedestrians and reversing cars in residential streets). It is assumed the effects on the landscape/townscape character and visual amenity will be more adverse if the option utilised is not bus transport (i.e. LRT, VLR), as this would introduce additional infrastructure and a new transport mode within a sensitive heritage character area (i.e. Bath WHS). It is assumed the route would follow the existing road network (i.e. assumed remains within current carriageway boundaries).
	Impact Assessment (operation)	**Moderate Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** This MT route is entirely above ground and would run near two Grade I Listed Buildings, 12 Grade II* Listed Buildings, 146 Grade II Listed Buildings, two Scheduled Monuments, one Conservation Area and two WHSs. Most of the assets are centred around Locksbrook, Twerton and Bath. A traffic diversion route along the A4 before crossing to the south and following the A36 has three Grade I Listed buildings, six Grade II* Listed Buildings, 76 Grade II Listed Buildings, one Scheduled Monument, one Conservation Area and two WHSs within a 100m buffer of the route.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction activities along the route (and presence of associated construction infrastructure) may impact the significance of heritage assets through temporary changes in

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		their settings. It is predicted that there is the potential for high impact to five heritage assets (potential for damage to an asset given their immediate proximity to the route) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that operational impacts associated with traffic noise and vibration would be reduced along the MT route although may be increased along diversionary routes. There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. It is predicted that there is the potential for high impact to the setting of five heritage assets during operation.
	Impact Assessment (operation)	**Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this scheme is provided in Annex B of this report.** The MT route and its zone of influence (200m buffer from the route) runs adjacent to Newton St Loe SSSI, which is designated for its geological assets, Carrs Woodland LNR, and four SNCIs: River Avon, Bitton to Bath railway track, Newton Brook, Carrs Wood. The general traffic diversionary route and its buffer runs adjacent to Locksbrook Cemetery SNCI and River Avon SNCI The MT route, diversionary route and it's buffer passes through or adjacent to the following habitats: • Habitat of Principal Importance (HPI)[12]: deciduous woodland. • Biodiversity Action Plan (BAP) priority habitat[13] wood pasture and parkland. • Other habitats along the scheme include scattered and lines of trees, hedgerows, amenity grassland. It is anticipated that the habitats present will support a range of protected and notable species.
	Likely Effects – Construction	It is anticipated that the existing road network will used for the MT and diversionary route, therefore it is anticipated that the majority of habitat loss will be limited to discrete areas of habitat associated with the road verge. Construction works may result in removal of verge vegetation including scrub, hedgerows and trees, this may adversely affect the species which rely on these habitats. Any widening of the road around the Bristol Road/Newbridge Road junction could adversely affect the geological features of Newton St Loe SSSI. The habitats to be lost is likely to be limited to discrete areas, as such a precautionary approach has been adopted. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	As the route uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. If overhead electrification infrastructure is required for the option, this could impact protected species through collision of species with cabling. The overhead infrastructure may also disrupt foraging and commuting routes for bats, however existing baseline conditions of the road may already reduce the suitability of the roads for bats.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**
Water	Baseline - key aspects and importance / significance	**Surface Water** The option follows the existing road network following from the Newbridge Road (A4)/Lower Bristol Road (A36), separating into two separate spurs for the MT route (southern spur) and diversionary route (northern spur): • The MT route runs along Lower Bristol Road (A36), intersecting with the general traffic diversion route at the Lower Bristol Road (A36)/Windsor Bridge Road (A3604) junction. This part of the route passes through large areas of Flood Zone 2 (Medium risk) and small areas of Flood Zone 3 (High risk). Flood Zone 2 (Medium risk) is present along Lower Bridge Road (A36) at multiple locations, in association with the River Avon and the Newton Brook floodplains (Ch. 800 to Ch. 950, Ch. 1300 to Ch. 2300 and Ch. 2650 to Ch. 3000). The only Flood Zone 3 (High risk) area is located where the route intersects Brislington Brook (Ch. 900). • The northern spur runs along Newbridge Road (A4) . It turns south along Windsor Bridge Road (A3604) to link with the MT route at the Lower Bristol Road (A36)/Windsor Bridge Road (A3604). This part of the route passes through areas of Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk). Flood Zone 2 (Medium risk) areas are located along Newbridge Road (A4), for approximately 300 m, in association with the River Avon floodplain. Also, there are small sections of Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk) areas located along Upper Bristol Road (A4), by the Upper Bristol Road (A4)/Windsor Bridge Road (A3604) junction, and for approximately 90 m. Additionally, there is a stretch of Flood Zone 2 (Medium risk), along Windsor Bridge Road (A3604), for approximately 150 m. From the Windsor Bridge roundabout junctions, the two spurs continue easterly, largely parallel to each other: • The southern MT route continues along Lower Bristol Road in an easterly direction, until it reaches Churchill Bridge roundabout. It is almost entirely within Flood Zone 2 (Medium risk) (Ch. 3000 to Ch. 3200, Ch. 3350 to Ch. 3400 and Ch. 4500 to Ch. 4700), and Flood Zone 3 (High risk) (Ch. 3200 to Ch. 3350 and Ch. 3400 to Ch. 4500) (approximately 1.6 km). • The northern diversion route continues along Upper Bristol Road, which is entirely within Flood Zone 1 (Low risk). It then turns south and follows Green Park Road (A367) and Corn Street (A367), before turning south to reach Churchill Bridge roundabout and the main scheme route. Along the majority from the junction Green Park Road to Churchill Bridge

[12] Protected under the Natural Environment and Rural Communities (NERC) Act 2006

[13] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

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		roundabout, the diversion is almost entirely within Flood Zone 2 (approximately 875 m). It is also briefly within Flood Zone 3 (High risk) for approximately 125 m, along Corn Street (A367). Large sections of the route are within Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk). Large sections of this route are affected by 1 in 30 year surface water flood events. Along the northern spur from the Newbridge Road (A4)/Bristol Road (A36) junction to Churchill Bridge roundabout, the main high risk areas of surface water flooding are located along Newbridge Road (A4) by the Aspley Road junction and by the Hungerford Road junction. Additionally, 1 in 30 year surface water food events are located along Upper Bristol Road (A4) by Marlborough Lane junction and along Corn Street (A367). A 1 in 30 year surface water flood event would affect large swathes of the southern spur between the Newbridge (A4)/Bristol Road (A36) to Churchill Bridge roundabout. These areas stretch along Lower Bristol Road (A36) for approximately 500 m (Ch. 1800 to Ch. 2300) and almost entirely from approximately Waterside Court to the Churchill Bridge roundabout, approximately 1.8 km (Ch. 2700 to Ch. 4500) in total. **Groundwater** A combination of head deposits, Alluvium and River Terrace deposits are present along most of this route, where these superficial deposits are associated with the River Avon. The dominant geology for this route comprises the Mercia Mudstone Group (sandstones and subordinate siltstone), Lias Group (Limestone and Mudstone) and the Charmouth Mudstone Formation (Mudstone and some limestone) from west (Newbridge) to east (Bath Spa) respectively. The route will overly Secondary A, Secondary B and Secondary (undifferentiated) aquifers. The majority of the route will overly Secondary A aquifers. The route will use the existing road network and no changes to ground level are expected thus reducing any risk to groundwater receptors identified.
	Likely Effects – Construction	• Any loss of fluvial floodplain during construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • Flood risk may increase temporarily, this should be quantified and mitigated. • There may be temporary adverse effects on groundwater quality particularly in fractured aquifers. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures.
	Impact Assessment (construction only)	**Slight Adverse**
	Likely Effects – Operation	• Parts of the scheme may be at risk of fluvial and tidal flooding. • The frequency and severity of flooding will increase with the impacts of climate change. • Use of existing road network with assumed no changes to ground level reduces the likelihood of pollution risk to groundwater receptors.
	Impact Assessment (operation only)	**Slight Adverse**

Option Ref		Option E
Option Summary		**General Option Description –** services would interchange with the anti-clockwise loop bus service stopping at Temple Meads, Old Market, Cabot Circus, the Hospital and the Centre As part of planned public transport improvements in Bristol outside of this project, an anticlockwise circular connector service will be introduced. Option E utilises this as a connection to key city centre destinations and therefore the Mass Transit routes through the centre of the city only. This relies on the alternative arrangements to ensure full segregation can be provided within the confines of the existing highway, achieving this by limiting general traffic in many locations. Refer to drawing 70069287-WSP-BCC-DG-HW-0404 • Route 1: East to Bristol – Bath Service providing direct access from both corridors to Old Market and Temple Meads • Route 2: North to South-West service, providing direct access from both corridors to Hospital, Victoria and Temple Meads
Noise and Vibration	Baseline - key aspects and importance / significance	The route passes through four road NIAs: • 281 runs along the A4044 temple way/ Bond Street South, A420 St Philips from the Old market roundabout to just before the Lawrence Hill roundabout. • 14824 runs along the A38 starting from the junction near Narrow Lewins Mead and Rupert Street to St Augustine's Parade. • 280 runs along the A38 Bridewell Street/Silver Street to the junction with Union Street; • 297 runs along the A38 the Haymarket/ Moon Street passes through St James Barton roundabout and continue to A4044 Bond Street, A4032 Newfoundland Street. The NIA also includes Dale Street, Houlton Street, clement Street. One road NIAs fall within 300m of the scheme: • 14353 runs along the A4 Temple Gate just before the Bath Bridge Roundabout and Bristol Temple Meads Railway station approach road to the junction with A4044. There are approximately 3800 properties along the route of which more than 1400 are residential properties and over 2450 are non-residential properties. The residential properties include house, dwelling, caravan, care/nursing home, religious community, residential education, safety home etc. The non-residential properties consist of Hotel/Motel, youth hostel, place of worship, play area, community service centre etc.

Option Ref		Option E
		According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[14], baseline daytime noise levels are generally above $L_{Aeq,16h}$ 65dB (free-field) at the nearest houses along the A38, A4, A420, A4044 and A4032. Noise levels are generally below $L_{Aeq,16h}$ 55dB (free-field) at houses away from the main roads.
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors. However, it is anticipated that adverse impacts associated with tunnelling and above ground construction works including from plant and waste (spoil) haulage are likely. Therefore, a quantitative assessment should be undertaken at the appropriate stage to determine the potential for ground-borne noise and vibration impact.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the scheme would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs. However, some additional above ground traffic noise is expected. A quantitative assessment should be undertaken at the appropriate stage in accordance with DMRB LA111 to ascertain the number of sensitive receptors adversely or beneficially impacted by the scheme. In the interim a neutral score has been attributed.
	Impact Assessment (operation)	**Neutral**
Air Quality	Baseline - key aspects and importance / significance	The scheme falls within the Bristol AQMA. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, a university, pharmacies, dentists, GP practices, hospitals and care homes along the proposed scheme. The Bristol's monitoring data shows that there are exceedances in annual mean NO2 concentrations at the monitoring sites in the vicinity if the Site between 2015 and 2019. Monitoring sites at The Horsefair, Fairfax Street, Newfoundland Circus, Lewins Mead, Rupert Street and Anchor Road, Stokes Craft and Upper Maudlin Street exceeded the AQS objective in 2019 for NO2.
	Likely Effects – Construction	It is anticipated that construction techniques adopted, and construction works planning would seek to avoid impacts from dust and exhaust emissions on human receptors but some adverse impacts as a result of disturbance from above ground construction works / material handlings and construction traffic and plant and waste (spoil) haulage cannot be ruled out. The efficacy of the mitigation measures will be dependent on a rigorous monitoring and enforcement regime. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. The segregation for Mass Transit would encourage modal shift and reducing the congestion; and this will reduce emissions of nitrogen dioxide (NO2) and particulate matter and subsequently improve roadside air quality and benefit the Bristol AQMA. There is the potential for disbenefits due to increased congestion with reduced/altered road space for general traffic along the scheme particularly at the corridor connections, although this will reduce over time as the effects of modal shift increase.
	Impact Assessment	**Slight to Moderate Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The scheme follows the existing road network and passes through the historic and largely commercial Bristol city centre landscape character. Local Sustrans route follow sections of the route near the St James Barton roundabout, and National Sustrans Route 4 crosses connects with the route to the south of Castle Park and at the junctions High Street and Victoria Street, and Baldwin Street and Broad Quay. No designated sites (relevant to Townscape) are noted within 1.5km of the route.
	Likely Effects – Construction	Significant adverse effects could arise as a result of construction infrastructure including temporary compounds, storage and construction parking in the Bristol city centre townscape character. There would be potentially large adverse effects given the likely extent of traffic disruption during the construction works.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	There may be potential moderate adverse effects on the townscape character of the MT route as a result of transportation modes not currently present within the carriageways and their associated MT infrastructure (i.e. introducing permanent infrastructure within commercial character areas), increased traffic flows along more residential carriageways and through associated character areas. Potential effects on visual amenity could arise as a result of introducing new transport modes and associated infrastructure for a number of sensitive receptors (i.e. residential, recreational, commercial and transport).
	Impact Assessment (operation)	**Moderate Adverse**
Historic Resources	Baseline - key aspects and importance / significance	The MT route is entirely above ground and would run near 10 Grade I Listed Buildings, 29 Grade II* Listed Buildings, 167 Grade II Listed Buildings, eight Scheduled Monuments and six Conservation Areas. Most of the assets are within the High Street, Temple Street, Victoria Street, St Nicholas Street, St Stephen's Street and Christmas Steps areas of Bristol.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction of the route (and associated construction infrastructure) may impact the significance of heritage assets through changes in their settings. It is predicted that there is the potential for high (direct) impact to two heritage assets and low to medium impact to other assets during the construction of the proposed scheme.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that operation impacts associated with noise and vibration would be avoided, but physical impacts to above ground cultural heritage assets and Conservation Areas cannot be ruled out. There may also be impacts to the significance of assets due to changes in their setting from the operation of the proposed scheme. It is predicted that there is the potential for a high impact to the setting of two heritage assets during operation.

[14] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		Option E
	Impact Assessment (operation)	**Slight Adverse**
Biodiversity	Baseline - key aspects and importance / significance	The route would pass over the Floating Harbour and River Avon SNCI which eventually leads into the Severn Estuary SAC, SPA, SSSI and Ramsar site The route would pass over, adjacent to or within 200m of the following habitats: • HPI: mudflats; and • Non-HPI habitat: Floating Harbour, River Avon, trees, amenity grassland. It is anticipated that the habitats present will support a range of protected and notable species.
	Likely Effects – Construction	It has been assumed that the option will be accommodated within the existing highway as present at the time that the MT scheme is constructed. It is anticipated that any habitat loss will be minimal. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	As the option uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. If overhead electrification infrastructure is required for the option this could impact protected species through collision of species with cabling and vehicles on the lines. Any overhead infrastructure may also disrupt foraging and commuting routes for bats.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**
Water	Baseline - key aspects and importance / significance	**Surface Water** The City Centre option E MT route follows from the Redcliffe Way/A4044 roundabout and continues west along this stretch for approximately 390 m, passing through Flood Zone 2 (Medium risk) for the majority of this stretch. The route then turns north-west along Temple Gate and then Victoria Street for approximately 920 m until it reaches High Street/Broad Street junction. This stretch passes through Flood Zone 2 (Medium risk) for the majority of the stretch, and Flood Zone 3 (High risk) for approximately 50 m, when it intercepts the Floating Harbour / River Avon. The route then continues along Wine Street, parallel to Castle Park, before separating into two spurs: • The northern spur turns off at Wine Street/Union Street junction for approximately 290 m, with the majority of this northern spur within Flood Zone 2 (Medium risk). • The eastern spur continues parallel to Castle Park along Newgate, before turning south to Lower Castle Street and the main route ending at Old Market roundabout. This stretch passes through an area of Flood Zone 2 (Medium risk) for approximately 150 m, just before the scheme turns south to Lower Castle Street. The cycle diversion through Castle Park is entirely within Flood Zone 1 (Low risk). The route follows along the existing road network from the Redcliffe Way/A4044 roundabout and continues west along the Grove, then north along Prince Street, Broad Quay, Colston Avenue (A38), Rupert Street (A38) and then the Haymarket (A38) where it reaches St James Barton Roundabout after approximately 1.3 km. The majority of this stretch is within Flood Zone 2 (Medium) risk, except for Prince Street which is within an area of Flood Zone 1 (Low risk). The Metrobus Feeder Service continues east from St James Barton roundabout, until it turns south at the Bond Street (A4044)/Bond Street South (A4044) junction, continuing along A4044, until it re-joins with the Temple Way (A4044)/Victoria Street junction after approximately 1.1 km. There is a small area of Flood Zone 2 (Medium risk), around the Bond Street (A4044)/Bond Street South (A4044) junction for approximately 350 m. There is also a small area along Temple Way (A4044) which intersects an area of Flood Zone 3 (High risk) for only approximately 20 m. The majority of the City Centre is a Low risk of surface water flooding. Ponding is shown in a couple of locations during a 1 in 30-year event (High risk). There is a couple of locations along Temple Way (A4044), including where it intersects the Bristol Channel, and along Victoria Street (B4053) where it intersects the Bristol Channel. **Groundwater** Superficial Tidal Flat Deposits, comprising clay and silt, are present across most of the option. The majority of the option is situated within the Redcliffe Sandstone Member (fine to medium grained sandstone), which forms part of the Mercia Mudstone Group. A small section of the route on the A38 is situated within the Quartzitic Sandstone Formation (hard quartzitic sandstone with mudstones). The scheme intercepts a combination of Secondary A and Secondary B Aquifers. The option is not located in or close to (within 1km) a Source Protection Zone (SPZ). At this stage, no information is available on private water supplies that may be directly or indirectly impacted by the route. The option is located within a medium to high Groundwater Vulnerability Zone (GWV). The SFRA identifies that groundwater can get within 1-2m of the ground surface. Groundwater flooding has been reported at locations throughout the city but this has tended to be in isolated basements, rather than groundwater rising above the ground surface.
	Likely Effects – Construction	• Any loss of fluvial floodplain during the construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water and groundwater quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • Flood risk may increase temporarily, this should be quantified and mitigated. .
	Impact Assessment (construction)	**Slight Adverse**

Option Ref		Option E
	Likely Effects – Operation	• New infrastructure passes through areas of surface water flood risk associated with the headwaters of small streams where there is the potential for adverse impacts on flood risk. • Parts of the scheme may be at risk of fluvial and tidal flooding, awareness of constraints to the operational impacts should be considered. The frequency and severity of flooding will increase with the impacts of climate change.
	Impact Assessment (operation)	**Slight Adverse**

Overall average scores

TAG Environmental Topic	Impact Assessment (construction) score	Average (construction) score (Total/7)	Impact Assessment (operation) score	Average (operation) score (Total/7)
Noise	-14	-2	4	0.6
Air Quality	0	0	8	1.1
Landscape/Townscape	-18	-2.6	-12	-1.7
Historic Resources	-21	-3	-10.5	-1.5
Biodiversity	-8.5	-1.2*	-1	-0.1*
Water	-8	-1.1	-7	-1

*Note: Excluding potential impacts to species

Summary paragraphs

Construction

The potential impact on Historic Resources during construction is considered Large Adverse as there is the potential for high impact to several heritage assets. This is because construction activities and infrastructure along the route may impact the significance of heritage assets through temporary changes in their settings. Sensitive receptors relevant to Landscape/Townscape, such as residential properties and commercial premises, also have the potential to experience Large Adverse impacts during construction. It is anticipated that above ground construction works, including plant operation and waste (spoil) haulage handling, could cause a Moderate Adverse impact on Noise. It is anticipated that Biodiversity (excluding species) and Water could experience Slight Adverse impacts due to a number of reasons including temporary increases in levels of noise and vibration, lighting and human activity disturbing ecological receptors, and potential runoff from earthworks and materials storage affecting surface water and groundwater quality. With regards to Air Quality, it is considered that the residual impacts of dust and PM10 generated by construction activities following the application of mitigation measures and good site practice would be Neutral.

Operation

The potential impact on Landscape/Townscape is considered Moderate Adverse mainly due to the introduction of new transport modes causing adverse effects to landscape/townscape character and visual amenity. The impact on Historic Resources is also anticipated to be Moderate Adverse due to potential physical impacts to above ground cultural heritage assets and Conservation Areas. There may also be impacts to the significance of assets due to changes in their setting. Slight Adverse has been allocated to Water due to new infrastructure introducing or exacerbating flood risk, and the impact of climate change increasing the frequency and severity of flooding. The impacts on Biodiversity (excluding potential impacts on species) are anticipated to be Neutral, largely due to the route using the existing road network, and thus having limited effects on ecological receptors. The potential impact on Air Quality and Noise during operation is considered Slight Beneficial. This is because the MT routes are likely to encourage modal shift, reducing the amount of surface road traffic and associated emissions of nitrogen dioxide (NO2) and particulate matter. This would improve roadside air quality and noise levels, benefiting nearby AQMAs and NIAs respectively.

Options Assessment Table - Underground Network 1 - NC04, EC04, SWC03, BBC-C+BBC-06+BBC-A5

(Please note an environmental appraisal for Bristol City Centre Option 1 was not undertaken due to the option being entirely underground)

<table>
<tr><th colspan="2">Option Ref</th><th>NC04</th></tr>
<tr><td rowspan="5">Noise and Vibration</td><td>Baseline - key aspects and importance / significance</td><td>The route passes (underground) through five road NIAs:
14824 runs along the A38 St Augustine's Parade/Lewis Mead/Rupert Street from St Mary on the Quay Roman Catholic Church until the junction with Narrow Lewins Mead. The NIA also includes from the Colston Avenue junction with the A38 St Augustine's Parade to Quay Street just before the Broad street/Christmas Street junction, Christmas Street, and parts of Zed Alley, Host Street and Christmas Steps;
280 runs along the A38 Lewins Mead/Rupert Street/Bridewell Street from Number One Bristol to the junction with Union Street;
297 runs south from the Arley Hull/Bath Buildings junction on the A38 Cheltenham Road/Stokes Croft to St James Barton roundabout. The NIA runs east from here along the A4044 Bond Street and the A4032 Newfoundland Street until just after the junction with Newfoundland Road. This NIA also runs south-west from St James Barton roundabout along the A38 The Haymarket until St James' Park;
296 runs along the A38 Cheltenham Road/Gloucester Road from the junction with Winsley Road to just before the junction with Bolton Road; and
294 runs along the A38 Gloucester Road from just before the junction with Tortworth Road to the junction with Beaufort Road.
The route passes (over ground) through three road NIAs:
288 runs along the A38 Gloucester Road from just after the junction with the B4057 Gipsy Patch Lane to just past where the A38 Gloucester Road crosses the railway line;
287 runs along the A38 Gloucester Road from just before Sandhurst Close to the junction with Hampton Lane; and
286 runs along the A38 Gloucester Road from the ends of Manor Grove and Oaktree Crescent.
The route passes (underground) adjacent to one road NIA:
295 runs along the A38 Gloucester Road from just after the junction with Brynland Avenue to the junction with Dongola Avenue.
According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[1], baseline daytime noise levels are generally above $L_{Aeq,16h}$ 65dB (free-field) at the nearest houses along the M5 and A38. Noise levels are generally below $L_{Aeq,16h}$ 55dB (free-field) at houses away from the main roads.</td></tr>
<tr><td>Likely Effects – Construction</td><td>It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors. However, it is anticipated that adverse impacts associated with tunnelling and above ground construction works including from plant and waste (spoil) haulage are likely. Therefore, a quantitative assessment should be undertaken at the appropriate stage to determine the potential for ground-borne noise and vibration impact.</td></tr>
<tr><td>Impact Assessment (construction)</td><td>Moderate Adverse</td></tr>
<tr><td>Likely Effects – Operation</td><td>It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic with the underground section of the MT route further benefitting NIAs.</td></tr>
<tr><td>Impact Assessment (operation)</td><td>Slight Beneficial</td></tr>
<tr><td rowspan="5">Air Quality</td><td>Baseline - key aspects and importance / significance</td><td>The route passes underneath the Bristol AQMA at its southern extent, between Bristol Temple Meads and Horfield.
There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices, hospitals and care homes with the study area.
The Bristol's monitoring data shows that there are exceedances in annual mean NO2 concentrations at the monitoring sites in the vicinity of the route between 2015 and 2019. Monitoring sites at Stokes Croft and Cheltenham Road exceeded the AQS objective for annual mean NO2 of 40µg/m^3 in 2019.</td></tr>
<tr><td>Likely Effects – Construction</td><td>It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works / materials handling and construction traffic and plant and waste (spoil) haulage cannot be ruled out.
Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.</td></tr>
<tr><td>Impact Assessment (construction)</td><td>Neutral</td></tr>
<tr><td>Likely Effects – Operation</td><td>It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. The underground section will significantly reduce the flow along the A38 between Bond Street and Hayes Way, this will reduce emissions of nitrogen dioxide (NO2) and particulate matter (PM) and improve roadside air quality along A38 and would benefit the AQMA. The ventilation portals from underground sections will require appropriate siting and ventilation strategy to reduce potential impacts from portal emissions.</td></tr>
<tr><td>Impact Assessment (operation)</td><td>Slight to Moderate Beneficial</td></tr>
<tr><td>Landscape/Townscape</td><td>Baseline - key aspects and importance / significance</td><td>The main land cover above the tunnelled section of the route is hard standing and passes under carriageways and residential / commercial areas, and a number of local green spaces (such as Monk's Park) and Filton Golf Couse. The over ground section of the route follows a section of existing carriageway at Highwood Road before joining the A38 and travelling north to Almondsbury and just beyond the A38 junction with the M5. The route avoids designated landscapes, however, within the 1.5km landscape study area, there are four areas of</td></tr>
</table>

[1] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

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		ancient woodland, one Registered Park and Garden, two LNR, one SSSI and portions of the Bristol to Bath Green Belt. Local Sustrans Cycleways cross and follow sections of the underground route close to Gloucester Road.
	Likely Effects – Construction	Potential large adverse effects could arise as a result of construction of the underground section of the route as a result of temporary compounds, spoil storage and construction parking and the construction of new above ground transport infrastructure such as the portal and the transport hubs / stops, which are close to residential / commercial locations, or would result in the loss of valuable habitat (i.e. location of Almondsbury Interchange Hub).
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	Introducing permanent infrastructure (rail lines to existing carriageway, station access points and associated infrastructure such as ventilation shafts) and locating key transport hubs/stops (including the associated loss of valuable soft landscape) within residential / commercial character areas, could result in potential large adverse effects on the landscape/townscape character. Potential effects on visual amenity could arise as a result of introducing new transport modes, station/hub access points and associated infrastructure for a number of sensitive receptors (residential properties, cycle routes, Golf Course, PRoW etc). In particular, the portal / transition between overground and underground sections would be expected to cause significant landscape and visual impacts given its location on the edge of Filton Golf Club and adjacent to a residential area.
	Impact Assessment (operation)	**Large Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** The tunnelled section of the route would pass below six Grade II* Listed Buildings, 74 Grade II Listed Buildings and nine Conservation Areas. Most heritage assets are focused on Bristol City Centre. The above ground section of the route would run adjacent to one Grade II Listed Building; this asset is located in the north-east area of Brentry.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation / vibration and settlement in the tunnelled sections cannot be ruled out. If any cultural heritage assets within a Conservation Area are physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction of the option (and presence of associated construction infrastructure and spoil storage) may still impact on the significance of heritage assets through temporary changes in their setting. It is predicted that there is the potential for high impact to 21 heritage assets (potential for damage to an asset given their immediate proximity to the route) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that above ground noise and vibration would be largely absent along the underground section and reduced along the overground section. There may be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated above ground infrastructure although sympathetic design is assumed. It is predicted that there is the potential for high impact to the setting of 21 heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this route is provided in Annex B of this report.** The underground section of the route passes underneath the Floating Harbour which is connected to the Feeder Side SNCI and the River Avon which eventually leads into the Severn Estuary SAC, SPA, SSSI and Ramsar site. The underground section of the route also passes under Filton Golf Course SNCI and within approximately 200m of a SNCI (name not provided) located at the former Filton Airport, to the west of the route. The underground route passes under several 'important open spaces'. The overground section of the route is located approximately 1km from the Pen Park Hole SSSI at its closest approach. The underground section of the option would pass under the following habitats: • BAP Priority habitat[5]: woodpasture and parkland; and • Other non-HPI habitats: Grassland fields, lines of trees, hedgerows and drains. The over ground section of the route would pass through the following habitats: • HPI: Deciduous woodland; and • Other non-HPI habitats: Woodland, linear trees and scrub, hedgerows and grassland fields. It is anticipated that the habitats present will support a range of protected and notable species.
	Likely Effects – Construction	Limited areas of habitat loss at the entrances of the underground tunnels and where associated infrastructure may be required. The underground tunnels may impede groundwater flow which may result in impacts on the hydrology and water table resulting in impacts on the species these habitats support. On the overground section it is anticipated that the route will largely follow the existing road network, therefore the loss of habitats and vegetation clearance during construction will be largely limited to discrete areas along the roadside which includes: HPI woodland, scrub, hedgerows and trees. The construction of the Almondsbury Interchange Hub could result in the direct loss of habitats which includes grassland fields, hedgerows, scrub and woodland (assessed via aerial imagery) based on the indicative location. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats. Increased levels of dust emissions and pollutants may result in temporary degradation of surrounding habitats if not suitably mitigated. The construction may also result in fragmentation of the habitats present, which may adversely affect the species that rely on these habitats.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is not anticipated that there will be an impact on ecological receptors during operation of the underground (southern) section of the scheme. It is anticipated that protected species may be potentially affected by direct impacts, from injury through to mortality of species and indirect disturbance impacts such as from noise and lighting if not suitably mitigated as a result of

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		the operation of the overground section of the route. If a steel wheeled mode is introduced as part of this option, this could impact protected species through collision with vehicles as well as any injury from associated infrastructure such as OLE the presence of which could also disrupt foraging and commuting routes for bats.
	Impact Assessment (operation)	**Slight Adverse (excluding potential species impacts)**
Water	Baseline - key aspects and importance / significance	**Surface Water** The option would initially run underground from Bristol Temple Meads Train Station in a westerly direction, before turning in a northerly direction, approximately along the A38 through Ashley Down, Horfield, Southmead Hospital and Filton Golf Course. The option then becomes overground at the Highwood Road/Hayes Way roundabout and turns in a north-easterly direction, following the pre-existing road network, running along Highwood Road, through Pathway until it reaches the Oaklands Rugby Football Ground where it ends. It initially passes through Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk) before completely, passing through Flood Zone 1 (Low risk) from the Bristol Bus and Coach Station, which is located by the Bearpit until it the end of the option. The majority of the route is at Low risk of surface water flooding. The route is shown to pass through a few places during a 1 in 30-year event; along Station Road by Montpelier High School, Dorian Way by Southmead Hospital, Dunkeld Avenue and B4056 located south of the Filton Golf Course for the underground section of the route. The overground section of the route is expected to be affected by ponding during a 1 in 30-year event along Highwood Road, just north of the Highwood Road/Hayes Way roundabout and along the A38, just south of the Bradley Stoke Way/A38 roundabout. **Groundwater** The dominant bedrock geology for this route comprises the Mercia Mudstone Group (sandstones and subordinate siltstone), Lias Group (interbedded limestone, mudstone and siltstone) and Penarth Group (mudstones with subordinate limestones and sandstones) from south to north respectively. Tidal Flat Deposits (comprising clay and silt) are present at the southerly most part of the option at Bristol Temple Meads. Alluvium Deposits (comprising clay, silt, sand and gravel) are present to the north at Filton and confined to minor watercourses. Minor faults are present to the north between Bristol City and Filton. The option is not located in or close to (within 1km) a Source Protection Zone (SPZ). At this stage, no information is available on private water supplies that may be directly or indirectly impacted by the route. The route passes through multiple Groundwater Vulnerability Zones (GWVZ). The southern-most part of the route (at Bristol Temple Meads) is located within a Medium GWVZ attributed to the Tidal Flat Deposits. Medium – High GWVZ are located in isolated areas, specifically where minor watercourses are present to the north of the route. The majority of option is located within a High GWVZ with soluble rock risk. The route intercepts a combination of Secondary A, Secondary B and Secondary (Undifferentiated) Aquifers. The SFRA identifies that groundwater can get within 1-2m of the ground surface. Groundwater flooding has been reported at locations throughout the city but this has tended to be in isolated basements, rather than groundwater rising above the ground surface.
	Likely Effects – Construction	• Any loss of fluvial floodplain during the construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water and groundwater quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures. • Dewatering activities may be required where penetration of the groundwater table is expected for earthworks. Impact on local/regional groundwater abstractions affecting groundwater level, flow and quality. • Flood risk may increase temporarily. • Changes to groundwater flow paths due to below ground structures extending below groundwater table and forming groundwater flow barriers that may increase pore water pressures and elevate the risk of groundwater flooding.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	• New infrastructure passes through areas of surface water flood risk associated with the headwaters of small streams where there is the potential for adverse impacts on flood risk. • Parts of the route may be at risk of fluvial and tidal flooding. The frequency and severity of flooding will increase with the impacts of climate change. • Parts of the route may be at risk of groundwater flooding (due to presence of groundwater flow barriers).
	Impact Assessment (operation)	**Slight Adverse**

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Noise	Baseline - key aspects and importance / significance	The route passes (underground) through three road NIAs: • 305 runs east from Lawrence Hill Roundabout along the A420 Lawrence Hill/Church Road until the junction with the A431 Summerhill Road. The NIA runs east from here along the A431 Summerhill Road/Air Balloon Road/Nags Head Hill until just after the junction with Kingsway; • 283 runs the A420 Two Mile Hill Road from just after the junction with Broadfield Avenue to just beyond the junction with Church Road; and • 302 runs along the A4174 from just beyond the footbridge near Palmers Close to just beyond Kingswood Remembrance Park. The route passes adjacent to (underground) one road NIAs: • 261 runs the A420 Two Mile Hill Road/Regent Street/High Street from the Charlton Road junction to just beyond the junction with Two Mile Court. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices, care homes and places of worship along the route.

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		According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[2], baseline daytime noise levels are generally above $L_{Aeq,16h}$ 60dB (free-field) at the nearest houses along the A420, A474 and Soundwell Road. Noise levels are generally below $L_{Aeq,16h}$ 55dB (free-field) at houses away from the main roads.
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors. However, it is anticipated that adverse impacts associated with tunnelling and above ground construction works including from plant and waste (spoil) haulage are likely. Therefore, a quantitative assessment should be undertaken at the appropriate stage to determine the potential for ground-borne noise and vibration impact.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, with the underground route further reducing the amount of surface road traffic thus benefitting NIAs.
	Impact Assessment (operation	**Slight Beneficial**
Air Quality	Baseline - key aspects and importance / significance	The route passes beneath: • Bristol AQMA at its western extent between Bristol Temple Meads and St George; • Kingswood – Warmley AQMA at its south-eastern extent, which is associated with the A420 Regent Street/High Street and extends from the junction with Blackhorse Road to the junction with Lansdown View; and • Staple Hill AQMA at its north-eastern extent, which is associated with the A4017 Victoria Street/Soundwell Road and the A4175 High Street/ Broad Street crossroads. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices and care homes within the study area. The Bristol's monitoring data shows that there are exceedances in annual mean NO2 concentrations at the monitoring sites in the vicinity of the Site between 2015 and 2019. Monitoring site at Church Road exceeded the AQS objective for annual mean NO2 of 40µg/m^3 in 2019.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works / materials handling and construction traffic and waste (spoil) haulage cannot be ruled out. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. Currently available traffic data shows that there will be significant reduction in flow along the A420, the A431 and the A4017 with the scheme; this will reduce emissions of nitrogen dioxide (NO2) and particulate matter (PM) and subsequently improve roadside air quality and benefit the AQMA. The ventilation portals will require appropriate siting and ventilation strategy to reduce potential impacts from portal emissions.
	Impact Assessment (operation)	**Slight to Moderate Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The route follows (underground) the existing carriageway/rail line at the western extent crossing under roads and residential development to the north-eastern and south-eastern extents. The main land cover above the tunnel is hard standing, passing under carriageways and residential areas, and a portion of the existing rail-line to the western extent. The route does not pass adjacent to any designated landscapes. Local, regional and national Sustrans Cycleways cross and follow portions of the route. Within the 1.5km landscape study area, there are two Registered Park and Garden, one LNR, two areas of ancient woodland and portions of the Bristol to Bath Green Belt.
	Likely Effects – Construction	Significant effects could arise as a result of construction of the tunnel and of the construction infrastructure such as temporary compounds, spoil storage and associated construction site parking within residential / commercial character areas. There could be potentially major adverse effects on townscape given the extent of traffic disruption associated with construction works within a residential / commercial locations.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	Effects on landscape/townscape character could arise from the introduction of permanent infrastructure such as station access points and ventilation shafts. It is assumed above ground infrastructure would be sensitively designed in character of the local townscape. Potential effects on visual amenity could arise as a result of introducing new transportation infrastructure in view of sensitive receptors (residential properties, cycle routes, PRoW etc.).
	Impact Assessment (operation)	**Moderate Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** The option would pass below two Grade I Listed Buildings and five Grade II Listed Buildings. Most of the assets are focused around the Bristol Temple Meads station area and the High Street area of Kingswood.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration, and settlement in the tunnelled sections, cannot be ruled out. The presence of temporary compounds, spoil storage and construction parking may impact on the significance of heritage assets through temporary changes in their setting. It is predicted that there is the potential for high impact to three heritage assets and low to medium impact to other assets.

[2] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

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	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that operational impacts associated with above ground noise and vibration would be avoided. There may however be impacts to the significance of assets due to changes in their setting from the presence of new above ground infrastructure such as station access points and ventilation shafts although sympathetic design is assumed. It is assumed that significant adverse impacts on the setting of the seven heritage assets from the presence of new above ground infrastructure would be avoided as far as possible as part of the design.
	Impact Assessment (operation)	**Slight Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this route is provided in Annex B of this report.** The option would go under the Floating Harbour which is connected to the Feeder Side SNCI and the River Avon which eventually leads into the Severn Estuary SAC/SPA SSSI and Ramsar. The option also passes directly under or within the zone of influence (200m buffer from the route) of three un-named SNCIs, one of which is located adjacent to the Walker Playing Field in the northern section of the route and two located within proximity of the A4174 in the south-east. The route passes under numerous important open spaces (IOS). The route would pass under or within the 200m buffer of the following habitats: • Habitats of Principal Importance (HPI)[3]; deciduous woodland, traditional orchard and good quality semi-improved grassland; • UK Biodiversity Action Plan (BAP) priority habitat[4]: wood pasture and parkland; and • Grassland fields and areas of woodland. It is anticipated that the habitats present will support a range of protected and notable species associated with the habitats present.
	Likely Effects – Construction	Limited areas of habitat loss for above ground infrastructure such as stations and ventilation shafts may be required. The tunnels may impede groundwater flow which may result in impacts on the hydrology and water table resulting in potential impacts on the surrounding habitats and species these habitats support. Increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area. Increased levels of dust emissions and pollutants may result in temporary degradation of surrounding habitats if not suitably mitigated.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	It is anticipated that impacts on ecological receptors during operation would be minimal as the route is underground. There are opportunities to improve biodiversity at the underground stations for example through the provision of landscape planting and green roofs.
	Impact Assessment (operation)	**Neutral**
Water	Baseline - key aspects and importance / significance	**Surface Water** The route runs underground from Bristol Temple Meads train station east through Lawrence Hill and Redfield for approximately 5.3 km, predominantly through Flood Zone 1 (Low risk), although it passes through areas of Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk), close to the Bristol Temple Meads train station, associated with the River Avon floodplain. The route then runs north in close proximity to the A4017 for 2 km, through Flood Zone 1 (Low risk). The route then splits into two spurs: • One spur turns north-easterly along Regent Street through Downend, intersecting Stockwell watercourse, a tributary of the River Frome (Ordinary Watercourse) in close proximity to Westerleigh Avenue, passing through Flood Zone 2 (Medium risk) & Flood Zone 3 (High risk), associated with this floodplain. There is also a small area of Flood Zone 2 (Medium risk) at the end of the route, just north of the Lyde Green roundabout. • The second spur turns south-easterly at Regent Street, until it reaches Cadbury Heath Primary School, it is entirely within Flood Zone 1 (Low risk). The majority of the route is at Low risk of surface water flooding. However, there is ponding shown at several locations which the route bypasses during a 1 in 30-year surface water flood event; just south of Lawrence Hill train station, along Alexandra Place by A4017, and at the northern extent of the route where there is a pond located close by, associated with Folly Brook. However, there is not a significant amount of high surface water flood risk across the route. **Groundwater** The option is situated within an area of superficial Tidal Flat Deposits at its western most end at Bristol Temple Meads Station. There are no superficial deposits present as the route progresses east (towards Warmley). The route transects multiple formations of variable lithology (sandstone, mudstone, coal measures) as it progresses east towards Emersons Green (far north of the route). The dominant bedrock geologies are the Mercia Mudstone Group, South Wales Coal Measures Group and Warwickshire Group. Multiple faults exist and the location of these faults may allow deep groundwater circulation and is believed to be the pathway for deep thermal waters supplying the Bath and Bristol hot springs. The Coal Authority Interactive Map designates the area from Junction of Regent Street (A420) and Cecil Road to Cadbury Heath as a High Risk Development Area with multiple mine entry points identified. Depending on how the mines were worked and groundwater managed during operation, groundwater rebound i.e. to shallow levels below the ground surface may exist for the area. There are also potential mine gas issues present around this location as well. The SFRA identifies that groundwater can get within 1-2m of the ground surface. Groundwater flooding has been reported at locations throughout Bristol city but this has tended to be in isolated basements, rather than groundwater rising above the ground surface. British Geological Survey (BGS) borehole ST57SE287 (near Temple Meads) indicates a rest water level

[3] Protected under the Natural Environment and Rural Communities (NERC) Act 2006

[4] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

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		(RWL) of approximately 3 mbgl (7 mAOD). BGS borehole ST67SW45 (near Lawrence Hill Station) indicates a RWL of 13 mbgl (7 mAOD). BGS borehole ST67NE90, situated near the Bristol Bath Science Park, indicates a rest water level of approximately 2 mbgl (49 mAOD). Groundwater is expected to be at shallow depth along the route. The option is not situated within or close to (within 1km) a Source Protection Zone (SPZ). At Bristol Temple Meads Station (western most part of the option), approximately 1km of the route is located within a Medium Groundwater Vulnerability Zone (GWVZ) associated with the Tidal Flat Deposits. Moving east towards St George and along the A420, approx. 3.2km of the route is located within a High GWVZ associated with the Mercia Mudstone Group (Sandstone). For a further 3.8km north towards Staple Hill the option is within a Medium GWVZ. The remaining 3.0km from Staple Hill north towards Emerson Green, is within a High GWVZ. Travelling south-east from St George to Cadbury Heath, the option is located within a Medium GWVZ. The entire route falls within a Secondary A aquifer designation.
	Likely Effects – Construction	• Any loss of fluvial floodplain during construction may require temporary floodplain compensation. • The construction works may expose construction workers to flood risk. • There may be temporary adverse effects on groundwater quality particularly in fractured aquifers. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures. • Dewatering activities may be required where penetration of the groundwater table is expected for earthworks. • Changes to groundwater flow paths due to below ground structures extending below groundwater table and forming groundwater flow barriers that may increase pore water pressures and elevate the risk of groundwater flooding.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	• Parts of the route may be at risk of fluvial and tidal flooding. The frequency and severity of flooding will increase with the impacts of climate change. • The option may be at risk of groundwater flooding (due to presence of a shallow groundwater table and groundwater flow barriers. Potential permanent changes to deep groundwater circulation pathways. • Permanent dewatering to lower groundwater levels in and around the tunnel may result in substantial energy costs. There is potential for permanent changes to deep groundwater circulation pathways.
	Impact Assessment (operation)	**Slight Adverse**

Option Ref		SWC03
Noise and Vibration	Baseline - key aspects and importance / significance	The route passes (over ground) adjacent to four road NIAs: • 3992 includes a residential property on the A38 Bridgewater Road, just before the junction with Filter Cottages; • 3991 includes commercial property on the A38 Bridgewater Road just before the junction with Hoobs Lane and Barrow Lane; • 13851 runs along the A38 Bridgewater Road from just before the junction with Naish Lane to before the junction with Dial Lane; and • 12785 runs along the A38 Potter Hill from just after the junction with Currells Lane to just after the junction with School Lane. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[5], baseline daytime noise levels are generally above $L_{Aeq,16h}$ 65dB (free-field) at the nearest houses along the A38 and A4174. Noise levels are generally below $L_{Aeq,16h}$ 55dB (free-field) at houses away from the main roads.
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors. However, it is anticipated that adverse impacts associated with tunnelling and above ground construction works including from plant and waste (spoil) haulage are likely. Therefore, a quantitative assessment should be undertaken at the appropriate stage to determine the potential for ground-borne noise and vibration impact.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic with the underground section of the MT route further benefitting NIAs.
	Impact Assessment – Operational Phase Only	**Slight Beneficial**
Air Quality	Baseline - key aspects and importance / significance	The route passes underneath the Bristol AQMA at its northern extent between Bristol Temple Meads and Bedminster. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices, care homes and places of worship within the study area. The Bristol's monitoring data shows that there are exceedances in annual mean NO2 concentrations at the monitoring sites in the northern section of the route between 2015 and 2019. Monitoring sites at Bath Road, West Street, Bedminster Road and Bedminster Down Road exceeded the AQS objective for annual mean NO2 of 40µg/m^3 in 2019.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works / materials handling and construction traffic and plant and waste (spoil) haulage cannot be ruled out. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.

[5] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		SWC03
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. The initial traffic data shown that there will be significant reduction in flow along the A38. Also, the underground section will reduce emissions of nitrogen dioxide (NO2) and particulate matter (PM) and improve roadside air quality and benefit the AQMA. The ventilation portals from underground sections will require appropriate siting and ventilation strategy to reduce potential impacts from portal emissions.
	Impact Assessment (operation)	**Slight to Moderate Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The main land cover above the tunnel section is hard standing (built-up urban areas) as it passes under the south-west fringe of Bristol, through Victoria Park, Knowle West and Bishopsworth. The area adjacent to the over ground sections is predominantly open space, passing within the Bristol and Bath Greenbelt. Within 1.5km landscape study area of the above ground section, there are two Registered Park and Gardens, one Local Nature Reserve, n two SSSIs and nine areas of Ancient Woodland. Local Sustrans Cycleways cross and follow along sections of the underground section of the route near the city centre, and National Sustrans Cycleways cross the over ground section of the route closer to Bristol Airport, and again to the south of Barrow Gurney.
	Likely Effects – Construction	Potential significant adverse effects could arise as a result of the presence of construction infrastructure such as temporary compounds, spoil storage and construction parking within residential / commercial areas as well as the construction of new above ground transportation infrastructure such as station access points and ventilation shafts. Furthermore, construction works would be undertaken within the Greenbelt and a more rural landscape setting (i.e. to the south of the route, towards the airport); however, there is recent precedent for development at this location (i.e. Bridgwater Road/Colliters Way roundabout). There would be potentially large adverse effects given the extent of traffic disruption and position of construction works within a residential and commercial location.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	Potential adverse effects on landscape/townscape character could arise as a result of introducing permanent infrastructure (rail lines to existing carriageway, station access points and associated infrastructure such as ventilation shafts) within residential / commercial character areas. Potential effects on visual amenity could arise as a result of station access points and associated infrastructure for a number of sensitive receptors (residential properties, Greenbelt). The transition between underground and overground parts of the option occurs outside of a residential area thereby reducing the potential effects on the landscape/townscape character and visual amenity to sensitive residential receptors, however the portal would be located in Greenbelt although the recently constructed roundabout at this location sets a precedent for development at this location. Potential effects on visual amenity could arise as a result of introducing of new transport infrastructure for a number of sensitive receptors (residential properties, cycle routes, PRoW etc).
	Impact Assessment (operation)	**Moderate Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** The tunnelled section of the route would pass below one Grade II* Listed Buildings, four Grade II Listed Buildings and two Conservation Areas. The above ground section of the route would run near four Grade II Listed Buildings and one conservation area. Most of the assets are within the Bristol City Centre, Temple Meads and Knowle area.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation / vibration and settlement in the tunnelled sections cannot be ruled out. If any cultural heritage assets within a Conservation Area are physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction of the option (and presence of associated construction infrastructure and spoil storage) may still impact on the significance of heritage assets through temporary changes in their setting. It is predicted that there is the potential for high impact to four heritage assets (potential for damage to an asset given their immediate proximity to the route) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that above ground noise and vibration would be largely absent along the underground section and reduced along the overground section of the MT route. There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated above ground infrastructure although sympathetic design is assumed. It is predicted that there is the potential for high impact to the setting of four heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**

Option Ref		SWC03
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this route is provided in Annex B of this report.** The underground section of the route would pass underneath the River Avon SNCI which also eventually leads into the Severn Estuary SAC, SPA, SSSI and Ramsar site. The route would also pass under Wedmore Vale SNCI, Crox Bottom SNCI, Highridge Common SNCI. The overground section of the route would pass through: • Felton Common LNR; • Highridge Common SNCI; and • North Somerset Council Wildlife Sites: Barrow Tanks, Fields East of Barrow Tanks. The underground section of the route would pass under the following habitats: • HPI: Mudflats, good quality semi-improved grassland, deciduous woodland; • UK Biodiversity Action PLAN (BAP) Priority habitat[6]: Wood pasture and parkland; and • Non-HPI habitat: River Avon, The Malago watercourse, Pigeonhouse stream, arable fields, hedgerows, areas of woodland, waterbodies, trees and amenity grassland. The overground section of the scheme would run adjacent to or within 200m of the following habitats: • HPI: good quality semi-improved grassland, lowland dry acid grassland and deciduous woodland; and • Areas of woodland, hedgerows, grassland, arable fields, trees, the Barrow Gurney Reservoirs and Colliter's Brook. It is anticipated that the habitats present will support a range of protected and notable species.
	Likely Effects – Construction	Limited areas of habitat loss at the entrances of the underground tunnels, the stations and at locations where associated infrastructure may be required. The overground section of the route will use existing road networks therefore it is anticipated that the majority of habitat loss will be limited to areas of habitat associated with the road verge, but may include woodland, trees, hedgerows, grassland and scrub. Felton Common LNR and other non-statutory designated sites are adjacent to the route, therefore any widening of the road network may adversely affect the features for which they are designated for. The construction of the underground tunnels may impede groundwater flow which may result in impacts on the hydrology and water table resulting in impacts on the SNCIs and habitats it passes under. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area. Increased levels of dust emissions and pollutants may result in temporary degradation of surrounding habitats if not suitably mitigated.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	It is anticipated that impacts on ecological receptors during operation of the underground section of the route would be minimal. There are opportunities to improve biodiversity at the underground stations for example through the provision of landscape planting and green roofs. As the overground route uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. However, if overhead electrification infrastructure is required for the over ground section of the route, this could impact protected species through collision of species with cabling and vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes for bats.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**
Water	Baseline - key aspects and importance / significance	**Surface Water** The route runs underground from Bristol Temple Meads train station, in a southerly direction before turning westerly through Bishopsworth where it becomes overground at the Colliters Way/A38 roundabout. The underground section of the route is predominantly within Flood Zone 1 (Low risk) but passes through Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk). When intersecting through the River Avon, near the Bedminster Trading Estate in association with the River Malago and two more occasions when going in a westerly direction, intersecting the Pigeonhouse Stream and the River Malago. The route then comes above ground and turns south along Bridgewater Road (A38), following the existing road network. This continues along this road, through the two Barrow Gurney reservoirs before ending at the Bristol Airport. This overground section is completely within Flood Zone 1 (Low risk). The majority of the option is at Low risk of surface water flooding. Ponding is shown in several locations during a 1 in 30-year event (High risk). These locations are across multiple locations along Bridgewater Road (A38); at the Bridgewater Road (A38)/Colliter's Way and across the A38 stretch to the Bristol Airport. However, across the entire route, there is not a significant amount of significant risk. **Groundwater** Superficial Tidal Flat Deposits, comprising clay and silt, are present at Temple Meads and confined to the location of the River Avon. The bedrock geology from Temple Meads (north) to Bristol International Airport (south west) comprises the Mercia Mudstone Group (sandstone, mudstone), Lias Group (limestone, mudstone, siltstone) and Pembroke Limestone Group (limestone, mudstone) respectively. Thrust faults transect the A38 in an east -west direction at Potters Hill and may provide a pathway for deep groundwater circulation. The Yanley Fault is also present in the area.

[6] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

Option Ref		SWC03
		The option is predominantly located within a High Groundwater Vulnerability Zone (GWVZ) with soluble rock risk. A Medium GWVZ is located in the area of Temple Meads and associated with the Tidal Flat Deposits. The route will intercept Secondary A, Secondary B, Secondary (undifferentiated) and Principal aquifers. The Principal aquifers are associated with the Pembroke Limestone Group in the south west close to Bristol International Airport. The route from Temple Meads up to Potters Hill is not within or close to (within 1km) a SPZ. There are 2 Source Protection Zones (SPZ) at Bristol International Airport and the over ground section of the route is located within 30m and 150m of SPZ Inner Protection Zone 1 and Outer Protection Zone 2 respectively. No details have been provided on the groundwater abstractions but based on the geology of the area they will be targeting the Pembroke Limestone Group for supply. The option will not intercept legacy mining features or the coal measures. The SFRA for Bristol identifies a generally low groundwater flood risk. The SFRA also identifies that groundwater can get within 1-2m of the ground surface. Groundwater flooding has been reported at locations throughout the city but this has tended to be in isolated basements, rather than groundwater rising above the ground surface.
	Likely Effects – Construction	• Appropriate design should be in place to protect access points of the underground stations and portals to prevent flood water (surface water and groundwater) from entering the stations. • Any loss of fluvial floodplain during construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • There may be temporary adverse effects on groundwater quality particularly in fractured aquifers. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures. • Changes to groundwater flow paths due to below ground structures extending below groundwater table or intercepting major fault zones and forming groundwater flow barriers that may increase pore water pressures and elevate the risk of groundwater flooding.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	• Some access points may be at risk of fluvial and tidal flooding. The frequency and severity of flooding will increase with the impacts of climate change. • Increased risk of spillage / runoff and creating pollutant pathways to groundwater depending on drainage design.
	Impact Assessment (operation)	**Slight Adverse**

Option Ref		BBC-C
Noise	Baseline - key aspects and importance / significance	The route passes through four road NIAs: • NIA ID 14353 is on the A4 Temple Gate from just after the junction with Station Approach to just after the junction with Chatterton Square and includes the commercial properties to the east of the A4 Temple Gate; • NIA ID 267 runs along the A4 Bath Road from just before to just after the junction with the A37 Wells Road. The NIA also runs south from this junction along the A37 Wells Road until just after the junction with Broadfield Road; • NIA ID 299 runs along the A4 Bath Road from just before the junction with Summer Hill to just after the junction with Chatsworth Road; and • NIA ID 268 runs along the A4 Bath Road/Eagle Road/Bristol Hill/Brislington Hill from the junction with Sandy Park Road to the junction with the A4174 Callington Road. This NIA also includes the section of the A4174 from the A4 Brislington Hill to the roundabout with West Town Lane. There are around 2677 properties along the MT route out of which 1705 are residential and 972 are non-residential. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[7], baseline daytime noise levels at the nearest houses are generally above $L_{Aeq,16h}$ 65dB. (free-field).
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors but there is potential for some adverse impacts associated with construction works including plant.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs. Benefits in noise levels due to modal shift will need to be verified during the quantitative assessment undertaken in accordance with DMRB LA111 at the appropriate stage.
	Impact Assessment (operation)	**Slight Beneficial**
Air Quality	Baseline - key aspects and importance / significance	The option lies within the Bristol AQMA, which extends as far as Brislington at its eastern extent. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices, a hospital and care homes within the study area.

[7] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		BBC-C
		Bristol's monitoring data show that there are exceedances in annual mean NO_2 concentrations at the monitoring sites in the vicinity of the western section of the corridor between 2015 and 2019. Monitoring sites at A4 Bath Road exceeded the AQS objective for annual mean NO2 in 2019.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. The initial traffic model shows a reduction in traffic in the Bristol City Centre as a result of the option; this will reduce emissions of nitrogen dioxide (NO2) and particulate matter; and subsequently improve roadside air quality and could benefit the Bristol AQMAs.
	Impact Assessment (operation)	**Slight Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The route follows the existing road network and passes through mainly residential and city centre landscape characters. The option lies adjacent to one Registered Park and Garden. There are several Sustrans Local Cycleways and one Sustrans National Cycleways crossing adjacent to Arno's Court park on the A4 and following sections of the route. Within the 1.5km landscape study area, there are two Local Nature Reserve (LNR), two ancient woodland areas and two Registered Park and Garden.
	Likely Effects – Construction	Potential significant adverse effects could arise as a result of construction of MT infrastructure and associated temporary compounds, storage and construction parking in residential / commercial townscape character areas There would be potentially large adverse effects on townscape given the extent of traffic disruption within residential / commercial locations and alterations to the existing cycle route to connect with Sustrans National Route 3.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed the landscape setting for the proposed new MT infrastructure would be in keeping with the existing local character. There may be potential adverse effects on the landscape/townscape character as a result of transportation modes not currently present within the carriageway and their associated MT infrastructure. The route also diverts cyclists off the carriageway and on to the Sustrans National Route 3 (existing infrastructure diverts to north side of River Avon). This diversion is longer and assumes existing infrastructure can accommodate number of cyclists; however, this may have beneficial effects (i.e. more scenic route and off-carriageway may encourage active travel).
	Impact Assessment (operation)	**Moderate Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** The MT route is entirely above ground and would run near two Grade I Listed Buildings, ten Grade II* Listed Buildings, 43 Grade II Listed Buildings, one Grade II Registered Park and Garden, and three Conservation Areas. Most of the assets are within Totterdown and Brislington.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction activities along the route (and presence of associated construction infrastructure) may impact the significance of heritage assets through temporary changes in their settings. It is predicted that there is the potential for high impact to six heritage assets (potential for damage to an asset given their immediate proximity to the route) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that operational impacts associated with noise and vibration would be reduced along the MT route. There may be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. It is predicted that there is the potential for high impact to the setting of six heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this route is provided in Annex B of this report.** The route and its ZoI (200m buffer from the route) passes adjacent to three SNCIs: River Avon, Arno's Vale Cemetery and Brislington Meadows. The route uses an existing bridge to cross the Floating Harbour and the River Avon, both of which feed into the Severn Estuary (approximately 8.5km downstream), which is designated nationally and internationally as a SSSI, SAC, SPA and a Ramsar site. The route and its buffer passes through or adjacent to the following habitats: • HPI: deciduous woodland. • Other habitats along the scheme include woodland, scrub, scattered and lines of trees and amenity grassland. It is anticipated that the habitats present will support a range of protected and notable species.
	Likely Effects – Construction	It is anticipated that the existing road network will be used for the MT route and cycleway diversion, therefore it is anticipated that the majority of habitat loss will be limited to discrete areas of habitat associated with the road verge. If any road widening is required this may adversely affect the habitats, including HPI and designated sites, as well as the species which rely on these habitats. The habitats to be lost is likely to be limited to discrete areas, as such a precautionary approach has been adopted. The increased levels of noise and vibration, lighting and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area.
	Impact Assessment (construction)	**Slight to Moderate Adverse**

Option Ref		BBC-C
	Likely Effects – Operation	As the route uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. If overhead electrification infrastructure is required for the option, this could impact protected species through collision of species with cabling and vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes for bats, however existing baseline conditions of the road may already reduce the suitability of the roads for bats.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**

Option Ref		BBC-C
Water	Baseline - key aspects and importance / significance	**Surface Water** The route runs along the existing road network following from the Redcliffe Way (A4044)/Temple Gate (A4) junction, near to Bristol Temple Meads railway station. It continues along the A4, through Totterdown in a south-easterly direction, before turning south and continuing to follow the A4 until it reaches Brislington at the Bath Road (A4)/Callington Road (A4174) junction. The route is a total length of approximately 3.63 km. The route passes through areas of Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk) on two occasions; the first location is at the Bath Bridge roundabout (Ch. 2050), associated with the River Avon floodplain and the second location is at Bath Road (A4) (Ch. 5300), associated with the Brislington Brook. The Off-Road Cycle Link (NCN 3) diverts from the main MT route from the Bath Road (A4)/Russet Lane junction (Ch. 2900), then runs along the River Avon, before turning south along A4320 and Bloomfield Road, re-joining the main MT route at the Bath Road (A4)/Bloomfield Road junction (Ch. 3850). The majority of the Off-Road Cycle Link (NCN-3) is within Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk), for approximately 1.1 km. There are no significant areas of the BBC-C option affected by 1 in 30 year surface water flood events. **Groundwater** The route from Temple Meads towards Totterdown / Brislington is located within a High GWVZ with soluble rock risk associated to the Lias Group. The majority of the route from Temple Meads to Totterdown is located within a Medium and High GWVZ. The GWVZ is associated to the Mercia Mudstone Group. The entire route is located upon a Secondary A aquifer. No SPZ are identified along the route.
	Likely Effects – Construction	• Any loss of fluvial floodplain during construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • Flood risk may increase temporarily, this should be quantified and mitigated. • There may be temporary adverse effects on groundwater quality particularly in fractured aquifers. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	• The option may be at risk of fluvial and tidal flooding. • The frequency and severity of flooding will increase with the impacts of climate change.
	Impact Assessment (operation)	**Slight Adverse**

Option Ref		BBC-06
Noise	Baseline - key aspects and importance / significance	The option passes through six road NIAs: • NIA ID 268 runs along the A4 Bath Road/Eagle Road/Bristol Hill/Brislington Hill from the junction with Sandy Park Road to the junction with the A4174 Callington Road. This NIA also includes the section of the A4174 from the A4 Brislington Hill to the roundabout with West Town Lane; • NIA ID 5515 includes a residential property on the A4 Bath Road; • NIA ID 12801 includes a residential property on Hicks Gate, adjacent to the A4 Bath Road; • NIA ID 12804 encompasses properties along The Avenue, Abbey Park, The Park, Station Road, Old Vicarage Green, Pool Barton, Bristol Road and the High Street in Keynsham; • NIA ID 3698 starts just beyond the bridge over Avon Mill Lane and runs along the A4 Bath Road until just beyond the junction with The Glen; and • NIA ID 4003 is located on the A4 Bath Road between the junction with Bristol Road and just beyond the junction with Corston Lane. There are around 1289 properties along the MT route out of which 445 are residential properties and 844 are non-residential properties. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[8], baseline daytime noise levels at the nearest houses are generally above $L_{Aeq,16h}$ 65dB. (free-field).
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors but there is potential for some temporary adverse impacts associated with construction works including plant.

[8] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		BBC-06
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs although the benefits would be reduced since MT will operate within the soon to be implemented Bristol Bath Strategic Corridor (BBSC) which it is anticipated will already have benefited NIAs. Benefits in noise levels due to modal shift will need to be verified during the quantitative assessment undertaken in accordance with DMRB LA111 at the appropriate stage.
	Impact Assessment (Operation only)	**Slight Beneficial**
Air Quality	Baseline - key aspects and importance / significance	The route lies partially within the Bristol AQMA at its westernmost extent at Brislington. The route runs adjacent to the Keynsham AQMA at its western extent, which includes Station Road, Bristol Road between St Old Vicarage Green junction to Keynsham Library, Bath Hill from Bristol Road to the junction with Back Lane and Charlton Road from Bristol Road to just before the junction with Cranmore Avenue. The route also passes through Saltford AQMA at its eastern extent, which is located on the A4 Bath Road from the Manor Road/Beech Road junction to just beyond the junction with The Glen. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices, care homes and places of worship within the study area, predominately associated with south-east Bristol, Keynsham, Saltford and Corston. The Bristol and B&NES monitoring data show that there are exceedances in annual mean NO2 concentrations at the monitoring sites in the vicinity of the route between 2015 and 2019. Monitoring sites at the A4 Bath Road exceeded the AQS objective for annual mean NO2 in 2019.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. This will reduce emissions of nitrogen dioxide (NO2) and particulate matter, and subsequently improve roadside air quality and benefit the AQMAs at Bristol, Keynsham and Saltford. However, it is anticipated that the benefit of the scheme is likely to be insignificant and overshadowed by the traffic reduction with the BBSC. There is the potential for disbenefits due to increased congestion with reduced/altered road space, although this will reduce over time as the effects of modal shift increase.
	Impact Assessment (operation)	**Slight Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The MT route follows the existing road network (and future BBSC route) and passes from the residential areas of Brislington, through Keynsham and Saltford; interspersed by the Bristol and Bath Greenbelt, either side of Keynsham. The eastern extent of the route runs adjacent to Newbridge Park and Ride on the edge of Bath World Heritage Site (WHS). The Local Sustrans Cycleway crosses and follows sections of the route and the National Avon Cycleway crosses the route to the east of Saltford. The route also runs adjacent to two Registered Parks and Gardens, one SSSI close to Newbridge and the Cotswold AONB close to Newbridge. Within the 1.5km landscape study area, there are three Registered Park and Garden, four Local Nature Reserve (LNR), seven ancient woodland, four SSSI sites and areas of the Bristol to Bath Green Belt.
	Likely Effects – Construction	It is assumed that construction impacts will be minimised by the use of the BBSC carriageway by MT for a large section of the route. There would be potentially slight adverse effects given the extent of traffic disruption within residential / commercial locations associated with construction of any additional associated MT infrastructure.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	There may be potential adverse effects on the landscape/townscape character of the MT route as a result of the introduction of transportation modes not currently present within the future BBSC carriageway (e.g. if steel wheeled transport modes are introduced) and any additional associated MT infrastructure.
	Impact Assessment (operation)	**Slight Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** The MT route is entirely above ground and would run near two Grade I Listed Buildings, four Grade II* Listed Buildings, 51 Grade II Listed Buildings, two Grade II* Registered Park and Garden, three Scheduled Monuments, two WHSs and five Conservation Areas. Most of the assets are within Keynsham and Saltford.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction activities along the route (and presence of associated construction infrastructure) may impact the significance of heritage assets through temporary changes in their settings. It is predicted that there is the potential for high impact to nine heritage assets (potential for damage to an asset given their immediate proximity to the works) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. It is predicted that there is the potential for high impact to the setting of nine heritage assets during operation.
	Impact Assessment (operation)	**Slight to Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this route is provided in Annex B of this report.**

Option Ref		BBC-06
		The route and its ZoI (200m buffer from the route) runs adjacent to Newton St Loe SSSI, which is designated for its geological assets and five SNCIs:, Brislington Meadows, East Wood and Keynsham Humpy Tumps complex, Charlton Bottom and Queen Charlton Watercourse, River Chew and Bitton to Bath railway track. The route and its buffer passes through or adjacent to the following habitats: • Habitat of Principal Importance (HPI)[9]: deciduous woodland, lowland calcareous grassland, traditional orchard, coastal and floodplain grazing marsh. • Biodiversity Action Plan (BAP) priority habitat[10] wood pasture and parkland. • Other habitats along the scheme include line of trees, hedgerows, grassland field and agricultural fields. It is anticipated that the habitats present will support a range of protected and notable species.
	Likely Effects – Construction	It is anticipated that the route would use the existing and future road network including any upgraded carriageways associated with the proposed BBSC, therefore it is anticipated that the majority of habitat loss will be limited to discrete areas of habitat associated with the road verge. Construction works may result in removal of verge vegetation including scrub, hedgerows and trees. Any widening of the road around the Bristol Road/Newbridge Road junction could adversely affect the geological features of Newton St Loe SSSI. The habitats to be lost is likely to be limited to discrete areas, as such a precautionary approach has been adopted. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area.
	Impact Assessment (construction)	**Slight Adverse**
	Likely Effects – Operation	As the route uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. If overhead electrification infrastructure is required for the option, this could impact protected species through collision of species with cabling and vehicles on the lines. The overhead infrastructure may also disrupt foraging and commuting routes for bats, however existing baseline conditions of the road may already reduce the suitability of the roads for bats.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**

Option Ref		BBC-06
Water	Baseline - key aspects and importance / significance	**Surface Water** The option follows along the existing road network from the Bath Road (A4)/Callington Road (A4174) junction (Ch. 5500), in a south-easterly direction along the A4 until it reaches Newbridge Road (A4), by the River Avon (Ch. 17200). It is approximately 11.5 km in length in total. The majority of the route is within Flood Zone 1 (Low risk), but there are a few instances when the route passes through Flood Zone 3 (High risk) and Flood Zone 2 (Medium risk). The first location is located west of the Hicks Gate roundabout, passing through approximately 250 m of Flood Zone 3 (High risk) and Flood Zone 2 (Medium risk) (Ch. 7350 to Ch. 7600), associated with the Scotland Bottom watercourse, a tributary of the River Avon which it also intersects (Ch. 7350). Additionally, at the eastern section of the Bath Road (A4)/Broadmead Lane roundabout, the route intersects the Broadmead watercourse, a tributary of the River Avon (Ch. 10500) and a small area of Flood Zone 2 (Medium risk). The eastern-most extent of the route (Ch. 17150 to Ch. 17200) also falls within a Flood Zone 2 (Medium risk) area, associated with the River Avon floodplain. The majority of the option is at Low risk of surface water flooding. Ponding is shown in several locations during 1 in 30-year events (High risk). These locations are: at Hicks Gate roundabout (Ch. 7600), west of the River Chew (Ch. 9300 to Ch. 9400), at Bath Road (A4)/Broadmead Lane roundabout (Ch. 10300 to Ch. 10500), in close approximation to the Bath Road (A4)/Grange Road junction to the Bath Road (A4)/Norman Road junction (Ch. 11800 to Ch. 12200), near Bath Road (A4)/Uplands Road junction (Ch. 12800 to Ch. 13100), at Bath Road (A4)/Glen junction (Ch. 13450) and east of the Bristol Road (A4)/Wells Road (A39) roundabout (Ch. 15400 to Ch. 15500). However, over the whole scheme, there is not a significant amount. **Groundwater** The dominant geology for this routing comprises the Mercia Mudstone Group (sandstones and subordinate siltstone) and Lias Group (Limestone and Mudstone) from west (Brislington) to east (Lower Weston) respectively. The route will intercept Secondary A, Secondary B and Secondary (undifferentiated) aquifers. The majority of the route will intercept Secondary A aquifers. A SPZ Outer Protection Zone 2 is present at Somerdale Pavilion approximately 0.2km north east of the route. No details are currently available on yield, target or purpose of this abstraction.
	Likely Effects – Construction	• Any loss of fluvial floodplain during construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • Flood risk may increase temporarily, this should be quantified and mitigated. • There may be temporary adverse effects on groundwater quality particularly in fractured aquifers. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures.
	Impact Assessment (construction only)	**Slight Adverse**
	Likely Effects – Operation	• Parts of the route may be at risk of fluvial and tidal flooding. • The frequency and severity of flooding will increase with the impacts of climate change. • Use of existing road network with assumed no changes to ground level reduces the likelihood of pollution risk to groundwater receptors.

[9] Protected under the Natural Environment and Rural Communities (NERC) Act 2006

[10] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

	Impact Assessment (operation only)	**Slight Adverse**

Option Ref		**BBC-A5**
Noise	Baseline - key aspects and importance / significance	The MT route passes through three road and one railway NIAs: • NIA ID RI_1333 is located along the railway line just west of Oldfield park station; • NIA ID 14682 runs along the A36 Lower Bristol Road from the Felding Road/Jews Lane junction to Pines Way, the A36 one-way system; • NIA ID 3700 runs along the A36 lower Bristol Road from St James's Cemetery entrance until the Westmoreland Road junction; and • NIA ID 12814 runs along the A36 Lower Bristol Road from just after The Square junction until the junction at Wood Street. The diversion route intersects with NIA 14682 at the A3604/ A36 junction. In addition the diversion passes through three road NIAs: • NIA 3697 runs along the A4 Newbridge Road from old Newbridge Hill /Brassmill Lane junction until just past Yomede Park junction; • NIA 12816 runs along the A4 Newbridge Road/Upper Bristol Road from just passed Lyme Gardens junction to just passed Cork Street junction; and • NIA 12817 runs along the A4 Upper Bristol Road from just past Sterling House junction to just past Little Stanhope Street. There are around 2732 properties along the MT and diversionary routes of which 876 are residential and 1856 are non-residential. According to the Environmental Noise Directive (END) Noise Mapping Round 3 published by Defra[11], baseline daytime noise levels at the nearest houses to the scheme and the diversion route are generally above $L_{Aeq,16h}$ 65dB (free-field).
	Likely Effects – Construction	It is anticipated that construction techniques would adopt Best Practicable Means (BPM) as advised in BS5228:2014+A1:2019 to minimise noise and vibration impacts on sensitive receptors but there is potential for some adverse impacts associated with construction works including plant.
	Impact Assessment (construction)	**Moderate Adverse**
	Likely Effects – Operation	It is assumed that the option would encourage modal shift, reducing the amount of surface road traffic thus benefitting NIAs. However, some additional above ground traffic noise is expected particularly associated with the diversion of general inbound traffic along the A4 Newbridge Road/ Upper Bristol Road which are predominately located through residential areas.
	Impact Assessment (Operation only)	**Neutral**
Air Quality	Baseline - key aspects and importance / significance	The MT route and inbound diversionary route lies partially within the Bath AQMA at its eastern extent, which is located largely along the A36 and A4 starting at the Fieldings Road/Jews Lane junction on the A36 and Roselyn Road junction along the A4 until Churchill Bridge Roundabout. There are numerous sensitive receptors such as residential housing, nurseries, primary and secondary schools, pharmacies, dentists, GP practices, care homes and places of worship along the proposed scheme, predominately associated with Twerton, Oldfield Park and Bath city centre. The B&NES monitoring data show that there are exceedance in annual mean NO2 concentrations at the monitoring sites in the vicinity of the corridor between 2015 and 2019. Monitoring sites at Wells Road, Dorchester Street, Lower Bristol Road and Upper Bristol Road exceeded the AQS objective in 2019 for annual mean NO2.
	Likely Effects – Construction	It is anticipated that construction techniques adopted and construction works planning would seek to avoid impacts from dust and exhaust emissions on human and ecological receptors but some adverse impacts as a result of disturbance from above ground construction works and construction traffic, cannot be ruled out. Overall, there will be a temporary and short term adverse impact during construction. The residual effects of dust and PM10 generated by construction activities following the application of the mitigation measures and good site practice will be negligible.
	Impact Assessment (construction)	**Neutral**
	Likely Effects – Operation	It is likely that the option will improve air quality in the long term by encouraging modal shift and reducing the amount of road traffic. The initial traffic model shows a reduction in traffic in the Bath City Centre with the scheme. This will reduce emissions of nitrogen dioxide (NO2) and particulate matter; and subsequently improve roadside air quality and could benefit the Bath City Centre AQMA. There is the potential for disbenefits due to increased congestion with reduced/altered road space and increase in general traffic along the A4 Upper Bristol Road diversion route, which will disbenefit the air quality at the sensitive receptors although this will reduce over time as the effects of modal shift increase.
	Impact Assessment (operation)	**Slight Beneficial**
Landscape/Townscape	Baseline - key aspects and importance / significance	The route follows the existing A4/A36 road network and initially passing through open space of the Bristol and Bath Greenbelt at the westernmost extent and then mainly through residential and city centre landscape characters including Bath WHS. The route crosses the National Sustrans Cycleway once at the eastern extent and once again at Fieldings Road/Jews Lane junction on the A36. The western extent of the route runs adjacent to the Cotswold AONB and Newton St. Loe SSSI near Newbridge Park and Ride and Carrs Woodland LNR located between Carrswood View junction and just before Connection Road junction along the A36. Additionally within the 1.5km landscape study area, there are three areas of Ancient Woodland and 11 registered Parks and Gardens.

[11] https://data.gov.uk/dataset/75c5806b-b060-4f84-96b5-cc356b9192e9/environmental-noise-directive-end-noise-mapping-agglomerations-england-round-3

Option Ref		BBC-A5
		The diversionary route runs adjacent to the Cotswold AONB at Newbridge park and ride and follows the A4 Newbridge Road and Upper Bristol Road, and onto the A357 as well as crossing the River Avon along the A3604 to join the A36 midway along the scheme. The diversionary route also runs adjacent to Royal Victoria Park Registered Park and Garden.
	Likely Effects – Construction	Potential significant effects could arise from construction of MT infrastructure including temporary compounds, storage and construction parking in residential / commercial townscape character areas. There would be potentially large adverse effects on townscape given the extent of traffic disruption within residential / commercial locations particularly in Bath WHS, and alterations to the existing cycle route (i.e. off A36).
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	There may be potential moderate adverse effects on the landscape/townscape character of the MT route as a result of the introduction of transportation modes not currently present within the carriageway and associated MT infrastructure. Diverted general traffic flows along residential / commercial area along the A4 Upper Bristol Road is also likely to adversely impact associated character areas. The route also diverts cyclists off a section of the A36 into more residential character areas; whilst this may be more enjoyable (i.e. off main road), there are alternative safety considerations (i.e. more pedestrians and reversing cars in residential streets). It is assumed the effects on the landscape/townscape character and visual amenity will be more adverse if the option utilised is not bus transport (i.e. LRT, VLR), as this would introduce additional infrastructure and a new transport mode within a sensitive heritage character area (i.e. Bath WHS). It is assumed the route would follow the existing road network (i.e. assumed remains within current carriageway boundaries).
	Impact Assessment (operation)	**Moderate Adverse**
Historic Resources	Baseline - key aspects and importance / significance	**Please note that a Gazetteer for this option is provided in Annex A of this report.** This MT route is entirely above ground and would run near two Grade I Listed Buildings, 12 Grade II* Listed Buildings, 146 Grade II Listed Buildings, two Scheduled Monuments, one Conservation Area and two WHSs. Most of the assets are centred around Locksbrook, Twerton and Bath. A traffic diversion route along the A4 before crossing to the south and following the A36 has three Grade I Listed buildings, six Grade II* Listed Buildings, 76 Grade II Listed Buildings, one Scheduled Monument, one Conservation Area and two WHSs within a 100m buffer of the route.
	Likely Effects – Construction	It is anticipated that construction techniques adopted would seek to avoid direct physical impacts to cultural heritage assets but some adverse impacts as a result of disturbance from excavation/vibration cannot be ruled out. If any cultural heritage asset within a Conservation Area is physically impacted, then it is assumed there will be an impact to the wider Conservation Area as well. Construction activities along the route (and presence of associated construction infrastructure) may impact the significance of heritage assets through temporary changes in their settings. It is predicted that there is the potential for high impact to five heritage assets (potential for damage to an asset given their immediate proximity to the route) and low to medium impact to other assets.
	Impact Assessment (construction)	**Large Adverse**
	Likely Effects – Operation	It is assumed that operational impacts associated with traffic noise and vibration would be reduced along the MT route although may be increased along diversionary routes. There may also be impacts to the significance of assets due to changes in their setting from the operation of new transport modes and their associated infrastructure although sympathetic design is assumed. It is predicted that there is the potential for high impact to the setting of five heritage assets during operation.
	Impact Assessment (operation)	**Moderate Adverse**
Biodiversity	Baseline - key aspects and importance / significance	**Please note that additional baseline summary information for this scheme is provided in Annex B of this report.** The MT route and its zone of influence (200m buffer from the route) runs adjacent to Newton St Loe SSSI, which is designated for its geological assets, Carrs Woodland LNR, and four SNCIs: River Avon, Bitton to Bath railway track, Newton Brook, Carrs Wood. The general traffic diversionary route and its buffer runs adjacent to Locksbrook Cemetery SNCI and River Avon SNCI The MT route, diversionary route and it's buffer passes through or adjacent to the following habitats: • Habitat of Principal Importance (HPI)[12]: deciduous woodland. • Biodiversity Action Plan (BAP) priority habitat[13] wood pasture and parkland. • Other habitats along the scheme include scattered and lines of trees, hedgerows, amenity grassland. It is anticipated that the habitats present will support a range of protected and notable species.
	Likely Effects – Construction	It is anticipated that the existing road network will used for the MT and diversionary route, therefore it is anticipated that the majority of habitat loss will be limited to discrete areas of habitat associated with the road verge. Construction works may result in removal of verge vegetation including scrub, hedgerows and trees, this may adversely affect the species which rely on these habitats. Any widening of the road around the Bristol Road/Newbridge Road junction could adversely affect the geological features of Newton St Loe SSSI. The habitats to be lost is likely to be limited to discrete areas, as such a precautionary approach has been adopted. The increased levels of noise and vibration, lighting, and human activity associated with the construction phase has the potential to result in disturbance impacts on protected species or habitats within the area.
	Impact Assessment (construction)	**Slight Adverse**

[12] Protected under the Natural Environment and Rural Communities (NERC) Act 2006

[13] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

Option Ref		BBC-A5
	Likely Effects – Operation	As the route uses the existing road network, it is anticipated that there would be limited adverse effects on the ecological receptors beyond the current levels of disturbance. If overhead electrification infrastructure is required for the option, this could impact protected species through collision of species with cabling. The overhead infrastructure may also disrupt foraging and commuting routes for bats, however existing baseline conditions of the road may already reduce the suitability of the roads for bats.
	Impact Assessment (operation)	**Neutral (excluding potential species impacts)**
Water	Baseline - key aspects and importance / significance	**Surface Water** The option follows the existing road network following from the Newbridge Road (A4)/Lower Bristol Road (A36), separating into two separate spurs for the MT route (southern spur) and diversionary route (northern spur): • The MT route runs along Lower Bristol Road (A36), intersecting with the general traffic diversion route at the Lower Bristol Road (A36)/Windsor Bridge Road (A3604) junction. This part of the route passes through large areas of Flood Zone 2 (Medium risk) and small areas of Flood Zone 3 (High risk). Flood Zone 2 (Medium risk) is present along Lower Bridge Road (A36) at multiple locations, in association with the River Avon and the Newton Brook floodplains (Ch. 800 to Ch. 950, Ch. 1300 to Ch. 2300 and Ch. 2650 to Ch. 3000). The only Flood Zone 3 (High risk) area is located where the route intersects Brislington Brook (Ch. 900). • The northern spur runs along Newbridge Road (A4) . It turns south along Windsor Bridge Road (A3604) to link with the MT route at the Lower Bristol Road (A36)/Windsor Bridge Road (A3604). This part of the route passes through areas of Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk). Flood Zone 2 (Medium risk) areas are located along Newbridge Road (A4), for approximately 300 m, in association with the River Avon floodplain. Also, there are small sections of Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk) areas located along Upper Bristol Road (A4), by the Upper Bristol Road (A4)/Windsor Bridge Road (A3604) junction, and for approximately 90 m. Additionally, there is a stretch of Flood Zone 2 (Medium risk), along Windsor Bridge Road (A3604), for approximately 150 m. From the Windsor Bridge roundabout junctions, the two spurs continue easterly, largely parallel to each other: • The southern MT route continues along Lower Bristol Road in an easterly direction, until it reaches Churchill Bridge roundabout. It is almost entirely within Flood Zone 2 (Medium risk) (Ch. 3000 to Ch. 3200, Ch. 3350 to Ch. 3400 and Ch. 4500 to Ch. 4700), and Flood Zone 3 (High risk) (Ch. 3200 to Ch. 3350 and Ch. 3400 to Ch. 4500) (approximately 1.6 km). • The northern diversion route continues along Upper Bristol Road, which is entirely within Flood Zone 1 (Low risk). It then turns south and follows Green Park Road (A367) and Corn Street (A367), before turning south to reach Churchill Bridge roundabout and the main scheme route. Along the majority from the junction Green Park Road to Churchill Bridge roundabout, the diversion is almost entirely within Flood Zone 2 (approximately 875 m). It is also briefly within Flood Zone 3 (High risk) for approximately 125 m, along Corn Street (A367). Large sections of the route are within Flood Zone 2 (Medium risk) and Flood Zone 3 (High risk). Large sections of this route are affected by 1 in 30 year surface water flood events. Along the northern spur from the Newbridge Road (A4)/Bristol Road (A36) junction to Churchill Bridge roundabout, the main high risk areas of surface water flooding are located along Newbridge Road (A4) by the Aspley Road junction and by the Hungerford Road junction. Additionally, 1 in 30 year surface water food events are located along Upper Bristol Road (A4) by Marlborough Lane junction and along Corn Street (A367). A 1 in 30 year surface water flood event would affect large swathes of the southern spur between the Newbridge (A4)/Bristol Road (A36) to Churchill Bridge roundabout. These areas stretch along Lower Bristol Road (A36) for approximately 500 m (Ch. 1800 to Ch. 2300) and almost entirely from approximately Waterside Court to the Churchill Bridge roundabout, approximately 1.8 km (Ch. 2700 to Ch. 4500) in total. **Groundwater** A combination of head deposits, Alluvium and River Terrace deposits are present along most of this route, where these superficial deposits are associated with the River Avon. The dominant geology for this route comprises the Mercia Mudstone Group (sandstones and subordinate siltstone), Lias Group (Limestone and Mudstone) and the Charmouth Mudstone Formation (Mudstone and some limestone) from west (Newbridge) to east (Bath Spa) respectively. The route will overly Secondary A, Secondary B and Secondary (undifferentiated) aquifers. The majority of the route will overly Secondary A aquifers. The route will use the existing road network and no changes to ground level are expected thus reducing any risk to groundwater receptors identified.
	Likely Effects – Construction	• Any loss of fluvial floodplain during construction may require temporary floodplain compensation. • There may be temporary adverse effects on surface water quality as a result of runoff from earthworks and materials storage. • The construction works may expose construction workers to flood risk. • Flood risk may increase temporarily, this should be quantified and mitigated. • There may be temporary adverse effects on groundwater quality particularly in fractured aquifers. • Potential impacts to groundwater quantity (level and flow) due to groundwater control measures.
	Impact Assessment (construction only)	**Slight Adverse**
	Likely Effects – Operation	• Parts of the scheme may be at risk of fluvial and tidal flooding. • The frequency and severity of flooding will increase with the impacts of climate change. • Use of existing road network with assumed no changes to ground level reduces the likelihood of pollution risk to groundwater receptors.
	Impact Assessment (operation only)	**Slight Adverse**

Overall average scores

TAG Environmental Topic	Impact Assessment (construction) score	Average (construction) score (Total/6)	Impact Assessment (operation) score	Average (operation) score (Total/6)
Noise	-12	-2	5	0.8
Air Quality	0	0	7.5	1.3
Landscape/Townscape	-16	-2.7	-12	-2
Historic Resources	-18	-3	-9	-1.5
Biodiversity	-8.5	-1.4*	-1	-0.2*
Water	-9	-1.5	-6	-1

*Note: Excluding potential impacts to species

Summary paragraphs

Construction

The potential impact on Historic Resources during construction is considered Large Adverse as there is the potential for high impact to several heritage assets. This is because construction activities and infrastructure along the route may impact the significance of heritage assets through temporary changes in their settings. Sensitive receptors relevant to Landscape/Townscape, such as residential properties and commercial premises, also have the potential to experience Large Adverse impacts during construction. It is anticipated that above ground construction works, including plant operation and waste (spoil) haulage, could cause a Moderate Adverse impact on Noise. It is anticipated that Water could experience Moderate Adverse impacts due to a number of reasons including potential runoff from earthworks and materials storage affecting surface water and groundwater quality, and the loss of fluvial floodplain areas requiring temporary floodplain compensation. Slight Adverse impacts could be experienced on Biodiversity (excluding species) mainly due to temporary increases in levels of noise and vibration, lighting and human activity disturbing ecological receptors, and the removal of habitats. With regards to Air Quality, it is considered that the residual impacts of dust and PM10 generated by construction activities following the application of mitigation measures and good site practice would be Neutral.

Operation

The potential impact on Landscape/Townscape is considered Moderate Adverse mainly due to the introduction of new transport modes causing adverse effects to landscape/townscape character and visual amenity. The impact on Historic Resources is also anticipated to be Moderate Adverse due to potential physical impacts to above ground cultural heritage assets and Conservation Areas. There may also be impacts to the significance of assets due to changes in their setting. Slight Adverse has been allocated to Water due to new infrastructure introducing or exacerbating flood risk, and the impact of climate change increasing the frequency and severity of flooding. The impacts on Biodiversity (excluding potential impacts on species) are anticipated to be Neutral, largely due to the route using the existing road network, and thus having limited effects on ecological receptors. The potential impact on Air Quality and Noise during operation is considered Slight Beneficial. This is because the MT routes are likely to encourage modal shift, reducing the amount of surface road traffic and associated emissions of nitrogen dioxide (NO2) and particulate matter. This would improve roadside air quality and noise levels, benefiting nearby AQMAs and NIAs respectively.

OPTION REF - NC04

S.No	Asset Name	Asset Number	NGR	Designation	Impact		Tunnelled?
	LISTED BUILDINGS						
1	9, MARSH STREET	1025062	ST 58687 72836	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
2	THE CARRIAGE WORKS	1025273	ST 59139 74029	Grade II* Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
3	WEST GATE	1052272	ST 58698 73140	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
4	WALSALL CONDUITS SITE	1187263	ST 58652 73251	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
5	5 AND 6, BROAD QUAY	1202016	ST 58617 72843	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
6	146, CHELTENHAM ROAD (See details for further address information)	1202058	ST 59114 74202	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
7	NUMBERS 159 TO 165 AND ATTACHED FRONT GARDEN WALLS AND PIERS	1202059	ST 59044 74204	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
8	CHRISTADELPHIAN CHAPEL	1202060	ST 59084 74130	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
9	THE SUGAR LOAF PUBLIC HOUSE	1202061	ST 58645 73170	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
10	20, CHRISTMAS STEPS	1202064	ST 58639 73190	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
11	ST BARTHOLOMEW'S HOSPITAL	1202066	ST 58660 73191	Grade II* Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
12	ABBEY CHAMBERS	1202084	ST 58649 72902	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
13	12, CLARE STREET	1202085	ST 58667 72910	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
14	13, CLARE STREET	1202086	ST 58667 72936	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
15	15, CLARE STREET	1202087	ST 58674 72939	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
16	25 AND 27, CLARE STREET	1202088	ST 58717 72958	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
17	DRINKING FOUNTAIN	1202136	ST 58639 73031	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
18	STATUE OF EDWARD COLSTON	1202137	ST 58628 73014	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
19	37 AND 39, JAMAICA STREET	1202319	ST 59074 73915	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
20	SUNDAY SCHOOL OF UNITARIAN CHAPEL AND TOWER HOUSE	1202352	ST 58669 73322	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
21	UNITARIAN CHAPEL	1202353	ST 58668 73294	Grade II* Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
22	WHITE HART INN AND ATTACHED WALL	1202364	ST 58852 73445	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
23	3, MIDDLE AVENUE	1202376	ST 58670 72582	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
24	QUEEN SQUARE HOUSE AND ATTACHED FRONT AREA WALLS AND PIERS	1202465	ST 58876 72519	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
25	22, 23 AND 24, QUEEN SQUARE	1202466	ST 58867 72491	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
26	NUMBERS 46 AND 47 AND ATTACHED RAILINGS AND PIERS	1202469	ST 58668 72502	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
27	NUMBER 48 AND ATTACHED RAILINGS AND PIERS	1202470	ST 58670 72514	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
28	49 AND 50, QUEEN SQUARE	1202471	ST 58668 72524	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
29	PHOENIX HOUSE AND ATTACHED RAILINGS AND PIERS	1202472	ST 58674 72537	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
30	NUMBER 54 AND ATTACHED RAILINGS AND PIERS	1202473	ST 58676 72556	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
31	58, QUEEN SQUARE	1202474	ST 58684 72602	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
32	WCA WAREHOUSE	1202485	ST 59011 72515	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
33	RINGER'S TOBACCO FACTORY	1202487	ST5911372510	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
34	CHATTERTON'S HOUSE AND SCHOOL AND ATTACHED SCREEN WALL	1202490	ST 59218 72393	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
35	CHURCH OF ST STEPHEN	1202558	ST 58684 72983	Grade I Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
36	1,3 AND 5, ST STEPHENS STREET	1202559	ST 58703 73048	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
37	13, ST STEPHENS STREET	1202560	ST 58708 73012	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
38	11, SMALL STREET	1202578	ST 58705 73084	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
39	THE OLD PINT AND PIE PUBLIC HOUSE	1202604	ST 59068 73854	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
40	59-65, STOKES CROFT	1202605	ST 59087 73878	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
41	93 AND 95, STOKES CROFT	1202606	ST 59108 73981	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
42	4 AND 5, CHARLES STREET	1205019	ST 58938 73659	Grade II* Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
43	173, CHELTENHAM ROAD	1205064	ST 59010 74358	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
44	NUMBERS 175, 177 AND 179 AND ATTACHED BOUNDARY WALLS, PIERS AND RAILINGS	1205067	ST 59006 74378	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
45	CONCORDE HOUSE INCLUDING RAILINGS AND LAMPS	1207730	ST 58705 73025	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
46	15 AND 17, ST STEPHENS STREET	1207761	ST 58713 73001	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
47	54-62, STOKES CROFT	1208927	ST 59110 73866	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
48	17 AND 18, QUEEN SQUARE	1217966	ST 58867 72536	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes

49	52 AND 53, QUEEN SQUARE	1218080	ST 58674 72551	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
50	55, QUEEN SQUARE	1218086	ST 58675 72564	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
51	57, QUEEN SQUARE	1218091	ST 58683 72594	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
52	NUMBERS 59 TO 62 AND ATTACHED RAILINGS AND PIERS	1218102	ST 58684 72609	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
53	EQUESTRIAN STATUE OF WILLIAM III	1218127	ST 58774 72561	Grade I Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
54	CHURCH HOUSE	1220220	ST 58879 73481	Grade II* Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
55	ATTACHED WALLS AND RAILINGS ENCLOSING GARDEN TO SOUTH OF CHURCH OF ST STEPHEN	1279619	ST 58682 72960	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
56	EYE HOSPITAL, BRISTOL ROYAL INFIRMARY, AND ATTACHED BASEMENT AREA RAILINGS	1280243	ST 58779 73450	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
57	3, CHRISTMAS STEPS	1280877	ST 58636 73175	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
58	148, CHELTENHAM ROAD	1280905	ST 59111 74209	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
59	NUMBER 152 AND ATTACHED HANDRAIL	1280906	ST 59111 74219	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
60	4, BROAD QUAY	1281282	ST 58617 72851	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
61	7, BROAD QUAY	1281286	ST 58624 72834	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
62	117 AND 119, STOKES CROFT	1282098	ST 59112 74039	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
63	56, QUEEN SQUARE	1282152	ST 58681 72586	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
64	RETAINING WALL EXTENDING APPROXIMATELY 80 METRES TO NORTH WEST OF GREYFRIARS HOUSE (NOT INCLUDED)	1282212	ST 58690 73366	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
65	WALLS, GATES AND RAILINGS TO THE FRONT OF UNITARIAN CHAPEL	1282213	ST 58692 73304	Grade II* Listed Building	High Impact	Potential Physical Impact	Yes
66	FOUR LAMPS APPROXIMATELY 4 METRES FROM EACH CORNER OF THE CENOTAPH	1282344	ST 58665 73059	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
67	17, 18 AND 19, CHRISTMAS STEPS	1282347	ST 58636 73187	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
68	GLASS CHAMBERS	1282356	ST 58635 72898	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
69	10, CLARE STREET	1282357	ST 58661 72907	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
70	14, CLARE STREET	1282358	ST 58674 72913	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
71	17 AND 19, CLARE STREET	1282359	ST 58696 72948	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
72	150, CHELTENHAM ROAD	1282383	ST 59111 74214	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
73	1, 2 AND 3, BROAD QUAY	1282403	ST 58614 72868	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
74	ARLEY CHAPEL	1282415	ST 59040 74295	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
75	WALLS, RAILINGS, PIERS AND GATES TO WEST SIDE OF CHURCH OF ST JAMES	1291054	ST 58848 73447	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
76	THE GEORGE RAILWAY HOTEL	1291650	ST 59447 72392	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
77	35-43, STOKES CROFT	1292924	ST 59059 73805	Grade II Listed Building	High Impact	Potential Physical Impact	Yes
78	QUAY HEAD HOUSE	1372267	ST 58702 73064	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
79	CENOTAPH	1372299	ST 58656 73058	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
80	Chapel Wing (only) to the former Bristol Royal Infirmary	1450692	ST5880773518	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	Yes
81	CEDAR HOUSE	1128967	ST 58730 80034	Grade II Listed Building	Low to Medium Impact	Potential Settings Impact	No
	CONSERVATION AREA						
82	St James' Parade				Low to Medium Impact	Potential Settings Impact	Yes
83	City and Queen Square				Low to Medium Impact	Potential Physical Impact	Yes
84	College Green				Low to Medium Impact	Potential Physical Impact	Yes
85	Cotham and Redland				Low to Medium Impact	Potential Physical Impact	Yes
86	Montpelier				Low to Medium Impact	Potential Physical Impact	Yes
87	Redcliffe				Low to Medium Impact	Potential Physical Impact	Yes
88	St Michael's Hill and Christmas Steps				Low to Medium Impact	Potential Physical Impact	Yes
89	Stokes Croft				Low to Medium Impact	Potential Physical Impact	Yes
90	Gloucester Road				Low to Medium Impact	Potential Settings Impact	Yes

Grade II Listed Buildings= 74+1 (AG)
Grade II* Listed Buildings = 6
Conservation Area = 9

OPTION REF - NC08

S.No	Asset Name	Asset Number	NGR	Designation	Impact		Tunelled?
	LISTED BUILDINGS						
1	THE CARRIAGE WORKS	1025273	ST 59139 74029	II*	Low to Medium Impact	Potential Settings Impact	
2	CHURCH OF ST PETER	1128827	ST 60306 79198	II	Low to Medium Impact	Potential Settings Impact	
3	FILTON HOUSE	1128828	ST 60161 79119	II	Low to Medium Impact	Potential Settings Impact	
4	GATE, PIERS AND OVERTHROW 30 METRES SOUTH EAST OF FILTON HOUSE	1128829	ST 60194 79090	II	High Impact	Potential Physical Impact	
5	THE GABLES WAYSIDE	1128830	ST 62334 79754	II	Low to Medium Impact	Potential Settings Impact	
6	CHURCH OF ST MICHAEL	1128831	ST 62261 79707	II*	Low to Medium Impact	Potential Settings Impact	
7	MONUMENT TO BLANDFORD IN THE CHURCHYARD AND 1 METRE TO THE NORTH OF VESTRY OF CHURCH OF ST MICHAEL	1128832	ST 62270 79716	II	Low to Medium Impact	Potential Settings Impact	
8	MONUMENT TO RHIND, IN THE CHURCHYARD AND 5 METRES TO NORTH OF VESTRY OF CHURCH OF ST MICHAEL	1128833	ST 62258 79715	II	Low to Medium Impact	Potential Settings Impact	
9	NUMBERS 16 TO 21 (CONSECUTIVE) AND ATTACHED AREA RAILINGS	1187179	ST 58969 74093	II	Low to Medium Impact	Potential Settings Impact	
10	BRISTOL NORTH BATHS	1187218	ST 59003 75271	II	Low to Medium Impact	Potential Settings Impact	
11	16 AND 18, NINETREE HILL	1187312	ST 58998 74095	II	Low to Medium Impact	Potential Settings Impact	
12	PUBLIC LAVATORY ON SOUTH EAST CORNER OF HORFIELD COMMON	1187314	ST 59478 76850	II	High Impact	Potential Physical Impact	Yes
13	HORFIELD BAPTIST CHURCH INSTITUTE	1187326	ST 59188 75754	II	Low to Medium Impact	Potential Settings Impact	
14	19, 21 AND 23, ASHLEY ROAD	1201962	ST 59205 74151	II	Low to Medium Impact	Potential Settings Impact	
15	27, ASHLEY ROAD	1201963	ST 59222 74161	II	Low to Medium Impact	Potential Settings Impact	
16	29, ASHLEY ROAD	1201964	ST 59230 74165	II	Low to Medium Impact	Potential Settings Impact	
17	37, ASHLEY ROAD	1201965	ST 59253 74175	II	Low to Medium Impact	Potential Settings Impact	
18	43 AND 45, ASHLEY ROAD	1201966	ST 59268 74186	II	Low to Medium Impact	Potential Settings Impact	
19	49, ASHLEY ROAD	1201967	ST 59278 74192	II	Low to Medium Impact	Potential Settings Impact	
20	57, ASHLEY ROAD	1201968	ST 59294 74199	II	Low to Medium Impact	Potential Settings Impact	
21	63 AND 63A, ASHLEY ROAD	1201969	ST 59310 74205	II	Low to Medium Impact	Potential Settings Impact	
22	OLD ENGLAND PUBLIC HOUSE	1201978	ST 59178 74405	II	Low to Medium Impact	Potential Settings Impact	
23	146, CHELTENHAM ROAD (See details for further address information)	1202058	ST 59114 74202	II	Low to Medium Impact	Potential Settings Impact	
24	NUMBERS 159 TO 165 AND ATTACHED FRONT GARDEN WALLS AND PIERS	1202059	ST 59044 74204	II	Low to Medium Impact	Potential Settings Impact	
25	CHRISTADELPHIAN CHAPEL	1202060	ST 59084 74130	II	Low to Medium Impact	Potential Settings Impact	
26	CITY ROAD BAPTIST CHAPEL AND ATTACHED STEPS AND RAILINGS	1202082	ST 59130 73843	II	Low to Medium Impact	Potential Settings Impact	
27	NUMBER 23 AND ATTACHED FRONT AREA RAILINGS	1202191	ST 59162 73644	II	Low to Medium Impact	Potential Settings Impact	
28	NUMBER 30 AND ATTACHED RAILINGS TO DOORWAY	1202192	ST 59177 73629	II	Low to Medium Impact	Potential Settings Impact	
29	NUMBERS 1 TO 6 (CONSECUTIVE) AND ATTACHED AREA RAILINGS	1202226	ST 58930 74034	II	Low to Medium Impact	Potential Settings Impact	
30	NUMBER 15 AND ATTACHED AREA RAILINGS	1202229	ST 58946 74116	II	Low to Medium Impact	Potential Settings Impact	
31	NUMBER 22 TO 26 (CONSECUTIVE) AND ATTACHED AREA RAILINGS	1202230	ST 58973 74054	II	Low to Medium Impact	Potential Settings Impact	
32	OLD CHAPEL BUILDINGS	1202235	ST 59669 77211	II	Low to Medium Impact	Potential Settings Impact	
33	8 AND 10, JAMAICA STREET	1202318	ST 59006 73804	II	Low to Medium Impact	Potential Settings Impact	
34	37 AND 39, JAMAICA STREET	1202319	ST 59074 73915	II	Low to Medium Impact	Potential Settings Impact	
35	NUMBERS 12 TO 15 (CONSECUTIVE) AND ATTACHED FRONT RAILINGS AND GATES	1202323	ST 58897 73828	II	Low to Medium Impact	Potential Settings Impact	
36	ENTRANCE ARCH TO FRONT YARD OF THE FULL MOON PUBLIC HOUSE	1202386	ST 59076 73667	II	Low to Medium Impact	Potential Settings Impact	
37	PICTON HOUSE AND FORECOURT RAILINGS	1202441	ST 59222 74223	II	Low to Medium Impact	Potential Settings Impact	
38	NUMBERS 28 AND 29 AND ATTACHED RAILINGS AND PIERS	1202586	ST 58901 73967	II	Low to Medium Impact	Potential Settings Impact	
39	NUMBER 31 AND ATTACHED RAILINGS AND STEPS	1202587	ST 58914 73985	II	Low to Medium Impact	Potential Settings Impact	
40	NUMBERS 41 AND 42 AND AREA RAILINGS	1202588	ST 58957 74033	II	Low to Medium Impact	Potential Settings Impact	
41	THE OLD PINT AND PIE PUBLIC HOUSE	1202604	ST 59068 73854	II	Low to Medium Impact	Potential Settings Impact	
42	59-65, STOKES CROFT	1202605	ST 59087 73878	II	High Impact	Potential Physical Impact	
43	93 AND 95, STOKES CROFT	1202606	ST 59108 73981	II	High Impact	Potential Physical Impact	
44	19,20 AND 21, SYDENHAM ROAD	1202613	ST 58924 74266	II	Low to Medium Impact	Potential Settings Impact	
45	25,26 AND 27, SYDENHAM ROAD	1202614	ST 58889 74299	II	Low to Medium Impact	Potential Settings Impact	
46	25, WILDER STREET	1202704	ST 59159 73733	II	Low to Medium Impact	Potential Settings Impact	
47	39, ASHLEY ROAD	1203539	ST 59255 74181	II	Low to Medium Impact	Potential Settings Impact	
48	47, ASHLEY ROAD	1203546	ST 59274 74189	II	Low to Medium Impact	Potential Settings Impact	
49	59 AND 61, ASHLEY ROAD	1203549	ST 59302 74201	II	Low to Medium Impact	Potential Settings Impact	
50	11-25, BATH BUILDINGS	1203680	ST 59128 74316	II	Low to Medium Impact	Potential Settings Impact	
51	NOS 1, 1A AND 2-6, BRUNSWICK SQUARE AND AREA WALLS	1204506	ST 59244 73585	II	Low to Medium Impact	Potential Settings Impact	
52	NUMBERS 14, 15 AND 16 AND ATTACHED AREA RAILINGS	1204541	ST 59207 73637	II	Low to Medium Impact	Potential Settings Impact	
53	4 AND 5, CHARLES STREET	1205019	ST 58938 73659	II*	Low to Medium Impact	Potential Settings Impact	
54	173, CHELTENHAM ROAD	1205064	ST 59010 74358	II	Low to Medium Impact	Potential Settings Impact	
55	NUMBERS 175, 177 AND 179 AND ATTACHED BOUNDARY WALLS, PIERS AND RAILINGS	1205067	ST 59006 74378	II	Low to Medium Impact	Potential Settings Impact	
56	COLSTON'S GIRL SCHOOL	1205072	ST 59027 74475	II	Low to Medium Impact	Potential Settings Impact	
57	NUMBERS 25 AND 27 AND ATTACHED FRONT AREA RAILINGS	1207909	ST 59171 73648	II	Low to Medium Impact	Potential Settings Impact	
58	NUMBER 29 AND ATTACHED FRONT AREA RAILINGS	1207920	ST 59180 73651	II	Low to Medium Impact	Potential Settings Impact	
59	32, SOMERSET STREET	1208619	ST 58918 73988	II	Low to Medium Impact	Potential Settings Impact	
60	36, SOMERSET STREET	1208631	ST 58934 74006	II	Low to Medium Impact	Potential Settings Impact	
61	2-50, PICTON STREET	1208728	ST 59196 74213	II	Low to Medium Impact	Potential Settings Impact	
62	PICTON LODGE AND ATTACHED FRONT RAILINGS	1208758	ST 59253 74260	II	Low to Medium Impact	Potential Settings Impact	
63	THE OLD GAOL	1208783	ST 59241 74276	II	Low to Medium Impact	Potential Settings Impact	
64	54-62, STOKES CROFT	1208927	ST 59110 73866	II	High Impact	Potential Physical Impact	
65	NUMBER 2, 4 AND 6 AND ATTACHED FRONT AREA RAILINGS AND PIER	1208950	ST 58989 73781	II	Low to Medium Impact	Potential Settings Impact	
66	18, JAMAICA STREET	1208954	ST 59012 73811	II	Low to Medium Impact	Potential Settings Impact	
67	NUMBER 21 AND ATTACHED AREA RAILINGS	1279517	ST 59156 73643	II	Low to Medium Impact	Potential Settings Impact	
68	28, CUMBERLAND STREET	1279524	ST 59170 73626	II	Low to Medium Impact	Potential Settings Impact	
69	NUMBER 32 AND ATTACHED FRONT AREA RAILINGS	1279529	ST 59184 73631	II	Low to Medium Impact	Potential Settings Impact	
70	148, CHELTENHAM ROAD	1280905	ST 59111 74209	II	Low to Medium Impact	Potential Settings Impact	
71	NUMBER 152 AND ATTACHED HANDRAIL	1280906	ST 59111 74219	II	Low to Medium Impact	Potential Settings Impact	
72	CHEST TOMB APPROXIMATELY 6 METRES SOUTH OF NORTH ENTRANCE TO BRUNSWICK SQUARE BURIAL GROUND	1281170	ST 59246 73741	II	Low to Medium Impact	Potential Settings Impact	
73	41, ASHLEY ROAD	1281638	ST 59260 74184	II	Low to Medium Impact	Potential Settings Impact	
74	51, 53 AND 55, ASHLEY ROAD	1281641	ST 59287 74195	II	Low to Medium Impact	Potential Settings Impact	
75	33, SOMERSET STREET	1282089	ST 58921 73992	II	Low to Medium Impact	Potential Settings Impact	
76	117 AND 119, STOKES CROFT	1282098	ST 59112 74039	II	Low to Medium Impact	Potential Settings Impact	
77	22,23 AND 24, SYDENHAM ROAD	1282103	ST 58910 74279	II	Low to Medium Impact	Potential Settings Impact	
78	52, PICTON STREET	1282178	ST 59222 74274	II	Low to Medium Impact	Potential Settings Impact	
79	THE FULL MOON PUBLIC HOUSE	1282188	ST 59063 73656	II	High Impact	Potential Physical Impact	
80	HORFIELD BAPTIST CHURCH	1282272	ST 59200 75771	II	Low to Medium Impact	Potential Settings Impact	
81	NUMBERS 13 TO 19 AND ATTACHED FRONT AREA RAILINGS	1282289	ST 59141 73637	II	Low to Medium Impact	Potential Settings Impact	
82	26, CUMBERLAND STREET	1282290	ST 59165 73624	II	Low to Medium Impact	Potential Settings Impact	

83	NUMBER 2 AND ATTACHED WALL AND FRONT AREA RAILINGS	1282293	ST 58864 73688	II	Low to Medium Impact	Potential Settings Impact	
84	BRUNSWICK CHAPEL	1282371	ST 59240 73679	II	Low to Medium Impact	Potential Settings Impact	
85	150, CHELTENHAM ROAD	1282383	ST 59111 74214	II	Low to Medium Impact	Potential Settings Impact	
86	174, CHELTENHAM ROAD	1282384	ST 59070 74362	II	Low to Medium Impact	Potential Settings Impact	
87	ARLEY CHAPEL	1282415	ST 59040 74295	II	Low to Medium Impact	Potential Settings Impact	
88	9-17, ASHLEY ROAD	1282417	ST 59186 74143	II	Low to Medium Impact	Potential Settings Impact	
89	25, ASHLEY ROAD	1282418	ST 59214 74158	II	Low to Medium Impact	Potential Settings Impact	
90	4, ASHLEY ROAD	1282420	ST 59169 74077	II	Low to Medium Impact	Potential Settings Impact	
91	CORONER'S COURT	1282422	ST 59124 73766	II	Low to Medium Impact	Potential Settings Impact	
92	BRUNSWICK CHAPEL ANNEX	1290763	ST 59220 73692	II	Low to Medium Impact	Potential Settings Impact	
93	28,29 AND 30, SYDENHAM ROAD	1292607	ST 58863 74325	II	Low to Medium Impact	Potential Settings Impact	
94	NUMBERS 2 TO 7 (CONSECUTIVE) AND ATTACHED FRONT AREA RAILINGS	1292616	ST 58906 73764	II	Low to Medium Impact	Potential Settings Impact	
95	THE TROPIC CLUB	1292874	ST 59154 73951	II	Low to Medium Impact	Potential Settings Impact	
96	35-43, STOKES CROFT	1292924	ST 59059 73805	II	Low to Medium Impact	Potential Settings Impact	
97	34, SOMERSET STREET	1293059	ST 58924 73996	II	Low to Medium Impact	Potential Settings Impact	
98	NUMBER 30 AND ATTACHED ENTRANCE RAILINGS	1293086	ST 58911 73982	II	Low to Medium Impact	Potential Settings Impact	
99	VICARAGE	1312877	ST 62224 79700	II	Low to Medium Impact	Potential Settings Impact	
100	MONUMENT TO TURNER IN THE CHURCHYARD AND 5 METRES SOUTH OF THE SOUTH PORCH OF THE CHURCH OF ST PETER	1321112	ST 60309 79174	II	Low to Medium Impact	Potential Settings Impact	
101	ST MICHAEL'S SCHOOL	1321113	ST 62338 79785	II	Low to Medium Impact	Potential Settings Impact	
102	THE COURT	1321114	ST 62392 79729	II	Low to Medium Impact	Potential Settings Impact	
103	MONUMENT TO TURNER IN THE CHURCHYARD AND 1 METRE NORTH OF VESTRY OF CHURCH OF ST MICHAEL	1321115	ST 62262 79716	II	Low to Medium Impact	Potential Settings Impact	
104	DOLPHIN HOUSE AND COLSTON HOUSE AND ATTACHED FRONT RAILINGS	1355135	ST 59146 74904	II	Low to Medium Impact	Potential Settings Impact	
105	K6 TELEPHONE KIOSK	1372264	ST 58924 74079	II	Low to Medium Impact	Potential Settings Impact	
106	NEW FILTON HOUSE	1379820	ST 60189 79138	II	Low to Medium Impact	Potential Settings Impact	
107	GATE PIERS AND GATES TO MEMORIAL STADIUM	1396388	ST 59508 76579	II	Low to Medium Impact	Potential Settings Impact	Yes
108	Pillbox at Filton Airfield	1416298	ST5978680032	II	Low to Medium Impact	Potential Settings Impact	
109	Stoke Gifford war memorial	1424779	ST6227579801	II	Low to Medium Impact	Potential Settings Impact	
110	Filton War Memorial	1427009	ST6031679171	II	Low to Medium Impact	Potential Settings Impact	
	CONSERVATION AREAS						
111	Kingsdown				Low to Medium Impact	Potential Settings Impact	
112	St James' Parade				Low to Medium Impact	Potential Settings Impact	
113	Cotham and Redland				Low to Medium Impact	Potential Physical Impact	
114	Montpelier				Low to Medium Impact	Potential Physical Impact	
115	Portland and Brunswick Square				Low to Medium Impact	Potential Settings Impact	
116	Stokes Croft				Low to Medium Impact	Potential Physical Impact	
117	Gloucester Road				High Impact	Potential Physical Impact	

Grade II Listed Buildings= 107
Grade II* Listed Buildings = 3
Conservation Area = 7

Diversion Route

ALTERNATE ROUTE (Diversion) FOR GENERAL TRAFFIC
Grade II* listed buildings = 1
Grade II listed buildings =44
Conservation Areas = 4

OPTION REF - NC08b

S.No	Asset Name	Asset Number	NGR	Designation	Impact	
	LISTED BUILDINGS					
1	THE CARRIAGE WORKS	1025273	ST 59139 74029	II*	Low to Medium Impact	Potential Settings Impact
2	CHURCH OF ST PETER	1128827	ST 60306 79198	II	Low to Medium Impact	Potential Settings Impact
3	FILTON HOUSE	1128828	ST 60161 79119	II	Low to Medium Impact	Potential Settings Impact
4	GATE, PIERS AND OVERTHROW 30 METRES SOUTH EAST OF FILTON HOUSE	1128829	ST 60194 79090	II	High Impact	Potential Physical Impact
5	THE GABLES WAYSIDE	1128830	ST 62334 79754	II	Low to Medium Impact	Potential Settings Impact
6	CHURCH OF ST MICHAEL	1128831	ST 62261 79707	II*	Low to Medium Impact	Potential Settings Impact
7	MONUMENT TO BLANDFORD IN THE CHURCHYARD AND 1 METRE TO THE NORTH OF VESTRY OF CHURCH OF ST MICHAEL	1128832	ST 62270 79716	II	Low to Medium Impact	Potential Settings Impact
8	MONUMENT TO RHIND, IN THE CHURCHYARD AND 5 METRES TO NORTH OF VESTRY OF CHURCH OF ST MICHAEL	1128833	ST 62258 79715	II	Low to Medium Impact	Potential Settings Impact
9	NUMBERS 16 TO 21 (CONSECUTIVE) AND ATTACHED AREA RAILINGS	1187179	ST 58969 74093	II	Low to Medium Impact	Potential Settings Impact
10	BRISTOL NORTH BATHS	1187218	ST 59003 75271	II	Low to Medium Impact	Potential Settings Impact
11	16 AND 18, NINETREE HILL	1187312	ST 58998 74095	II	Low to Medium Impact	Potential Settings Impact
12	PUBLIC LAVATORY ON SOUTH EAST CORNER OF HORFIELD COMMON	1187314	ST 59478 76850	II	High Impact	Potential Physical Impact
13	HORFIELD BAPTIST CHURCH INSTITUTE	1187326	ST 59188 75754	II	Low to Medium Impact	Potential Settings Impact
14	19, 21 AND 23, ASHLEY ROAD	1201962	ST 59205 74151	II	Low to Medium Impact	Potential Settings Impact
15	27, ASHLEY ROAD	1201963	ST 59222 74161	II	Low to Medium Impact	Potential Settings Impact
16	29, ASHLEY ROAD	1201964	ST 59230 74165	II	Low to Medium Impact	Potential Settings Impact
17	37, ASHLEY ROAD	1201965	ST 59253 74175	II	Low to Medium Impact	Potential Settings Impact
18	43 AND 45, ASHLEY ROAD	1201966	ST 59268 74186	II	Low to Medium Impact	Potential Settings Impact
19	49, ASHLEY ROAD	1201967	ST 59278 74192	II	Low to Medium Impact	Potential Settings Impact
20	57, ASHLEY ROAD	1201968	ST 59294 74199	II	Low to Medium Impact	Potential Settings Impact
21	63 AND 63A, ASHLEY ROAD	1201969	ST 59310 74205	II	Low to Medium Impact	Potential Settings Impact
22	OLD ENGLAND PUBLIC HOUSE	1201978	ST 59178 74405	II	Low to Medium Impact	Potential Settings Impact
23	146, CHELTENHAM ROAD (See details for further address information)	1202058	ST 59114 74202	II	Low to Medium Impact	Potential Settings Impact
24	NUMBERS 159 TO 165 AND ATTACHED FRONT GARDEN WALLS AND PIERS	1202059	ST 59044 74204	II	Low to Medium Impact	Potential Settings Impact
25	CHRISTADELPHIAN CHAPEL	1202060	ST 59084 74130	II	Low to Medium Impact	Potential Settings Impact
26	CITY ROAD BAPTIST CHAPEL AND ATTACHED STEPS AND RAILINGS	1202082	ST 59130 73843	II	Low to Medium Impact	Potential Settings Impact
27	NUMBER 23 AND ATTACHED FRONT AREA RAILINGS	1202191	ST 59162 73644	II	Low to Medium Impact	Potential Settings Impact
28	NUMBER 30 AND ATTACHED RAILINGS TO DOORWAY	1202192	ST 59177 73629	II	Low to Medium Impact	Potential Settings Impact
29	NUMBERS 1 TO 6 (CONSECUTIVE) AND ATTACHED AREA RAILINGS	1202226	ST 58930 74034	II	Low to Medium Impact	Potential Settings Impact
30	NUMBER 15 AND ATTACHED AREA RAILINGS	1202229	ST 58946 74116	II	Low to Medium Impact	Potential Settings Impact
31	NUMBER 22 TO 26 (CONSECUTIVE) AND ATTACHED AREA RAILINGS	1202230	ST 58973 74054	II	Low to Medium Impact	Potential Settings Impact
32	OLD CHAPEL BUILDINGS	1202235	ST 59669 77211	II	Low to Medium Impact	Potential Settings Impact
33	8 AND 10, JAMAICA STREET	1202318	ST 59006 73804	II	Low to Medium Impact	Potential Settings Impact
34	37 AND 39, JAMAICA STREET	1202319	ST 59074 73915	II	Low to Medium Impact	Potential Settings Impact
35	NUMBERS 12 TO 15 (CONSECUTIVE) AND ATTACHED FRONT RAILINGS AND GATES	1202323	ST 58897 73828	II	Low to Medium Impact	Potential Settings Impact
36	ENTRANCE ARCH TO FRONT YARD OF THE FULL MOON PUBLIC HOUSE	1202386	ST 59076 73667	II	Low to Medium Impact	Potential Settings Impact
37	PICTON HOUSE AND FORECOURT RAILINGS	1202441	ST 59222 74223	II	Low to Medium Impact	Potential Settings Impact
38	NUMBERS 28 AND 29 AND ATTACHED RAILINGS AND PIERS	1202586	ST 58901 73967	II	Low to Medium Impact	Potential Settings Impact
39	NUMBER 31 AND ATTACHED RAILINGS AND STEPS	1202587	ST 58914 73985	II	Low to Medium Impact	Potential Settings Impact
40	NUMBERS 41 AND 42 AND AREA RAILINGS	1202588	ST 58957 74033	II	Low to Medium Impact	Potential Settings Impact
41	THE OLD PINT AND PIE PUBLIC HOUSE	1202604	ST 59068 73854	II	Low to Medium Impact	Potential Settings Impact
42	59-65, STOKES CROFT	1202605	ST 59087 73878	II	High Impact	Potential Physical Impact
43	93 AND 95, STOKES CROFT	1202606	ST 59108 73981	II	High Impact	Potential Physical Impact
44	19,20 AND 21, SYDENHAM ROAD	1202613	ST 58924 74266	II	Low to Medium Impact	Potential Settings Impact
45	25,26 AND 27, SYDENHAM ROAD	1202614	ST 58889 74299	II	Low to Medium Impact	Potential Settings Impact
46	25, WILDER STREET	1202704	ST 59159 73733	II	Low to Medium Impact	Potential Settings Impact
47	39, ASHLEY ROAD	1203539	ST 59255 74181	II	Low to Medium Impact	Potential Settings Impact
48	47, ASHLEY ROAD	1203546	ST 59274 74189	II	Low to Medium Impact	Potential Settings Impact
49	59 AND 61, ASHLEY ROAD	1203549	ST 59302 74201	II	Low to Medium Impact	Potential Settings Impact
50	11-25, BATH BUILDINGS	1203680	ST 59128 74316	II	Low to Medium Impact	Potential Settings Impact
51	NOS 1, 1A AND 2-6, BRUNSWICK SQUARE AND AREA WALLS	1204506	ST 59244 73585	II	Low to Medium Impact	Potential Settings Impact
52	NUMBERS 14, 15 AND 16 AND ATTACHED AREA RAILINGS	1204541	ST 59207 73637	II	Low to Medium Impact	Potential Settings Impact
53	4 AND 5, CHARLES STREET	1205019	ST 58938 73659	II*	Low to Medium Impact	Potential Settings Impact
54	173, CHELTENHAM ROAD	1205064	ST 59010 74358	II	Low to Medium Impact	Potential Settings Impact
55	NUMBERS 175, 177 AND 179 AND ATTACHED BOUNDARY WALLS, PIERS AND RAILINGS	1205067	ST 59006 74378	II	Low to Medium Impact	Potential Settings Impact
56	COLSTON'S GIRL SCHOOL	1205072	ST 59027 74475	II	Low to Medium Impact	Potential Settings Impact
57	NUMBERS 25 AND 27 AND ATTACHED FRONT AREA RAILINGS	1207909	ST 59171 73648	II	Low to Medium Impact	Potential Settings Impact
58	NUMBER 29 AND ATTACHED FRONT AREA RAILINGS	1207920	ST 59180 73651	II	Low to Medium Impact	Potential Settings Impact
59	32, SOMERSET STREET	1208619	ST 58918 73988	II	Low to Medium Impact	Potential Settings Impact
60	36, SOMERSET STREET	1208631	ST 58934 74006	II	Low to Medium Impact	Potential Settings Impact
61	2-50, PICTON STREET	1208728	ST 59196 74213	II	Low to Medium Impact	Potential Settings Impact
62	PICTON LODGE AND ATTACHED FRONT RAILINGS	1208758	ST 59253 74260	II	Low to Medium Impact	Potential Settings Impact
63	THE OLD GAOL	1208783	ST 59241 74276	II	Low to Medium Impact	Potential Settings Impact
64	54-62, STOKES CROFT	1208927	ST 59110 73866	II	High Impact	Potential Physical Impact
65	NUMBER 2, 4 AND 6 AND ATTACHED FRONT AREA RAILINGS AND PIER	1208950	ST 58989 73781	II	Low to Medium Impact	Potential Settings Impact
66	18, JAMAICA STREET	1208954	ST 59012 73811	II	Low to Medium Impact	Potential Settings Impact
67	NUMBER 21 AND ATTACHED AREA RAILINGS	1279517	ST 59156 73643	II	Low to Medium Impact	Potential Settings Impact
68	28, CUMBERLAND STREET	1279524	ST 59170 73626	II	Low to Medium Impact	Potential Settings Impact
69	NUMBER 32 AND ATTACHED FRONT AREA RAILINGS	1279529	ST 59184 73631	II	Low to Medium Impact	Potential Settings Impact
70	148, CHELTENHAM ROAD	1280905	ST 59111 74209	II	Low to Medium Impact	Potential Settings Impact
71	NUMBER 152 AND ATTACHED HANDRAIL	1280906	ST 59111 74219	II	Low to Medium Impact	Potential Settings Impact

72	CHEST TOMB APPROXIMATELY 6 METRES SOUTH OF NORTH ENTRANCE TO BRUNSWICK SQUARE BURIAL GROUND	1281170	ST 59246 73741	II	Low to Medium Impact	Potential Settings Impact
73	41, ASHLEY ROAD	1281638	ST 59260 74184	II	Low to Medium Impact	Potential Settings Impact
74	51, 53 AND 55, ASHLEY ROAD	1281641	ST 59287 74195	II	Low to Medium Impact	Potential Settings Impact
75	33, SOMERSET STREET	1282089	ST 58921 73992	II	Low to Medium Impact	Potential Settings Impact
76	117 AND 119, STOKES CROFT	1282098	ST 59112 74039	II	Low to Medium Impact	Potential Settings Impact
77	22,23 AND 24, SYDENHAM ROAD	1282103	ST 58910 74279	II	Low to Medium Impact	Potential Settings Impact
78	52, PICTON STREET	1282178	ST 59222 74274	II	Low to Medium Impact	Potential Settings Impact
79	THE FULL MOON PUBLIC HOUSE	1282188	ST 59063 73656	II	High Impact	Potential Physical Impact
80	HORFIELD BAPTIST CHURCH	1282272	ST 59200 75771	II	Low to Medium Impact	Potential Settings Impact
81	NUMBERS 13 TO 19 AND ATTACHED FRONT AREA RAILINGS	1282289	ST 59141 73637	II	Low to Medium Impact	Potential Settings Impact
82	26, CUMBERLAND STREET	1282290	ST 59165 73624	II	Low to Medium Impact	Potential Settings Impact
83	NUMBER 2 AND ATTACHED WALL AND FRONT AREA RAILINGS	1282293	ST 58864 73688	II	Low to Medium Impact	Potential Settings Impact
84	BRUNSWICK CHAPEL	1282371	ST 59240 73679	II	Low to Medium Impact	Potential Settings Impact
85	150, CHELTENHAM ROAD	1282383	ST 59111 74214	II	Low to Medium Impact	Potential Settings Impact
86	174, CHELTENHAM ROAD	1282384	ST 59070 74362	II	Low to Medium Impact	Potential Settings Impact
87	ARLEY CHAPEL	1282415	ST 59040 74295	II	Low to Medium Impact	Potential Settings Impact
88	9-17, ASHLEY ROAD	1282417	ST 59186 74143	II	Low to Medium Impact	Potential Settings Impact
89	25, ASHLEY ROAD	1282418	ST 59214 74158	II	Low to Medium Impact	Potential Settings Impact
90	4, ASHLEY ROAD	1282420	ST 59169 74077	II	Low to Medium Impact	Potential Settings Impact
91	CORONER'S COURT	1282422	ST 59124 73766	II	Low to Medium Impact	Potential Settings Impact
92	BRUNSWICK CHAPEL ANNEX	1290763	ST 59220 73692	II	Low to Medium Impact	Potential Settings Impact
93	28,29 AND 30, SYDENHAM ROAD	1292607	ST 58863 74325	II	Low to Medium Impact	Potential Settings Impact
94	NUMBERS 2 TO 7 (CONSECUTIVE) AND ATTACHED FRONT AREA RAILINGS	1292616	ST 58906 73764	II	Low to Medium Impact	Potential Settings Impact
95	THE TROPIC CLUB	1292874	ST 59154 73951	II	Low to Medium Impact	Potential Settings Impact
96	35-43, STOKES CROFT	1292924	ST 59059 73805	II	Low to Medium Impact	Potential Settings Impact
97	34, SOMERSET STREET	1293059	ST 58924 73996	II	Low to Medium Impact	Potential Settings Impact
98	NUMBER 30 AND ATTACHED ENTRANCE RAILINGS	1293086	ST 58911 73982	II	Low to Medium Impact	Potential Settings Impact
99	VICARAGE	1312877	ST 62224 79700	II	Low to Medium Impact	Potential Settings Impact
100	MONUMENT TO TURNER IN THE CHURCHYARD AND 5 METRES SOUTH OF THE SOUTH PORCH OF THE CHURCH OF ST PETER	1321112	ST 60309 79174	II	Low to Medium Impact	Potential Settings Impact
101	ST MICHAEL'S SCHOOL	1321113	ST 62338 79785	II	Low to Medium Impact	Potential Settings Impact
102	THE COURT	1321114	ST 62392 79729	II	Low to Medium Impact	Potential Settings Impact
103	MONUMENT TO TURNER IN THE CHURCHYARD AND 1 METRE NORTH OF VESTRY OF CHURCH OF ST MICHAEL	1321115	ST 62262 79716	II	Low to Medium Impact	Potential Settings Impact
104	DOLPHIN HOUSE AND COLSTON HOUSE AND ATTACHED FRONT RAILINGS	1355135	ST 59146 74904	II	Low to Medium Impact	Potential Settings Impact
105	K6 TELEPHONE KIOSK	1372264	ST 58924 74079	II	Low to Medium Impact	Potential Settings Impact
106	NEW FILTON HOUSE	1379820	ST 60189 79138	II	Low to Medium Impact	Potential Settings Impact
107	GATE PIERS AND GATES TO MEMORIAL STADIUM	1396388	ST 59508 76579	II	Low to Medium Impact	Potential Settings Impact
108	Pillbox at Filton Airfield	1416298	ST5978680032	II	Low to Medium Impact	Potential Settings Impact
109	Stoke Gifford war memorial	1424779	ST6227579801	II	Low to Medium Impact	Potential Settings Impact
110	Filton War Memorial	1427009	ST6031679171	II	Low to Medium Impact	Potential Settings Impact
	CONSERVATION AREAS					
111	Kingsdown				Low to Medium Impact	Potential Settings Impact
112	St James' Parade				Low to Medium Impact	Potential Settings Impact
113	Cotham and Redland				Low to Medium Impact	Potential Physical Impact
114	Montpelier				Low to Medium Impact	Potential Physical Impact
115	Portland and Brunswick Square				Low to Medium Impact	Potential Settings Impact
116	Stokes Croft				Low to Medium Impact	Potential Physical Impact
117	Gloucester Road				High Impact	Potential Physical Impact

Grade II Listed Buildings= 107
Grade II* Listed Buildings = 3
Conservation Area = 7

OPTION REF - EC04

S.No	Asset Name	Asset Number	NGR	Designation	Impact		Tunnelled?
	LISTED BUILDINGS						
1	BOUNDARY STONE SET INTO PLINTH OF NUMBER 1 REGENT STREET	1116168	ST 64568 73910	II	High Impact	Potential Physical Impact	Yes
2	DRINKING FOUNTAIN AND HORSE TROUGH AT JUNCTION WITH SUMMERHILL ROAD	1202121	ST 62368 73636	II	Low to Medium Impact	Potential Settings Impact	Yes
3	CHURCH OF ST MICHAEL	1202641	ST 63889 73787	II	High Impact	Potential Physical Impact	Yes
4	BRISTOL OLD STATION, TEMPLE MEADS	1209622	ST 59592 72419	I	Low to Medium Impact	Potential Settings Impact	Yes
5	TEMPLE MEADS STATION	1282106	ST 59749 72461	I	High Impact	Potential Physical Impact	Yes
6	PIERS, GATES AND RAILINGS OF ST GEORGE'S PUBLIC LIBRARY (LIBRARY NOT INCLUDED)	1282353	ST 62267 73614	II	Low to Medium Impact	Potential Settings Impact	Yes
7	THE GEORGE RAILWAY HOTEL	1291650	ST 59447 72392	II	Low to Medium Impact	Potential Settings Impact	Yes

Grade I Listed Buildings = 2
Grade II Listed Buildings = 5

OPTION REF - EC08

S.No	Asset Name	Asset Number	NGR	Designation	Impact	
	LISTED BUILDINGS					
1	GARDINER'S WAREHOUSE	1025259	ST 59696 73007	II	Low to Medium Impact	Potential Settings Impact
2	BOUNDARY STONE SET INTO PLINTH OF NUMBER 1 REGENT STREET	1116168	ST 64568 73910	II	High Impact	Potential Physical Impact
3	THE GREEN DRAGON PUBLIC HOUSE	1116176	ST 65214 76941	II	Low to Medium Impact	Potential Settings Impact
4	DOWNEND HOUSE	1116188	ST 65113 76608	II	Low to Medium Impact	Potential Settings Impact
5	THE FIRS	1116194	ST6524776786	II	Low to Medium Impact	Potential Settings Impact
6	Cleeve Lodge	1116195	ST6536176909	II	Low to Medium Impact	Potential Settings Impact
7	OLD CASTLE GREEN PUBLIC HOUSE	1187245	ST 59897 73283	II	Low to Medium Impact	Potential Settings Impact
8	THE VOLUNTEER TAVERN	1187337	ST 59658 73345	II	Low to Medium Impact	Potential Settings Impact
9	NUMBER 2 AND AREA RAILINGS	1202014	ST 59635 72956	II	Low to Medium Impact	Potential Settings Impact
10	8 AND 9, BROAD PLAIN	1202015	ST 59592 72954	II	Low to Medium Impact	Potential Settings Impact
11	DRINKING FOUNTAIN AND HORSE TROUGH AT JUNCTION WITH SUMMERHILL ROAD	1202121	ST 62368 73636	II	High Impact	Potential Physical Impact
12	COMPANY HOUSE	1202316	ST 59491 73058	II	Low to Medium Impact	Potential Settings Impact
13	ANNEX TO CHURCH OF ST JUDE THE APOSTLE AND ATTACHED RAILINGS	1202351	ST 59809 73337	II	Low to Medium Impact	Potential Settings Impact
14	OLD MARKET TAVERN	1202393	ST 59648 73187	II	Low to Medium Impact	Potential Settings Impact
15	32 AND 33, OLD MARKET STREET	1202394	ST 59667 73187	II	Low to Medium Impact	Potential Settings Impact
16	40 AND 41, OLD MARKET STREET	1202395	ST 59721 73206	II	Low to Medium Impact	Potential Settings Impact
17	50 AND 51, OLD MARKET STREET	1202396	ST 59760 73169	II	Low to Medium Impact	Potential Settings Impact
18	MASONS ARMS PUBLIC HOUSE	1202397	ST 59742 73163	II	Low to Medium Impact	Potential Settings Impact
19	NUMBER 69 AND ATTACHED AREA RAILINGS	1202398	ST 59628 73124	II	Low to Medium Impact	Potential Settings Impact
20	HOLY TRINITY ALMSHOUSES AND ATTACHED WALLS AND RAILINGS TO JACOB STREET	1202399	ST 59786 73162	II*	Low to Medium Impact	Potential Settings Impact
21	7, REDCROSS STREET	1202492	ST 59589 73268	II	Low to Medium Impact	Potential Settings Impact
22	ST PHILIP'S PUBLIC LIBRARY	1202638	ST 60051 73477	II	Low to Medium Impact	Potential Settings Impact
23	CHURCH OF ST MICHAEL	1202641	ST 63889 73787	II	Low to Medium Impact	Potential Settings Impact
24	13, VICTORIA AVENUE	1202656	ST 61092 73271	II	Low to Medium Impact	Potential Settings Impact
25	22, WEST STREET	1202680	ST 59876 73223	II	Low to Medium Impact	Potential Settings Impact
26	76, WEST STREET	1202681	ST 60000 73296	II	High Impact	Potential Physical Impact
27	CHURCH OF ST JUDE THE APOSTLE WITH ST MATTHIAS ON THE WEIR	1204207	ST 59805 73321	II	Low to Medium Impact	Potential Settings Impact
28	NUMBER 5 AND AREA RAILINGS	1204279	ST 59609 72954	II	Low to Medium Impact	Potential Settings Impact
29	THE PRINTER'S DEVIL PUBLIC HOUSE	1204281	ST 59583 72945	II	Low to Medium Impact	Potential Settings Impact
30	31, OLD MARKET STREET	1207430	ST 59660 73184	II	Low to Medium Impact	Potential Settings Impact
31	38 AND 39, OLD MARKET STREET	1207446	ST 59714 73203	II	Low to Medium Impact	Potential Settings Impact
32	42, OLD MARKET STREET	1207506	ST 59726 73209	II	Low to Medium Impact	Potential Settings Impact
33	48, OLD MARKET STREET	1207530	ST 59775 73225	II	Low to Medium Impact	Potential Settings Impact
34	52, OLD MARKET STREET	1207557	ST 59749 73163	II	Low to Medium Impact	Potential Settings Impact
35	KINGSLEY HALL	1207565	ST 59708 73137	II*	Low to Medium Impact	Potential Settings Impact
36	STAG AND HOUNDS PUBLIC HOUSE AND ATTACHED GATES	1207592	ST 59594 73116	II	Low to Medium Impact	Potential Settings Impact
37	CHURCH OF ST PHILIP AND ST JACOB	1218100	ST 59491 73003	II*	Low to Medium Impact	Potential Settings Impact
38	PIERS, PERIMETER WALLS AND RAILINGS TO HOLY TRINITY CHURCH	1218195	ST 60048 73378	II	High Impact	Potential Physical Impact
39	The Former Palace Hotel	1219436	ST5980473234	II	High Impact	Potential Physical Impact
40	12 AND 14, WEST STREET	1219448	ST 59847 73217	II	High Impact	Potential Physical Impact
41	28 AND 30, WEST STREET	1219469	ST 59887 73235	II	High Impact	Potential Physical Impact
42	74, WEST STREET	1219480	ST 60000 73295	II	High Impact	Potential Physical Impact
43	MASTERS CHURCH	1246335	ST 64881 73917	II	Low to Medium Impact	Potential Settings Impact
44	WESLEYAN MEETING ROOM	1278330	ST 64504 73712	II	Low to Medium Impact	Potential Settings Impact
45	68, OLD MARKET STREET	1279654	ST 59640 73117	II	Low to Medium Impact	Potential Settings Impact
46	THE THREE HORSESHOES PUBLIC HOUSE	1279658	ST 59624 73119	II	Low to Medium Impact	Potential Settings Impact
47	55 AND 56, OLD MARKET STREET	1279689	ST 59731 73160	II	Low to Medium Impact	Potential Settings Impact
48	22, OLD MARKET STREET	1279734	ST 59605 73170	II	Low to Medium Impact	Potential Settings Impact
49	26, 27 AND 28, OLD MARKET STREET	1279740	ST 59641 73179	II	Low to Medium Impact	Potential Settings Impact
50	35, OLD MARKET STREET	1279747	ST 59698 73198	II	Low to Medium Impact	Potential Settings Impact
51	NUMBER 3 AND AREA RAILINGS	1281273	ST 59627 72955	II	Low to Medium Impact	Potential Settings Impact
52	8A, WEST STREET	1282056	ST 59833 73211	II	High Impact	Potential Physical Impact
53	72, WEST STREET	1282057	ST 59997 73292	II	High Impact	Potential Physical Impact
54	HOLY TRINITY CHURCH	1282076	ST 60062 73392	II*	Low to Medium Impact	Potential Settings Impact
55	227, TWO MILE HILL ROAD	1282078	ST 64077 73895	II	Low to Medium Impact	Potential Settings Impact
56	THE PUNCHBOWL PUBLIC HOUSE	1282192	ST 59606 73186	II	Low to Medium Impact	Potential Settings Impact
57	36 AND 37, OLD MARKET STREET	1282193	ST 59708 73202	II	Low to Medium Impact	Potential Settings Impact
58	46 AND 47, OLD MARKET STREET	1282194	ST 59762 73219	II	Low to Medium Impact	Potential Settings Impact
59	60, OLD MARKET STREET	1282195	ST 59696 73146	II	Low to Medium Impact	Potential Settings Impact
60	NUMBER 71 AND ATTACHED AREA RAILINGS AND GATE	1282196	ST 59618 73119	II	Low to Medium Impact	Potential Settings Impact
61	COACH AND HORSES PUBLIC HOUSE	1282271	ST 59868 73341	II	Low to Medium Impact	Potential Settings Impact
62	PIERS, GATES AND RAILINGS OF ST GEORGE'S PUBLIC LIBRARY (LIBRARY NOT INCLUDED)	1282353	ST 62267 73614	II	High Impact	Potential Physical Impact
63	NUMBER 4 AND AREA RAILINGS	1282402	ST 59620 72956	II	Low to Medium Impact	Potential Settings Impact
64	THE OLD VICARAGE AND ATTACHED AREA RAILINGS	1292082	ST 60050 73454	II	Low to Medium Impact	Potential Settings Impact
65	WESLEYAN SUNDAY SCHOOL	1319744	ST 64496 73750	II	Low to Medium Impact	Potential Settings Impact
66	WESLEYAN METHODIST CHAPEL	1319772	ST 64483 73786	II	Low to Medium Impact	Potential Settings Impact
67	CHRIST CHURCH	1320055	ST 64965 76496	II	Low to Medium Impact	Potential Settings Impact
68	ENTRANCE GATES, WALL AND DRINKING FOUNTAIN TO HOLY TRINITY ALMSHOUSES	1366064	ST 59778 73196	II	High Impact	Potential Physical Impact
69	BARN APPROXIMATELY 8 METRES WEST OF VINNEY GREEN FARMHOUSE	1375526	ST 66463 77311	II	Low to Medium Impact	Potential Settings Impact
70	NEW STREET FLATS (FORMER QUAKER WORKHOUSE)	1393302	ST 59615 73384	II	Low to Medium Impact	Potential Settings Impact
71	Downend Boy Scouts' War Memorial	1424745	ST6516176740	II	High Impact	Potential Physical Impact
	CONSERVATION AREA					
72	Avon Valley				Low to Medium Impact	Potential Settings Impact
73	City and Queen Square				Low to Medium Impact	Potential Settings Impact
74	Old Market				Low to Medium Impact	Potential Physical Impact
75	Whitfield Tabernacle				Low to Medium Impact	Potential Settings Impact

Grade II Listed Buildings= 67
Grade II* Listed Buildings = 4
Conservation Area = 4

Diversion Route
Diversion for A431
Grade II listed buildings = 6 nos.
Conservation Area = 1

Please note : RLB for Diversion for A431 not provided

OPTION REF - BBC-C

S.No	Asset Name	Asset Number	NGR	Designation		
	LISTED BUILDINGS					
1	LYNWOOD	1201979	ST 61598 71003	II	Low to Medium Impact	Potential Settings Impact
2	1914 TO 1918 WAR MEMORIAL, ARNOS VALE CEMETERY	1201980	ST 60768 71631	II	Low to Medium Impact	Potential Settings Impact
3	MONUMENT TO HEBER DENTY, ARNOS VALE CEMETERY	1201981	ST 60713 71484	II	Low to Medium Impact	Potential Settings Impact
4	MONUMENT TO FRANCIS BARBER OGDEN APPROXIMATELY 20 METRES NORTH OF CHURCH OF ENGLAND MORTUARY CHAPEL	1201982	ST 60862 71531	II	Low to Medium Impact	Potential Settings Impact
5	SCREEN WALLS TO MAIN ENTRANCE OF ARNOS VALE CEMETERY	1201986	ST 60810 71654	II*	Low to Medium Impact	Potential Settings Impact
6	BRISLINGTON TRANSPORT DEPOT ENTRANCE AND ATTACHED GATES, WALL AND SHED	1201987	ST 61187 71555	II	Low to Medium Impact	Potential Settings Impact
7	PARKSIDE HOTEL	1201988	ST 61117 71540	II*	Low to Medium Impact	Potential Settings Impact
8	THE TURNPIKE PUBLIC HOUSE	1201989	ST 60182 71656	II	High Impact	Potential Physical Impact
9	Hill Cottage	1202012	ST 62182 70516	II	Low to Medium Impact	Potential Settings Impact
10	GRIGG MONUMENT ATTACHED TO NORTH END OF VESTRY OF CHURCH OF ST LUKE	1202070	ST 62102 70794	II	Low to Medium Impact	Potential Settings Impact
11	CHEST TOMB AND 2 HEADSTONES AT SOUTH EAST CORNER OF PORCH OF CHURCH OF ST LUKE	1202071	ST 62092 70770	II	Low to Medium Impact	Potential Settings Impact
12	THE WOODLANDS	1202075	ST 62042 70754	II	Low to Medium Impact	Potential Settings Impact
13	WALLS, GATES AND RAILINGS TO GROVE HALL	1202253	ST 61696 70762	II	Low to Medium Impact	Potential Settings Impact
14	3, WELLS ROAD	1202672	ST 59862 71840	II	Low to Medium Impact	Potential Settings Impact
15	ARNO'S COURT TRIUMPHAL ARCH	1203684	ST 61157 71582	II*	High Impact	Potential Physical Impact
16	NONCONFORMIST MORTUARY CHAPEL, ARNOS VALE CEMETERY	1203858	ST 60741 71533	II*	Low to Medium Impact	Potential Settings Impact
17	ENTRANCE LODGES AND GATES TO ARNOS VALE CEMETERY	1203895	ST 60835 71635	II*	High Impact	Potential Physical Impact
18	BRISLINGTON TRANSPORT DEPOT TRAM SHEDS AND ATTACHED WALL	1203950	ST 61248 71589	II	High Impact	Potential Physical Impact
19	FORMER CONVENT AT REAR OF PARKSIDE HOTEL	1203961	ST 61100 71545	II	Low to Medium Impact	Potential Settings Impact
20	SIGN POST AND THREE LAMPS, AT INTERSECTION WITH WELLS ROAD SIGN POST AT THREE LAMPS, AT INTERSECTION WITH BATH ROAD	1203998	ST 59896 71857	II*	High Impact	Potential Physical Impact
21	THE CHESTNUTS	1204182	ST 62334 70539	II	Low to Medium Impact	Potential Settings Impact
22	KEEPERS COTTAGE	1204247	ST 62183 70498	II	Low to Medium Impact	Potential Settings Impact
23	CHURCH OF ST LUKE	1205151	ST 62090 70784	II*	Low to Medium Impact	Potential Settings Impact
24	CROSS SHAFT APPROXIMATELY 5 METRES SOUTH OF SOUTH AISLE OF CHURCH OF ST LUKE	1205159	ST 62095 70772	II	Low to Medium Impact	Potential Settings Impact
25	CHEST TOMB AND 2 HEADSTONES APPROXIMATELY 3 METRES SOUTH OF CHANCEL OF CHURCH OF ST LUKE	1205162	ST 62105 70779	II	Low to Medium Impact	Potential Settings Impact
26	GROUP OF 5 RAILED ENCLOSURES APPROXIMATELY 20 METRES EAST OF CHURCH OF ST LUKE	1205168	ST 62131 70784	II	Low to Medium Impact	Potential Settings Impact
27	GROVE HALL	1207492	ST 61712 70766	II	Low to Medium Impact	Potential Settings Impact
28	GEORGIAN COTTAGE ROSE COTTAGE	1208490	ST 61960 70779	II	Low to Medium Impact	Potential Settings Impact
29	BRISTOL AND EXETER BUILDING	1209608	ST 59669 72351	II*	Low to Medium Impact	Potential Settings Impact
30	BRISTOL OLD STATION, TEMPLE MEADS	1209622	ST 59592 72419	I	Low to Medium Impact	Potential Settings Impact
31	GOTLEY LODGE	1219095	ST 61656 70669	II	Low to Medium Impact	Potential Settings Impact
32	THE OLD VICARAGE	1280844	ST 62110 70806	II	Low to Medium Impact	Potential Settings Impact
33	ROSE VILLA	1282104	ST 61596 70752	II	Low to Medium Impact	Potential Settings Impact
34	KINGS ARMS PUBLIC HOUSE	1282265	ST 61972 70795	II	Low to Medium Impact	Potential Settings Impact
35	BOUNDARY WALL, PIERS AND RAILINGS TO SOUTH EAST AND SOUTH OF CHURCHYARD OF CHURCH OF ST LUKE	1282351	ST 62124 70771	II	Low to Medium Impact	Potential Settings Impact
36	MONUMENT WITH RAILING SURROUND TO THOMAS GADD MATTHEWS	1282388	ST 60728 71478	II	Low to Medium Impact	Potential Settings Impact
37	Chhatri containing the tomb of Rammohun Roy	1282389	ST6079171605	II*	Low to Medium Impact	Potential Settings Impact
38	WHITE HART HOTEL	1282401	ST 62018 70632	II	Low to Medium Impact	Potential Settings Impact
39	CHURCH OF ENGLAND MORTUARY CHAPEL, ARNOS VALE CEMETERY	1282425	ST 60850 71492	II*	Low to Medium Impact	Potential Settings Impact
40	THE GEORGE RAILWAY HOTEL	1291650	ST 59447 72392	II	Low to Medium Impact	Potential Settings Impact
41	BLACK CASTLE PUBLIC HOUSE	1292881	ST 61114 71753	I	Low to Medium Impact	Potential Settings Impact
42	TOMB OF GWYER IN ARNOS VALE CEMETERY	1350403	ST 60789 71464	II	Low to Medium Impact	Potential Settings Impact
43	TOMB OF DODDSELL IN ARNOS VALE CEMETERY	1350404	ST 60845 71438	II	Low to Medium Impact	Potential Settings Impact
44	SMART MONUMENT IN ARNOS VALE CEMETERY	1350405	ST 60833 71542	II	Low to Medium Impact	Potential Settings Impact
45	GARDNER MONUMENT IN ARNOS VALE CEMETERY	1350411	ST 60855 71566	II	Low to Medium Impact	Potential Settings Impact
46	WILLIAMS MONUMENT IN ARNOS VALE CEMETERY	1350412	ST 60777 71576	II	Low to Medium Impact	Potential Settings Impact
47	CHALLENGER MONUMENT IN ARNOS VALE CEMETERY	1350413	ST 60785 71564	II	Low to Medium Impact	Potential Settings Impact
48	TOMB OF CLARK IN ARNOS VALE CEMETERY	1350414	ST 60769 71555	II	Low to Medium Impact	Potential Settings Impact
49	TOMB OF HILL IN ARNOS VALE CEMETERY	1350415	ST 60682 71554	II	Low to Medium Impact	Potential Settings Impact
50	TOMB OF REYNOLDS IN ARNOS VALE CEMETERY	1350416	ST 60745 71576	II	Low to Medium Impact	Potential Settings Impact
51	PRATT MONUMENT IN ARNOS VALE CEMETERY	1350417	ST 60800 71621	II	Low to Medium Impact	Potential Settings Impact
52	ELIZABETH PADDON MONUMENT IN ARNOS VALE CEMETERY	1350418	ST 60798 71617	II	Low to Medium Impact	Potential Settings Impact
53	TOMB OF BENN IN ARNOS VALE CEMETERY	1350419	ST 60721 71478	II	Low to Medium Impact	Potential Settings Impact
54	TOMB OF WHITING IN ARNOS VALE CEMETERY	1350420	ST 60748 71456	II	Low to Medium Impact	Potential Settings Impact
55	TOMB OF HARWOOD IN ARNOS VALE CEMETERY	1350421	ST 60739 71464	II	Low to Medium Impact	Potential Settings Impact
	REGISTERED PARK AND GARDEN					
56	ARNOS VALE CEMETERY	1000559	ST 60689 71520	II*	High Impact	Potential Physical Impact
	CONSERVATION AREA					
57	Brislington				Low to Medium Impact	Potential Physical Impact
58	Arnos Vale				Low to Medium Impact	Potential Physical Impact
59	Redcliffe				Low to Medium Impact	Potential Settings Impact

Grade I Listed Buildings= 2
Grade II Listed Buildings= 43
Grade II* Listed Buildings = 10
Registered Prak and Graden = 1 Grade II*
Conservation Area = 3

OPTION REF - BBC-06

S.No	Asset Name	Asset Number	NGR	Designation		
	LISTED BUILDINGS					
1	PAIR OF GATEPIERS,RAILINGS,OUTERPIERS AND FLANKING QUADRANT WALLS TO NEWTON PARK	1129479	ST 70018 65298	II	Low to Medium Impact	Potential Settings Impact
2	ROAD BRIDGE OVER THE RAILWAY	1136338	ST 71418 65454	II	Low to Medium Impact	Potential Settings Impact
3	LODGE COTTAGE TO BRISLINGTON HOUSE	1281465	ST 63092 70049	II	Low to Medium Impact	Potential Settings Impact
4	OAKLEIGH	1281588	ST 63663 69936	II	Low to Medium Impact	Potential Settings Impact
5	MILESTONE AT NATIONAL GRID REFERENCE ST 6973 6579	1312960	ST 69745 65780	II	High Impact	Potential Physical Impact
6	THE GLOBE	1365666	ST 70132 65279	II	Low to Medium Impact	Potential Settings Impact
7	KEYNSHAM ABBEY PIER BASE IN THE GARDEN OF NUMBER 3 (NUMBER 3 NOT INCLUDED)	1384576	ST 65600 68833	I	Low to Medium Impact	Potential Settings Impact
8	KEYNSHAM ABBEY REMAINS TO THE SOUTH OF NUMBER 3 (NUMBER 3 NOT INCLUDED)	1384577	ST 65584 68812	I	Low to Medium Impact	Potential Settings Impact
9	AVON HOUSE	1384578	ST 65848 68800	II	Low to Medium Impact	Potential Settings Impact
10	20 AND 22, AVON ROAD	1384581	ST 65766 68447	II	Low to Medium Impact	Potential Settings Impact
11	TEMPLE COUNTY PRIMARY SCHOOL	1384586	ST 65533 68542	II	Low to Medium Impact	Potential Settings Impact
12	ELLSBRIDGE HOUSE	1384590	ST 66782 68220	II	Low to Medium Impact	Potential Settings Impact
13	MILESTONE AT NGR ST 674 678	1384591	ST 67352 67767	II	High Impact	Potential Physical Impact
14	7A AND 7B, BRISTOL ROAD	1384592	ST 65276 68868	II	Low to Medium Impact	Potential Settings Impact
15	ST DUNSTANS PRESBYTERY	1384593	ST 65225 68914	II	Low to Medium Impact	Potential Settings Impact
16	FREELAND HOUSE	1384594	ST 65202 68925	II	Low to Medium Impact	Potential Settings Impact
17	26 AND 28, BRISTOL ROAD	1384595	ST 65189 68928	II	Low to Medium Impact	Potential Settings Impact
18	K6 TELEPHONE BOX BY OLD MANOR HOUSE HOTEL	1384599	ST 65309 68853	II	Low to Medium Impact	Potential Settings Impact
19	MILWARD HOUSE	1384600	ST 65324 68837	II	Low to Medium Impact	Potential Settings Impact
20	THE OLD MANOR HOUSE AND ATTACHED REAR COURTYARD WALL	1384601	ST 65292 68851	II	Low to Medium Impact	Potential Settings Impact
21	CHANDOS LODGE	1384614	ST 64674 69654	II	Low to Medium Impact	Potential Settings Impact
22	2 AND 4, HIGH STREET	1384615	ST 65339 68828	II	Low to Medium Impact	Potential Settings Impact
23	WEST END HOUSE	1384616	ST 65358 68807	II	Low to Medium Impact	Potential Settings Impact
24	14, HIGH STREET	1384617	ST 65366 68797	II	Low to Medium Impact	Potential Settings Impact
25	THE OLD BANK PUBLIC HOUSE	1384618	ST 65378 68777	II	Low to Medium Impact	Potential Settings Impact
26	ARCHWAY BETWEEN NUMBER 20 AND NUMBER 22	1384619	ST 65384 68769	II	Low to Medium Impact	Potential Settings Impact
27	CONSERVATIVE CLUB	1384620	ST 65381 68757	II	Low to Medium Impact	Potential Settings Impact
28	23, HIGH STREET	1384621	ST 65420 68733	II	Low to Medium Impact	Potential Settings Impact
29	NATIONAL WESTMINSTER BANK	1384622	ST 65394 68739	II	Low to Medium Impact	Potential Settings Impact
30	28 AND 28A, HIGH STREET	1384623	ST 65397 68728	II	Low to Medium Impact	Potential Settings Impact
31	31, HIGH STREET	1384624	ST 65433 68715	II	Low to Medium Impact	Potential Settings Impact
32	LONGTON HOUSE NUMBER 33 AND ATTACHED FRONT AREA WALL AND GATE PIERS	1384625	ST 65431 68707	II	Low to Medium Impact	Potential Settings Impact
33	BAPTIST CHURCH (EBENEZER CHAPEL)	1384627	ST 65460 68687	II	Low to Medium Impact	Potential Settings Impact
34	CHURCH OF ST JOHN THE BAPTIST	1384628	ST 65426 68829	II*	Low to Medium Impact	Potential Settings Impact
35	ARCHWAY ON STREET AT THE ENTRANCE TO PARK HOUSE (PARK HOUSE NOT INCLUDED)	1384632	ST 65518 68912	II*	Low to Medium Impact	Potential Settings Impact
36	THE OLD SHIP AND WINDMILL COTTAGE	1384649	ST 68730 66751	II	Low to Medium Impact	Potential Settings Impact
37	565, BATH ROAD	1384650	ST6890666487	II	Low to Medium Impact	Potential Settings Impact
38	THE TURNPIKE	1384651	ST 68861 66474	II	Low to Medium Impact	Potential Settings Impact
39	BOUNDARY MARKER AT ST 6914 6621	1384652	ST 69131 66217	II	High Impact	Potential Physical Impact
40	THE CROWN HOTEL	1384653	ST 68370 66984	II	High Impact	Potential Physical Impact
41	WICK HOUSE FARMHOUSE	1384654	ST 67729 67446	II	Low to Medium Impact	Potential Settings Impact
42	PARISH BOUNDARY MARKER AT NGR ST 678 673	1384655	ST 67841 67275	II	High Impact	Potential Physical Impact
43	MILL COTTAGES	1384674	ST 68688 66958	II	Low to Medium Impact	Potential Settings Impact
44	MILL COTTAGE	1384675	ST 68712 66967	II	Low to Medium Impact	Potential Settings Impact
45	OLD BRASS MILL	1384676	ST 68714 67002	II*	Low to Medium Impact	Potential Settings Impact
46	WILLOW COTTAGES	1384678	ST 68673 67136	II	Low to Medium Impact	Potential Settings Impact
47	ORNAMENTAL GARDEN ALCOVE AT LONG FOX MANOR	1389633	ST 63228 70115	II	Low to Medium Impact	Potential Settings Impact
48	Precinct wall to Keynsham Abbey	1392955	ST 65450 68763	II	Low to Medium Impact	Potential Settings Impact
49	NEW BRIDGE OR NEWTON BRIDGE	1395726	ST7168065783	II*	High Impact	Potential Physical Impact
50	NEWBRIDGE HOUSE	1395939	ST 72086 65838	II	Low to Medium Impact	Potential Settings Impact
51	River Chew Bridge (MNL111354)	1409179	ST6572568835	II	Low to Medium Impact	Potential Settings Impact
52	Highnams Farm Bridge (MLN111115)	1409187	ST6893166619	II	Low to Medium Impact	Potential Settings Impact
53	Keynsham Hams Bridge (MLN111404)	1409190	ST6525169160	II	Low to Medium Impact	Potential Settings Impact
54	Avon Mill Lane Bridge (MLN111350)	1409194	ST6581468787	II	Low to Medium Impact	Potential Settings Impact
55	Durley Lane Bridge (MLN111439)	1409195	ST6468169592	II	Low to Medium Impact	Potential Settings Impact
56	Stone Wharf Bridge (MLN111042)	1409217	ST6977365966	II	Low to Medium Impact	Potential Settings Impact
57	Stream Culvert (MLN111428)	1410955	ST6484669460	II	Low to Medium Impact	Potential Settings Impact
	REGISTERED PARK AND GARDEN					
58	NEWTON PARK	1000567	ST 69529 64332	II*	High Impact	Potential Physical Impact
59	The park and garden to Brislington House (known as Long Fox Manor)	1001529	ST6332570220	II*	High Impact	Potential Physical Impact
	SCHEDULED MONUMENTS					
60	Saltford brass battery mill	1004607	ST 68724 67011		Low to Medium Impact	Potential Settings Impact
61	The Abbey	1005416	ST 65599 68821		Low to Medium Impact	Potential Settings Impact
62	Roman Settlement at Keynsham Hams, former Cadbury's Factory	1416459	ST6535769411		Low to Medium Impact	Potential Settings Impact
	WORLD HERITAGE SITE					
63	City of Bath	1000103	ST 74574 64641		Low to Medium Impact	Potential Physical Impact
64	The Great Spas of Europe				Low to Medium Impact	Potential Physical Impact
	CONSERVATION AREA					
65	Avon Valley				Low to Medium Impact	Potential Physical Impact
66	Keynsham				High Impact	Potential Physical Impact
67	Bath				Low to Medium Impact	Potential Physical Impact
68	Corston				Low to Medium Impact	Potential Settings Impact
69	Saltford				Low to Medium Impact	Potential Settings Impact

Grade I Listed Buildings= 2
Grade II Listed Buildings= 51
Grade II* Listed Buildings = 4
Registered Prak and Graden = 2 Grade II*
Scheduled Monument = 3
Conservation Area = 5
World Heritage Site = 2

OPTION REF - BBC-A5

S.No	Asset Name	Asset Number	NGR	Designation	Impact	
	LISTED BUILDINGS					
1	ROAD BRIDGE OVER THE RAILWAY	1136338	ST 71418 65454	II	Low to Medium Impact	Potential Settings Impact
2	4, ABBEY GREEN	1394030	ST 75138 64657	II	Low to Medium Impact	Potential Settings Impact
3	5, ABBEY GREEN	1394033	ST 75128 64649	II	Low to Medium Impact	Potential Settings Impact
4	8, ABBEY GREEN	1394035	ST 75110 64653	II	Low to Medium Impact	Potential Settings Impact
5	9, ABBEY GREEN	1394048	ST 75107 64658	II	Low to Medium Impact	Potential Settings Impact
6	CRYSTAL PALACE PUBLIC HOUSE	1394050	ST 75102 64667	II	Low to Medium Impact	Potential Settings Impact
7	Elton House	1394064	ST 75096 64680	II*	Low to Medium Impact	Potential Settings Impact
8	NOS 7 AND 8 INCLUDING PINTLE FOR ABBI	1394080	ST7512864640	II	Low to Medium Impact	Potential Settings Impact
9	1-8, BATH STREET	1394178	ST 74994 64693	I	Low to Medium Impact	Potential Settings Impact
10	CLAVERTON BUILDINGS	1394179	ST 75404 64238	II	Low to Medium Impact	Potential Settings Impact
11	1-6, PARK VIEW	1394334	ST 73898 64819	II	Low to Medium Impact	Potential Settings Impact
12	GARDEN WALLS OPPOSITE NOS 1-6 PARK \	1394338	ST 73904 64819	II	Low to Medium Impact	Potential Settings Impact
13	3, BEAU STREET	1394365	ST 75021 64645	II	Low to Medium Impact	Potential Settings Impact
14	4 AND 5, BEAU STREET	1394367	ST 75027 64647	II	Low to Medium Impact	Potential Settings Impact
15	GAINSBOROUGH BUILDING, BATH TECHNI	1394368	ST 74968 64638	II	Low to Medium Impact	Potential Settings Impact
16	BELLOTT'S	1394369	ST 75007 64643	II	Low to Medium Impact	Potential Settings Impact
17	BELLOTTS ROAD BRIDGE	1394496	ST 73313 64584	II	Low to Medium Impact	Potential Settings Impact
18	CLAVERTON BUILDINGS NOS 8 AND 9 AND	1394535	ST 75362 64246	II	Low to Medium Impact	Potential Settings Impact
19	CLAVERTON BUILDINGS	1394537	ST 75379 64243	II	Low to Medium Impact	Potential Settings Impact
20	CLAVERTON BUILDINGS	1394540	ST 75398 64241	II	Low to Medium Impact	Potential Settings Impact
21	FIRST CHURCH OF CHRIST SCIENTIST, WITH	1394563	ST 75252 64225	II	Low to Medium Impact	Potential Settings Impact
22	HALFPENNY BRIDGE AND LODGE HOUSE	1394582	ST 75296 64281	II	Low to Medium Impact	Potential Settings Impact
23	1-6, RACKFIELD PLACE	1394601	ST 72639 64756	II	Low to Medium Impact	Potential Settings Impact
24	RALPH ALLEN HOUSE	1394602	ST 75339 64419	II	Low to Medium Impact	Potential Settings Impact
25	ST CATHERINE'S HOSPITAL	1394758	ST 75001 64672	II	Low to Medium Impact	Potential Settings Impact
26	THE DOLPHIN PUBLIC HOUSE	1394802	ST 72703 64891	II	Low to Medium Impact	Potential Settings Impact
27	6-18, ST JAMES'S PARADE	1394829	ST7496164540	II	Low to Medium Impact	Potential Settings Impact
28	THE BATH TAP	1394830	ST 74985 64501	II	Low to Medium Impact	Potential Settings Impact
29	CHRISTIAN CENTRE	1394832	ST 74999 64461	II*	Low to Medium Impact	Potential Settings Impact
30	LOMBARD HOUSE	1394833	ST 75022 64495	II	Low to Medium Impact	Potential Settings Impact
31	31-40, ST JAMES'S PARADE	1394835	ST 74989 64541	II	Low to Medium Impact	Potential Settings Impact
32	44 St James's Parade and 9 Lower Borough	1394836	ST 74955 64588	II	Low to Medium Impact	Potential Settings Impact
33	45, ST JAMES'S PARADE	1394838	ST 74950 64594	II	Low to Medium Impact	Potential Settings Impact
34	46, ST JAMES'S PARADE	1394839	ST 74946 64599	II	Low to Medium Impact	Potential Settings Impact
35	THE HOBGOBLIN PUBLIC HOUSE	1394840	ST 74941 64607	II	Low to Medium Impact	Potential Settings Impact
36	1-6, ST MARK'S ROAD	1394867	ST 75247 64191	II	Low to Medium Impact	Potential Settings Impact
37	7-14, ST MARK'S ROAD	1394868	ST 75209 64192	II	Low to Medium Impact	Potential Settings Impact
38	15-18, ST MARK'S ROAD	1394869	ST 75175 64191	II	Low to Medium Impact	Potential Settings Impact
39	19-26, ST MARK'S ROAD	1394870	ST 75139 64192	II	Low to Medium Impact	Potential Settings Impact
40	27, ST MARK'S ROAD	1394871	ST 75170 64241	II	Low to Medium Impact	Potential Settings Impact
41	28 AND 29, ST MARK'S ROAD	1394872	ST 75187 64236	II	Low to Medium Impact	Potential Settings Impact
42	30 AND 31, ST MARK'S ROAD	1394873	ST 75206 64234	II	Low to Medium Impact	Potential Settings Impact
43	32 AND 33, ST MARK'S ROAD	1394875	ST 75228 64228	II	Low to Medium Impact	Potential Settings Impact
44	BOUM TOMB, 20M WEST OF FORMER ST I	1394876	ST 75118 64213	II	Low to Medium Impact	Potential Settings Impact
45	Former Church of St Mark	1394877	ST 75145 64219	II	Low to Medium Impact	Potential Settings Impact
46	1-9, ST MARY'S BUILDINGS	1394879	ST 74775 64262	II	Low to Medium Impact	Potential Settings Impact
47	PEOPLE'S MISSION HALL	1394965	ST 74932 64515	II	Low to Medium Impact	Potential Settings Impact
48	5, LOWER BOROUGH WALLS	1395076	ST 75021 64579	II	Low to Medium Impact	Potential Settings Impact
49	6, LOWER BOROUGH WALLS	1395081	ST 75013 64580	II	Low to Medium Impact	Potential Settings Impact
50	NOS. 16, 17 AND 18	1395092	ST 75030 64598	II	Low to Medium Impact	Potential Settings Impact
51	LOWER BRISTOL ROAD (See details for furt	1395093	ST 74034 64775	II	Low to Medium Impact	Potential Settings Impact
52	NOS. 7-10 (CONSEC) VICTORIA BUILDINGS,	1395094	ST 74010 64781	II	Low to Medium Impact	Potential Settings Impact
53	11-24, VICTORIA BUILDINGS (See details fo	1395096	ST 73964 64791	II	Low to Medium Impact	Potential Settings Impact
54	17-29, DENMARK ROAD	1395097	ST 73730 64679	II	Low to Medium Impact	Potential Settings Impact
55	NOS. 25, 26 AND 27	1395099	ST 73918 64800	II	Low to Medium Impact	Potential Settings Impact
56	NOS. 30, 31 AND 32	1395102	ST 73881 64796	II	Low to Medium Impact	Potential Settings Impact
57	NO. 87 CEMETERY LODGE AND GATEWAY	1395104	ST 74201 64634	II	High Impact	Potential Physical Impact
58	BOUNDARY WALL TO ST JAMES'S CEMETEI	1395107	ST 74181 64648	II	High Impact	Potential Physical Impact
59	CEMETERY CHAPEL OF WIDCOMBE, LYNCC	1395111	ST 74123 64562	II	Low to Medium Impact	Potential Settings Impact
60	HUNTER OBELISK IN ST JAMES CEMETERY	1395114	ST 74098 64559	II	Low to Medium Impact	Potential Settings Impact
61	NOS. 238 AND 240	1395115	ST 74862 64374	II	High Impact	Potential Physical Impact
62	TECHNOLOGY HOUSE	1395119	ST 72908 64693	II	Low to Medium Impact	Potential Settings Impact
63	AVON HOUSE	1395121	ST 72971 64676	II	Low to Medium Impact	Potential Settings Impact
64	CAMDEN MILL	1395124	ST 74774 64413	II	Low to Medium Impact	Potential Settings Impact
65	MALTINGS DEPOSITORY	1395128	ST 72858 64701	II	Low to Medium Impact	Potential Settings Impact
66	NEWARK WORKS (EX STOTHERT AND PITT)	1395130	ST 74638 64461	II	Low to Medium Impact	Potential Settings Impact
67	GOVERNOR'S HOUSE	1395132	ST 73679 64628	II	Low to Medium Impact	Potential Settings Impact
68	St James' Viaduct (MLN110705)	1395135	ST7504264298	II*	Low to Medium Impact	Potential Settings Impact

69	THE WOODLANDS	1395136	ST 72359 64892	II	High Impact	Potential Physical Impact
70	TWERTON TUNNEL: EAST ENTRANCE (ADJ(	1395139	ST 72160 64985	II*	Low to Medium Impact	Potential Settings Impact
71	TWERTON TUNNEL: WEST ENTRANCE (ADJ	1395140	ST 72129 65008	II*	Low to Medium Impact	Potential Settings Impact
72	TWERTON VILLA, WITH FRONT BOUNDARY	1395141	ST 72886 64692	II	Low to Medium Impact	Potential Settings Impact
73	Twerton Wood Tunnel East Portal (MLN11	1395142	ST7197065147	II*	Low to Medium Impact	Potential Settings Impact
74	Twerton Wood Tunnel West Portal (MLN1:	1395143	ST7177865281	II*	Low to Medium Impact	Potential Settings Impact
75	TWERTON VIADUCT, THE OLD STATION HC	1395144	ST7289264658	II	Low to Medium Impact	Potential Settings Impact
76	FORMER CABINET MAKERS FACTORY	1395150	ST 73153 64762	II	Low to Medium Impact	Potential Settings Impact
77	ST JAMES'S RAILWAY BRIDGE	1395151	ST 75394 64423	II	Low to Medium Impact	Potential Settings Impact
78	1, 3 AND 5, LYNCOMBE HILL	1395165	ST 75306 64215	II	Low to Medium Impact	Potential Settings Impact
79	2, LYNCOMBE HILL	1395171	ST 75280 64181	II	Low to Medium Impact	Potential Settings Impact
80	9-15, LYNCOMBE HILL	1395175	ST 75308 64199	II	Low to Medium Impact	Potential Settings Impact
81	5 AND 6, STALL STREET	1395177	ST 75047 64685	II	Low to Medium Impact	Potential Settings Impact
82	7 AND 8, STALL STREET	1395179	ST 75054 64677	II	Low to Medium Impact	Potential Settings Impact
83	17, LYNDALE (See details for further addre:	1395180	ST 75313 64187	II	Low to Medium Impact	Potential Settings Impact
84	9, STALL STREET	1395181	ST 75056 64667	II	Low to Medium Impact	Potential Settings Impact
85	10 AND 11, STALL STREET	1395182	ST 75058 64660	II	Low to Medium Impact	Potential Settings Impact
86	26, STALL STREET	1395184	ST 75033 64633	II	Low to Medium Impact	Potential Settings Impact
87	27, 28 AND 29, STALL STREET	1395186	ST 75035 64644	II	Low to Medium Impact	Potential Settings Impact
88	Nos. 34, 35 and 36, STALL STREET	1395189	ST 75019 64693	I	Low to Medium Impact	Potential Settings Impact
89	FORMER BATH CITY LAUNDRY	1395214	ST 75072 64684	II	Low to Medium Impact	Potential Settings Impact
90	ENTRANCE GATES AND PIERS TO LYNCOMI	1395266	ST 75314 64209	II	Low to Medium Impact	Potential Settings Impact
91	NORTH AND EAST BOUNDARY WALLS TO L	1395267	ST 75358 64219	II	Low to Medium Impact	Potential Settings Impact
92	ARGYLE HOTEL	1395338	ST 75234 64396	II	Low to Medium Impact	Potential Settings Impact
93	SKEW BRIDGE AND ASSOCIATED CANTILEV	1395344	ST7513664309	II	Low to Medium Impact	Potential Settings Impact
94	CHAPEL OF ST MICHAEL WITHIN	1395489	ST 74934 64679	II	Low to Medium Impact	Potential Settings Impact
95	CHARLTON HOUSE	1395586	ST 73361 64832	II	Low to Medium Impact	Potential Settings Impact
96	OLD RECTORY	1395602	ST 72362 64680	II	Low to Medium Impact	Potential Settings Impact
97	12 and 14, WELLS ROAD	1395605	ST 74838 64315	II	Low to Medium Impact	Potential Settings Impact
98	16, 18 AND 20, WELLS ROAD	1395607	ST 74821 64316	II	Low to Medium Impact	Potential Settings Impact
99	22 AND 24, WELLS ROAD	1395608	ST 74807 64316	II	Low to Medium Impact	Potential Settings Impact
100	THE RAILWAY BREWERY	1395610	ST 74796 64315	II	Low to Medium Impact	Potential Settings Impact
101	30 AND 32, WELLS ROAD	1395611	ST 74780 64314	II	Low to Medium Impact	Potential Settings Impact
102	42, WELLS ROAD	1395612	ST 74749 64313	II	Low to Medium Impact	Potential Settings Impact
103	44 AND 46, WELLS ROAD	1395613	ST 74740 64313	II	Low to Medium Impact	Potential Settings Impact
104	48, WELLS ROAD	1395614	ST 74729 64309	II	Low to Medium Impact	Potential Settings Impact
105	SOUTH HAYES HOUSE	1395615	ST 74579 64279	II	Low to Medium Impact	Potential Settings Impact
106	1, MANVERS STREET	1395625	ST 75226 64577	II	Low to Medium Impact	Potential Settings Impact
107	2, MANVERS STREET	1395627	ST 75229 64570	II	Low to Medium Impact	Potential Settings Impact
108	BATH SPA STATION	1395629	ST 75245 64350	II*	Low to Medium Impact	Potential Settings Impact
109	13 AND 14, WESTGATE BUILDINGS	1395633	ST 74878 64659	II	Low to Medium Impact	Potential Settings Impact
110	22, WESTGATE BUILDINGS	1395634	ST 74928 64637	II	Low to Medium Impact	Potential Settings Impact
111	CHANDOS HOUSE	1395635	ST 74898 64681	II*	Low to Medium Impact	Potential Settings Impact
112	BAYNTUN'S BOOKSHOP	1395636	ST 75269 64421	II	Low to Medium Impact	Potential Settings Impact
113	MANVERS STREET BAPTIST CHURCH	1395639	ST 75272 64480	II	Low to Medium Impact	Potential Settings Impact
114	ROYAL HOTEL	1395642	ST 75269 64400	II	Low to Medium Impact	Potential Settings Impact
115	BRIDGE	1395658	ST 72687 64869	II	Low to Medium Impact	Potential Settings Impact
116	WESTON LOCK	1395660	ST 72470 64912	II	Low to Medium Impact	Potential Settings Impact
117	NEW BRIDGE OR NEWTON BRIDGE	1395726	ST7168065783	II*	High Impact	Potential Physical Impact
118	NO. 86 WITH PIERS AND RAILINGS	1395862	ST 74795 64174	II	Low to Medium Impact	Potential Settings Impact
119	PARADISE HOUSE HOTEL	1395863	ST 74786 64171	II	Low to Medium Impact	Potential Settings Impact
120	OLD ROYAL BATHS	1395891	ST 74966 64667	II*	Low to Medium Impact	Potential Settings Impact
121	CHURCH ROOM	1395894	ST 72425 64738	II	Low to Medium Impact	Potential Settings Impact
122	CHURCH OF ST MICHAEL AND ALL ANGELS	1395896	ST 72393 64721	II*	Low to Medium Impact	Potential Settings Impact
123	THREE CHURCHYARD MONUMENTS C 3.5N	1395898	ST 72387 64709	II	Low to Medium Impact	Potential Settings Impact
124	HOPE COTTAGE	1395902	ST 72339 64778	II	Low to Medium Impact	Potential Settings Impact
125	RAISED PAVEMENT IN FRONT OF FULL MO	1395903	ST7245564736	II	Low to Medium Impact	Potential Settings Impact
126	THE FULL MOON PUBLIC HOUSE	1395904	ST7245464730	II	Low to Medium Impact	Potential Settings Impact
127	GARAGE (FORMER ENGINE HOUSE)	1395945	ST 75421 64304	II	Low to Medium Impact	Potential Settings Impact
128	BRIDGE ADJOINING LOWER LOCK	1395950	ST 75392 64300	II	Low to Medium Impact	Potential Settings Impact
129	LOWER LOCK	1395962	ST7541464296	II	Low to Medium Impact	Potential Settings Impact
130	BLENHEIM HOUSE AND ATTACHED RAILIN(	1396008	ST 75212 64577	II	Low to Medium Impact	Potential Settings Impact
131	THE FORMER NEW JERUSALEM CHURCH, A	1396012	ST 75204 64574	II	Low to Medium Impact	Potential Settings Impact
132	THE OLD HETLING COURT PUMP ROOM	1396013	ST 74937 64666	II	Low to Medium Impact	Potential Settings Impact
133	NO. 2 AND ABBEY CHURCH HOUSE	1396014	ST 74921 64656	II	Low to Medium Impact	Potential Settings Impact
134	11 AND 12, HIGH STREET	1396025	ST 72807 64642	II	Low to Medium Impact	Potential Settings Impact
135	13 AND 14, HIGH STREET	1396026	ST 72790 64641	II	Low to Medium Impact	Potential Settings Impact
136	NELSON HOUSE	1396028	ST 72780 64645	II	Low to Medium Impact	Potential Settings Impact
137	16 AND 17, HIGH STREET	1396029	ST 72772 64645	II	Low to Medium Impact	Potential Settings Impact
138	18 AND 18A, HIGH STREET (See details for	1396034	ST 72762 64644	II	Low to Medium Impact	Potential Settings Impact
139	20 AND 21, HIGH STREET	1396035	ST 72725 64626	II	Low to Medium Impact	Potential Settings Impact
140	22 AND 23, HIGH STREET	1396036	ST 72717 64624	II	Low to Medium Impact	Potential Settings Impact
141	ROSE COTTAGE	1396037	ST 72589 64643	II	Low to Medium Impact	Potential Settings Impact

142	132, HIGH STREET	1396038	ST 72750 64612	II	Low to Medium Impact	Potential Settings Impact
143	133, HIGH STREET	1396039	ST 72755 64613	II	Low to Medium Impact	Potential Settings Impact
144	145 AND 146, HIGH STREET	1396041	ST 72808 64618	II	Low to Medium Impact	Potential Settings Impact
145	CLYDE HOUSE	1396042	ST 72528 64701	II	Low to Medium Impact	Potential Settings Impact
146	BOUNDARY WALLS, PIERS AND GATE TO Cl	1396048	ST 72514 64685	II	Low to Medium Impact	Potential Settings Impact
147	THE OLD CROWN PUBLIC HOUSE	1396053	ST 72732 64608	II	Low to Medium Impact	Potential Settings Impact
148	ZION CHAPEL	1396054	ST 72820 64648	II	Low to Medium Impact	Potential Settings Impact
149	1, 1A AND 2-5, OAK STREET	1396206	ST 74702 64343	II	Low to Medium Impact	Potential Settings Impact
150	20-28, OAK STREET	1396208	ST 74689 64397	II	Low to Medium Impact	Potential Settings Impact
151	33-38, OAK STREET	1396210	ST 74681 64333	II	Low to Medium Impact	Potential Settings Impact
152	CITY WALLS (REMAINS OF)	1396232	ST 75156 64612	II	Low to Medium Impact	Potential Settings Impact
153	MANVERS HALL	1396233	ST 75170 64624	II	Low to Medium Impact	Potential Settings Impact
154	20-30, GREEN PARK	1396258	ST 74488 64677	II	Low to Medium Impact	Potential Settings Impact
155	Abbey Dairy	1405763	ST7495164602	II	Low to Medium Impact	Potential Settings Impact
156	Administration Building within the 1935 Bu	1406078	ST7534364524	II	Low to Medium Impact	Potential Settings Impact
157	Rear of Nos. 30-31 Stall Street (Formerly N	1406370	ST7502764662	II	Low to Medium Impact	Potential Settings Impact
158	No. 33 Stall Street	1406372	ST7502664673	II	Low to Medium Impact	Potential Settings Impact
159	Nos 72-84 (Even) Wells Road with front bo	1406378	ST7450264264	II	Low to Medium Impact	Potential Settings Impact
160	The Herman Miller Factory	1415261	ST7311564889	II	Low to Medium Impact	Potential Settings Impact
	SCHEDULED MONUMENTS					
161	The Roman Baths and site of Roman town,	1004678	ST 75186 64566		Low to Medium Impact	Potential Settings Impact
162	Bath City Walls	1007017	ST 75159 64619		Low to Medium Impact	Potential Settings Impact
	CONSERVATION AREA					
163	Bath				Low to Medium Impact	Potential Physical Impact
	WORLD HERITAGE PROPERTY					
164	City of Bath	1000103	ST 74574 64641		Low to Medium Impact	Potential Physical Impact
165	The Great Spas of Europe				Low to Medium Impact	Potential Physical Impact

Grade I Listed Buildings= 2
Grade II Listed Buildings= 146
Grade II* Listed Buildings = 12
Scheduled Monument = 2
Conservation Area = 1
World Heritage Site = 2

OPTION REF - SWC-03

S.No	Asset Name	Asset Number	NGR	Designation	Impact		Tunnelled ?
	LISTED BUILDINGS						
1	MILIESTONE AT ST 544678	1129076	ST 54401 67760	II	High Impact	Potential Physical Impact	
2	TURNPIKE TRUST MARKER	1129175	ST 53135 66936	II	High Impact	Potential Physical Impact	
3	COLLITER'S BROOK FARMHOUSE	1129845	ST 55322 68528	II	Low to Medium Impact	Potential Settings Impact	
4	ST ELIZABETH'S	1202483	ST 59998 70903	II	Low to Medium Impact	Potential Settings Impact	Yes
5	CONVENT OF THE SISTERS OF CHARITY	1218650	ST 59936 70856	II*	Low to Medium Impact	Potential Settings Impact	Yes
6	CHAPEL OF THE CONVENT OF THE SISTERS OF CHARITY	1218668	ST 59914 70827	II	Low to Medium Impact	Potential Settings Impact	Yes
7	LAUNDRY TO THE CONVENT OF THE SISTERS OF CHARITY	1218695	ST 59905 70898	II	Low to Medium Impact	Potential Settings Impact	Yes
8	BOUNDARY WALL AND GATES TO THE CONVENT OF THE SISTERS OF CHARITY	1282159	ST 59951 70828	II	High Impact	Potential Physical Impact	Yes
9	CASTLE FARMHOUSE	1312068	ST 55745 68968	II	Low to Medium Impact	Potential Settings Impact	
	CONSERVATION AREA						
10	Bishopsworth and Malago				High Impact	Potential Physical Impact	Yes
11	Bedminster				Low to Medium Impact	Potential Physical Impact	Yes

Grade II Listed Buildings = 8
Grade II* Listed Buildings = 1
Conservation Area = 2

OPTION REF - SWC 11

S.No	Asset Name	Asset Number	NGR	Designation	Impact	
	LISTED BUILDINGS					
1	MILIESTONE AT ST 544678	1129076	ST 54401 67760	II	High Impact	Potential Physical Impact
2	TURNPIKE TRUST MARKER	1129175	ST 53135 66936	II	High Impact	Potential Physical Impact
3	COLLITER'S BROOK FARMHOUSE	1129845	ST 55322 68528	II	Low to Medium Impact	Potential Settings Impact
4	ST ELIZABETH'S	1202483	ST 59998 70903	II	Low to Medium Impact	Potential Settings Impact
5	NUMBERS 108 TO 120 (EVEN) AND ATTACHED FRONT BASEMENT AREA RAILINGS	1202722	ST 59281 71914	II	Low to Medium Impact	Potential Settings Impact
6	LANGTON STREET BRIDGE	1202723	ST 59417 72015	II	Low to Medium Impact	Potential Settings Impact
7	BRISTOL AND EXETER BUILDING	1209608	ST 59669 72351	II*	Low to Medium Impact	Potential Settings Impact
8	BRISTOL OLD STATION, TEMPLE MEADS	1209622	ST 59592 72419	I	Low to Medium Impact	Potential Settings Impact
9	CONVENT OF THE SISTERS OF CHARITY	1218650	ST 59936 70856	II*	Low to Medium Impact	Potential Settings Impact
10	CHAPEL OF THE CONVENT OF THE SISTERS OF CHARITY	1218668	ST 59914 70827	II	Low to Medium Impact	Potential Settings Impact
11	LAUNDRY TO THE CONVENT OF THE SISTERS OF CHARITY	1218695	ST 59905 70898	II	Low to Medium Impact	Potential Settings Impact
12	138-142 (even) York Road	1282038	ST5940071954	II	Low to Medium Impact	Potential Settings Impact
13	BOUNDARY WALL AND GATES TO THE CONVENT OF THE SISTERS OF CHARITY	1282159	ST 59951 70828	II	High Impact	Potential Physical Impact
14	THE GEORGE RAILWAY HOTEL	1291650	ST 59447 72392	II	Low to Medium Impact	Potential Settings Impact
15	CASTLE FARMHOUSE	1312068	ST 55745 68968	II	Low to Medium Impact	Potential Settings Impact
16	Lakeshore, the former Wills Tobacco Headquarters	1380423	ST 58168 68619	II	Low to Medium Impact	Potential Settings Impact
	CONSERVATION AREA					
17	Bishopsworth and Malago				High Impact	Potential Physical Impact
18	Bedminster				Low to Medium Impact	Potential Physical Impact
19	Redcliffe				Low to Medium Impact	Potential Settings Impact

Grade I Listed Buildings = 1
Grade II Listed Buildings = 13
Grade II* Listed Buildings = 2
Conservation Area = 3

Additional Ecology Baseline – North Corridor Shortlisted Options

<table>
<tr><th colspan="2">Scheme Ref</th><th>NC04</th><th>NC08 / NC08b</th></tr>
<tr><td rowspan="2">Biodiversity</td><td rowspan="2">Baseline - key aspects and importance / significance</td><td colspan="2">The North Corridor is within 2km of several statutory designated sites including Sites of Special Scientific Interest (SSSIs), the corridor is also located within the Impact Risk Zones of the SSSIs for this type of development.
The Corridor is within 10km of the Avon Gorge Woodland Special Area of Conservation (SAC) and the Severn Estuary National Site Network (previously known as Natura 2000) internationally designated sites (Ramsar, SAC and Special Protection Area (SPA), linked by watercourses to NC04 option.
The Corridor is within 30km of four SACs that are designated for the bat species they support: Bath & Bradford on Avon Bats, North Somerset & Mendip Bats, Wye Valley Woodlands and Wye Valley & Forest of Dean Bat Sites.

The impacts upon statutory designated sites are only considered below if the specified option has a direct effect on individual sites. The impacts to Ramsar, SAC, SPA should be assessed as part of a Habitats Regulation Assessment (HRA).
The names of the Sites of Nature Conservation Interest (SNCI) within the South Gloucestershire authority region[1] were not available on publicly accessible maps, and so are un-named within this assessment.

Species records from the local environmental record centre, Bristol Regional Environmental Records Centre (BRERC), and appraisal surveys would be required to determine habitat suitability for species along each route. The impact on protected and notable species cannot be fully assessed at the OAR stage, therefore the Impact Assessment score is based on habitats only. A full assessment on the impacts to protected species should be undertaken to determine the level of impact on specific species to determine appropriate avoidance and mitigation.

The options within the North Corridor pass through the following Green Infrastructure Areas, as listed in the WECA Joint Green Infrastructure Strategy[2]:
• 19 – Greater Bristol.
Any impacts to green infrastructure will require appropriate mitigation and / or compensation.

For the purpose of this study, a Zone of Influence (ZoI) has been taken to be 200m of the individual options, to take into account the likely maximum edge effects of air pollution on ecology[3].</td></tr>
<tr><td>Designated Sites:
Underground Section:
The route and its ZoI passes underneath the Floating Harbour which is connected to the Feeder Side SNCI and the River Avon which eventually leads into the Severn Estuary SAC, SPA, SSSI and Ramsar site.
The route and its ZoI also passes under Filton Golf Course SNCI and within approximately 200m of a SNCI (name not provided) located at Filton Airport, to the west of the route.
The route and its ZoI also passes adjacent to numerous important open spaces (IOS).

Overground Section:
The route and its ZoI lies within the IRZ of Pen Park Hole SSSI (located approximately 1km from the route at the shortest distance), which lists 'Any transport proposal including road, rail and by water (excluding maintenance)' as requiring LPA consultation with Natural England.
The route and its ZoI also passes under numerous IOS.
Habitats:
Underground Section:
The underground section and its ZoI passes under:
• BAP Priority habitat[4]: woodpasture and parkland; deciduous woodland
• Other non-HPI habitats: Grassland fields, lines of trees, hedgerows and drains.
Overground Section:</td><td>Designated Sites:
The route and its ZoI would pass within the Impact Risk Zone (IRZ) of several Sites of Special Scientific Interest (SSSI). The route would require consultation with Natural England with regards to Pen Park Hole SSSI (located approximately 1km from the route at the shortest distance), as the route lies within the risk category; 'Any transport proposal including road, rail and by water (excluding maintenance)'. The scheme does not fall within the categories requiring consultation with Natural England for the other SSSI IRZs.

The route and its ZoI passes adjacent to Three Brooks LNR.
The route and its ZoI passes adjacent to one SNCI which runs along Stoke Brook (names not provided)
The route and its ZoI also passes adjacent to numerous important open spaces (IOS).
NC08 route only - Diversionary route ch.550 to 3000:
The route and its ZoI would pass adjacent to Narroways Junction SINC, and within 80m of Narroways Millennium Green LNR.

Habitats:
The route and its ZoI passes adjacent to two areas of deciduous woodland designated as HPI[5]as well as alongside roadside vegetation including trees and grass verges.</td></tr>
</table>

[1] http://map.n-somerset.gov.uk/southglos.html
[2] https://www.westofengland-ca.gov.uk/wp-content/uploads/2020/07/Joint-Green-Infrastructure-Strategy-%E2%80%93-June-2020..pdf
[3] Bignal, K.L., Ashmore, M.R. & Power, S.A. (2004). The ecological effects of diffuse air pollution from road transport. English Nature Research Report 580. Available at: http://publications.naturalengland.org.uk/category/47017
[4] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.
[5] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

		The overground scheme and its ZoI passes through: • HPI: Deciduous woodland; • Other non-HPI habitats: Woodland, linear trees and scrub, hedgerows and grassland fields It is anticipated that the habitats present will support a range of protected and notable species.	The route and its ZoI passes through grassland habitats at Filton airport and at the northern end of the scheme there is also woodland and hedgerows with grassland fields where the scheme terminates. There are drains and ditches within the route ZoI and the scheme passes over and adjacent to Stoke Brook using existing road networks. It is anticipated that the habitats present will support a range of protected and notable species.

Additional Ecology Baseline - East Corridor

<table>
<tr><th colspan="2">Topic / Scheme Ref</th><th>EC01</th><th>EC04</th><th>EC08</th></tr>
<tr><td rowspan="2">Biodiversity</td><td rowspan="2">Baseline - key aspects and importance / significance</td><td colspan="3">The East Corridor is within 2km of several statutory designated sites including Sites of Special Scientific Interest (SSSIs) and their Impact Risk Zones (IRZs).
The Corridor is within 10km of the Severn Estuary Natura 2000 designated sites (Ramsar, SAC and SPA), linked by watercourses.
The Corridor is within 30km of four SACs that are designated for bat species: Bath & Bradford on Avon Bats, North Somerset & Mendip Bats, Wye Valley Woodlands and Wye Valley & Forest of Dean Bat Sites.

The impacts upon statutory designated sites are only considered below if the specified scheme has a direct effect on individual sites. The impacts to Ramsar, SAC, SPA and SSSIs should be assessed via appropriate assessments such as a HRA or SSSI Assent.

Species records from the local environmental record centre, Bristol Regional Environmental Records Centre (BRERC), and appraisal surveys would be required to determine habitat suitability for species along each scheme. The impact on protected and notable species cannot be fully assessed at the OAR stage, therefore the Impact Assessment score is based on habitats only. A full assessment on the impacts to protected species should be undertaken to determine the level of impact on specific species to determine appropriate avoidance and mitigation.

The routes within the East Corridor pass through the following Green Infrastructure Areas, as listed in the WECA Joint Green Infrastructure Strategy[1]:
• 17 – Frome Valley – Westerleigh Vale – Oldland Ridge
• 19 – Greater Bristol.
Any impacts to green infrastructure will require appropriate mitigation and compensation.

For the purpose of this study, a Zone of Influence (ZoI) has been taken to be 200m of the individual schemes, to take in account the edge effects of air pollution on ecology[2].</td></tr>
<tr><td>Designated Sites:
There is one non-statutory designated sites within the ZoI of the option – an un-named SNCI which is located adjacent to the Walker Playing Field in the northern section of the route.
The route would go under the Floating Harbour which is connected to the Feeder Side SNCI and the River Avon which eventually leads into the Severn Estuary SAC / SPA / SSSI and Ramsar.
The route also passes under numerous important open spaces (IOS).

Habitats:
The route and its ZoI passes under:
• Habitats of Principal Importance (HPI)[3]; deciduous woodland;
• UK Biodiversity Action Plan (BAP) Priority habitat[4]: wood pasture and parkland; and
• Other non-HPI habitats: Grassland fields, areas of woodland and watercourses.

It is anticipated that the habitats present will support a range of protected and notable species.</td><td>Designated Sites:
The route would go under the Floating Harbour which is connected to the Feeder Side SNCI and the River Avon which eventually leads into the Severn Estuary SAC/SPA SSSI and Ramsar.
The route also passes directly under or within 200m of three un-named SNCIs, one of which is located adjacent to the Walker Playing Field in the northern section of the route and two located within proximity of the A4174 in the south-east.
The route also passes under numerous important open spaces (IOS).

Habitats:
The route and its ZoI passes under:
• Habitats of Principal Importance (HPI)[5]; deciduous woodland, traditional orchard and good quality semi-improved grassland;
• UK Biodiversity Action Plan (BAP) priority habitat[6]: wood pasture and parkland; and
• Grassland fields and areas of woodland.

It is anticipated that the habitats present will support a range of protected and notable species associated with the habitats present.</td><td>Designated Sites:
The route runs above Easton-Staple Hill Disused Railway SNCI near Lawrence Hill roundabout and also runs adjacent to the Folly Brook SNCI. The route also passes adjacent to numerous important open spaces (IOS).

<u>Diversionary and one-way system routes:</u>
Beaufort Road along the A431 Diversion Route runs adjacent to Blackswarth Road Wood SNCI, Crew's Hole Woodland SNCI and Troopers Hill SNCI.
The A420 Diversion (Light Vehicles) runs adjacent to an un-named SNCI adjacent to Acacia Road.

Cycle Diversion: The cycle diversion and directly through St George's Park IOS.

Habitats:
The route, its ZoI and some diversionary routes lie adjacent to:
• Habitats of Principal Importance (HPI); deciduous woodland; and
• UK BAP Priority habitat: wood pasture and parkland.
• Grassland fields, scrub, individual trees and areas of woodland.

It is anticipated that the habitats present will support a range of protected and notable species associated with the habitats present.</td></tr>
</table>

[1] https://www.westofengland-ca.gov.uk/wp-content/uploads/2020/07/Joint-Green-Infrastructure-Strategy-%E2%80%93-June-2020..pdf
[2] Bignal, K.L., Ashmore, M.R. & Power, S.A. (2004). The ecological effects of diffuse air pollution from road transport. English Nature Research Report 580. Available at: http://publications.naturalengland.org.uk/category/47017
[3] Protected under the Natural Environment and Rural Communities (NERC) Act 2006
[4] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.
[5] Protected under the Natural Environment and Rural Communities (NERC) Act 2006
[6] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

Additional Ecology Baseline – Shortlist Options, Bristol to Bath Corridor

Option Ref		**BBC-C**
Biodiversity	Baseline - key aspects and importance / significance	The Bristol – Bath Corridor is within 2km of several statutory designated sites including Sites of Special Scientific Interest (SSSIs) and within the Impact Risk Zones (IRZs) for this type of development. The Bristol – Bath Corridor is within 10km of the Severn Estuary which has been designated as a Ramsar site, Special Area of Conservation (SAC) and Special Protection Area (SPA), which is linked hydrologically to the Bristol – Bath Corridor, the Severn Estuary forms part of the National Site Network (formally known as Natura 2000 sites). The Bristol – Bath Corridor is within 30km of four SACs that are designated for bat species: Bath & Bradford on Avon Bats, North Somerset & Mendip Bats, Wye Valley Woodlands and Wye Valley & Forest of Dean Bat Sites. The impacts upon statutory designated sites are only considered below if the specified route has a specific direct / indirect effect on individual sites. The impacts pathways that may affect the National Site Network and Ramsar sites will be similar irrelevant of the options considered, as such have not been assessed within this document. The assessment of Likely Significant Effects on the National Site Network and Ramsar sites will be completed as part of a Habitats Regulation Assessment (HRA). Species records from the local environmental record centre, Bristol Regional Environmental Records Centre (BRERC), and appraisal surveys would be required to determine habitat suitability for species along each scheme. The impact on protected and notable species cannot be fully assessed at the OAR stage, **therefore the Impact Assessment score is based on habitats only.** A full assessment on the impacts to protected species should be undertaken to determine the level of impact on specific species to determine appropriate avoidance and mitigation. The routes within the Bristol to Bath Corridor pass through the following Green Infrastructure Areas, as listed in the WECA Joint Green Infrastructure Strategy[1]: • 19 – Greater Bristol • 20 – Keynsham and Environs • 22 – River Avon Valley • 13 – Bath and Environs – Bathscape Any impacts to green infrastructure will require appropriate mitigation and compensation. For the purpose of this study, a Zone of Influence (ZoI) has been taken to be 200m of the individual routes, to take in account the edge effects of air pollution from roads on ecology[2].
		Designated Sites: The route and its ZoI would pass adjacent to three SNCIs: River Avon, Arno's Vale Cemetery and Brislington Meadows. The route uses an existing bridge to cross the Floating Harbour and the River Avon, both of which feed into the Severn Estuary (approximately 8.5km downstream), which is designated nationally and internationally as a SSSI, SAC, SPA and a Ramsar site. **Habitats:** The route and its ZoI pass through: • HPI: deciduous woodland • Other habitats along the route include: woodland, scrub, scattered and lines of trees and amenity grassland. The route also passes over the Floating Harbour and River Avon using the existing road network It is anticipated that the habitats present will support a range of protected and notable species associated with the habitats present.

[1] https://www.westofengland-ca.gov.uk/wp-content/uploads/2020/07/Joint-Green-Infrastructure-Strategy-%E2%80%93-June-2020..pdf

[2] Bignal, K.L., Ashmore, M.R. & Power, S.A. (2004). The ecological effects of diffuse air pollution from road transport. English Nature Research Report 580. Available at: http://publications.naturalengland.org.uk/category/47017

<table>
<tr><th colspan="2">Option Ref</th><th>BBC-06</th></tr>
<tr><td rowspan="2">Biodiversity</td><td rowspan="2">Baseline - key aspects and importance / significance</td><td>The Bristol – Bath Corridor is within 2km of several statutory designated sites including Sites of Special Scientific Interest (SSSIs) and within the Impact Risk Zones (IRZs).
The Bristol – Bath Corridor is within 10km of the Severn Estuary which has been designated as a Ramsar site, Special Area of Conservation (SAC) and Special Protection Area (SPA), which is linked hydrologically to the Bristol – Bath Corridor, the Severn Estuary forms part of the National Site Network (formally known as Natura 2000 sites).
The Corridor is within 30km of four SACs that are designated for bat species: Bath & Bradford on Avon Bats, North Somerset & Mendip Bats, Wye Valley Woodlands and Wye Valley & Forest of Dean Bat Sites.

The impacts upon statutory designated sites are only considered below if the specified route has a specific direct / indirect effect on individual sites. The impacts pathways that may affect the National Site Network and Ramsar sites will be similar irrelevant of the options considered, as such have not been assessed within this document. The assessment of Likely Significant Effects on the National Site Network and Ramsar sites will be completed as part of a Habitats Regulation Assessment (HRA).

Species records from the local environmental record centre, Bristol Regional Environmental Records Centre (BRERC), and appraisal surveys would be required to determine habitat suitability for species along each scheme. The impact on protected and notable species cannot be fully assessed at the OAR stage, therefore the Impact Assessment score is based on habitats only. A full assessment on the impacts to protected species should be undertaken to determine the level of impact on specific species to determine appropriate avoidance and mitigation.
The routes within the Bristol to Bath Corridor pass through the following Green Infrastructure Areas, as listed in the WECA Joint Green Infrastructure Strategy[3]:
• 19 – Greater Bristol
• 20 – Keynsham and Environs
• 22 – River Avon Valley
• 13 – Bath and Environs – Bathscape
Any impacts to green infrastructure will require appropriate mitigation and compensation.

For the purpose of this study, a Zone of Influence (ZoI) has been taken to be 200m of the individual routes, to take in account the edge effects of air pollution from roads on ecology[4].</td></tr>
<tr><td>Designated Sites:
The route and its ZoI runs adjacent to Newton St Loe SSSI, which is designated for its geological assets and five SNCIs: Brislington Meadows, East Wood and Keynsham Humpy Tumps complex, Charlton Bottom and Queen Charlton Watercourse, River Chew and Bitton to Bath railway track.

Habitats:
The route and its ZoI pass through:
• Habitat of Principal Importance (HPI)[5]: deciduous woodland, lowland calcareous grassland, traditional orchard, coastal and floodplain grazing marsh.
• Biodiversity Action Plan (BAP) priority habitat[6]: woodpasture and parkland
• Other habitats along the route include; line of trees, hedgerows, grassland field and agricultural fields.

It is anticipated that the habitats present will support a range of protected and notable species associated with the habitats present.</td></tr>
</table>

[3] https://www.westofengland-ca.gov.uk/wp-content/uploads/2020/07/Joint-Green-Infrastructure-Strategy-%E2%80%93-June-2020..pdf
[4] Bignal, K.L., Ashmore, M.R. & Power, S.A. (2004). The ecological effects of diffuse air pollution from road transport. English Nature Research Report 580. Available at: http://publications.naturalengland.org.uk/category/47017
[5] Protected under the Natural Environment and Rural Communities (NERC) Act 2006
[6] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

Option Ref		BBC-A5
Biodiversity	Baseline - key aspects and importance / significance	The Bristol – Bath Corridor is within 2km of several statutory designated sites including Sites of Special Scientific Interest (SSSIs) and within the Impact Risk Zones (IRZs). The Bristol – Bath Corridor is within 10km of the Severn Estuary which has been designated as a Ramsar site, Special Area of Conservation (SAC) and Special Protection Area (SPA), which is linked hydrologically to the Bristol – Bath Corridor, the Severn Estuary forms part of the National Site Network (formally known as Natura 2000 sites). The Corridor is within 30km of four SACs that are designated for bat species: Bath & Bradford on Avon Bats, North Somerset & Mendip Bats, Wye Valley Woodlands and Wye Valley & Forest of Dean Bat Sites. The impacts upon statutory designated sites are only considered below if the specified route has a specific direct / indirect effect on individual sites. The impacts pathways that may affect the National Site Network and Ramsar sites will be similar irrelevant of the options considered, as such have not been assessed within this document. The assessment of Likely Significant Effects on the National Site Network and Ramsar sites will be completed as part of a Habitats Regulation Assessment (HRA). Species records from the local environmental record centre, Bristol Regional Environmental Records Centre (BRERC), and appraisal surveys would be required to determine habitat suitability for species along each scheme. The impact on protected and notable species cannot be fully assessed at the OAR stage, **therefore the Impact Assessment score is based on habitats only.** A full assessment on the impacts to protected species should be undertaken to determine the level of impact on specific species to determine appropriate avoidance and mitigation. The routes within the Bristol to Bath Corridor pass through the following Green Infrastructure Areas, as listed in the WECA Joint Green Infrastructure Strategy[7]: • 22 – River Avon Valley • 13 – Bath and Environs – Bathscape Any impacts to green infrastructure will require appropriate mitigation and compensation. For the purpose of this study, a Zone of Influence (ZoI) has been taken to be 200m of the individual routes, to take in account the edge effects of air pollution from roads on ecology[8].
		Designated Sites: The route and its ZoI runs adjacent to Newton St Loe SSSI, which is designated for its geological assets, Carrs Woodland LNR, and four SNCIs: River Avon, Bitton to Bath railway track, Newton Brook, Carrs Wood. Diversionary route: The traffic diversionary route and its ZoI runs adjacent to Locksbrook Cemetery SNCI and River Avon SNCI **Habitats:** The route, diversionary route and its ZoI pass through or adjacent to: • Habitat of Principal Importance (HPI)[9]: deciduous woodland, lowland calcareous grassland, traditional orchard, coastal and floodplain grazing marsh. • Biodiversity Action Plan (BAP) priority habitat[10]: woodpasture and parkland • Other habitats along the route include; scattered and lines of tree, hedgerows, amenity grassland It is anticipated that the habitats present will support a range of protected and notable species associated with the habitats present.

[7] https://www.westofengland-ca.gov.uk/wp-content/uploads/2020/07/Joint-Green-Infrastructure-Strategy-%E2%80%93-June-2020..pdf
[8] Bignal, K.L., Ashmore, M.R. & Power, S.A. (2004). The ecological effects of diffuse air pollution from road transport. English Nature Research Report 580. Available at: http://publications.naturalengland.org.uk/category/47017
[9] Protected under the Natural Environment and Rural Communities (NERC) Act 2006
[10] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

Options Assessment Table – South West Corridor options - SW05 and SW011

<table>
<tr><th colspan="2">Option Ref</th><th>SWC05</th><th>SWC11</th><th>SWC03</th></tr>
<tr><td rowspan="2">Biodiversity</td><td rowspan="2">Baseline - key aspects and importance / significance</td><td colspan="3">The South-West Corridor is within 2km of several statutory designated sites including Sites of Special Scientific Interest (SSSIs) the corridor is located within the Impact Risk Zones of the SSSIs for this type of development.
The Corridor is within 10km of the Severn Estuary which is part of the National Site Network (previously known as Natura 2000) designated sites (Ramsar, Special Area of Conservation (SAC) and Special Protection Area (SPA)), linked by watercourses.
The Corridor is within 30km of four Special Area of Conservation (SAC) that are designated for the bat species they support: Bath & Bradford on Avon Bats, North Somerset & Mendip Bats, Wye Valley Woodlands and Wye Valley & Forest of Dean Bat Sites.

The impacts upon statutory designated sites are only considered below if the specified route has a direct effect on individual sites. The impacts to Ramsar, SAC, and SPAs should be assessed as part of a Habitats Regulation Assessment (HRA).

Species records from the local environmental record centre, Bristol Regional Environmental Records Centre (BRERC), and appraisal surveys would be required to determine habitat suitability for species along each route. The impact on protected and notable species cannot be fully assessed at the OAR stage, therefore the Impact Assessment score is based on habitats only. A full assessment on the impacts to protected species should be undertaken to determine the level of impact on specific species to determine appropriate avoidance and mitigation.

The routes within the South-West Corridor pass through the following Green Infrastructure Areas, as listed in the WECA Joint Green Infrastructure Strategy[1]:
• 9 – Nailsea, Backwell, Long Ashton and Environs
• 10 – Dundry Hill
• 19 – Greater Bristol
Any impacts to green infrastructure will require appropriate mitigation and / or compensation.

For the purpose of this study, a Zone of Influence (ZoI) has been taken to be 200m of the individual routes, to take into account the likely maximum edge effects of air pollution associated with infrastructure on ecological features[2].
Where existing road networks are used for bus/ BRT routes, it has been assumed that no additional lighting will be required as part of the route.</td></tr>
<tr><td>Designated Sites:
The route and its ZoI passes over the Floating Harbour and River Avon SNCI which eventually leads into the Severn Estuary SAC, SPA, SSSI and Ramsar site. The route and its ZoI also passes adjacent or over the following designated sites:
• Felton Common LNR
• Colliter’s Brook SNCI
• North Somerset Council Wildlife Sites: Barrow Tanks, Fields East of Barrow Tanks
The route and its ZoI also passes adjacent to numerous important open spaces (IOS).

Habitats: The route and its ZoI passes over or adjacent to the following habitats:
• HPI: mudflats, good quality semi-improved grassland, lowland dry acid grassland and deciduous woodland;
• Non-HPI habitat: Floating Harbour, River Avon, the Barrow Gurney Reservoirs and Colliter’s Brook, trees, amenity grassland, areas of woodland, hedgerows, arable and grassland fields.
It is anticipated that the habitats present will support a range of protected and notable species.</td><td>Designated Sites:
The route and its ZoI passes over or adjacent to:
• Felton Common Local Nature Reserve (LNR)
• Sites of Nature Conservation Interest (SNCI)[3]: River Avon, Wedmore Vale, Hengrove Park, Crox Bottom, Highridge Common,
• North Somerset Council Wildlife Sites[4]: Barrow Tanks, Fields East of Barrow Tanks
The route and its ZoI also passes adjacent to numerous important open spaces (IOS).

Habitats: The route and its ZoI passes over or adjacent to:
• HPI: Mudflats, good quality semi-improved grassland, lowland dry acid grassland and deciduous woodland;
• UK Biodiversity Action Plan (BAP) Priority habitat[5]: Wood pasture and parkland;
• Non-HPI habitat: Floating Harbour, River Avon, the Barrow Gurney Reservoirs, Colliter’s Brook, arable and grassland fields, reservoirs, hedgerows, trees, amenity grassland, and areas of woodland.
It is anticipated that the habitats present will support a range of protected and notable species associated with the habitats present.</td><td>Designated Sites:
The underground section of the route and its ZoI would pass underneath the River Avon SNCI which also eventually leads into the Severn Estuary SAC, SPA, SSSI and Ramsar site. The route would also pass under Wedmore Vale SNCI, Crox Bottom SNCI, Highridge Common SNCI.

• The overground section of the route and its ZoI would pass adjacent to Felton Common LNR;
• Highridge Common SNCI; and
• North Somerset Council Wildlife Sites: Barrow Tanks, Fields East of Barrow Tanks.

Habitats: The underground section of the route and its ZoI would pass under the following habitats:
HPI: Mudflats, good quality semi-improved grassland, deciduous woodland;
UK Biodiversity Action PLAN (BAP) Priority habitat : Wood pasture and parkland; and
Non-HPI habitat: River Avon, , The Malago watercourse, Pigeonhouse stream, arable fields, hedgerows, areas of woodland, waterbodies, trees and amenity grassland.

The over ground section of the route and its ZoI would run adjacent to:
HPI: good quality semi-improved grassland, lowland dry acid grassland and deciduous woodland; and
Areas of woodland, hedgerows, grassland, arable fields, trees, the Barrow Gurney Reservoirs and Colliter’s Brook.
It is anticipated that the habitats present will support a range of protected and notable species.</td></tr>
</table>

[1] https://www.westofengland-ca.gov.uk/wp-content/uploads/2020/07/Joint-Green-Infrastructure-Strategy-%E2%80%93-June-2020..pdf
[2] Bignal, K.L., Ashmore, M.R. & Power, S.A. (2004). The ecological effects of diffuse air pollution from road transport. English Nature Research Report 580. Available at: http://publications.naturalengland.org.uk/category/47017
[3] https://maps.bristol.gov.uk/policies/
[4] http://map.n-somerset.gov.uk/PoliciesMap.html
[5] UK BAP priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK Post-2010 Biodiversity Framework Revised Implementation Plan (2018) superseded the UK BAP, however the UK BAP lists of priority species and habitats remain important and valuable reference sources and have been used to help draw up statutory lists of priority species and habitats.

Appendix M

Capital Cost Breakdown

Item	Series	Quantity	Unit	Comment	Rubber-wheeled - North Corridor									
					NC04	Total	NC08 East	Total	NC08 West	Total	NC08 (b) East	Total	NC08 (b) West	Total
Topsoil strip existing unpaved area	200	see option breakdown	m2	Assume take up all unpaved surfacing ready for new layout	25527	£ 578,996	36539.006	£ 828,778	23479.884	£ 532,571	36539.006	£ 828,778	23479.884	£ 532,571
Break out and remove existing paved footway / central reserve surface	200	see option breakdown	m2	Assume take up all paved footway / central reserve surface ready for new layout	17513.476	£ 288,972	81542.961	£ 1,345,459	25197.655	£ 415,761	81542.961	£ 1,345,459	25197.655	£ 415,761
Break out existing kerbs to tip off site	200	see option breakdown	l/m	Assume 2no sets of kerbs to be removed along entire length of route	13632	£ 224,928	28838	£ 475,827	12070	£ 199,155	28838	£ 475,827	12070	£ 199,155
Existing gullies to be removed to tip off site	200	see option breakdown	nr	Assume gullies on one side of road to be removed, assume gully spacing is 40m	170	£ 1,870	360	£ 3,960	151	£ 1,661	360	£ 3,960	151	£ 1,661
Existing lighting columns to be removed and stored on site for re-use	200	see option breakdown	nr	Assume lighting columns placed alternatingly on each side of carriageway. Columns 10m tall and spacing 2.5 times the height. Assume 1 side needs removal	136	£ 20,036	288	£ 42,429	121	£ 17,826	288	£ 42,429	121	£ 17,826
Gullies to be installed	500	see option breakdown	nr	Assume gullies on one side of road to be replaced, assume gully spacing is 40m	170	£ 154,724	360	£ 327,650	151	£ 137,431	360	£ 327,650	151	£ 137,431
Gully pipework extension	500	see option breakdown	l/m	Assume on average 7.5m offset from existing gully placement	1275	£ 106,674	2700	£ 225,898	1133	£ 94,794	2700	£ 225,898	1133	£ 94,794
Additional drainage works / attenuation due to increased impermeable surfacing	500	see option breakdown	m2	Quantity given is the increase in impermeable area across the route, including carriageway and footway	51215.969	£ 12,535,108	18375	£ 4,497,281	25514.204	£ 6,244,601	18375	£ 4,497,281	25514.204	£ 6,244,601
Carriageway resurfacing	700	see option breakdown	m2	Assumed entire carriageway to be resurfaced	93379	£ 13,493,948	176777.8	£ 25,545,630	82679.5	£ 11,947,767	169257.8	£ 24,458,937	82679.5	£ 11,947,767
Carriageway widening	700	see option breakdown	m2		21017.445	£ 3,815,822	18375	£ 3,336,073	8466.859	£ 1,537,201	18375	£ 3,336,073	8466.859	£ 1,537,201
Proposed new footway construction	1100	see option breakdown	m2	Assume all new footways	27264	£ 3,637,536	54876	£ 7,321,501	24140	£ 3,220,735	54876	£ 7,321,501	24140	£ 3,220,735
Proposed new cycleway construction	1100	see option breakdown	m2	Assume all new cycleways	20448	£ 3,415,307	41157	£ 6,874,207	18105	£ 3,023,970	41157	£ 6,874,207	18105	£ 3,023,970
Propose new road markings and signs	1200	see option breakdown	%			£ 50,000		£ 100,000		£ 50,000		£ 100,000		£ 50,000
Install lighting columns from store and associated electrical work	1300 / 1400	see option breakdown	nr		136	£ 644,758	288	£ 1,365,370	121	£ 573,645	288	£ 1,365,370	121	£ 573,645
Alteration to existing major junction; signalised	Gen	see option breakdown	nr		3	£ 600,000	18	£ 3,600,000	6	£ 1,200,000	18	£ 3,600,000	6	£ 1,200,000
Alteration to existing major junction; normal / compact roundabout	Gen	see option breakdown	nr		2	£ 1,600,000	8	£ 6,400,000	2	£ 1,600,000	8	£ 6,400,000	2	£ 1,600,000
Alteration to existing major junction; signalised roundabout	Gen	see option breakdown	nr		2	£ 2,000,000	1	£ 1,000,000	2	£ 2,000,000	1	£ 1,000,000	2	£ 2,000,000
Alteration to existing pedestrian crossing type; zebra crossing	Gen	see option breakdown	nr		2	£ 20,000	7	£ 70,000	0	£ -	7	£ 70,000	0	£ -
Alteration to existing pedestrian crossing type; zebra crossing with refuge island	Gen	see option breakdown	nr		0	£ -	4	£ 60,000	0	£ -	4	£ 60,000	0	£ -
Alteration to existing pedestrian crossing type; signal controlled crossing	Gen	see option breakdown	nr		0	£ -	1	£ 105,000	1	£ 105,000	1	£ 105,000	1	£ 105,000
Alteration to existing pedestrian crossing type; signal controlled crossing with refuge island	Gen	see option breakdown	nr		2	£ 220,000	13	£ 1,430,000	4	£ 440,000	13	£ 1,430,000	4	£ 440,000
Alteration to existing bridges; underbridge	Gen	see option breakdown	nr		0	£ -	4	£ 2,000,000	2	£ 1,000,000	4	£ 2,000,000	2	£ 1,000,000
Alteration to existing bridges; overbridge	Gen	see option breakdown	nr		2	£ 1,000,000	5	£ 2,500,000	1	£ 500,000	5	£ 2,500,000	1	£ 500,000
Proposed green / planting strip	3000	see option breakdown	m2		0	£ -	1892.994	£ 156,776	9000	£ 745,371	1892.994	£ 156,776	9000	£ 745,371
Tunneling options - Including underground stations			item		1	£ 1,394,379,753		£ -		£ -		£ -		£ -
Overground stations			item		6	£ 6,000,000	25	£ 25,000,000		£ -	25	£ 25,000,000		£ -

	NC04	NC08 East	NC08 West	NC08 (b) East	NC08 (b) West
Sub-total	£ 1,444,788,432	£ 94,611,839	£ 35,587,488	£ 93,525,146	£ 35,587,488
Utilities (30%) (tunneling sections adjusted individually)	£ 13,322,604	£ 20,883,552	£ 10,676,246	£ 20,557,544	£ 10,676,246
Utilities (tunneling sections)	£ 27,887,595	£ -	£ -	£ -	£ -
Traffic Management (15%) (reduced for tunneling options)	£ 6,661,302	£ 10,441,776	£ 5,338,123	£ 10,278,772	£ 5,338,123
Traffic Management (tunneling sections)	£ 1,394,380	£ -	£ -	£ -	£ -
Preliminaries (30%)	£ 288,957,686	£ 18,922,368	£ 7,117,498	£ 18,705,029	£ 7,117,498
Project/design team fees (10%)	£ 144,478,843	£ 9,461,184	£ 3,558,749	£ 9,352,515	£ 3,558,749
Project management team fees (10%)	£ 144,478,843	£ 9,461,184	£ 3,558,749	£ 9,352,515	£ 3,558,749
Client costs (5%)	£ 72,239,422	£ 4,730,592	£ 1,779,374	£ 4,676,257	£ 1,779,374
Biodiversity net gain (3%)	£ 43,343,653	£ 2,838,355	£ 1,067,625	£ 2,805,754	£ 1,067,625
Surveys	£ 1,000,000	£ 500,000	£ 300,000	£ 500,000	£ 300,000
Overheads and profit (15%)	£ 281,733,744	£ 18,449,309	£ 6,939,560	£ 18,237,404	£ 6,939,560
Risk (40%)	£ 988,114,602	£ 76,120,063	£ 30,369,364	£ 75,196,374	£ 30,369,364
Inflation (40%)	£ 1,383,360,443	£ 106,568,088	£ 42,517,110	£ 105,274,924	£ 42,517,110
Total	£ 4,841,761,550	£ 372,988,309	£ 148,809,886	£ 368,462,234	£ 148,809,886
	£ 4,800,000,000	£ 372,000,000	£ 148,000,000		£ 148,000,000

Exclusions
Optimism bias
Land
Building demolitions
VAT
Legal fees
Purchase of TBM - Potentially multiple purchases
Public realm improvements
Active travel solutions
Operating costs for bus/tram companies
Maintenenace/renewal costs

Item	Series	Quantity	Unit	Comment	Steel-wheeled - North Corridor									
					NC04	Total	NC08 East	Total	NC08 West	Total	NC08 (b) East	Total	NC08 (b) West	Total
Topsoil strip existing unpaved area	200	see option breakdown	m2	Assume take up all unpaved surfacing ready for new layout	25527	£ 578,996	36539.006	£ 828,778	23479.884	£ 532,571	36539.006	£ 828,778	23479.884	£ 532,571
Break out and remove existing paved footway / central reserve surface	200	see option breakdown	m2	Assume take up all paved footway / central reserve surface ready for new layout	17513.476	£ 288,972	81542.961	£ 1,345,459	25197.655	£ 415,761	81542.961	£ 1,345,459	25197.655	£ 415,761
Break out existing kerbs to tip off site	200	see option breakdown	l/m	Assume 2no sets of kerbs to be removed along entire length of route	13632	£ 224,928	28838	£ 475,827	12070	£ 199,155	28838	£ 475,827	12070	£ 199,155
Existing gullies to be removed to tip off site	200	see option breakdown	nr	Assume gullies on one side of road to be removed, assume gully spacing is 40m	170	£ 1,870	360	£ 3,960	151	£ 1,661	360	£ 3,960	151	£ 1,661
Existing lighting columns to be removed and stored on site for re-use	200	see option breakdown	nr	Assume lighting columns placed alternatingly on each side of carriageway. Columns 10m tall and spacing 2.5 times the height. Assume 1 side needs removal	136	£ 20,036	288	£ 42,429	121	£ 17,826	288	£ 42,429	121	£ 17,826
Gullies to be installed	500	see option breakdown	nr	Assume gullies on one side of road to be replaced, assume gully spacing is 40m	170	£ 154,724	360	£ 327,650	151	£ 137,431	360	£ 327,650	151	£ 137,431
Gully pipework extension	500	see option breakdown	l/m	Assume on average 7.5m offset from existing gully placement	1275	£ 106,674	2700	£ 225,898	1133	£ 94,794	2700	£ 225,898	1133	£ 94,794
Additional drainage works / attenuation due to increased impermeable surfacing	500	see option breakdown	m2	Quantity given is the increase in impermeable area across the route, including carriageway and footway	51215.969	£ 12,535,108	18375	£ 4,497,281	25514.204	£ 6,244,601	18375	£ 4,497,281	25514.204	£ 6,244,601
Carriageway resurfacing	700	see option breakdown	m2	Assumed entire carriageway to be resurfaced	93379	£ 15,922,859	176777.8	£ 30,143,843	82679.5	£ 14,098,364	169257.8	£ 28,861,546	82679.5	£ 14,098,364
Carriageway widening	700	see option breakdown	m2		21017.445	£ 4,502,670	18375	£ 3,936,566	8466.859	£ 1,813,897	18375	£ 3,936,566	8466.859	£ 1,813,897
Proposed new footway construction	1100	see option breakdown	m2	Assume all new footways	27264	£ 3,637,536	54876	£ 7,321,501	24140	£ 3,220,735	54876	£ 7,321,501	24140	£ 3,220,735
Proposed new cycleway construction	1100	see option breakdown	m2	Assume all new cycleways	20448	£ 3,415,307	41157	£ 6,874,207	18105	£ 3,023,970	41157	£ 6,874,207	18105	£ 3,023,970
Propose new road markings and signs	1200	see option breakdown	%			£ 50,000		£ 100,000		£ 50,000		£ 100,000		£ 50,000
Install lighting columns from store and associated electrical work	1300 / 1400	see option breakdown	nr		136	£ 644,758	288	£ 1,365,370	121	£ 573,645	288	£ 1,365,370	121	£ 573,645
Alteration to existing major junction; signalised	Gen	see option breakdown	nr		3	£ 600,000	18	£ 3,600,000	6	£ 1,200,000	18	£ 3,600,000	6	£ 1,200,000
Alteration to existing major junction; normal / compact roundabout	Gen	see option breakdown	nr		2	£ 1,600,000	8	£ 6,400,000	2	£ 1,600,000	8	£ 6,400,000	2	£ 1,600,000
Alteration to existing major junction; signalised roundabout	Gen	see option breakdown	nr		2	£ 2,000,000	1	£ 1,000,000	2	£ 2,000,000	1	£ 1,000,000	2	£ 2,000,000
Alteration to existing pedestrian crossing type; zebra crossing	Gen	see option breakdown	nr		2	£ 20,000	7	£ 70,000	0	£ -	7	£ 70,000	0	£ -
Alteration to existing pedestrian crossing type; zebra crossing with refuge island	Gen	see option breakdown	nr		0	£ -	4	£ 60,000	0	£ -	4	£ 60,000	0	£ -
Alteration to existing pedestrian crossing type; signal controlled crossing	Gen	see option breakdown	nr		0	£ -	1	£ 105,000	1	£ 105,000	1	£ 105,000	1	£ 105,000
Alteration to existing pedestrian crossing type; signal controlled crossing with refuge island	Gen	see option breakdown	nr		2	£ 220,000	13	£ 1,430,000	4	£ 440,000	13	£ 1,430,000	4	£ 440,000
Alteration to existing bridges; underbridge	Gen	see option breakdown	nr		0	£ -	4	£ 2,000,000	2	£ 1,000,000	4	£ 2,000,000	2	£ 1,000,000
Alteration to existing bridges; overbridge	Gen	see option breakdown	nr		2	£ 1,000,000	5	£ 2,500,000	1	£ 500,000	5	£ 2,500,000	1	£ 500,000
Proposed green / planting strip	3000	see option breakdown	m2		0	£ -	1892.994	£ 156,776	9000	£ 745,371	1892.994	£ 156,776	9000	£ 745,371
Tunneling options - Including underground stations			item		1	£ 1,645,368,109		£ -		£ -		£ -		£ -
Overground stations			item		6	£ 6,000,000	25	£ 25,000,000		£ -	25	£ 25,000,000		£ -

	NC04	NC08 East	NC08 West	NC08 (b) East	NC08 (b) West
Sub-total	£ 1,698,892,547	£ 99,810,545	£ 38,014,782	£ 98,528,248	£ 38,014,782
Utilities (30%) (tunneling sections adjusted individually)	£ 14,257,331	£ 22,443,164	£ 11,404,434	£ 22,058,474	£ 11,404,434
Utilities (tunneling sections)	£ 32,907,362	£ -	£ -	£ -	£ -
Traffic Management (15%) (reduced for tunneling options)	£ 7,128,666	£ 11,221,582	£ 5,702,217	£ 11,029,237	£ 5,702,217
Traffic Management (tunneling sections)	£ 1,645,368	£ -	£ -	£ -	£ -
Preliminaries (30%)	£ 339,778,509	£ 19,962,109	£ 7,602,956	£ 19,705,650	£ 7,602,956
Project/design team fees (10%)	£ 169,889,255	£ 9,981,055	£ 3,801,478	£ 9,852,825	£ 3,801,478
Project management team fees (10%)	£ 169,889,255	£ 9,981,055	£ 3,801,478	£ 9,852,825	£ 3,801,478
Client costs (5%)	£ 84,944,627	£ 4,990,527	£ 1,900,739	£ 4,926,412	£ 1,900,739
Biodiversity net gain (3%)	£ 50,966,776	£ 2,994,316	£ 1,140,443	£ 2,955,847	£ 1,140,443
Surveys	£ 1,000,000	£ 500,000	£ 300,000	£ 500,000	£ 300,000
Overheads and profit (15%)	£ 331,284,047	£ 19,463,056	£ 7,412,882	£ 19,213,008	£ 7,412,882
Risk (40%)	£ 1,161,033,497	£ 80,538,963	£ 32,432,564	£ 79,449,011	£ 32,432,564
Inflation (40%)	£ 1,625,446,896	£ 112,754,549	£ 45,405,590	£ 111,228,615	£ 45,405,590
Total	£ 5,689,064,136	£ 394,640,921	£ 158,919,566	£ 389,300,153	£ 158,919,566
	£ 5,700,000,000	£ 395,000,000	£ 159,000,000	£ 390,000,000	£ 159,000,000

Exclusions
Optimism bias
Land
Building demolitions
VAT
Legal fees
Purchase of TBM - Potentially multiple purchases
Public realm improvements
Active travel solutions
Operating costs for bus/tram companies
Maintenenace/renewal costs

Item	Series	Quantity	Unit	Comment	Rubber-wheeled - East Corridor					
					EC01	Total	EC04	Total	EC08	Total
Topsoil strip existing unpaved area	200	see option breakdown	m2	Assume take up all unpaved surfacing ready for new layout	0	£ -	0	£ -	10150.278	£ 230,229
Break out and remove existing paved footway / central reserve surface	200	see option breakdown	m2	Assume take up all paved footway / central reserve surface ready for new layout	0	£ -	0	£ -	60267.665	£ 994,416
Break out existing kerbs to tip off site	200	see option breakdown	l/m	Assume 2no sets of kerbs to be removed along entire length of route	0	£ -	0	£ -	21170	£ 349,305
Existing gullies to be removed to tip off site	200	see option breakdown	nr	Assume gullies on one side of road to be removed, assume gully spacing is 40m	0	£ -	0	£ -	265	£ 2,915
Existing lighting columns to be removed and stored on site for re-use	200	see option breakdown	nr	Assume lighting columns placed alternatingly on each side of carriageway. Columns 10m tall and spacing 2.5 times the height. Assume 1 side needs removal	0	£ -	0	£ -	212	£ 31,232
Gullies to be installed	500	see option breakdown	nr	Assume gullies on one side of road to be replaced, assume gully spacing is 40m	0	£ -	0	£ -	265	£ 241,187
Gully pipework extension	500	see option breakdown	l/m	Assume on average 7.5m offset from existing gully placement	0	£ -	0	£ -	1988	£ 166,328
Additional drainage works / attenuation due to increased impermeable surfacing	500	see option breakdown	m2	Quantity given is the increase in impermeable area across the route, including carriageway and footway	0	£ -	0	£ -	8250	£ 2,019,188
Carriageway resurfacing	700	see option breakdown	m2	Assumed entire carriageway to be resurfaced	0	£ -	0	£ -	70929.5	£ 10,249,809
Carriageway widening	700	see option breakdown	m2		0	£ -	0	£ -	8250	£ 1,497,829
Proposed new footway construction	1100	see option breakdown	m2	Assume all new footways	0	£ -	0	£ -	29340	£ 3,914,513
Proposed new cycleway construction	1100	see option breakdown	m2	Assume all new cycleways	0	£ -	0	£ -	13005	£ 2,172,147
Propose new road markings and signs	1200	see option breakdown	%			£ -		£ -		£ 75,000
Install lighting columns from store and associated electrical work	1300 / 1400	see option breakdown	nr		0	£ -	0	£ -	212	£ 1,005,064
Alteration to existing major junction; signalised	Gen	see option breakdown	nr		0	£ -	0	£ -	19	£ 3,800,000
Alteration to existing major junction; normal / compact roundabout	Gen	see option breakdown	nr		0	£ -	0	£ -	5	£ 4,000,000
Alteration to existing major junction; signalised roundabout	Gen	see option breakdown	nr		0	£ -	0	£ -	2	£ 2,000,000
Alteration to existing pedestrian crossing type; zebra crossing	Gen	see option breakdown	nr		0	£ -	0	£ -	7	£ 70,000
Alteration to existing pedestrian crossing type; zebra crossing with refuge island	Gen	see option breakdown	nr		0	£ -	0	£ -	4	£ 60,000
Alteration to existing pedestrian crossing type; signal controlled crossing	Gen	see option breakdown	nr		0	£ -	0	£ -	16	£ 1,680,000
Alteration to existing pedestrian crossing type; signal controlled crossing with refuge island	Gen	see option breakdown	nr		0	£ -	0	£ -	7	£ 770,000
Alteration to existing bridges; underbridge	Gen	see option breakdown	nr		0	£ -	0	£ -	2	£ 1,000,000
Alteration to existing bridges; overbridge	Gen	see option breakdown	nr		0	£ -	0	£ -	0	£ -
Proposed green / planting strip	3000	see option breakdown	m2		0	£ -	0	£ -	9904.722	£ 820,299
Tunneling options - Including underground stations			item		1	£ 1,434,529,887	1	£ 1,809,823,319		£ -
Overground stations			item			£ -		£ -	13	£ 13,000,000

	EC01	EC04	EC08
Sub-total	£ 1,434,529,887	£ 1,809,823,319	£ 50,149,462
Utilities (30%) (tunneling sections adjusted individually)	£ -	£ -	£ 11,144,839
Utilities (tunneling sections)	£ 28,690,598	£ 36,196,466	£ -
Traffic Management (15%) (reduced for tunneling options)	£ -	£ -	£ 5,572,419
Traffic Management (tunneling sections)	£ 1,434,530	£ 1,809,823	£ -
Preliminaries (30%)	£ 286,905,977	£ 361,964,664	£ 10,029,892
Project/design team fees (10%)	£ 143,452,989	£ 180,982,332	£ 5,014,946
Project management team fees (10%)	£ 143,452,989	£ 180,982,332	£ 5,014,946
Client costs (5%)	£ 71,726,494	£ 90,491,166	£ 2,507,473
Biodiversity net gain (3%)	£ 43,035,897	£ 54,294,700	£ 1,504,484
Surveys	£ 1,000,000	£ 1,000,000	£ 300,000
Overheads and profit (15%)	£ 279,733,328	£ 352,915,547	£ 9,779,145
Risk (40%)	£ 973,585,075	£ 1,228,184,140	£ 40,407,043
Inflation (40%)	£ 1,363,019,105	£ 1,719,457,795	£ 56,569,860
Total	£ 4,770,566,869	£ 6,018,102,284	£ 197,994,509
	£ 4,770,000,000	£ 6,018,000,000	£ 200,000,000

Exclusions

Optimism bias
Land
Building demolitions
VAT
Legal fees
Purchase of TBM - Potentially multiple purchases
Public realm improvements
Active travel solutions
Operating costs for bus/tram companies
Maintenenace/renewal costs

Item	Series	Quantity	Unit	Comment	Steel-wheeled - East Corridor					
					EC01	Total	EC04	Total	EC08	Total
Topsoil strip existing unpaved area	200	see option breakdown	m2	Assume take up all unpaved surfacing ready for new layout	0	£ -	0	£ -	10150.278	£ 230,229
Break out and remove existing paved footway / central reserve surface	200	see option breakdown	m2	Assume take up all paved footway / central reserve surface ready for new layout	0	£ -	0	£ -	60267.665	£ 994,416
Break out existing kerbs to tip off site	200	see option breakdown	l/m	Assume 2no sets of kerbs to be removed along entire length of route	0	£ -	0	£ -	21170	£ 349,305
Existing gullies to be removed to tip off site	200	see option breakdown	nr	Assume gullies on one side of road to be removed, assume gully spacing is 40m	0	£ -	0	£ -	265	£ 2,915
Existing lighting columns to be removed and stored on site for re-use	200	see option breakdown	nr	Assume lighting columns placed alternatingly on each side of carriageway. Columns 10m tall and spacing 2.5 times the height. Assume 1 side needs removal	0	£ -	0	£ -	212	£ 31,232
Gullies to be installed	500	see option breakdown	nr	Assume gullies on one side of road to be replaced, assume gully spacing is 40m	0	£ -	0	£ -	265	£ 241,187
Gully pipework extension	500	see option breakdown	l/m	Assume on average 7.5m offset from existing gully placement	0	£ -	0	£ -	1988	£ 166,328
Additional drainage works / attenuation due to increased impermeable surfacing	500	see option breakdown	m2	Quantity given is the increase in impermeable area across the route, including carriageway and footway	0	£ -	0	£ -	8250	£ 2,019,188
Carriageway resurfacing	700	see option breakdown	m2	Assumed entire carriageway to be resurfaced	0	£ -	0	£ -	70929.5	£ 12,094,775
Carriageway widening	700	see option breakdown	m2		0	£ -	0	£ -	8250	£ 1,767,438
Proposed new footway construction	1100	see option breakdown	m2	Assume all new footways	0	£ -	0	£ -	29340	£ 3,914,513
Proposed new cycleway construction	1100	see option breakdown	m2	Assume all new cycleways	0	£ -	0	£ -	13005	£ 2,172,147
Propose new road markings and signs	1200	see option breakdown	%			£ -		£ -		£ 75,000
Install lighting columns from store and associated electrical work	1300 / 1400	see option breakdown	nr		0	£ -	0	£ -	212	£ 1,005,064
Alteration to existing major junction; signalised	Gen	see option breakdown	nr		0	£ -	0	£ -	19	£ 3,800,000
Alteration to existing major junction; normal / compact roundabout	Gen	see option breakdown	nr		0	£ -	0	£ -	5	£ 4,000,000
Alteration to existing major junction; signalised roundabout	Gen	see option breakdown	nr		0	£ -	0	£ -	2	£ 2,000,000
Alteration to existing pedestrian crossing type; zebra crossing	Gen	see option breakdown	nr		0	£ -	0	£ -	7	£ 70,000
Alteration to existing pedestrian crossing type; zebra crossing with refuge island	Gen	see option breakdown	nr		0	£ -	0	£ -	4	£ 60,000
Alteration to existing pedestrian crossing type; signal controlled crossing	Gen	see option breakdown	nr		0	£ -	0	£ -	16	£ 1,680,000
Alteration to existing pedestrian crossing type; signal controlled crossing with refuge island	Gen	see option breakdown	nr		0	£ -	0	£ -	7	£ 770,000
Alteration to existing bridges; underbridge	Gen	see option breakdown	nr		0	£ -	0	£ -	2	£ 1,000,000
Alteration to existing bridges; overbridge	Gen	see option breakdown	nr		0	£ -	0	£ -	0	£ -
Proposed green / planting strip	3000	see option breakdown	m2		0	£ -	0	£ -	9904.722	£ 820,299
Tunneling options - Including underground stations			item		1	£ 1,692,745,267	1	£ 2,135,591,516		£ -
Overground stations			item			£ -		£ -	13	£ 13,000,000

	EC01	EC04	EC08
Sub-total	£ 1,692,745,267	£ 2,135,591,516	£ 52,264,037
Utilities (30%) (tunneling sections adjusted individually)	£ -	£ -	£ 11,779,211
Utilities (tunneling sections)	£ 33,854,905	£ 42,711,830	£ -
Traffic Management (15%) (reduced for tunneling options)	£ -	£ -	£ 5,889,606
Traffic Management (tunneling sections)	£ 1,692,745	£ 2,135,592	£ -
Preliminaries (30%)	£ 338,549,053	£ 427,118,303	£ 10,452,807
Project/design team fees (10%)	£ 169,274,527	£ 213,559,152	£ 5,226,404
Project management team fees (10%)	£ 169,274,527	£ 213,559,152	£ 5,226,404
Client costs (5%)	£ 84,637,263	£ 106,779,576	£ 2,613,202
Biodiversity net gain (3%)	£ 50,782,358	£ 64,067,745	£ 1,567,921
Surveys	£ 1,000,000	£ 1,000,000	£ 300,000
Overheads and profit (15%)	£ 330,085,327	£ 416,440,346	£ 10,191,487
Risk (40%)	£ 1,148,758,389	£ 1,449,185,285	£ 42,204,431
Inflation (40%)	£ 1,608,261,744	£ 2,028,859,399	£ 59,086,204
Total	£ 5,628,916,106	£ 7,101,007,895	£ 206,801,713
	£ 5,600,000,000	£ 7,100,000,000	£ 207,000,000

Exclusions
Optimism bias
Land
Building demolitions
VAT
Legal fees
Purchase of TBM - Potentially multiple purchases
Public realm improvements
Active travel solutions
Operating costs for bus/tram companies
Maintenenace/renewal costs

Item	Series	Quantity	Unit	Comment	Rubber-wheeled - Bristol-Bath Corridor			
					BBC-C & BBC06	**Total**	**Bath A5**	**Total**
Topsoil strip existing unpaved area	200	see option breakdown	m2	Assume take up all unpaved surfacing ready for new layout	3936.727	£ 89,293	4957.677	£ 112,450.03
Break out and remove existing paved footway / central reserve surface	200	see option breakdown	m2	Assume take up all paved footway / central reserve surface ready for new layout	30405.844	£ 501,696	16855	£ 278,101.56
Break out existing kerbs to tip off site	200	see option breakdown	l/m	Assume 2no sets of kerbs to be removed along entire length of route	12100	£ 199,650	10244	£ 169,026.00
Existing gullies to be removed to tip off site	200	see option breakdown	nr	Assume gullies on one side of road to be removed, assume gully spacing is 40m	152	£ 1,672	128	£ 1,408.00
Existing lighting columns to be removed and stored on site for re-use	200	see option breakdown	nr	Assume lighting columns placed alternatingly on each side of carriageway. Columns 10m tall and spacing 2.5 times the height. Assume 1 side needs removal	121	£ 17,826	102	£ 15,026.95
Gullies to be installed	500	see option breakdown	nr	Assume gullies on one side of road to be replaced, assume gully spacing is 40m	152	£ 138,341	128	£ 116,497.92
Gully pipework extension	500	see option breakdown	l/m	Assume on average 7.5m offset from existing gully placement	1141	£ 95,463	960	£ 80,319.36
Additional drainage works / attenuation due to increased impermeable surfacing	500	see option breakdown	m2	Quantity given is the increase in impermeable area across the route, including carriageway and footway	17289.104	£ 4,231,508	40839	£ 9,995,367.92
Carriageway resurfacing	700	see option breakdown	m2	Assumed entire carriageway to be resurfaced	74312.5	£ 10,738,676	70171.4	£ 10,140,258.50
Carriageway widening	700	see option breakdown	m2		12735.267	£ 2,312,151	21840	£ 3,965,112.66
Proposed new footway construction	1100	see option breakdown	m2	Assume all new footways	24200	£ 3,228,740	20488	£ 2,733,488.47
Proposed new cycleway construction	1100	see option breakdown	m2	Assume all new cycleways	11250	£ 1,879,020	15366	£ 2,566,490.78
Propose new road markings and signs	1200	see option breakdown	%		0	£ 50,000		£ 50,000.00
Install lighting columns from store and associated electrical work	1300 / 1400	see option breakdown	nr		121	£ 573,645	102	£ 483,568.54
Alteration to existing major junction; signalised	Gen	see option breakdown	nr		9	£ 1,800,000	8	£ 1,600,000.00
Alteration to existing major junction; normal / compact roundabout	Gen	see option breakdown	nr		0	£ -	0	£ -
Alteration to existing major junction; signalised roundabout	Gen	see option breakdown	nr		1	£ 1,000,000	0	£ -
Alteration to existing pedestrian crossing type; zebra crossing	Gen	see option breakdown	nr		0	£ -	2	£ 20,000.00
Alteration to existing pedestrian crossing type; zebra crossing with refuge island	Gen	see option breakdown	nr		0	£ -	0	£ -
Alteration to existing pedestrian crossing type; signal controlled crossing	Gen	see option breakdown	nr		0	£ -	5	£ 525,000.00
Alteration to existing pedestrian crossing type; signal controlled crossing with refuge island	Gen	see option breakdown	nr		9	£ 990,000	1	£ 110,000.00
Alteration to existing bridges; underbridge	Gen	see option breakdown	nr		7	£ 3,500,000	2	£ 1,000,000.00
Alteration to existing bridges; overbridge	Gen	see option breakdown	nr		1	£ 500,000	0	£ -
Proposed green / planting strip	3000	see option breakdown	m2		9728.273	£ 805,686	10408	£ 862,006.90
Tunneling options - Including underground stations			item			£ -		£ -
Overground stations			item		19	£ 19,000,000		£ -

Sub-total	£ 51,653,368	£ 34,824,123.59
Utilities (30%) (tunneling sections adjusted individually)	£ 9,796,010	£ 10,447,237.08
Utilities (tunneling sections)		£ -
Traffic Management (15%) (reduced for tunneling options)	£ 4,898,005	£ 5,223,618.54
Traffic Management (tunneling sections)		£ -
Preliminaries (30%)	£ 10,330,674	£ 6,964,824.72
Project/design team fees (10%)	£ 5,165,337	£ 3,482,412.36
Project management team fees (10%)	£ 5,165,337	£ 3,482,412.36
Client costs (5%)	£ 2,582,668	£ 1,741,206.18
Biodiversity net gain (3%)	£ 1,549,601	£ 1,044,723.71
Surveys	£ 499,998	£ 300,000.00
Overheads and profit (15%)	£ 10,072,407	£ 6,790,704.10
Risk (40%)	£ 40,685,362	£ 29,720,505.05
Inflation (40%)	£ 56,959,507	£ 41,608,707.07
Total	£ 199,358,275	£ 145,630,474.74
	£ 200,000,000	£ 145,000,000.00

Exclusions
Optimism bias
Land
Building demolitions
VAT
Legal fees
Purchase of TBM - Potentially multiple purchases
Public realm improvements
Active travel solutions
Operating costs for bus/tram companies
Maintenenace/renewal costs

Item	Series	Quantity	Unit	Comment	Steel-wheeled - Bristol-Bath Corridor BBC-C & BBC06	Total	Bath A5	Total
Topsoil strip existing unpaved area	200	see option breakdown	m2	Assume take up all unpaved surfacing ready for new layout	3936.727	£ 89,293	4957.677	£ 112,450
Break out and remove existing paved footway / central reserve surface	200	see option breakdown	m2	Assume take up all paved footway / central reserve surface ready for new layout	30405.844	£ 501,696	16855	£ 278,102
Break out existing kerbs to tip off site	200	see option breakdown	l/m	Assume 2no sets of kerbs to be removed along entire length of route	12100	£ 199,650	10244	£ 169,026
Existing gullies to be removed to tip off site	200	see option breakdown	nr	Assume gullies on one side of road to be removed, assume gully spacing is 40m	152	£ 1,672	128	£ 1,408
Existing lighting columns to be removed and stored on site for re-use	200	see option breakdown	nr	Assume lighting columns placed alternatingly on each side of carriageway. Columns 10m tall and spacing 2.5 times the height. Assume 1 side needs removal	121	£ 17,826	102	£ 15,027
Gullies to be installed	500	see option breakdown	nr	Assume gullies on one side of road to be replaced, assume gully spacing is 40m	152	£ 138,341	128	£ 116,498
Gully pipework extension	500	see option breakdown	l/m	Assume on average 7.5m offset from existing gully placement	1141	£ 95,463	960	£ 80,319
Additional drainage works / attenuation due to increased impermeable surfacing	500	see option breakdown	m2	Quantity given is the increase in impermeable area across the route, including carriageway and footway	17289.104	£ 4,231,508	40839	£ 9,995,368
Carriageway resurfacing	700	see option breakdown	m2	Assumed entire carriageway to be resurfaced	74312.5	£ 12,671,638	70171.4	£ 11,965,505
Carriageway widening	700	see option breakdown	m2		12735.267	£ 2,728,339	21840	£ 4,678,833
Proposed new footway construction	1100	see option breakdown	m2	Assume all new footways	24200	£ 3,228,740	20488	£ 2,733,488
Proposed new cycleway construction	1100	see option breakdown	m2	Assume all new cycleways	11250	£ 1,879,020	15366	£ 2,566,491
Propose new road markings and signs	1200	see option breakdown	%		0	£ 50,000		£ 50,000
Install lighting columns from store and associated electrical work	1300 / 1400	see option breakdown	nr		121	£ 573,645	102	£ 483,569
Alteration to existing major junction; signalised	Gen	see option breakdown	nr		9	£ 1,800,000	8	£ 1,600,000
Alteration to existing major junction; normal / compact roundabout	Gen	see option breakdown	nr		0	£ -	0	£ -
Alteration to existing major junction; signalised roundabout	Gen	see option breakdown	nr		1	£ 1,000,000	0	£ -
Alteration to existing pedestrian crossing type; zebra crossing	Gen	see option breakdown	nr		0	£ -	2	£ 20,000
Alteration to existing pedestrian crossing type; zebra crossing with refuge island	Gen	see option breakdown	nr		0	£ -	0	£ -
Alteration to existing pedestrian crossing type; signal controlled crossing	Gen	see option breakdown	nr		0	£ -	5	£ 525,000
Alteration to existing pedestrian crossing type; signal controlled crossing with refuge island	Gen	see option breakdown	nr		9	£ 990,000	1	£ 110,000
Alteration to existing bridges; underbridge	Gen	see option breakdown	nr		7	£ 3,500,000	2	£ 1,000,000
Alteration to existing bridges; overbridge	Gen	see option breakdown	nr		1	£ 500,000	0	£ -
Proposed green / planting strip	3000	see option breakdown	m2		9728.273	£ 805,686	10408	£ 862,007
Tunneling options - Including underground stations			item			£ -		£ -
Overground stations			item		19	£ 19,000,000		£ -

Sub-total	£ 54,002,517	£ 37,363,090
Utilities (30%) (tunneling sections adjusted individually)	£ 10,500,755	£ 11,208,927
Utilities (tunneling sections)		£ -
Traffic Management (15%) (reduced for tunneling options)	£ 5,250,378	£ 5,604,464
Traffic Management (tunneling sections)		£ -
Preliminaries (30%)	£ 10,800,503	£ 7,472,618
Project/design team fees (10%)	£ 5,400,252	£ 3,736,309
Project management team fees (10%)	£ 5,400,252	£ 3,736,309
Client costs (5%)	£ 2,700,126	£ 1,868,155
Biodiversity net gain (3%)	£ 1,620,076	£ 1,120,893
Surveys	£ 499,998	£ 300,000
Overheads and profit (15%)	£ 10,530,491	£ 7,285,803
Risk (40%)	£ 42,682,139	£ 31,878,627
Inflation (40%)	£ 59,754,994	£ 44,630,078
Total	£ 209,142,480	£ 156,205,271
	£ 209,000,000	£ 156,000,000

Exclusions
Optimism bias
Land
Building demolitions
VAT
Legal fees
Purchase of TBM - Potentially multiple purchases
Public realm improvements
Active travel solutions
Operating costs for bus/tram companies
Maintenenace/renewal costs

Item	Series	Quantity	Unit	Comment	SWC03	Total	SWC05	Total	SWC11	Total
					Rubber-wheeled - South-West Corridor					
Topsoil strip existing unpaved area	200	see option breakdown	m2	Assume take up all unpaved surfacing ready for new layout	23642.052	£ 536,249	42788.466	£ 970,528	81367.702	£ 1,845,582
Break out and remove existing paved footway / central reserve surface	200	see option breakdown	m2	Assume take up all paved footway / central reserve surface ready for new layout	11573.134	£ 190,957	40010	£ 660,172	53114.693	£ 876,392
Break out existing kerbs to tip off site	200	see option breakdown	l/m	Assume 2no sets of kerbs to be removed along entire length of route	14220	£ 234,630	23960	£ 395,340	31080	£ 512,820
Existing gullies to be removed to tip off site	200	see option breakdown	nr	Assume gullies on one side of road to be removed, assume gully spacing is 40m	178	£ 1,958	300	£ 3,300	389	£ 4,279
Existing lighting columns to be removed and stored on site for re-use	200	see option breakdown	nr	Assume lighting columns placed alternatingly on each side of carriageway. Columns 10m tall and spacing 2.5 times the height. Assume 1 side needs removal	142	£ 20,920	240	£ 35,358	311	£ 45,817
Gullies to be installed	500	see option breakdown	nr	Assume gullies on one side of road to be replaced, assume gully spacing is 40m	178	£ 162,005	300	£ 273,042	389	£ 354,044
Gully pipework extension	500	see option breakdown	l/m	Assume on average 7.5m offset from existing gully placement	1335	£ 111,694	2250	£ 188,249	2918	£ 244,137
Additional drainage works / attenuation due to increased impermeable surfacing	500	see option breakdown	m2	Quantity given is the increase in impermeable area across the route, including carriageway and footway	62759.248	£ 15,360,326	61680	£ 15,096,224	70127.96479	£ 17,163,819
Carriageway resurfacing	700	see option breakdown	m2	Assumed entire carriageway to be resurfaced	97407	£ 14,075,993	155331	£ 22,446,417	200183	£ 28,927,845
Carriageway widening	700	see option breakdown	m2		24562.382	£ 4,459,423	19581	£ 3,554,956	14462.65779	£ 2,625,768
Proposed new footway construction	1100	see option breakdown	m2	Assume all new footways	28440	£ 3,794,436	46920	£ 6,260,019	62160	£ 8,293,325
Proposed new cycleway construction	1100	see option breakdown	m2	Assume all new cycleways	21330	£ 3,562,622	35190	£ 5,877,575	46620	£ 7,786,659
Propose new road markings and signs	1200	see option breakdown	%			£ 50,000		£ 100,000		£ 100,000
Install lighting columns from store and associated electrical work	1300 / 1400	see option breakdown	nr		142	£ 673,203	240	£ 1,137,808	311	£ 1,474,410
Alteration to existing major junction; signalised	Gen	see option breakdown	nr		2	£ 400,000	13	£ 2,600,000	16	£ 3,200,000
Alteration to existing major junction; normal / compact roundabout	Gen	see option breakdown	nr		3	£ 2,400,000	5	£ 4,000,000	7	£ 5,600,000
Alteration to existing major junction; signalised roundabout	Gen	see option breakdown	nr		0	£ -	4	£ 4,000,000	2	£ 2,000,000
Alteration to existing pedestrian crossing type; zebra crossing	Gen	see option breakdown	nr		0	£ -	2	£ 20,000	3	£ 30,000
Alteration to existing pedestrian crossing type; zebra crossing with refuge island	Gen	see option breakdown	nr		1	£ 15,000	3	£ 45,000	4	£ 60,000
Alteration to existing pedestrian crossing type; signal controlled crossing	Gen	see option breakdown	nr		0	£ -	1	£ 105,000	0	£ -
Alteration to existing pedestrian crossing type; signal controlled crossing with refuge island	Gen	see option breakdown	nr		0	£ -	18	£ 1,980,000	15	£ 1,650,000
Alteration to existing bridges; underbridge	Gen	see option breakdown	nr		0	£ -	2	£ 1,000,000	1	£ 500,000
Alteration to existing bridges; overbridge	Gen	see option breakdown	nr		0	£ -	0	£ -	1	£ 500,000
Proposed green / planting strip	3000	see option breakdown	m2		0	£ -	0	£ -	0	£ -
Tunneling options - Including underground stations			item		1	£ 1,239,568,619		£ -		£ -
Overground stations			item		4	£ 4,000,000	17	£ 17,000,000	23	£ 23,000,000

	SWC03	SWC05	SWC11
Sub-total	£ 1,289,618,036	£ 87,748,987	£ 106,794,899
Utilities (30%) (tunneling sections adjusted individually)	£ 13,814,825	£ 21,224,696	£ 25,138,470
Utilities (tunneling sections)	£ 24,791,372	£ -	£ -
Traffic Management (15%) (reduced for tunneling options)	£ 6,907,413	£ 10,612,348	£ 12,569,235
Traffic Management (tunneling sections)	£ 1,239,569	£ -	£ -
Preliminaries (30%)	£ 257,923,607	£ 17,549,797	£ 21,358,980
Project/design team fees (10%)	£ 128,961,804	£ 8,774,899	£ 10,679,490
Project management team fees (10%)	£ 128,961,804	£ 8,774,899	£ 10,679,490
Client costs (5%)	£ 64,480,902	£ 4,387,449	£ 5,339,745
Biodiversity net gain (3%)	£ 38,688,541	£ 2,632,470	£ 3,203,847
Surveys	£ 1,000,000	£ 500,000	£ 500,000
Overheads and profit (15%)	£ 251,475,517	£ 17,111,053	£ 20,825,005
Risk (40%)	£ 883,145,355	£ 71,726,639	£ 86,835,664
Inflation (40%)	£ 1,236,403,497	£ 100,417,295	£ 121,569,930
Total	£ 4,327,412,241	£ 351,460,533	£ 425,494,754
	£ 4,300,000,000	£ 351,000,000	£ 425,000,000

Exclusions
Optimism bias
Land
Building demolitions
VAT
Legal fees
Purchase of TBM - Potentially multiple purchases
Public realm improvements
Active travel solutions
Operating costs for bus/tram companies
Maintenenace/renewal costs

Item	Series	Quantity	Unit	Comment	Steel-wheeled - South-West Corridor SWC03	Total	SWC05	Total	SWC11	Total
Topsoil strip existing unpaved area	200	see option breakdown	m2	Assume take up all unpaved surfacing ready for new layout	23642.052	£ 536,249	42788.466	£ 970,528	81367.702	£ 1,845,582
Break out and remove existing paved footway / central reserve surface	200	see option breakdown	m2	Assume take up all paved footway / central reserve surface ready for new layout	11573.134	£ 190,957	40010	£ 660,172	53114.693	£ 876,392
Break out existing kerbs to tip off site	200	see option breakdown	l/m	Assume 2no sets of kerbs to be removed along entire length of route	14220	£ 234,630	23960	£ 395,340	31080	£ 512,820
Existing gullies to be removed to tip off site	200	see option breakdown	nr	Assume gullies on one side of road to be removed, assume gully spacing is 40m	178	£ 1,958	300	£ 3,300	389	£ 4,279
Existing lighting columns to be removed and stored on site for re-use	200	see option breakdown	nr	Assume lighting columns placed alternatingly on each side of carriageway. Columns 10m tall and spacing 2.5 times the height. Assume 1 side needs removal	142	£ 20,920	240	£ 35,358	311	£ 45,817
Gullies to be installed	500	see option breakdown	nr	Assume gullies on one side of road to be replaced, assume gully spacing is 40m	178	£ 162,005	300	£ 273,042	389	£ 354,044
Gully pipework extension	500	see option breakdown	l/m	Assume on average 7.5m offset from existing gully placement	1335	£ 111,694	2250	£ 188,249	2918	£ 244,137
Additional drainage works / attenuation due to increased impermeable surfacing	500	see option breakdown	m2	Quantity given is the increase in impermeable area across the route, including carriageway and footway	62759.248	£ 15,360,326	61680	£ 15,096,224	70127.96479	£ 17,163,819
Carriageway resurfacing	700	see option breakdown	m2	Assumed entire carriageway to be resurfaced	97407	£ 16,609,672	155331	£ 26,486,772	200183	£ 34,134,857
Carriageway widening	700	see option breakdown	m2		24562.382	£ 5,262,119	19581	£ 4,194,848	14462.65779	£ 3,098,406
Proposed new footway construction	1100	see option breakdown	m2	Assume all new footways	28440	£ 3,794,436	46920	£ 6,260,019	62160	£ 8,293,325
Proposed new cycleway construction	1100	see option breakdown	m2	Assume all new cycleways	21330	£ 3,562,622	35190	£ 5,877,575	46620	£ 7,786,659
Propose new road markings and signs	1200	see option breakdown	%			£ 50,000		£ 100,000		£ 100,000
Install lighting columns from store and associated electrical work	1300 / 1400	see option breakdown	nr		142	£ 673,203	240	£ 1,137,808	311	£ 1,474,410
Alteration to existing major junction; signalised	Gen	see option breakdown	nr		2	£ 400,000	13	£ 2,600,000	16	£ 3,200,000
Alteration to existing major junction; normal / compact roundabout	Gen	see option breakdown	nr		3	£ 2,400,000	5	£ 4,000,000	7	£ 5,600,000
Alteration to existing major junction; signalised roundabout	Gen	see option breakdown	nr		0	£ -	4	£ 4,000,000	2	£ 2,000,000
Alteration to existing pedestrian crossing type; zebra crossing	Gen	see option breakdown	nr		0	£ -	2	£ 20,000	3	£ 30,000
Alteration to existing pedestrian crossing type; zebra crossing with refuge island	Gen	see option breakdown	nr		1	£ 15,000	3	£ 45,000	4	£ 60,000
Alteration to existing pedestrian crossing type; signal controlled crossing	Gen	see option breakdown	nr		0	£ -	1	£ 105,000	0	£ -
Alteration to existing pedestrian crossing type; signal controlled crossing with refuge island	Gen	see option breakdown	nr		0	£ -	18	£ 1,980,000	15	£ 1,650,000
Alteration to existing bridges; underbridge	Gen	see option breakdown	nr		0	£ -	2	£ 1,000,000	1	£ 500,000
Alteration to existing bridges; overbridge	Gen	see option breakdown	nr		0	£ -	0	£ -	1	£ 500,000
Proposed green / planting strip	3000	see option breakdown	m2		0	£ -	0	£ -	0	£ -
Tunneling options - Including underground stations			item		1	£ 1,462,690,970		£ -		£ -
Overground stations			item		4	£ 4,000,000	17	£ 17,000,000	23	£ 23,000,000

	SWC03	SWC05	SWC11
Sub-total	£ 1,516,076,762	£ 92,429,235	£ 112,474,549
Utilities (30%) (tunneling sections adjusted individually)	£ 14,815,738	£ 22,628,770	£ 26,842,365
Utilities (tunneling sections)	£ 29,253,819	£ -	£ -
Traffic Management (15%) (reduced for tunneling options)	£ 7,407,869	£ 11,314,385	£ 13,421,182
Traffic Management (tunneling sections)	£ 1,462,691	£ -	£ -
Preliminaries (30%)	£ 303,215,352	£ 18,485,847	£ 22,494,910
Project/design team fees (10%)	£ 151,607,676	£ 9,242,923	£ 11,247,455
Project management team fees (10%)	£ 151,607,676	£ 9,242,923	£ 11,247,455
Client costs (5%)	£ 75,803,838	£ 4,621,462	£ 5,623,727
Biodiversity net gain (3%)	£ 45,482,303	£ 2,772,877	£ 3,374,236
Surveys	£ 1,000,000	£ 500,000	£ 500,000
Overheads and profit (15%)	£ 295,634,969	£ 18,023,701	£ 21,932,537
Risk (40%)	£ 1,037,347,477	£ 75,704,849	£ 91,663,367
Inflation (40%)	£ 1,452,286,468	£ 105,986,789	£ 128,328,713
Total	£ 5,083,002,639	£ 370,953,762	£ 449,150,497
	£ 5,080,000,000	£ 371,000,000	£ 449,000,000

Exclusions
Optimism bias
Land
Building demolitions
VAT
Legal fees
Purchase of TBM - Potentially multiple purchases
Public realm improvements
Active travel solutions
Operating costs for bus/tram companies
Maintenenace/renewal costs

Item	Series	Quantity	Unit	Comment	Rubber-wheeled - Bristol City Centre					
					BCC-OPB	Total	BCC-OPD	Total	BCC-OPE	Total
Topsoil strip existing unpaved area	200	see option breakdown	m2	Assume take up all unpaved surfacing ready for new layout	4104.359	£ 93,095	4737.994	£ 107,467	232.394	£ 5,271
Break out and remove existing paved footway / central reserve surface	200	see option breakdown	m2	Assume take up all paved footway / central reserve surface ready for new layout	31116.461	£ 513,422	35876.319	£ 591,959	18502.98	£ 305,299
Break out existing kerbs to tip off site	200	see option breakdown	l/m	Assume 2no sets of kerbs to be removed along entire length of route	7000	£ 115,500	8200	£ 135,300	4550	£ 75,075
Existing gullies to be removed to tip off site	200	see option breakdown	nr	Assume gullies on one side of road to be removed, assume gully spacing is 40m	88	£ 968	103	£ 1,133	57	£ 627
Existing lighting columns to be removed and stored on site for re-use	200	see option breakdown	nr	Assume lighting columns placed alternatingly on each side of carriageway. Columns 10m tall and spacing 2.5 times the height. Assume 1 side needs removal	70	£ 10,313	82	£ 12,080	46	£ 6,777
Gullies to be installed	500	see option breakdown	nr	Assume gullies on one side of road to be replaced, assume gully spacing is 40m	88	£ 80,092	103	£ 93,744	57	£ 51,878
Gully pipework extension	500	see option breakdown	l/m	Assume on average 7.5m offset from existing gully placement	660	£ 55,220	773	£ 64,674	428	£ 35,809
Additional drainage works / attenuation due to increased impermeable surfacing	500	see option breakdown	m2	Quantity given is the increase in impermeable area across the route, including carriageway and footway	0	£ -	0	£ -	0	£ -
Carriageway resurfacing	700	see option breakdown	m2	Assumed entire carriageway to be resurfaced	40942	£ 5,916,406	49162	£ 7,104,253	20911	£ 3,021,786
Carriageway widening	700	see option breakdown	m2		0	£ -	0	£ -	0	£ -
Proposed new footway construction	1100	see option breakdown	m2	Assume all new footways	14000	£ 1,867,866	16400	£ 2,188,072	9100	£ 1,214,113
Proposed new cycleway construction	1100	see option breakdown	m2	Assume all new cycleways	10500	£ 1,753,752	12300	£ 2,054,395	3450	£ 576,233
Propose new road markings and signs	1200	see option breakdown	%			£ 50,000		£ 50,000		£ 30,000
Install lighting columns from store and associated electrical work	1300 / 1400	see option breakdown	nr		70	£ 331,861	82	£ 388,751	46	£ 218,080
Alteration to existing major junction; signalised	Gen	see option breakdown	nr		18	£ 3,600,000	20	£ 4,000,000	11	£ 2,200,000
Alteration to existing major junction; normal / compact roundabout	Gen	see option breakdown	nr		0	£ -	0	£ -	0	£ -
Alteration to existing major junction; signalised roundabout	Gen	see option breakdown	nr		2	£ 2,000,000	2	£ 2,000,000	0	£ -
Alteration to existing pedestrian crossing type; zebra crossing	Gen	see option breakdown	nr		0	£ -	0	£ -	0	£ -
Alteration to existing pedestrian crossing type; zebra crossing with refuge island	Gen	see option breakdown	nr		3	£ 45,000	3	£ 45,000	3	£ 45,000
Alteration to existing pedestrian crossing type; signal controlled crossing	Gen	see option breakdown	nr		3	£ 315,000	3	£ 315,000	1	£ 105,000
Alteration to existing pedestrian crossing type; signal controlled crossing with refuge island	Gen	see option breakdown	nr		4	£ 440,000	4	£ 440,000	3	£ 330,000
Alteration to existing bridges; underbridge	Gen	see option breakdown	nr		1	£ 500,000	4	£ 2,000,000	1	£ 500,000
Alteration to existing bridges; overbridge	Gen	see option breakdown	nr		1	£ 500,000	1	£ 500,000	0	£ -
Proposed green / planting strip	3000	see option breakdown	m2		6395.641	£ 529,681	7562.006	£ 626,278	6592.606	£ 545,993
Tunneling options - Including underground stations			item			£ -		£ -		£ -
Overground stations			item			£ -		£ -		£ -

	BCC-OPB	BCC-OPD	BCC-OPE
Sub-total	£ 18,718,174	£ 22,718,107	£ 9,266,941
Utilities (30%) (tunneling sections adjusted individually)	£ 5,615,452	£ 6,815,432	£ 2,780,082
Utilities (tunneling sections)	£ -	£ -	£ -
Traffic Management (15%) (reduced for tunneling options)	£ 2,807,726	£ 3,407,716	£ 1,390,041
Traffic Management (tunneling sections)	£ -	£ -	£ -
Preliminaries (30%)	£ 3,743,635	£ 4,543,621	£ 1,853,388
Project/design team fees (10%)	£ 1,871,817	£ 2,271,811	£ 926,694
Project management team fees (10%)	£ 1,871,817	£ 2,271,811	£ 926,694
Client costs (5%)	£ 935,909	£ 1,135,905	£ 463,347
Biodiversity net gain (3%)	£ 561,545	£ 681,543	£ 278,008
Surveys	£ 250,000	£ 250,000	£ 200,000
Overheads and profit (15%)	£ 3,650,044	£ 4,430,031	£ 1,807,053
Risk (40%)	£ 16,010,448	£ 19,410,391	£ 7,956,900
Inflation (40%)	£ 22,414,627	£ 27,174,547	£ 11,139,660
Total	£ 78,451,195	£ 95,110,916	£ 38,988,808
	£ 80,000,000	£ 95,000,000	£ 40,000,000

Exclusions
Optimism bias
Land
Building demolitions
VAT
Legal fees
Purchase of TBM - Potentially multiple purchases
Public realm improvements
Active travel solutions
Operating costs for bus/tram companies
Maintenenace/renewal costs

Item	Series	Quantity	Unit	Comment	Steel-wheeled - Bristol City Centre BCC-OPB	Total	BCC-OPD	Total	BCC-OPE	Total
Topsoil strip existing unpaved area	200	see option breakdown	m2	Assume take up all unpaved surfacing ready for new layout	4104.359	£ 93,095	4737.994	£ 107,467	232.394	£ 5,271
Break out and remove existing paved footway / central reserve surface	200	see option breakdown	m2	Assume take up all paved footway / central reserve surface ready for new layout	31116.461	£ 513,422	35876.319	£ 591,959	18502.98	£ 305,299
Break out existing kerbs to tip off site	200	see option breakdown	l/m	Assume 2no sets of kerbs to be removed along entire length of route	7000	£ 115,500	8200	£ 135,300	4550	£ 75,075
Existing gullies to be removed to tip off site	200	see option breakdown	nr	Assume gullies on one side of road to be removed, assume gully spacing is 40m	88	£ 968	103	£ 1,133	57	£ 627
Existing lighting columns to be removed and stored on site for re-use	200	see option breakdown	nr	Assume lighting columns placed alternatingly on each side of carriageway. Columns 10m tall and spacing 2.5 times the height. Assume 1 side needs removal	70	£ 10,313	82	£ 12,080	46	£ 6,777
Gullies to be installed	500	see option breakdown	nr	Assume gullies on one side of road to be replaced, assume gully spacing is 40m	88	£ 80,092	103	£ 93,744	57	£ 51,878
Gully pipework extension	500	see option breakdown	l/m	Assume on average 7.5m offset from existing gully placement	660	£ 55,220	773	£ 64,674	428	£ 35,809
Additional drainage works / attenuation due to increased impermeable surfacing	500	see option breakdown	m2	Quantity given is the increase in impermeable area across the route, including carriageway and footway	0	£ -	0	£ -	0	£ -
Carriageway resurfacing	700	see option breakdown	m2	Assumed entire carriageway to be resurfaced	40942	£ 6,981,359	49162	£ 8,383,019	20911	£ 3,565,707
Carriageway widening	700	see option breakdown	m2		0	£ -	0	£ -	0	£ -
Proposed new footway construction	1100	see option breakdown	m2	Assume all new footways	14000	£ 1,867,866	16400	£ 2,188,072	9100	£ 1,214,113
Proposed new cycleway construction	1100	see option breakdown	m2	Assume all new cycleways	10500	£ 1,753,752	12300	£ 2,054,395	3450	£ 576,233
Propose new road markings and signs	1200	see option breakdown	%			£ 50,000		£ 50,000		£ 30,000
Install lighting columns from store and associated electrical work	1300 / 1400	see option breakdown	nr		70	£ 331,861	82	£ 388,751	46	£ 218,080
Alteration to existing major junction; signalised	Gen	see option breakdown	nr		18	£ 3,600,000	20	£ 4,000,000	11	£ 2,200,000
Alteration to existing major junction; normal / compact roundabout	Gen	see option breakdown	nr		0	£ -	0	£ -	0	£ -
Alteration to existing major junction; signalised roundabout	Gen	see option breakdown	nr		2	£ 2,000,000	2	£ 2,000,000	0	£ -
Alteration to existing pedestrian crossing type; zebra crossing	Gen	see option breakdown	nr		0	£ -	0	£ -	0	£ -
Alteration to existing pedestrian crossing type; zebra crossing with refuge island	Gen	see option breakdown	nr		3	£ 45,000	3	£ 45,000	3	£ 45,000
Alteration to existing pedestrian crossing type; signal controlled crossing	Gen	see option breakdown	nr		3	£ 315,000	3	£ 315,000	1	£ 105,000
Alteration to existing pedestrian crossing type; signal controlled crossing with refuge island	Gen	see option breakdown	nr		4	£ 440,000	4	£ 440,000	3	£ 330,000
Alteration to existing bridges; underbridge	Gen	see option breakdown	nr		1	£ 500,000	4	£ 2,000,000	1	£ 500,000
Alteration to existing bridges; overbridge	Gen	see option breakdown	nr		1	£ 500,000	1	£ 500,000	0	£ -
Proposed green / planting strip	3000	see option breakdown	m2		6395.641	£ 529,681	7562.006	£ 626,278	6592.606	£ 545,993
Tunneling options - Including underground stations			item			£ -		£ -		£ -
Overground stations			item			£ -		£ -		£ -

	BCC-OPB	BCC-OPD	BCC-OPE
Sub-total	£ 19,783,127	£ 23,996,873	£ 9,810,862
Utilities (30%) (tunneling sections adjusted individually)	£ 5,934,938	£ 7,199,062	£ 2,943,259
Utilities (tunneling sections)	£ -	£ -	£ -
Traffic Management (15%) (reduced for tunneling options)	£ 2,967,469	£ 3,599,531	£ 1,471,629
Traffic Management (tunneling sections)	£ -	£ -	£ -
Preliminaries (30%)	£ 3,956,625	£ 4,799,375	£ 1,962,172
Project/design team fees (10%)	£ 1,978,313	£ 2,399,687	£ 981,086
Project management team fees (10%)	£ 1,978,313	£ 2,399,687	£ 981,086
Client costs (5%)	£ 989,156	£ 1,199,844	£ 490,543
Biodiversity net gain (3%)	£ 593,494	£ 719,906	£ 294,326
Surveys	£ 250,000	£ 250,000	£ 200,000
Overheads and profit (15%)	£ 3,857,710	£ 4,679,390	£ 1,913,118
Risk (40%)	£ 16,915,658	£ 20,497,342	£ 8,419,233
Inflation (40%)	£ 23,681,921	£ 28,696,278	£ 11,786,926
Total	£ 82,886,724	£ 100,436,974	£ 41,254,241
	£ 83,000,000	£ 101,000,000	£ 41,000,000

Exclusions
Optimism bias
Land
Building demolitions
VAT
Legal fees
Purchase of TBM - Potentially multiple purchases
Public realm improvements
Active travel solutions
Operating costs for bus/tram companies
Maintenenace/renewal costs

Appendix N

OMR Cost Build-Up

Figure N-1 - OMR cost by option (BRT)

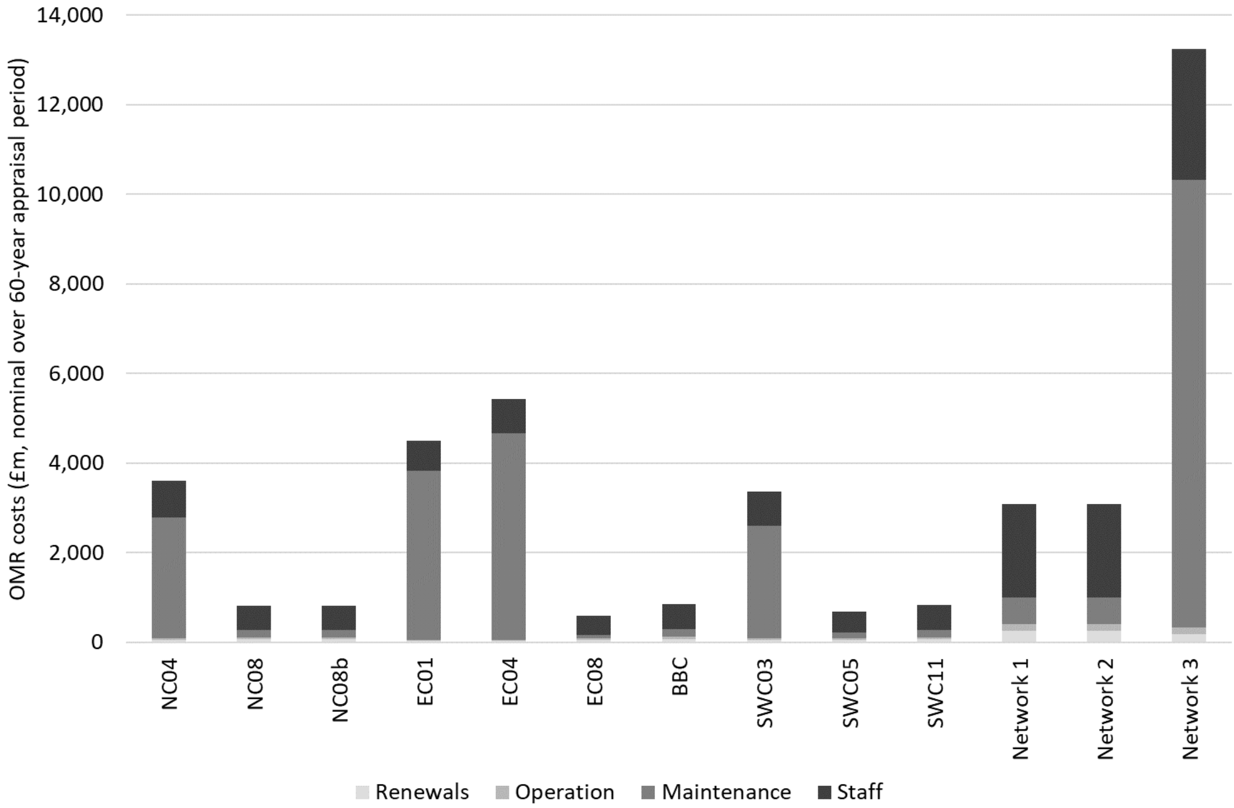
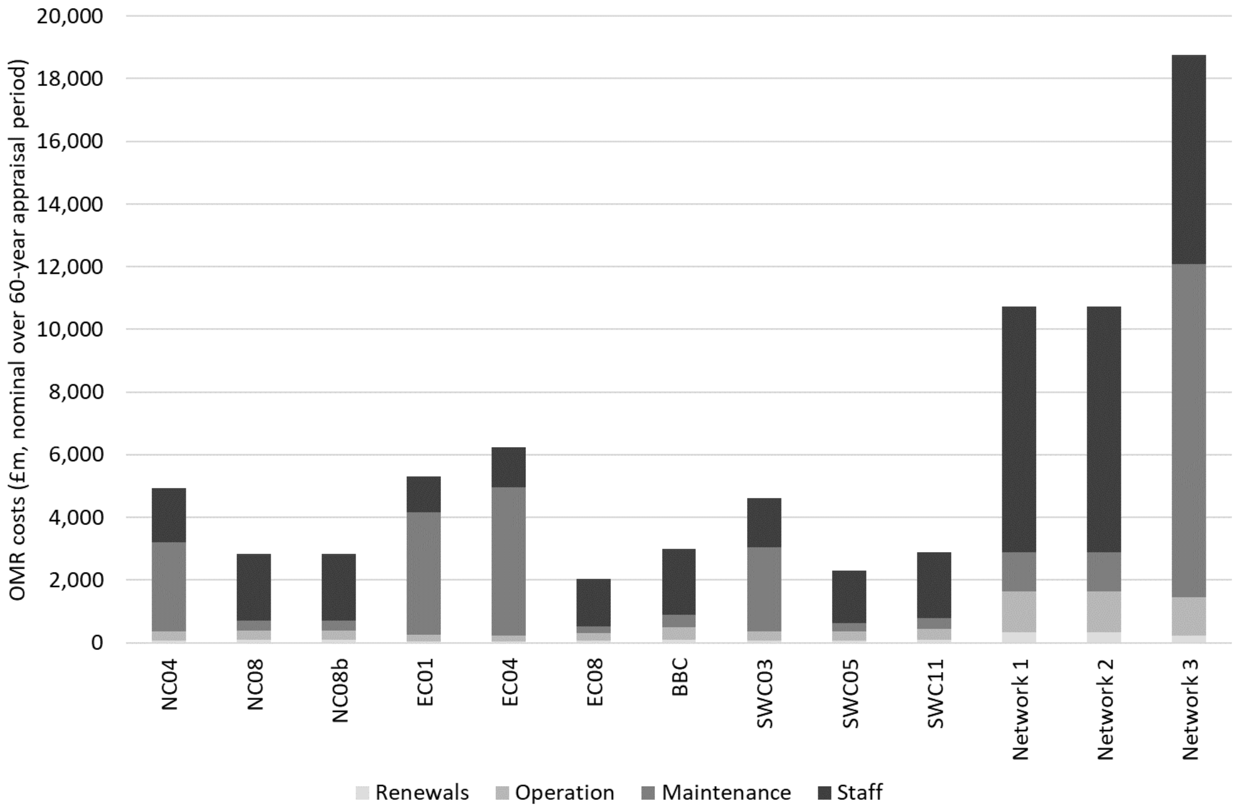


Figure N-2 - OMR cost by option (LRT)



Appendix O

Strategic Risk Register

Risk ID	Category	Threat or Opportunity?	Risk/Opportunity Description	Impact Description	Response (Mitigation and/or Contingency)	Risk Owner	Review Date	Residual Impact	Residual Probability	Residual Rating	Status
S1	Political	Threat	There may be difference in priorities or lack of buy-in between authorities when key decisions and agreements are needed to progress the programme to OBC. This includes decisions on solutions, funding and communications of the scheme.	1) If an agreement can't be reached, it would stop the development of the programme. In this scenario, WECA will be unable to progress the project through the business case process. 2) Delay to revist items and come to a concensus for all. 3) Reputation impact with DFT.	1) Achieving cross party support will serve to strengthen strategic supporting narrative. 2) Regular catch ups and updates with politicians from all local authorities to keep them informed and address issues early. 3) Look at better use of the steering groups to make this more effective. 4) A consistent and appropriate communication process should be in place to avoid inconsistency. WECA to coordinate messaging but then local partners to deliver to ensure the message is tailored to their key local stakeholders' priorities. WSP to pick this up as part of their monthly progress reporting through an agreed template for an effective messaging process. 5) Keep other, non-elected parties informed of progress.	WECA	Dec-22	Very High	Probable	High	Open
S2	Political	Threat	There is a threat that the programme does not communicate appropriately with key local politicians	1) Uncertainty from key local stakeholders on progress and expectations of the scheme. 2) Issues getting key decisions and options ratified.	1) Achieving cross party support will serve to strengthen strategic supporting narrative. 3) A consistent and appropriate communication process should be in place to avoid inconsistency. WECA to coordinate messaging but then local partners to deliver to ensure the message is tailored to their key local stakeholders' priorities. WSP to pick this up as part of their monthly progress reporting through an agreed template for an effective messaging process. 4) Stick to the existing governance. The CA is developing a reporting approach for CRSTS which could be rolled out across MT. But, this is still being explored	WECA	Dec-22	High	Very probable	High	Open
S3	Political	Threat	There is a risk that local projects and programmes which interface with this scheme may not be aligned.	1) Without awareness and cognisance of local development and plans, priorities may change or progress on interfacing projects/programmes may differ. This could lead to issues later down the line with buy in, sequencing etc	1) Ensure the process is in place and clear to allow an effective alignment, where it is required - including a dependency dates. 2) Dependencies Register regularly reviewed to ensure all interfaces are tracked. 3) Map developments to allow interfaces to come together at the right point. 4) Recognise that compromise must take place between individual corridors. Need to agree solution for allow this to move forward. 5) Integration of MT with CRSTS/ BB-SC working/steering groups to clearly understand the interface	WECA	Dec-22	Moderate	Very probable	High	Open
S4	Economic	Threat	There is an uncertainty on the funding allocation to develop the MT programme past OBC	1) Lack of clarity on funding will impact how and when Contractors are brought in to the scheme 2) The CA will not be able deliver the benefits to the region	1) Joint Committe have made clear their funding positions for the business cases and therefore risk for development is mitigated. However, the delivery funding will need to be clarified through the process.	WECA	Dec-22	Very High	Probable	High	Open
S16	Technological	Threat	Integrating with interfacing schemes at later stage may see the Mass Transit scheme not aligning with the proposed development sites. This includes: SDS, future technologies and all other emerging developments	1) There may be a need to re-align the 'concept' stage design 2) There may need to be process changes to ensure alignment between SDS and Mass Transit throughout 3) Cost associated with delivering metrobus and then Mass Transit	1) Ensure the interdependencies between Mass Transit and SDS are clearly defined in the Project Management Plan. 5) Review timeframe for local plan updates to confirm when route safeguarding will happen to support UAs. MT must hit local plan update dates. 6) Address how SDS not being live can be an opportunity to MT	WECA	Dec-22	High	Very probable	High	Open

S27	Stakeholder	Threat	WECA may not sufficiently capture the needs/wants of key stakeholders which influence Mass Transit. This includes the key stakeholders and the ways in which they should be engaged on key decisions.	1) A lack of stakeholder buy-in to the scheme, with potential for objector letters to be submitted to deciding bodies in response to the SOC / OBC.	1) Get approval for 1-2-1 engagement from the Infra Director's Board - particularly between now and the start of OBC	WECA	Dec-22	High	Very probable	High	Open
S29	Economic	Threat	The environment in which the MT is delivering – economic, political, geopolitical – could change overtime which result in uncertainties in areas difficult for WECA to control.	1) Challenges continuing to get buy in for the MT scheme	1) Regular stakeholder engagement 2) Maintain ability to be flexible as part of technical deliverable 3) Keeping abreast of latest guidance & central govt policy with a review to adjusting project to suit, wherever possible.	WECA	Dec-22	Moderate	Very probable	High	Open
S31	Governance	Threat	Substantial management and/or governance changes might be needed to deliver the MT than is assumed by WECA	1) Delay in MT progress while required governance processes are adhered to 2) Inefficient decision making and issues with delegation of authority	1) Undertake a delivery model assessment to understand the key delivery challenges and how these can be overcome	WECA	Dec-22	High	Probable	High	Open
S37	Organisation	Threat	WECA may not transform sufficiently - people and governance - to allow the CA to deliver a scheme of the complexity of MT which meets the outcomes and benefits of the intervention	1) Missed opportunity to capture benefits for the region, with the scale of ambition for Mass Transit not being achieved 2) An inadequate procurement process which sees the key objectives of MT missed 3) Inability to retain key staff 4) Curtailing of MT during the business case cycle	1) Mitigations to be determined	WECA	Dec-22	High	Probable	High	Open
S5	Sociological	Threat	There may be a client reputation risk due to the public perception of delivering a mass transit scheme under the current global economic environment	1) Lack of buy in from key stakeholders for the Mass Transit could lead to support being withdrawn or increased friction between the stakeholders at key decision points	1) Monitor and update key stakeholders at each checkpoint to understand that this risk is being mitigated. 2) A common message to go into the first month brief to politicians so they can answer it when it comes to it. 3) Highlight congestion, air quality narrative as part of transport delivery plan. 4) Address this as part of engagement/consultation	WECA	Dec-22	Moderate	Probable	Medium	Open
S6	Economic	Threat	Uncertain impact on the case for a mass transit scheme due to the national and/ or regional economic result of the Brexit process.	1) Lack of buy in from key stakeholders for the Mass Transit could lead to support being withdrawn or increased friction between the stakeholders at key decision points	1) Monitor and update key stakeholders at each checkpoint to understand that this risk is being mitigated. 2) A common message to go into the first month brief to politicians so they can answer it when it comes to it. 3) Highlight congestion, air quality narrative as part of transport delivery plan. 4) Monitor potential change in legislative environment	WECA	Dec-22	High	Unlikely	Medium	Open
S10	Technological	Threat	Due to the development of new technologies, the scheme may not provide a suitable solution for future travel needs	1) The future demand and assumptions which underpin the need for the construction scheme may be wrong/outdated 2) Cost impacts to revisit designs if decisions on technology are made now which need to be reversed at a later date	2) Confirm what decisions must be made and those which can remain open to allow flexibility later down the line. Client needs to give steer on this. Tech sifting has taken place with comments. 3) Confirm timeline for when technology decisions need to be made. 5) Engagement with the DfT for lessons learned on 'very light rail' 6) MT and BBSC to confirm a communications forum at OBC	WECA	Dec-22	Low	Very probable	Medium	Open

S11	Enviromental	Threat	The scheme may not appropriately address environmental issues This includes addressing - the climate emergency, potential declaration of a biodiversity emergency, green infrastructure plans, ecological, air quality	1) Cost implication of under estimating the environmental impacts and required mitigations which would be needed 2) Potential legal challenges if processes are not adhered to 3) Objections from local stakeholders	1) Ensure the narrative around how mass transit will help address the climate emergency is clear 2) Assure the evidence which underpins the narrative -- evidence must be clear and passed on to stakeholders. Role in addressing environmental issues. 3) Carbon Management Plan	WECA	Dec-22	High	Unlikely	Medium	Open
S12	Economic	Threat	The scheme may not interpret LTN1/20 consistently across the authorities Authorities being able to MEET the LTN1/20 not interpretation. Conflicts between bus priority measures and hiting LTN1/20	1) Not sufficiently considering active travel may see the appetite for funding the Mass Transit scheme reduce.	1) WECA to ensure LTN1/20 is tracked. 2) Ensure the designs are picking this up early and develop in line with requirements	WECA	Dec-22	Moderate	Probable	Medium	Open
S25	Political	Threat	There may not be the political will to resolve the complex Brisol City Centre issues.	1) Local and regional opposition to the Mass Transit scheme. 2) Impact of delay and additional cost 3) Loss of a fair amount of demand	1) Need to work closely with UA's to ensure they fully engaged in the SOC process and content.	WECA	Dec-22	Moderate	Probable	Medium	Open
S26	Stakeholder	Threat	MT may not meet the expectations set by local politicians, the public and/or other key stakeholder influences.	1) Mass Transit to be reduced in scale to accommodate funding and financing constraints. 2) Reputational impacts at a local and regional level.	1) Stakeholder engagement and public consultation to ensure that the public (and press) are brought along on the journey of Mass Transit's development and are able to impact the end-product.	WECA	Dec-22	High	Unlikely	Medium	Open
S28	Scope	Threat	The scope of MT may change or develop further due to the current/changing global situation – end of Covid, inflation, war in Ukraine.	1) Reduction in the value for money of the scheme as it develops	1) Continue to monitor the impact of events on the MT 2) Continue to raise early warnings and issues as they raise through the contract	WECA	Dec-22	Moderate	Probable	Medium	Open
S32	Technological	Threat	During the design and development of MT, opetational limitations and constraints may not be sufficiently considered	1) Technical solution achieved is not future-proofed or flexible enough to take on the region's changing requirements	1) Early contractor involvement; 2) Engagement with other authorities and delivery bodies undertaking similar schemes - selection of delivery partner with this in mind 3) Get Operators involved - this must be in the programme and picked up at the start of the OBC programme. 4) Does the CRSTS and BSIP integration need to be considered here?	WECA	Dec-22	Moderate	Probable	Medium	Open
S36	Economic	Threat	Delays in developing and developing MT may see the underlying dependent economic growth in the region missed	1) Reduction in the benefits of the programme	1) Track dependency register carefully 2) Track S106 or CIL requirements that set out a need for improved public transport. May also impact first mile last mile decisions. 3) Clarity around phasing to develop in line with policy, including local plans	WECA	Dec-22	High	Unlikely	Medium	Open
S13	Political	Threat	There is a risk that future infrastructure building will be objected to due to the fallout of the COVID-19 pandemic and greater environmental considerations	1) Local and regional opposition to the Mass Transit scheme. 2) Lack of public support evident from consultation	1) Subject to final BCC proposals, which could be for outbound bus link with fully segregated cycle route in both directions. 2) A consistent and appropriate communication process should be in place to avoid inconsistency. 3) Reinforcing the premise in JLTP4 which will allow for reallocation on A4. 4) Take this in to consideration and focused on while assessing options.	WECA	Dec-22	Moderate	Very unlikely	Low	Open

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