MOTT MACDONALD

Cambridge South East Transport Phase 2

Outline Business Case - Economic Case

15 May 2020

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Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	20/03/2020	A Hewitt M Lambert K Bell H Kenyon J Vickers-Strutt	H Clarke M Payne	J Saldanha	Draft for client review
B	15/05/2020	A Hewitt M Lambert K Bell	H Kenyon	M Payne	Issued for approval

Document reference: 403394-MMD-BCA-00-RP-BC-0292 Rev B

Information class: Standard

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Glossary of Terms

Analysis of Monetised Cost and Benefits (AMCB) table: Summarises the monetised impacts of a scheme that are included in the scheme's Net Present Value and Benefit-Cost Ratio.

Appraisal Summary Table (AST): Provides a complete summary of the scheme impacts, including the scheme's monetised impacts and non-monetised impacts (both quantitative and qualitative).

Assumption: A statement which is not yet known to be true. It can be a bridge in the planning process to answer an uncertainty, and to allow scope and plans to be developed

Benefit Cost Ratio (BCR): Benefit Cost Ratio, is an indicator of the overall value for money of a project or proposal.

CaCC: Cambridge City Council

CCC: Cambridgeshire County Council

Cambridge Autonomous Metro (CAM): CAM is the proposed metro style system for Greater Cambridge.

Committed Schemes: Where a scheme has been deemed likely to proceed and is therefore included within the option appraisals.

Conservation Area: An area designated under Section 69 of the Planning (Listed Buildings and Conservation Areas) Act 1990 as being of special architectural or historic interest and with a character or appearance which is desirable to preserve or enhance.

Context: The setting of a site or area, including factors such as traffic, activities and land uses as well as landscape and built form.

Controls: Risk response activities that are undertaken as business as usual. These are identified as an aide-memoire, to draw attention to the purpose and aim of standard procedures and drive appropriate focus. Typically, controls will not incur any additional cost to delivery.

Countryside: The rural environment and its associated communities.

Cumulative Impact: The summation of effects that result from changes caused by a development in conjunction with other past, present or reasonably foreseeable actions.

Department of Transport (DfT): is a ministerial department, supported by 24 agencies and public bodies that plans and invests in transport infrastructure in the UK.

Dependency: An activity or activities which cannot be undertaken or completed until another scope of work has completed or reached a defined stage or point.

Early Assessment Sifting Tool (EAST): Early Assessment Sifting Tool is used by DfT, to quickly summarise and present evidence on options. INSET is an enhancement of EAST and follows the same broad principles and approach.

Effect: The consequence of the scale of any change to the baseline environment, i.e. impact, on the environmental receptor, taking account of its particular value or sensitivity.

Element: A component part of the landscape (for example, roads, hedges, woods).

Emerging Scheme: The best performing route alignment option for CSET phase 2 based on assessment to date.

Enhancement: Landscape improvement through restoration, reconstruction or creation.

Environment: Our physical surroundings including air, water and land.

Environmental Impact Assessment (EIA): A formal, structured process of evaluating the likely environmental impacts of a proposed scheme, considering inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.

Exclusion: An activity or product that has been specifically removed or omitted from the scope of work for the defined project.

Fall-backs: Contingency actions taken in response to a risk impact. Generally, risks that are tolerated should have fall-back actions identified, as should significant risks that are being treated, where the treatment has a significant likelihood of not fully mitigating the risk.

Full Business Case (FBC): The culmination of the three-stage business case process is the Full Business Case. This follows on from initial exploratory work to establish the strategic need for intervention in the Strategic Outline Business Case and the optioneering and appraisal work undertaken in the Outline Business Case. Generally, an investment committee will consider the Full Business Case then make a recommendation to ministers. Ministers will decide whether a proposal should proceed to implementation, however as funding and powers for transport investment have been devolved to the Greater Cambridge Partnership (GCP) as part of the Greater Cambridge City Deal, the decision to implement the scheme resides with GCP.

Form: The layout (structure and urban grain), density, scale (height and massing), appearance (materials and details) and landscape of development.

Gross Domestic Product (GDP): A measure of the total value of goods produced and services provided in an area.

Gross Value Added (GVA): A measure of the economic productivity of an area.

High Quality Public Transport (HQPT): High Quality Public Transport, is a transport system that includes a range of features such as high levels of segregation, junction priority, high quality infrastructure (shelters, CCTV, real time, lighting, seating, help points etc), and high quality vehicles to name but a few.

Heritage Asset: A building, monument, site, place, area or landscape of historic value.

Investment Sifting and Evaluation Tool (INSET): INSET is Mott MacDonald's evaluation tool used in the optioneering process. INSET is an enhancement and expansion of EAST.

Issue: A significant unanticipated event, or a risk which has impacted or has a >99% likelihood of occurrence, that affects the achievement of the project objectives.

Landform: Combination of slope and elevation that produce the shape and form of the land.

Landscape: The character and appearance of land, including its shape, form, ecology, natural features, colours and elements and the way these components combine. Landscape character can be expressed through landscape appraisal, and maps or plans. In towns 'townscape' describes the same concept.

Landscape Character: The distinct and recognisable pattern of elements that occur consistently in a particular type of landscape, and how this is perceived by people. It reflects particular combinations of geology, landform, soils, vegetation, land use and human settlement. It creates the particular sense of place of different areas of the landscape.

Landscape Feature: A prominent eye-catching element, for example, wooded hilltop or church spire.

Landscape Quality: Based on judgements about the physical state of the landscape, and about its intactness, from visual, functional, and ecological perspectives. It also reflects the state of repair of individual features and elements which make up the character in any one place.

Landscape Sensitivity: The extent to which a landscape can accept change of a particular type and scale without unacceptable adverse effects on its character.

Land Use: The primary use of the land, including both rural and urban activities.

Local Liaison Forum (LLF): The LFF provide a link between a project team and the local community.

Multi Criteria Assessment Framework (MCAF): Multi-Criteria Assessment Frameworks are used in the optioneering assessment process and allow options to be assessed against a range of criteria linked to the scheme objectives as well as wider policy and strategy objectives.

Methodology: The specific approach and techniques used for a given study.

Mitigation: Measures, including any process, activity or design to avoid, reduce, remedy or compensate for adverse landscape and visual effects of a development project.

Modal Shift: A shift from one transport type to another e.g. road travel to rail travel.

Movement: People and vehicles going to and passing through buildings, places and spaces. The movement network can be shown on plans, by space syntax analysis, by highway designations, by figure and ground diagrams, through data on origins and destinations or pedestrian flows, by desire lines, by details of public transport services, by walk bands or by details of cycle routes.

Nomis: A service provided by the Office for National Statistics, ONS, that provides free access to the most detailed and up-to-date UK labour market statistics from official sources.

Option Appraisal Report (OAR): The Options Appraisal Report sets out the process undertaken to identify and assess options, leading to the selection of the preferred option.

Outline Business Case (OBC): Is the second phase of the process which reconfirms the conclusions set out in the Strategic Outline Business Case (SOBC). The OBC focuses on the detailed assessment of the options to find the best solution.

Prince 2: PRojects **IN C**ontrolled **E**nvironments is a process-based method for effective project management, used extensively by the UK Government. It adopts a product-based planning approach to project management with emphasis on dividing projects into manageable and controllable stages.

Public Accounts (PA) table: Records the investment and operating costs incurred by a public sector in delivering the scheme.

Receptor: Something that makes up the environmental baseline e.g. humans or other biological species, elements of the physical environment including water, air and soil assets that make up the cultural heritage of an area.

Risk (Threat): An uncertain event or set of circumstances that, should it occur, will have an adverse effect on the achievement of the objectives of the project.

Risk (Opportunity): An uncertain event or set of circumstances that, should it be exploited, will have a positive effect on the achievement of the objectives of the project.

SATURN: Simulation and Assignment of Traffic in Urban Road Networks, is a computer program that calculates route choices between origin and destination.

Social and Distributional Impacts (SDI): considers the variance of transport intervention impacts across different social groups.

Strategic Outline Business Case (SOBC): This sets out the need for intervention (the case for change) and how this will meet strategic aims and objectives (the strategic fit). It provides suggested or preferred ways forward and presents the evidence for a decision.

Strategic View: The line of sight from a particular point to an important landmark or skyline.

Sustainability: The principle that the environment should be protected in such a condition and to such a degree that ensures new development meets the needs of the present without compromising the ability of future generations to meet their own needs.

Topography: A description or representation of artificial or natural features on or off the ground.

Townscape: Physical and social characteristics of the built and unbuilt urban environment and the way in which those characteristics are perceived. The physical characteristics are expressed by the development

form of buildings, structures and space, whilst the social characteristics are determined by how the physical characteristics are used and managed.

Transport Appraisal Guidance (TAG): The DfT's Transport Appraisal Guidance (often referred to as TAG)

Transparent Economic Assessment Model (TEAM): TEAM is a tool designed to calculate the economic impacts and benefits of proposed infrastructure interventions and policy measures.

Tranquillity: A state of calm or quiet.

Transport Economic Efficiency (TEE) table: Summarises the monetised impacts against different user groups.

Transport User Benefit Appraisal (TUBA): TUBA is an economic appraisal computer program developed for the Department for Transport (DfT) for appraising multi modal transport studies.

Uncertainty: A condition where the outcome can only be estimated.

Visual Impact: Change in the appearance of the landscape as a result of development. This can be positive (i.e. beneficial or an improvement) or negative (i.e. adverse or a detraction).

Wider Economic Benefits (WEBs): improvements in economic benefits that are acknowledged, but which are not typically captured in traditional transport cost-benefit analysis.

1 Introduction

The Economic Case is one of the five cases that form the DfT's Transport Business Case process. The Economic Case assesses options to identify all their impacts, and the resulting value for money, to fulfil Treasury's requirements for appraisal and demonstrating value for money in the use of taxpayer's money. The Economic Case identifies what economic, environmental, social and distribution impacts the scheme is expected to deliver.

The other four cases which make up the Transport Business Case Process are:

- The **Strategic Case** which determines whether an investment is needed, either now or in the future. It demonstrates the case for change – that is, a clear rationale for making the investment and its strategic fit – how an investment will further the aims and objectives of the organisation. The Strategic Case is presented in document 403394-MMD-BCA-00-RP-BC-0247.
- The **Financial Case** which outlines the affordability of the preferred option, its funding arrangements and technical accounting issues. The case also presents the financial profile of the preferred option and an overview of how the scheme will be funded. The Financial Case is presented in document 403394-MMD-BCA-00-RP-BC-0293.
- The **Commercial Case** which provides evidence on the commercial viability of a proposal and the procurement strategy that is used to engage the market. It presents evidence on risk allocation and transfer, contract timescales and implementation timescale as well as details of the capability and skills of the team delivering the project. The Commercial Case is presented in document 403394-MMD-BCA-00-RP-BC-0231.
- The **Management Case** which assesses whether a proposal is deliverable. It tests the project planning, governance structure, risk management, communications and stakeholder management, benefits realisation and assurance (e.g. a Gateway Review). The Management Case is presented in document 403394-MMD-BCA-00-RP-BC-0277.

The remainder of this document comprises the Economic Case for Phase 2 of the Cambridge South East Transport (CSET) Phase 2 project.

1.1 Approach

The Economic Case for CSET Phase 2 has been developed to ensure that it proportionally follows the requirements of the DfT's 'The Transport Business Case: Economic Case' which are noted in Table 1.1.

Table 1.1: Compliance with DfT Requirements for the Economic Case at OBC

Content	DfT Requirements	Section Number and Title (s)
Introduction	Outline approach to assessing value for money	1 Introduction
Options appraised	A list of options (set out in the Strategic Case) that have been appraised	3 Options Appraised
Assumptions	TAG sets out assumptions that should be used in the conduct of transport studies. List any further assumptions supporting the analysis.	5.2 Assumptions
Sensitivity and risk profile	Set out how changes in different variables affect the Net Present Value/Net Present Cost. The risk profile should show how likely it is that these changes will happen.	13 Sensitivity Tests
Appraisal Summary Table	See TAG for detailed guidance on producing the Appraisal Summary table	12.4 Appraisal Summary Table
Value for Money Statement	See Value for Money guidance on producing the VfM statement.	12.2 Value for Money Statement

Source: DfT

1.2 Scheme Overview

The Greater Cambridge Partnership (GCP) is promoting a transport scheme to improve links between Cambridge Biomedical Campus and the junctions of the A11 with the A1307 and A505, providing improved connectivity for peripheral communities such as: Linton, the Abingtons, Babraham, Pampisford, Sawston, Stapleford and Great and Little Shelford. This scheme will create a vital link to ease congestion, offer sustainable travel choices, connect communities and support growth. The scheme is known as the Cambridge South East Transport (CSET). Phase 1 of CSET consists of 15 small-to-medium work packages, with a timeline for completion between 2018-2020.

It is proposed that Phase 2 of CSET will deliver a new dedicated public transport route between a new Travel Hub near the A11/A1307/A505 junction and the Cambridge Biomedical Campus via Sawston, Stapleford and Great Shelford. This report presents the economic case for the preferred route option known as the Brown option. Full details of the preferred scheme design are presented in Section 1.4.

The Economic Case assesses options to identify all their impacts, and the resulting value for money, to fulfil Treasury's requirements for appraisal and demonstrating value for money in the use of taxpayers' money the Economic Case identifies what economic, environmental, social and distributional impacts the scheme is expected to have.

This report presents the economic case for the scheme and focuses on the monetised impacts of the scheme. The report sets out to provide:

- An assessment of the economic benefits of the CSET Phase 2 project capturing economic, environmental, social and distribution impacts of the scheme.
- An assessment of the scheme Value for Money (VfM) based on outputs from the Cambridge Sub-Regional Model 2 (CSRM2), as well as the monetisation of other scheme benefits where proportional to their impact, and the latest available scheme costs following current guidance on VfM.

The report describes the methodology used to produce the transport economic appraisal, the calculation of accidents benefits, journey time reliability benefits and wider economic impacts. Furthermore, this report describes the methodologies used to complete the appraisals of noise, air quality and greenhouse gases.

1.3 Scheme Objectives

The key objectives of the proposed scheme are to:

1
- **Support the continued growth of Cambridge and south Cambridge's economy.**
- Deliver journey time savings for commuters travelling by public transport to job opportunities in south east Cambridge and central Cambridge.
- Improve journey time reliability for users of the A1307 corridor.
- Provide the transport infrastructure necessary to sustain economic growth.

2
- **Relieve congestion and improve air quality in south east Cambridge.**
- Encourage use of sustainable transport modes for journeys through south east Cambridge and into central Cambridge.
- Enhance quality of life by relieving congestion and improving air quality in south east Cambridge.
- Relieve pressure at network pinch points.

3
- **Improve active travel infrastructure and public transport provision in south east Cambridge.**
- Deliver a High Quality Public Transport (HQPT) offer between Cambridge and Haverhill.
- Increase frequency of public transport services during peak periods.
- Reduce severance for cyclists, pedestrians and equestrians.
- Increase uptake of sustainable transport modes for commuter journeys.

4
- **Improve road safety for all users of the A1307 corridor.**
- Reduce the number of accidents at identified accident clusters along the corridor.
- Reduce the number of speed related incidents along the corridor.
- Improve the safety of crossing movements for cyclists, pedestrians and equestrians.

5
- **Improve connectivity to employment sites in south east Cambridge and central Cambridge.**
- Provide improved access to the Granta Park, Addenbrooke's Hospital, Cambridge Biomedical Campus (CBC) and a number of other employment sites in south east Cambridge.
- Increase modal options for commuters travelling to and from employment sites in south east Cambridge and central Cambridge by delivering a HQPT network and improved active travel routes for users.

1.4 The Preferred Option

The preferred option for the CSET Phase 2 project is the Brown route, with a detailed description as follows:

- The preferred option starts on the Cambridge Biomedical Campus (CBC) at the junction of the existing guided busway with Francis Crick Avenue. It runs along Francis Crick Avenue before exiting on the southern side of the CBC and running parallel with the railway.
- It then diverts to the east of Great Shelford and Stapleford before crossing the River Granta and running to the east of Sawston.
- Four passenger stops are proposed at the CBC, Hinton Way (Great Shelford), Haverhill Road (Stapleford) and Sawston Road (Sawston).
- The route then crosses each of these roads and Granham's Road, via a new at-grade junction to be signalised with priority given to public transport vehicles.
- Before reaching High Street the route then cuts across fields towards the A11 which includes a second crossing of the River Granta.

- The route ends at Travel Hub Site B, located to the south west of the junction between the A1307 and A11. General traffic would access it from the A1307 via a new roundabout junction whilst the site itself would have a linear arrangement in order to accommodate it between a high-pressure gas main, over which development is restricted, and the A11. The site could provide parking for up to 2,800 cars.

Figure 1.1: CSET Phase 2 Preferred Option

Source: Mott MacDonald

1.5 Scheme Key Features

The CSET Phase 2 project will offer the following features and benefits: (all benefits shown for forecast year 2026).

Table 1.2: CSET Phase 2 Preferred Option Key Features

Benefit	Preferred Option
Journey Times: Travel Hub Site B to Cambridge	**AM Peak (08:00-09:00)** • 23 minutes **PM Peak (17:00-18:00)** • 25 minutes
Demand (peak hour P&R vehicles)	**AM Peak Hour (08:00-9:00)** • Inbound - 430 vehicles of which 170 are new P&R vehicle trips (40%) **PM Peak Hour (17:00-18:00)** • Outbound - 380 vehicles of which 170 are new P&R vehicle trips (45%)
Demand (peak hour P&R passengers)	**AM Peak Hour (08:00-09:00)** • Inbound - 580 P&R passengers of which 230 are new P&R passenger trips (40%) **PM Peak Hour (17:00-18:00)** • Outbound - 530 P&R passengers of which 240 are new P&R passenger trips (45%)
HQPT Service Frequency (peak)	30 minute frequency (2 services per hour) between Haverhill and Cambridge City Centre 15 minute frequency (4 services per hour) between Granta Park and Cambridge City Centre 7/8-minute frequency (8 services per hour) between Travel Hub and Cambridge City Centre
Parking Capacity at Travel Hub	Up to 2,800 additional P&R car spaces
HQPT Service Capacity (peak)	Circa 600 passenger capacity (Example 46 seats + 30 standing per vehicle)
Journey Time Reliability	Provision of reliable service operating on segregated public transport route between Travel Hub and Cambridge
Mode Shift	Minimal transfer to P&R Key objective is to increase P&R choice, availability and capacity
Wider Economic Impacts	Supports continued investment in key employment locations including: • Cambridge Biomedical Campus • Babraham Research Centre • Granta Park Supports the delivery of housing along the CSET corridor, including: • Sawston
Environmental	Reduces distance travelled purely by private car Improves air quality in the Cambridge City Centre AQMA

Source: Mott MacDonald

2 Approach to Economic Appraisal

2.1 Introduction

As detailed in Appendix A: Options Appraisal Report (OAR), document reference 403394-MMD-BCA-00-RE-BC-0024, and in Section 18 of the Strategic Case, document reference 403394-MMD-BCA-00-RP-BC-0247, a total of 231 option packages consisting of combinations of 11 potential Travel Hub sites and 25 different route alignments were appraised in a 4-stage appraisal process to arrive at an indicative preferred option.

The initial 231 option packages were reduced to 90 following a gateway assessment. These 90 options were then subject to a rigorous qualitative appraisal process using INSET. INSET is a decision support toolkit developed in-house by Mott MacDonald and was used to carry out the initial high level sift of route alignment options. Based on HM Treasury Green Book compliant Multi-Criteria Decision Analysis (MCDA) and accepted by the DfT as a valid assessment framework, INSET is flexible, replicable and transparent and can be used for both high level qualitative option sifting and detailed quantitative appraisal. Detail on the operation of INSET can be found in Appendix A: OAR (document reference 403394-MMD-BCA-00-RE-BC-0024).

The results of the INSET appraisal led to an option shortlist of five options, which were then quantitatively assessed to identify an indicative preferred option as summarised in Section 19 of the Strategic Case (document reference: 403394-MMD-BCA-00-RP-BC-0247) and detailed in Appendix A: OAR (document reference 403394-MMD-BCA-00-RE-BC-0024).

The five shortlisted options were also taken to public consultation and feedback was also considered in the identification of the preferred option.

Both the INSET appraisal process and feedback from public consultation identified the Brown Option, detailed in Section 19 of the Strategic Case, as the indicative preferred option.

As a means of sense checking the INSET appraisal results and consultation feedback, this Economic Case documents an additional appraisal process and has compared the Benefit Cost Ratio (BCR) and VfM of the five shortlisted options in line with DfT TAG guidance. The BCR and VfM were not included in the appraisal criteria established for INSET and as such the appraisal documented here is independent of the INSET process.

Social and Distributional Appraisals were also undertaken on the five shortlisted options, again adopting DfT TAG guidance and established appraisal criteria that were not included in the INSET appraisal.

2.2 Transport Guidance and Wider Economic Impacts

The HM Treasury (HMT) Green Book[1] provides central government guidance on how to appraise and evaluate public policies, projects and programmes (the Five Case Model), which is based on the principles of welfare economics. The Department for Transport (DfT) Transport Appraisal Guidance (TAG) is the Department's internal guidance on business case making, which the Outline Business Case (OBC) for this scheme is consistent with.

The Economic Case for the scheme includes Cost-Benefit Analysis (CBA) of user and non-user impacts (from changes in travel costs and times, including decongestion), changes in the externalities associated with car use (e.g. emissions and accidents), and changes in operating costs and revenue to the public and private sector. These, under an assumption of no changes in land use, are all termed Level 1 impacts. When set against a scheme's projected capital and operating expenditure, these result in an Initial BCR. User benefits (in the form of monetised travel time savings) are typically the principal effect of a transport improvement and form the core of an economic appraisal but there is wide agreement that they fail to capture the full impact of major projects.

[1] The Green Book: Central Government Guidance on Appraisal and Evaluation, HM Treasury, 2018

Through consumer surplus theory, user benefits are assumed to act as a proxy for conventional economic impacts, e.g. changes in Gross Domestic Product (GDP), or, at a local/regional level, Gross Value Added (GVA) and the associated jobs gains and productivity uplifts. In practice, however, because of the presence of market failures the benefits accruing to users may only partially account for the benefits of a transport improvement.

Since the mid-2000s, this analysis has been augmented within TAG[2] with recommendations for the assessment of Wider Economic Impacts (WEIs), as set out in TAG units A.2.1-A.2.4 (& TAG unit M5.3) and shown in Figure 2.1 below. This guidance seeks to capture the net additional impacts (at the UK level) that can arise as the impact of the transport improvements are transmitted into the wider economy, beyond those businesses and passengers that are directly affected by the transport change.

The DfT's latest guidance on WEIs (published May 2018, updated May 2019) identifies three 'levels' of impact and these have been incorporated into the VfM assessment. These include:

- **Level 1 (User benefits):** These are direct effects and comprise the savings in time, vehicle operating costs and other elements of 'generalised travel cost' associated with better transport. The Level 1 BCR also includes some monetised externalities to society and the environment. These are also termed 'established' monetised economic impacts of transport investment (as they have long been the mainstay of economic appraisal).
- **Level 2 (Productivity effects):** these are productivity gains accruing to firms and workers, including those that are not themselves necessarily users of the transport improvement. These arise because of the economic benefits of scale and economic density, both of which are known to lead to higher productivity. These are also termed 'evolving' monetised economic impacts and are initially (for Level 2) considered in terms of **fixed land use** scenarios, i.e. no interaction between transport supply and land use patterns.
- **Level 3 (Investment and employment effects):** these result from the potential for transport to alter patterns of private sector investment and employment, and thereby land use. This is a complex area of debate given transport links are but one factor shaping the location decisions for firm's investment. The concepts of additionality, displacement and the social value of investment are important here. These effects are also 'indicative' monetised impacts and can involve **dynamic land use** scenarios (in response to changes in transport supply).

[2] https://www.gov.uk/guidance/transport-analysis-guidance-TAG

Figure 2.1: WEIs and Levels of Analysis

Table 2 - Relationships between Wider Economic Impacts, Levels of Analysis and Land Use assumptions

	Level 1 (Initial BCR)	Level 2 (Adjusted BCR)	Level 3 (Indicative Monetised Impacts or Non-Monetised Impacts)
Fixed Land Use	User benefits →		
		Static Clustering →	
Implicit Land Use Change		Output Change in Imperfectly Competitive Markets →	
		Labour Supply Impacts →	
Explicit Land Use Change			Dependent Development
			Move to More/Less Productive Jobs
			Dynamic Clustering
			Supplementary Economic Modelling

***Note that the arrows signify the previous levels of analysis are required**

Source: TAG Unit A2.1, Wider Economic Impacts Appraisal, May 2018[3]

The primary rationale of the CSET Phase 2 project is to support the continued growth of Greater Cambridge by providing new transport infrastructure that will provide effective links to development sites, supporting housing and employment growth. Fundamentally, given the overall aim of these proposals are to enable growth by ensuring sufficient transport capacity, it is critical that the business case, whilst adhering to DfT's TAG Unit A2.1 guidance, looks more widely from a local economic development perspective at how the scheme supports economic growth in Greater Cambridge and how these translate into net economic impacts at the UK level.

The remaining sections provide an overview of the adopted approach for the assessment of each identified benefit level in the context of CSET Phase 2.

2.2.1 Level 1: Transport Impacts

The Level 1 benefits for the CSET Phase 2 project have been calculated in line with DfT guidance to inform the initial VfM assessments and the initial BCR. The appraisal focused on the monetised transport user benefits to produce the initial BCR, as shown in Table 2.1 below.

Table 2.1: Level 1 Benefits Informing Core VfM Statement

Benefit	Description
Transport User Benefits (TAG A5-4)	• Transport economic appraisal is undertaken in accordance with published DfT guidance This has followed the marginal external costs method from TAG unit A5-4. • The use of road vehicles incurs both private costs borne by the individual traveller, such as fuel and personal travel time, and external costs borne by others. For car use, these external costs include congestion, air pollution, noise, infrastructure and accident costs.

[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/712878/tag-unit-a2-1-wider-impacts-overview-document.pdf

Benefit	Description
	• The MEC method is based on the change in these external costs arising from a change in vehicle kms as a result of the scheme.
Safety (TAG A5-4)	• As with the transport user benefits, this has followed the marginal external costs method from TAG unit A5-4.
Air Quality (TAG A5-4)	• As with the transport user benefits, this has followed the marginal external costs method from TAG unit A5-4.
Noise (TAG A5-4)	• As with the transport user benefits, this has followed the marginal external costs method from TAG unit A5-4.
Greenhouse Gases (TAG A5-4)	• As with the transport user benefits, this has followed the marginal external costs method from TAG unit A5-4.
Active Travel (TAG A5-4)	• Appraisal of the active travel benefits associated with changes to walking and cycling trips using the DfT Active Mode Appraisal Toolkit (AMAT)

Source: Mott MacDonald

2.2.2 Level 2: Wider Economic Impacts (Fixed Land Use)

Level 2 benefits have been calculated in accordance with TAG Unit A2-1 and use the transport modelling outputs as a basis for all calculations. The results of the Level 2 benefit appraisal were used to inform an adjusted BCR that takes into account the WEIs of the CSET Phase 2 project, assuming fixed land use.

This appraisal, shown in Table 2.2 below, only captures impacts that are not already included in the conventional transport user benefit calculations, including:

- Agglomeration;
- Tax revenues arising from labour market impacts, and;
- Output change in imperfectly competitive markets.

Table 2.2: Level 2 - Project Benefits Informing Adjusted VfM Statement

Benefit	Description
Agglomeration (TAG Unit A2.1)	• Agglomeration refers to the concentration of economic activity over an area. Transport can increase the accessibility of an area for businesses and workers, therefore impacting on the level of agglomeration, through the reduction of generalised costs for business and commuting trips. • The level of agglomeration reflects the productivity benefits experienced by businesses as a result of improved connections to other businesses and to potential employees thus improving interaction, knowledge exchange and access to markets, including labour markets.
Tax revenues arising from labour market impacts (TAG Unit A2.1)	• Transport can have an impact on labour supply by affecting the overall costs and benefits to individual workers. An individual will weigh the cost of travel against the wages of a job travelled to. Changes in transport costs is likely to have an impact on the incentives of individuals to work and hence have an impact on the overall level of labour supplied in the economy. • This can have a positive impact on the economic at a national level with an increase in potential workers employed affecting the level of UK GDP through increases in tax revenues
Output change in imperfectly competitive markets (TAG Unit A2.1)	• Markets are generally considered not to be perfectly competitive, thus leading to lower production and higher prices than would exist in a perfectly competitive market. This is seen as being detrimental to consumers and the economy as a whole. • Reductions in transport costs allows for an increase in production in the goods and services that use transport, reducing costs so that businesses can make more profit or pass on the saving to customers so they can be more competitive.

Source: Mott MacDonald

2.2.3 Level 3: Wider Economic Impacts (Land Use Change)

The CSET Phase 2 project supports the spatial growth planned in Greater Cambridge and therefore has the potential to alter patterns of private sector investment and employment, and thereby land use.

The assessment of the Level 3 impacts has been based on a Land Value Uplift (LVU) approach which examines how the CSET Phase 2 project supports the planned development along the corridor. This includes the economic impacts at a:

- **Greater Cambridge level**, which focuses on how the CSET Phase 2 project helps to address transport and housing bottlenecks along the corridor and therefore support development. The economic impacts are measured in terms of gross jobs and the associated Gross Value Added (GVA) supported at development sites along the corridor. This primarily informs the Strategic Case.
- **UK level**, which focuses on the net benefits for the UK. A key consideration in order to set out the Level 3 WEIs is producing a best understanding of the difference between the net impacts at the sub-national level, i.e. Greater Cambridge, and national level. This depends on assessing the level of likely displacement of economic activity between Greater Cambridge and the rest of the UK which the scheme will support.

The UK impacts are primarily measured in terms of the LVU associated with dependent development (adjusted for displacement) while the sub-national impacts focus on the jobs and GVA generated as outlined in Table 2.3 below.

Within this Economic Case it is envisaged that the Level 3 impacts discussed in Appendix H: Wider Economic Impacts Report, document reference 403394-MMD-BCA-00-RP-BC-0289, are used to inform the Value for Money (VfM) assessment using a 'Switching Value' approach following DfT VfM guidance. This examines the additional level of benefits required to change the scheme's VfM category and how the additional benefits brought about through LVU contribute to this switch.

A detailed assessment has been carried out for the CSET Phase 2 corridor to review the current economic activity and the proposed investment (developments – residential and employment), based on the principles of the Level 3 Wider Economic Impacts assessment, as outlined above.

This assessment has essentially concluded that based on the current known proposed investments there are **no developments** which could be classified as scheme dependent or directly attributed to the influence of the CSET Phase 2 proposal, as presented within the Wider Economic Benefits assessment in Section 7.

The assessment acknowledges the potential continued expansion of existing key employment sites, Granta Park and Babraham Research Campus. However, based on the current course of investment, the CSET Phase 2 project would be a supporting feature rather than an instigator of this investment. It is considered that the Level 2 appraisal as previously outlined is sufficient to capture this influence.

Table 2.3: Level 3 Economic Impacts – Informing this Economic Case

Benefit	Description
Dependent development	
Land Value Uplift (LVU)	• Relates to the increase in land value as a result of a change in its use reflecting the economic benefits of conversion to a more productive use. The estimate is then adjusted for any change that would occur without the proposed intervention, displacement of demand from other potential developments and the wider effects of the resulting development. • Calculated for Greater Cambridge and the net UK impacts. • Forms 'non-traditional' Level 3 impacts using dynamic land use modelling. • LVU impact at the UK level is the core Level 3 impact.
Labour supply	
Changes in total employment and GDP welfare at a net UK level	• Level 3 SEM – 'non-traditional' using dynamic land use modelling and context specific additionality. • Used as a validation test for the LVU assessment.

Source: Mott MacDonald

3 Options Appraised

The five shortlisted options that are the focus of this Economic Case are shown in Figure 3.1. There are five route alignments, which are denoted by colour; Brown, Blue, Black, Pink and Purple and three travel Hub sites denoted by letter; A, B and C.

The optioneering process to arrive at the above route alignments and travel sites are summarised in Section 18 of the Strategic Case (document reference: 403394-MMD-BCA-00-RP-BC-0247) and detailed in full in Appendix A: OAR (document reference 403394-MMD-BCA-00-RP-BC-0024-C).

All five options follow the same route between CBC and Sawston, from which point they diverge into five alternative alignments, leading to one of three Travel Hub sites. All options would have the same service frequencies and have similar levels of provision for pedestrians and cyclists. The main differences between each option and the Travel Hub sites are summarised below.

CBC to Sawston

This section of the route common to all options runs along Francis Crick Avenue before exiting on the southern side of the CBC and running parallel with the railway. It then diverts to the east of Great Shelford and Stapleford before crossing the River Granta and running to the east of Sawston. All four stops proposed at this stage are within this section and in the same locations for each option. These would be at the CBC, Hinton Way (Great Shelford), Haverhill Road (Stapleford) and Sawston Road (Sawston). The route would cross each of these roads and Granham's Road, via new at-grade junctions to be signalised with priority given to public transport vehicles. Before reaching High Street, the route options then diverge as outlined within the following sections.

Brown Option

The Brown (and Blue) route takes a direct alignment across fields towards the A11 which includes a second crossing of the River Granta. The Brown route ends at Travel Hub Site B, located to the south west of the junction between the A1307 and A11. General traffic would access it from the A1307 via a new junction whilst the site itself would have a linear arrangement in order to accommodate it between a high-pressure gas main, over which development is restricted, and the A11. The site could provide parking for up to 2,800 cars.

Blue Option

The Blue route extends beyond the Brown route to cross the A11 via a new bridge. The route would then cross Newmarket Road at a new junction, before running through the south of the former Comfort Café site and crossing the A1307 via a new junction to connect with Travel Hub Site C, located on the north side of the A1307. As with the junctions on the common section of route, all new junctions would be at-grade and signalised with priority for public transport vehicles. Site C would have a separate roundabout junction to provide general traffic with access into the site at the current junction between the A1307 and Newmarket Road. It could provide parking for up to 2,100 cars.

Black Option

The Black, Purple and Pink routes follow the route of a former railway; however, as this is now designated as a County Wildlife Site, the proposed alignment would be slightly to the north of this, also avoiding the need for a bridge or significant regrading works at the former High Street crossing. All three options follow the same route initially with the Black and Pink options continuing to the A505 junction before running parallel with the A11 and crossing the River Granta. The Black route would then cross the A11 before following the same alignment as the Blue option from Newmarket Road to Travel Hub Site C. It could provide parking for up to 2,100 cars.

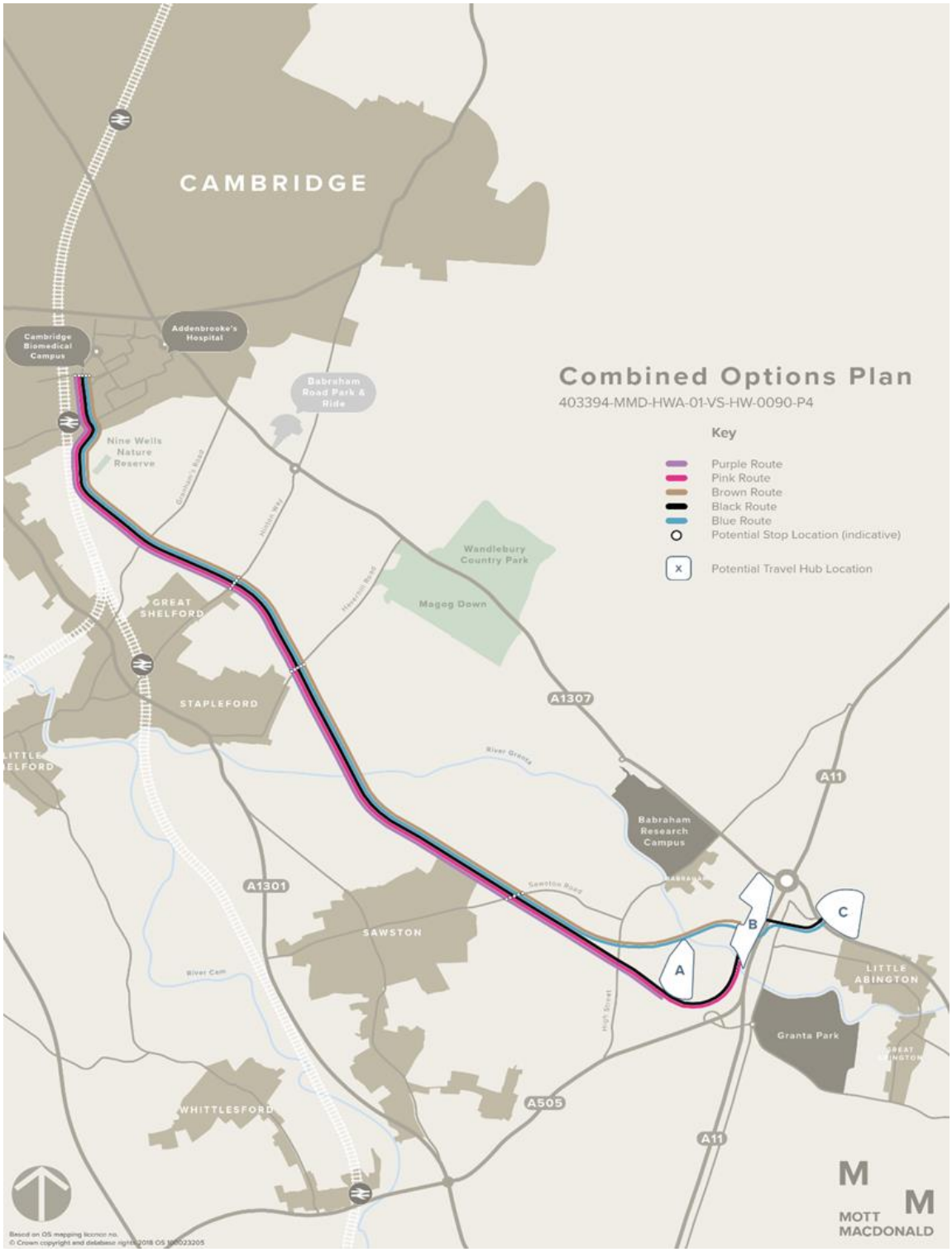
Pink Option

The Pink option is the same as the Black option but, instead of crossing the A11, it terminates at Travel Hub Site B to the north of the River Granta. This would be the same as the Travel Hub site for the Brown route but have a slightly different layout in order to accommodate public transport vehicles entering the site from the south rather than west. This would result in a slightly lower capacity of up to 2,500 cars.

Purple Option

The Purple route is the shortest of all options and, unlike other options, crosses the River Granta once only. It follows the same route as the Pink and Black route but stops to the west of the A11/A505 junction and would serve Travel Hub Site A. This would be accessed via a new roundabout junction to the north of the A505 slip road and require an extended access road to the site itself. This would be necessary in order to avoid the high-pressure gas pipeline. The site would provide capacity for approximately 2,000 cars but has potential for expansion.

Figure 3.1: Option Shortlist



Source: Mott MacDonald

4 Transport Modelling Framework

The Cambridge Sub Regional Model D-Series (CSRM2) has been used as the basis of the assessment of the different options. This has been enhanced with additional local refinements to its highway model and the creation of a new public transport model to provide a more accurate assessment of the public transport impacts of the options being considered.

The following reports explain the CSRM2 base year model, demand model set-up and forecasting approach:

- CSRM2 D-Series Highway Local Model Validation Report (v3.0, October 2018)[4];
- CSRM2 D-Series Transport Demand and Public Transport Model Development and Validation Report (v3.0, October 2018); and
- CSRM2 D-Series Model Forecasting Report.

These provide details of the survey data used to build the base year traffic model and the network and planning assumptions used to produce the forecast assignments.

4.1 Base Year Modelling

4.1.1 2015 Base Year Highway Model

The base year CSRM2 SATURN highway model structure was initially reviewed along the A1307, A428/A1303 and A10/A1309 corridors.

The modelled flows at various points along the A1307 corridor were compared to the observed data available to ensure the model was accurately reflecting current base year (2015) flows.

4.1.2 2015 Base Year Public Transport Model

Public transport supply data was sourced from CSRM2 and converted from MEPLAN software to build a standalone model in CUBE software. During this conversion process, the hierarchical network of connections between modes as coded in MEPLAN was simplified such that transfers within a transit node did not require additional walk connections. The physical transit network was developed based on links describing the stopping sequences of transit lines. Thus, intermediate nodes such as junctions are not represented.

Journey times for transit services are based on the congested times modelled in the CSRM2 highway module, which are added to the timetabled running times in the MEPLAN model. Where transit lines were coded with varying headways along the route in MEPLAN, this was converted into additional variant transit lines such that link vehicle frequencies matched those in CSRM.

The zoning system was retained as per CSRM2 and additional connectors added where zones were not directly connected to constituent transit nodes served by transit lines. Direct zone connectors were added where excessively long public transport routings were being made between adjacent zones.

Rail demand matrices were sourced directly from CSRM2. New bus matrices were developed using a combination of onboard bus origin-destination surveys and ticket sales data from November 2015. Ticket sales data controlled the magnitude of the demand matrices with the Origin Destination survey data providing trip end distributions. Separate matrices were developed for conventional bus, Guided Bus and Park & Ride bus based on observed usage of each sub mode in the survey data.

For Park & Ride demand, the highway element of these trips is not modelled explicitly in the public transport model. Trips in the rail and bus Park & Ride matrices were aggregated to the zones representing either the bus Park & Ride site or the relevant rail station, using a gravity function to distribute zonal trip ends to up to three competing Pare & Ride locations. This was based on the principle that AM Peak trips predominantly

[4] CSRM2 D-Series Highway Local Model Validation Report, Transport Demand and Public Transport Model Development and Validation Report and Model Forecasting Report produced by Atkins

drive to the Park & Ride site and thus trip origins are aggregated to the site, and likewise trip destinations in the PM Peak.

The aggregation process resulted in demand at most bus Park & Ride sites being up to 85% of car parking capacity, with only Madingley Road and Newmarket Road having over 100%. However, these proportions do not take account of the proportion of Park & Ride bus service usage by non-drivers (e.g. car passengers, kiss & ride, walk/PT access).

For rail, any excess in Park & Ride demand allocated to stations in excess of parking availability was not aggregated to the site but retained as full Origin Destinations and assumed to access the station by public transport. Most station car parks are effectively filled in the morning peak.

The modelled flows across the Cambridge Radial Cordon were compared to the observed data available to ensure the model was accurately reflecting current base year (2015) flows. The observed data used as part of the CSRM calibration and validation was used, with additional data cleaning to remove Monday and Friday data to be consistent with the data used to build the bus matrices and improve matching of fare stage data to model sectors.

In all cases, all modelled bus flows across the cordon were higher than observed; however, all flows were within TAG unit M3.2 acceptance criteria except for AM Peak outbound. Modelled guided bus flows alone were mostly lower than observed, though in most cases meeting TAG criteria. In many cases hourly flows were lower than the minimum threshold of 150 passengers per hour required to satisfy TAG criteria. Further analysis of average vehicle loadings across the cordon demonstrated no excessive loadings with average loadings in the main peak flow directions varying between 20 and 50 passengers per vehicle.

4.2 Forecast Years Modelling

Foundation Case CSRM2 demand model runs for the Do Minimum scenario and the five shortlisted scheme options were produced for the AM peak period (07:00-10:00), Interpeak period (10:00– 16:00) and PM peak period (16:00-19:00) for the forecast years of 2026 and 2036.

The Foundation Case represents a scenario which is consistent with the currently proposed Local Plans for the four Local Authority Districts represented in CSRM2 (Cambridge City, South Cambridgeshire, Huntingdonshire and East Cambridgeshire). This includes local assumptions on housing, employment and other developments, along with transport schemes which are either committed or expected to be required to support development.

The changes made to the base year highway networks were similarly applied to the forecast year highway networks. Separate networks were then created for the Do Minimum and the five Do Something options (set out in Section 3). In addition to the network changes, new High Quality Public Transport services between Haverhill, Granta Park, the new Travel Hub site and Cambridge city centre were included in line with the CSET Phase 2 Public Transport Network Strategy Report (Appendix D, document reference 403394-MMD-BCA-00-RP-BC-0370). CSRM uses reduced waiting and travel time weightings for high quality bus services compared to ordinary bus services. These reduced waiting and travel time weightings have been applied to the new services along the CSET scheme corridor.

The changes between the CSRM2 base year output highway and public transport matrices and those output for the two forecast years were applied to the enhanced highway model and the new public transport model to provide the final highway and public transport assignments with and without the scheme options.

For forecast year scenarios, separate Park & Ride matrices for each site were provided from CSRM2. These splits were used in forecasting and aggregating the bus and rail Park & Ride demand, removing the need to estimate Park & Ride site choice as undertaken for the base year.

The CSRM2 demand model had more highway trips entering than leaving both the existing Babraham Road Park & Ride site and the proposed new Travel Hub sites over a 12-hour period. This was due to non-home-based, other trips being generated by direction and therefore able to choose a different mode of travel for each direction of their journey.

A process to adjust the model outputs to balance highway trips entering and leaving the Park & Ride / Travel Hub sites over a 12-hour day was derived. This retained the CSRM2 AM peak period results and then applied the observed profiles of arrivals and departures across the day from the existing Babraham Road Park & Ride site to provide Interpeak and PM peak period highway trips to and from the Park & Ride / Travel Hub sites.

It was also noted that the CSRM2 outputs did not include any trips in the pre-peak hour highway matrices to or from the new Travel Hub sites proposed. These were additionally added in based on the peak hour trips to and from the new Travel Hub sites to ensure the operation of the junctions close to the sites proposed was modelled as accurately as possible.

4.3 Key Modelling Results

4.3.1 Public Transport Journey Times

The public transport journey time benefit of the CSET Phase 2 proposal is presented in two comparison analysis (Inbound and Outbound), as follows for the Preferred option (Brown):

- Haverhill to Cambridge via Travel Hub Site B; and
- Travel Hub Site B to Cambridge Biomedical Campus (CBC).

Travel Hub B is a new location for public transport movements, therefore direct comparisons with competing services are slightly misleading, as existing services are not tailored to serve this demand, travel time varies by service and within the peak period. In addition, travel by private car remains a viable option. Nevertheless, the following tables present a journey time comparison with a comparable existing service.

Table 4.1 and Table 4.2 indicate that in the case of the maximum extent of the service from Haverhill to Cambridge, the CSET Phase 2 public transport route provides a modest travel time saving on average eight minutes (15%), with higher levels of benefit in the PM.

Table 4.1: 2026 Inbound Journey Times – Haverhill to Cambridge via Travel Hub Site B

Option	AM (07-10)		IP (10-16)		PM (16-19)	
Do Minimum (X13 AM, 13 IP, 13 PM)	48 mins		50 mins		54 mins	
Scheme Preferred Option (Brown)	42 mins	%	42 mins	%	42 mins	%
Saving & Percentage	6 mins	-13%	8 mins	-16%	12 mins	-22%

Table 4.2: 2026 Outbound Journey Times – Cambridge to Haverhill via Travel Hub Site B

Option	AM (07-10)		IP (10-16)		PM (16-19)	
Do Minimum (13 AM & IP, X13 PM)	51 mins		51 mins		54 mins	
Scheme Preferred Option (Brown)	43 mins	%	43 mins	%	46 mins	%
Saving & Percentage	8 mins	-16%	8 mins	-16%	8 mins	-15%

Table 4.3 and Table 4.4 provide the direct comparison with the CSET Phase 2 segregated route between Travel Hub Site B and the CBC and the existing service from/to A1307 Cambridge Lodge bus stops.

At this localised level, the travel time saving for the segregated route represents a significant saving at over 40% of the Do Minimum travel time.

Table 4.3: 2026 Inbound Journey Times – Travel Hub B to CBC

Option	AM (07-10)		PM (16-19)	
Do Minimum (X13 AM, 13 PM)	16 mins		15 mins	
Scheme Preferred Option (Brown)	9 mins	%	9 mins	%
Saving & Percentage	7 mins	-44%	6 mins	40%

Table 4.4: 2026 Outbound Journey Times – CBC to Travel Hub B

Option	AM (07-10)		PM (16-19)	
Do Minimum (13 AM, X13 PM)	17 mins		17 mins	
Scheme Preferred Option (Brown)	9 mins	%	9 mins	%
Saving & Percentage	8 mins	-47%	8 mins	-47%

Source: Mott MacDonald

4.3.2 Bus Passenger Demand

Passenger demand for the proposed CSET Phase 2 High Quality Public Transport (HQPT) service has been divided into three distinct classifications:

1. Travel Hub Site B passengers;
2. Extended service passengers – Granta Park, Linton and Haverhill; and
3. On-route passengers – Sawston, Stapleford and Great Shelford.

In addition to connecting the Travel Hub site with the Cambridge Biomedical Campus and Cambridge City Centre, the CSET Phase 2 scheme has been designed to provide an enhanced public transport service to wider locations e.g. Haverhill and Linton, whilst providing improved public transport connectivity for intermediate locations on the CSET public transport route, with dedicated stops at Sawston, Stapleford and Great Shelford.

The following detailed passenger volumes are presented for the Travel Hub site and the on-route locations to provide context to the CSET Phase 2 service patronage. The extended services generate a relatively low level of patronage, as indicated in the economic appraisal, therefore the information is presented for those locations that influence the assessment.

4.3.2.1 Travel Hub Site B

Table 4.5 and Table 4.6 provide the total Travel Hub vehicles and passenger demand for 2026 and 2036. Overall the assessment indicates that on average 40% of the total P&R users are new users attracted by the provision of the Travel Hub and the CSET Phase 2 HQPT service.

Table 4.5: AM Peak Hourly 2-way P&R Passengers (08:00-09:00)

Forecast Year		P&R Total	New	% New
2026	Vehicles	447	180	40%
	Passengers	593	239	
2036	Vehicles	408	156	38%
	Passengers	563	215	

Source: Mott MacDonald

Table 4.6: PM Peak hourly 2-way P&R Passengers (17:00-18:00)

Forecast Year		P&R Total	New	% New
2026	Vehicles	447	192	43%
	Passengers	593	255	
2036	Vehicles	394	174	44%
	Passengers	544	240	

Source: Mott MacDonald

4.3.2.2 On-route Demand

The On-route locations of Sawston, Stapleford and Great Shelford represent key locations for the attraction of patronage to the CSET Phase 2 HQPT service. The service has been designed to accommodate and encourage patronage through dedicated stops. Table 4.7 presents the modelled patronage per stop location for the modelled periods and daily. Overall the service is popular with over 1,200 daily journeys.

Table 4.7: Period 2-way Passengers – On-route Demand

Forecast Year	Location	AM (07:00-10:00)	IP (10:00-16:00)	PM (16:00-19:00)	Weekday 12hr	%
2026	Sawston	121	241	127	**489**	40%
	Stapleford	19	30	15	**64**	5%
	Great Shelford	192	318	173	**683**	55%
	Total	**332**	**589**	**315**	**1,236**	**100%**

Source: Mott MacDonald

5 Transport Economic Appraisal

5.1 Benefit Cost Ratio and Value for Money Appraisal

In the calculation of the Benefit Cost Ratio (BCR) and subsequent Value for Money calculation (VfM) several assumptions have been made and these are outlined below.

5.2 Assumptions

5.2.1 General Costs

In line with the guidance on cost the following assumptions have been applied to generate a Present Value of Costs (PVC) in 2010 prices, discounted:

- Spend Profile – It has been assumed that all costs are expended over the period 2020 to 2025 inclusive;
- Risk contingency of 25% (P80) has been applied to costs;
- Costs have been uplifted by a Market Price Factor of 1.19;
- Costs have then been modified by GDP deflator from 2020 to 2010; and
- Finally, costs have been discounted to 2010 prices to arrive at a figure for the PVC.

5.2.2 Environmental Costs

Costs for Noise, Air Quality and Greenhouse Gases, are based on the standardised reduction in Car based distance travelled. These are based on the Marginal External Cost (MEC) prices, as defined in TAG Table 5.4.2 which shows the pence per km saved for different road classifications. We have classified the A1307, which is the main impacted corridor, as a Rural ‘A’ Road. Under this assumption:

- A saving of 0.2p per km is applied for Local Air Quality;
- A saving of 0.8p per km is applied for Greenhouse Gases;
- Noise impacts are excluded based on the Rural ‘A’ Road classification within the MEC.

5.2.3 Opening Year

The opening year for the scheme was assumed to be 2024. Modelling was undertaken for 2026 and has been discounted to 2024.

5.2.4 Appraisal Period

A 60-year appraisal period has been used, with a horizon year of 2083.

5.2.5 Revenue and OPEX (currently excluded)

At present the assessment excludes the contribution of additional revenue and operational costs (OPEX). It is likely that due to the volume of new users, the potential revenue generation would be a significant contributing factor, however, careful consideration is required as to who will benefit from this revenue.

5.3 Establishing Demand

Demand for the CSET Phase 2 HQPT service was established for the appraised options based on a consistent method, as outlined previously. The demand for the service is divided into three classifications:

1. Travel Hub demand – consisting of:
   - Existing users (transferred from existing services) and;
   - New users
2. Extended services demand – for Granta Park, Linton and Haverhill
   - Existing users (transferred from existing services) and;
   - New users
3. On-route demand – for Sawston, Stapleford and Great Shelford
   - Existing users (transferred from existing services)

A detailed breakdown of the demand by location over the 60-year appraisal period is shown in Table 5.1.

The table includes the proportion of total users by location and the proportion of new users attracted by the provision of the CSET Phase 2 HQPT service. Overall the assessment indicates that the service would generate between 80-90 million users over the 60-year period with 40% being new users, principally associated with the Travel Hub itself.

The Travel Hub accounts for the highest proportion of total patronage at approaching 70%, followed by the On-route demand at nearly 30%. The route alignment for these On-route locations is consistent across options therefore the demand is consistent. The variances in the total demand between the options is accounted for by the Extended services equating to 4-5% at 3-4 million users.

In terms of total patronage, the Travel Hub Site A Purple option generates the highest demand. However, the overall patronage is reasonably consistent across all option with the exception of the slightly longer alignment routes Pink and Black, which indicated that the extended route journey time is likely to reduce the overall attractiveness of the service.

Table 5.1: Detailed CSET Phase 2 User Breakdown

User Trips (2-way) 60 Years	Site A PUR	Site B BRN	Site B PNK	Site C BLU	Site C BLK
Rank	**1**	**3**	**2**	**4**	**5**
Total users (2-way)	**88.15**	**83.93**	**78.01**	**87.11**	**80.61**
Existing user trips (m)	52.57	50.36	47.83	51.13	47.90
New user trips (m)	35.58	33.57	30.18	35.98	32.71
% New users	40%	40%	39%	41%	41%
1 - Travel Hub users (m)	**59.90**	**55.63**	**49.70**	**58.83**	**52.38**
% Total	68%	66%	64%	68%	65%
% New users	56%	57%	57%	58%	59%
2 - Extended service users (m)	**3.70**	**3.75**	**3.75**	**3.72**	**3.67**
% Total	4%	4%	5%	4%	5%
% New users	51%	51%	51%	51%	51%
3 - On-route users (m)	**24.55**	**24.55**	**24.55**	**24.55**	**24.55**
% Total	28%	29%	31%	28%	30%
% New users	0%	0%	0%	0%	0%

Source: Mott MacDonald Notes: (m = millions)

In line with the Consumer Surplus theory, new users will experience half of the benefit of existing users, under the Rule of Half (RoH). RoH suggests that when consumers change their travel in response to a financial incentive, the net consumer surplus averages half of their price change (called the “rule of half”). This considers total changes in financial costs, travel time, convenience and mobility as perceived by consumers.

The proportion of existing and new users for the Travel Hub site and the extended bus routes was determined through highway and public transport modelling.

Annualised patronage represents 305 days per annum (excluding holidays etc. in accordance with TAG Guidance, this includes:

- 253 weekdays – based on AM (x3 hours), Inter-peak (IP) (x6 hours) and PM (x3 hours) modelling, representing 12 hours of daily operation; and
- 52 weekends (18hrs per weekend) – based on IP modelling.

Annualisation factors vary between the Highway and Public Transport (PT) models:

- Highway expands hourly volumes to period volumes, based on the Travel Hub profile
- Public transport is modelled in periods.

5.4 Transport Benefits

The benefits within the options appraisal were divided into two classifications:

1. Journey time savings, accounting for 80% of benefits and consisting of travel time savings for all users, including:
    - Travel Hub users (passengers);
    - Extended service users (passengers); and
    - On-route service users (passengers).

Travel time savings were monetised based on specified values of time (commute, work and other).

2. Non-user benefits classified as Marginal External Costs (MEC), amounting to the remaining 20% of benefits. These comprised additional non-user benefits based on distance saved by Travel Hub vehicles only, including:
    - Congestion;
    - Infrastructure;
    - Accident;
    - Local Air Quality;
    - Noise;
    - Greenhouse Gases; and
    - Indirect Tax (cost).

DfT TAG Databook A.5.4.2 provides pence-per kilometre factors to convert the distance saved into a monetised value and the RoH is applied to new users. Journey time saving benefits are shown in Table 5.2 and monetised values of both journey time savings and non-user benefits in Table 5.3.

5.4.1 Journey Time Benefits

The journey time benefits represent the travel time savings experienced by users of the CSET Phase 2 HQPT service in comparison to the existing bus services and forecasted travel times.

In the case of this assessment, the journey time savings are based on standardised assumptions regarding the proposed infrastructure and services and the most direct existing service during the relevant period, including the existing peak hours X13 service where applicable. The option to travel by car is also considered.

Table 5.2 below presents an example set of journey time savings by direction and time period for the Brown option for the CSET Phase 2 infrastructure itself which is applied to the Travel Hub and Extended service users. This demonstrates a modest travel time saving of up to 12 minutes in the PM period. The relatively modest travel time saving is due to the comparison with the express service (X13) and travel time by car. There is a marginal increase in journey time savings during the Inter-peak period when the X13 service does not operate.

In terms of the options assessed, there are marginal differences between the options. These are related to the changes in the route alignment and Travel Hub locations relative to the Brown option, as follows:

- Travel Hub A – Purple – On average 1-minute additional saving (+10%), due to shorter route;
- Travel Hub B – Pink – On average 1-minute additional travel time (+10%), due to longer route than Brown; and
- Travel Hub C – Blue – On average 30 seconds additional travel time (+5%), due to route crossing A11, with the Black option incurring an additional 1-minute (+10%), due to the longer route.

Table 5.2: Example Journey Time Saving per Route Brown Option (2026)

Time Saving (mm:ss)	AM (07-10)		IP (10-16)		PM (16-19)	
	In	Out	In	Out	In	Out
CSET Phase 2	06:01	07:28	08:09	08:09	12:06	08:10
On-route (PT)	29:08	26:52	15:00	15:00	25:16	24:11

In contrast, users from the On-route locations of Sawston, Stapleford and Great Shelford experience significant travel time savings, as the analysis only considers the currently modelled Public Transport demand and therefore the journey time savings are substantial at 25-30 minutes in the peak periods and a standardised 15 minutes in the Inter-peak. A key factor contributing to this is the reduction in wait time due to the enhanced service frequency relative to the existing Citi 7 route.

The total travel time savings for the scheme over the 60-year appraisal are calculated by the multiplication of the travel time savings for the forecast years (2026 and 2036), based on the following approach:

- Opening Year (2024 to 2026) – based on back casting from interpolated trend from 2036 to 2026;
- 30 Year Projection (2024 to 2053) – TAG guidance specifies that benefits are projected for 30 years from the Opening Year. The patronage and journey time savings for this period are based on the extrapolation of the 2026 to 2036 trend up to 2053; and
- Horizon Period (2053 to 2083) – TAG guidance specifies that benefits beyond the initial 30 years are held constant. The demand and time savings determined in 2053 are therefore sustained until the appraisal horizon year of 2083.

Table 5.3 below presents the calculated total journey time savings for the 60-year appraisal period, based on the multiplication of the travel time savings and the calculated demand, which show marginal variance by option.

The analysis includes the presentation of the journey time savings by component, summarised as:

1. Travel Hub users – represent up to 40% of the total benefits due to the proportion of new users.
2. Extended service users – represent a small proportion of benefits at less than £1 million.

3. On-route users – represent up to 60% of the total benefits due to the scale of travel time savings achieved for these users. However, the option alignments are consistent therefore the option assessment identifies no additional benefit.

Table 5.3: Transport Benefits – Journey Time Savings

Journey Time Savings (m/hrs) 60 Years	Site A PUR	Site B BRN	Site B PNK	Site C BLU	Site C BLK
Rank	3	2	5	1	4
Total Journey Time Savings (m/hrs)	**13.83**	**14.14**	**12.81**	**14.39**	**13.03**
Existing user trips - JT savings (m/hrs)	11.22	11.34	10.58	11.43	10.60
New user trips - JT savings (m/hrs)	2.61	2.81	2.23	2.96	2.43
% New users	19%	20%	17%	21%	19%
1 - Travel Hub users (m/hrs)	**5.17**	**5.58**	**4.34**	**5.82**	**4.56**
% Total	37%	39%	34%	40%	35%
% New users	45%	46%	46%	46%	48%
2 - Extended service users (m/hrs)	**0.86**	**0.77**	**0.67**	**0.77**	**0.67**
% Total	6%	5%	5%	5%	5%
% New users	35%	35%	35%	35%	35%
3 - On-route users (m/hrs)	**7.80**	**7.80**	**7.80**	**7.80**	**7.80**
% Total	56%	55%	61%	54%	60%
% New users	0%	0%	0%	0%	0%

Source: Mott MacDonald Notes: (m = millions, hrs = hours)

A monetised value for the journey time savings was calculated by the multiplication of the time savings based on a defined Value of Time (VoT) per user purpose split as shown in Table 5.4 below.

Table 5.4: Public Transport User Value of Time (VoT)

Purpose	2010 VoT	% Bus Travel			
		AM	IP	PM	Weekend
Business	£12.94	26%	7%	33%	11%
Commute	£12.85	2%	2%	3%	1%
Other	£5.86	72%	91%	64%	88%

Source: DfT TAG data book Table A1.3.4, May 2019 - Percentage of Person Trips

Table 5.5 below presents the monetised journey time benefits for the shortlisted CSET Phase 2 options, based on the above monetisation methodology and the application of the Rule of Half (RoH) for new users, based on the identified components.

Overall the monetised journey time benefits across the options are reasonably consistent, with the scheme generating benefits in the region of £40-£46m over the 60-year appraisal period. The influence of the RoH is present in the economics, as the new users represent approximately 20% of the overall journey time benefit.

Based on the scale of travel time saving, the On-route patronage accounts for 50% of the total benefit.

Table 5.5: Monetised Transport Benefits – Journey Time Savings

Journey Time Savings (£m) 60 Years, (2010 prices, discounted)	Site A PUR	Site B BRN	Site B PNK	Site C BLU	Site C BLK
Rank	3	2	5	1	4
Total Journey Time Savings (£m)	**£45.03**	**£46.05**	**£41.18**	**£47.03**	**£42.03**
Existing user trips - JT savings (£m)	£34.84	£35.42	£32.69	£35.82	£32.80
New user trips - JT savings (£m)	£10.19	£10.63	£8.49	£11.20	£9.23
% New users	23%	23%	21%	24%	22%
1 - Travel Hub users	**£18.43**	**£19.88**	**£15.46**	**£20.84**	**£16.31**
% Total	41%	43%	38%	44%	39%
% New users	42%	43%	43%	43%	45%
2 - Extended service users	**£4.03**	**£3.59**	**£3.15**	**£3.61**	**£3.14**
% Total	29%	25%	25%	25%	24%
% New users	60%	60%	60%	61%	60%
3 - On-route users	**£22.57**	**£22.57**	**£22.57**	**£22.57**	**£22.57**
% Total	50%	49%	55%	48%	54%
% New Users	0%	0%	0%	0%	0%

Source: Mott MacDonald Notes: (£m = millions)

5.4.2 Marginal External Cost (MEC) Benefits – Travel Hub Users

The Marginal External Cost (MEC) approach is designed to capture the secondary benefits of the proposed intervention in terms of the change in the distance travelled. This method has been adopted as a proportionate approach to establishing a monetised benefit for the reduction in distance travelled by car.

The method is based on the application of DfT defined costs (pence per kilometre) for a range of predefined factors, as presented for 2010, 2025 & 2035 in Table 5.6 below. DfT has defined assumptions regarding the increase in these costs over time as indicated by the noticeable increase in congestion. For the assessment of the change on travel along principally the A1307 corridor the Rural 'A' Road costs have been applied. Values are calculated for the 60-year appraisal period by interpolation of the provided DfT costs up to 2035, after which they are held constant for the remainder of the appraisal period.

Table 5.6: MEC External Cost Assumptions – Rural 'A' Road

ID	Factor (pence-per-km)	2010	2025	%	2035	%
1	Congestion Average	2.0	3.4	76%	5.3	170%
2	Infrastructure	0.1	0.1	32%	0.2	66%
3	Accident	0.7	1.1	56%	1.6	135%
4	Local Air Quality	0.2	0.0	-72%	0.0	-76%
5	Noise	0.0	0.0	0%	0.0	0%
6	Greenhouse Gases	0.8	0.6	-23%	0.7	-17%
7	Indirect Taxation	-4.4	-2.7	-39%	-1.6	-63%

Source: Table A 5.4.2a: Marginal External Costs and Indirect Tax

For the MEC assessment, a standardised distance saving for Travel Hub users has been applied based on distance that would otherwise be travelled along the A1307 to the Babraham Park & Ride site (6km), with the following assumptions applied:

- Existing P&R users – 12km daily distance saving per two-way trip; and
- New users – 6km daily distance saving per two-way trip, after applying the RoH (50%).

MEC benefits have only been calculated for the Travel Hub users, with the results summarised in Table 5.7.

Overall the analysis indicates that the options generate a similar level of distance saving over the 60-year appraisal period of between 300-350 million kilometres, with the Travel Hub A Purple option attracting the highest level of demand and therefore kilometres saved.

At a monetised level, this distance saving equates to an economic benefit of between £10-12m, with most of this benefit associated with congestion relief, as indicated by the MEC assumptions presented in Table 5.6. A reduction in distance travelled will lead to a reduction in fuel consumed, resulting in a reduction in revenue received by government from indirect taxation. This is treated as an economic cost.

Table 5.7: Monetised MEC Benefits

Vehicle Distance Saving 60 Years, (2010 prices, discounted)	Site A PUR	Site B BRN	Site B PNK	Site C BLU	Site C BLK	
Rank	**1**	**3**	**5**	**2**	**4**	
Total Vehicle Distance Saving (m/km)	**353**	**326**	**292**	**345**	**310**	
Existing user vehicle distance saving (m/km)	200	182	163	189	165	
New user vehicle distance saving (m/km)	153	144	129	156	145	
% New users	43%	44%	44%	45%	47%	
MEC Non-User Benefits (£m)	**£12.03**	**£11.06**	**£9.92**	**£11.73**	**£10.54**	**% Ave**
All User - 1. Congestion (£m)	£10.59	£9.76	£8.75	£10.34	£9.29	**88%**
All User - 2. Infrastructure (£m)	£0.34	£0.31	£0.28	£0.33	£0.30	**3%**
All User - 3. Accident (£m)	£3.31	£3.05	£2.73	£3.23	£2.90	**28%**
All User - 4. Local Air Quality (£m)	£0.09	£0.08	£0.07	£0.09	£0.08	**1%**
All User - 5. Noise (£m)	£0.00	£0.00	£0.00	£0.00	£0.00	**0%**
All User - 6. Greenhouse Gases (£m)	£1.39	£1.29	£1.15	£1.36	£1.22	**12%**
All User - 7. Indirect Taxation (£m)	-£3.69	-£3.43	-£3.08	-£3.61	-£3.24	**-31%**

5.4.3 Options Assessment Benefits Summary

Table 5.8 below presents a summary of the monetised benefits calculated for the shortlisted options based on the identified approach.

- The Brown (Site B), Purple (Site A) and Blue (Site C) options generate reasonably consistent results in terms of journey time savings and MEC benefits, based on a different balance in benefits;
- The Purple option (Site A) generates the highest level of users at nearly 90 million over 60 years; and
- The Pink (Site B) and Black (Site C) options generate noticeably lower levels of benefits, due to the extended route length relative to the Brown and Blue options and associated increased travel time.

Table 5.8: Summary of Option Assessment Monetised Benefits

Assessment Summary 60 Years	Site A PUR	Site B BRN	Site B PNK	Site C BLU	Site C BLK
Total Users (2-way)	**88.15**	**83.93**	**78.01**	**87.11**	**80.61**
Rank	**1**	**3**	**2**	**4**	**5**
Total Journey Time Savings (£m)	£45.03	£46.05	£41.18	£47.03	£42.03
Rank	**3**	**2**	**5**	**1**	**4**
MEC Non-User Benefits (£m)	£12.03	£11.06	£9.92	£11.73	£10.54
Rank	**1**	**3**	**5**	**2**	**4**
Total Benefits (£m)	**£57.05**	**£57.11**	**£51.10**	**£58.76**	**£52.57**
Rank	**3**	**2**	**5**	**1**	**4**

Source: Mott MacDonald Notes: (£m = millions)

5.5 Capital Costs (CAPEX)

Table 5.9 presents for each of the shortlisted options:

- The raw capital cost (2019 prices); and
- The Present Value Cost (PVC), at 2010 prices with market prices adjustments and discounted.

The Purple option (Site A) has the lowest capital cost due to the avoidance of the cost of the infrastructure required on other routes to cross key obstacles i.e. the River Granta (Sites B and C) and crossing the A11 (Site C).

A cost comparison with the Purple option (Site A) indicates that approximately an additional £10m PVC is required to extend the route across the River Granta to reach Site B and a further £15m to cross the A11 to reach Site C.

This cost assessment identifies that the Site C options are unviable based on an additional cost of 38% to 45% relative to lowest cost option with limited additional benefit, as previously indicated.

Table 5.9: Capital Expenditure (CAPEX) Costs in £ millions

Costs CAPEX (£m)	Site A	Site B	Site B	Site C	Site C
	PUR	BRN	PNK	BLU	BLK
Rank	1	3	2	5	4
Cost CAPEX (£m)	**£94.86**	**£109.24**	**£107.90**	**£137.29**	**£130.75**
Present Value Cost (PVC) (2010 Prices, Discounted) (£m)	**£70.24**	**£80.90**	**£79.91**	**£101.67**	**£96.82**
% Difference Purple	0%	15%	14%	45%	38%
Difference Purple (£m)	£0.00	£10.66	£9.67	£31.43	£26.58

Source: Mott MacDonald Notes: (£m = millions)

5.6 Options Assessment – Value for Money (VfM)

The Value for Money (VfM) for the options assessment is based on the calculated Benefit to Cost Ratio (BCR), which is based on comparison of the Present Value of Benefits (PVB) and the Present Value of Costs (PVC). A positive number in excess of 1.0 is considered to represent an economic return on the initial investment.

The DfT has defined standard categories for the VfM based on the BCR, as follows:

- Very High - BCR greater than or equal to 4;
- High - BCR between 2 and 4;
- Medium - BCR between 1.5 and 2;
- Low - BCR between 1 and 1.5;
- Poor - BCR between 0 and 1; and
- Very Poor - BCR less than or equal to 0.

Table 5.10 below presents the BCR and VfM calculation for each of the shortlisted options. The assessment indicates that all options presently represent a Poor VfM, based on the applied consistent methodology with the level of PVB remaining reasonably consistent and PVC noticeably varying.

Table 5.10: Option Assessment Value for Money Comparison

Economic Summary 60 Years (2010, discounted)	Site A PUR	Site B BRN	Site B PNK	Site C BLU	Site C BLK
(Present Value Benefits) PVB	£57.1	£57.2	£51.1	£58.8	£52.6
(Present Value Costs) PVC	£70.2	£80.9	£79.9	£101.7	£96.8
(Benefit Cost Ratio) BCR	**0.81**	**0.71**	**0.64**	**0.58**	**0.54**
BCR Rank	**1**	**2**	**3**	**4**	**5**
Difference PVB-PVC	**(£13.17)**	**(£23.73)**	**(£28.84)**	**(£42.90)**	**(£44.25)**
(Value for Money) VfM	Poor	Poor	Poor	Poor	Poor

Source: Mott MacDonald Notes: (£m = millions)

Based on the lowest cost in CAPEX, the **Purple Option** generates the highest BCR at **0.81** making it the **indicative preferred option under this appraisal mechanism**. However, this and indeed all options at present represent a Poor VfM case**,** based on the DfT appraisal criteria. For the option appraisal all options have performed similarly with the CAPEX being a key factor in the BCR.

The Brown Option is also considered as a viable option based on the Travel Hub B direct connection with the A1307 itself, consistent performance in terms of PVB with the Purple option and a comparable BCR of **0.71**.

Based on this the two highest performing deliverable options from the appraisal have been identified as the Purple (Site A) and Brown (Site B) Options. These were then taken forward to operational assessment (microsimulation) modelling to assess the detailed operation of the access arrangements to each of the proposed Travel Hub sites.

5.7 Microsimulation Modelling

Further operational modelling (microsimulation) has been undertaken to assess the traffic impact of the access arrangements at each of these Travel Hub sites, Site A (accessed from the A505 Granta Park junction) and Site B (accessed from the A1307).

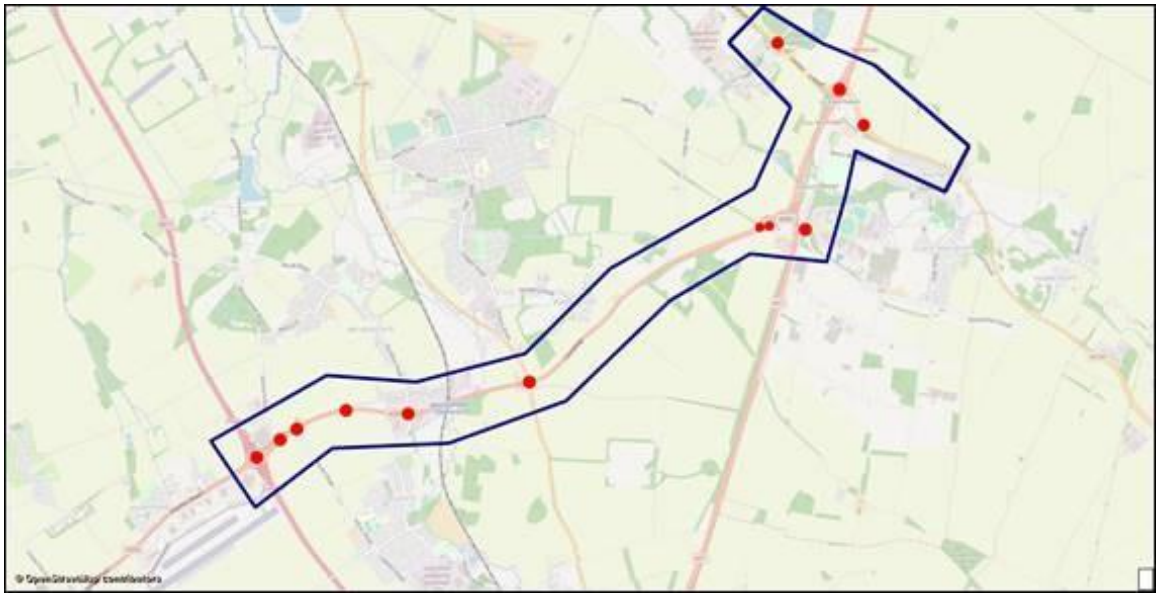
5.7.1 Overview of VISSIM

VISSIM is a microscopic real time traffic flow simulation model based on individual vehicles and driver behaviour. VISSIM can analyse vehicular traffic including bus/ tram, pedestrian and bicycle operations under constraints such as lane change configuration, traffic composition, traffic signals and bus/tram stops.

5.7.2 VISSIM Modelling Scope and Development

A base model and a future year (2036) model were developed. The model extents are shown in Figure 5.1 and include the surrounding local and strategic highway network. The blue line represents the model extents and the red circles represent the modelled junctions. Note that the M11 motorway junction and the junction with the A11/A1307 include the slip road approaches and exits but exclude the mainline carriageway.

Figure 5.1: Model Extents



Source: Mott MacDonald

5.7.3 Base Model Development

The base model has been developed using CAD drawings and online mapping sources and the traffic counts have been used to develop balanced flows as inputs into the VISSIM model, for static assignment within the model for peak hour periods with a 30-minute seed period to populate the model initially. The assessment periods cover the weekday peak hours of 07:30-08:30 and 16:45-17:45, in 15-minute intervals.

The model has been validated against Trafficmaster journey times for routes between the M11 junction 10 through to the A11 / A1307 roundabout, travelling both eastbound and westbound. Both journey time routes validate to within 15% in both peak hours. The base models are therefore considered suitable for the purpose of assessing the forecast scenario including the impact of the proposed Travel Hub.

5.7.4 Future Year Model Development

The 2036 flows for each future year model combine outputs from the SATURN highway model and the base VISSIM model inputs to derive the future year VISSIM model demand. Differences in turning flows between the SATURN Base and SATURN Forecast year were calculated and added to the VISSIM base flows.

As the SATURN model period is a single hour, the difference applied to the VISSIM model has been proportionally profiled into 15-minute intervals, based on the VISSIM Base flows.

It has been assumed that the vehicle composition would not change from the VISSIM Base model, therefore differences have been applied on an all-vehicle basis, with the vehicle type split being determined by surveys undertaken in March 2019.

5.7.5 VISSIM Outcomes

When modelled in VISSIM, the Purple option results in the best modelled operational performance, however, the differences to the Brown option are marginal and the benefit with the Purple scheme is likely to be due to the lower traffic flow using the site access as predicted by the SATURN model.

Further detail on the VISSIM modelling exercise can be found in the VISSIM Assessment Report, Document reference 403394-MMD-TRA-00-RP-TA-0241.

5.7.6 Preferred Option

As noted in Section 2.1, the five shortlisted options were appraised from multiple perspectives utilising three mechanisms. Aside from Benefit Cost Ratio calculation and Value for Money assessment, which is the subject of this Economic Case the following two processes contributed to the identification of a preferred option:

1. Mott MacDonald's in-house Multi-Criteria Assessment Framework INSET, (INvestment, Sifting and Evaluation Tool): a quantitative and more detailed qualitative assessment of the shortlisted options was undertaken to aid in the identification of the preferred option. A detailed account of this process can be found in the OAR, document reference MMD-BCA-00-RE-BC-0024-B.
2. Consultation Feedback: based on public consultation held during the autumn of 2019. A summary of the consultation process and the subsequent feedback can be found in the Management Case of the OBC and the results are reported fully in the consultation summary report produced by the Cambridgeshire Research Group for GCP.[5]

Following consideration of all of the appraisal perspectives and mechanisms outlined above it was concluded that the Brown option was the best performing in terms of both route alignment and Travel Hub site, performing best both under the INSET appraisal process, which assessed options against a total 92 criteria under seven themes, and at public consultation, while ranking second for value for money. Although the BCR calculation showed that the Purple option provided the best value for money, this is only one element or rationale for implementing the scheme and it considers only a narrow set of economic criteria in the appraisal process.

[5] Cambridge South East Transport – Better Public Transport Project: Summary Report of Consultation Findings, Cambridgeshire Research Group, January 2020

6 Reliability Benefits

6.1 Approach to Calculation of Reliability Ratios and Benefits

This assessment of reliability benefits was undertaken for CSET Phase 2 to look at bus service reliability by deriving reliability ratios for existing services operating on the Cambridgeshire Guided Busway and non-busway services.

DfT TAG Unit A1.3[6] states that for most public transport journeys, the existence of timetabled arrival times means that it is usual to consider reliability in terms of lateness, defined as the difference between travellers' actual and timetabled arrival times. Adopting this definition means that arrival before the timetabled arrival time is usually ignored. Two measures of lateness must be considered: average lateness; and the variability of lateness, measured by the standard deviation of lateness.

The reliability ratio for public transport is defined as the ratio of the value of the standard deviation of lateness to the value of average lateness, where the value of average lateness is a factor of the value of travel time savings:

Reliability Ratio = Value of SD of lateness / Value of average lateness

where

Value of average lateness = factor * value of travel time

DfT TAG Unit A1.3 suggests that the value of average lateness for public transport is 2.5 times the value of in-vehicle time. Taking the value of commuting time as 8.36[7] gives a Value of Average Lateness = 20.9.

Real Time Passenger Information (RTPI) data for Monday to Friday journeys in November 2018 was obtained for services 1, 7, 12, 13/13A/X13 and Busway B and has been analysed by looking at certain sections where:

- Services operate on segregated Busway infrastructure;
- On-road bus lanes are in place; and
- Services operate on-road with no bus priority.

The data showed the “actual run time” and the “scheduled run time”.

For each section, the maximum journey times, the average lateness (taking the lateness of on time and early journeys as zero) and the standard deviation of lateness have been derived for each hour from 0700 to 1800. The Reliability Ratio has also been calculated.

The results for the 0700 to 1800 period for each section, ranked by the reliability ratio are summarised in Figure 6.1 and Table 6.1.

6.2 Reliability Ratios

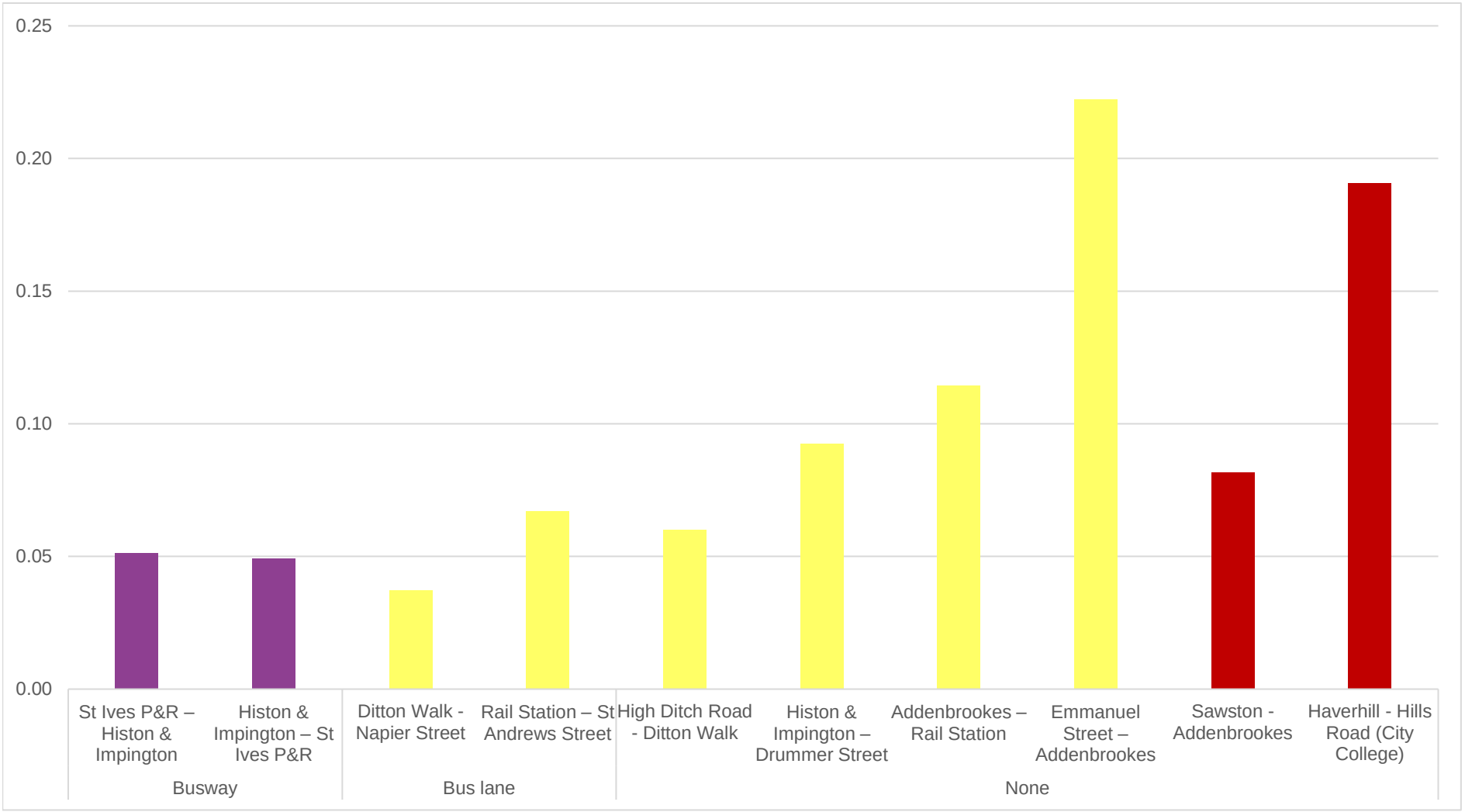
The Reliability Ratios show that the Busway sections perform better than the non-busway sections which is the expected result, meaning that the segregated infrastructure is delivering journey times that are more consistent.

While the Busway sections are not affected by traffic congestion, there are other factors that affect journey time variability, especially boarding times, which might be extended on certain journeys due to volume of passengers or the driver having to deal with queries.

[6] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/603254/TAG-tag-unit-a1-3-user-and-provider-impacts-march-2017.pdf

[7] TAG Data Book – July 2019 table A1.3.1 see https://www.gov.uk/government/publications/tag-data-book

Figure 6.1: Reliability Ratios



Source: Mott MacDonald

Table 6.1: Route Reliability Data

Route	Section	Bus Lanes/Busway	0700-1800 sample size (no of journeys)	0700-1800 maximum journey time (mins)	0700-1800 average lateness (mins)	0700-1800 standard deviation of lateness	Reliability ration	Rank (low to high reliability ratio)
Citi 1	Addenbrooke's – Rail Station	None	271	26.42	1.10	2.40	0.11	8
	Rail Station – St Andrews Street	Hills Road bus lane	270	26.47	0.66	1.40	0.07	5
	Emmanuel Street – Addenbrooke's	None	260	58.90	2.77	4.66	0.22	10
Citi 7	Sawston – Addenbrooke's	None	671	44.50	1.21	1.71	0.08	6
12	High Ditch Road – Ditton Walk	None	238	17.50	0.46	1.25	0.06	4
	Ditton Walk – Napier Street	Newmarket Road bus lane	238	10.62	0.46	0.78	0.04	1
13/13A/X13	Haverhill – Hills Road (City College)	None	446	98.90	2.25	3.99	0.19	9
Busway B	St Ives P&R – Histon and Impington	Busway	758	27.48	0.47	1.07	0.05	=2
	Histon and Impington – Drummer Street	None	427	32.50	1.53	1.93	0.09	7
	Histon and Impington – St Ives P&R	Busway	910	27.88	0.53	1.03	0.05	=2

Source: Mott MacDonald

Note: the end points of the sections are partly determined by the number of journeys recorded at each point: For service 12, the end point of Napier Street is used instead of the more logical Drummer Street because a greater number of journeys are recorded at Napier Street, similarly for the 13/13A/X13 Hills Road (City College) has a greater number of journeys recorded there than at Addenbrooke's.

6.3 Reliability Economic Benefits

The reliability assessment has identified noticeable variability in the travel time reliability for key competing services with CSET Phase 2, for example services 13/13A/X13, which operate along the A1307 corridor. This variability equates to over 2 minutes of average lateness, as shown in Table 6.2.

Based on the comparison between the CSET Phase 2 service and the existing 13 service variants, the segregated service offers the potential to generate substantial benefit, if the cause of this lateness is mitigated by the provision of a segregated route.

The economic benefit for improvements in reliability has been calculated as follows:

- Extraction of service patronage from the modelled Do-Minimum (DM) and Do-Something (DS) Brown option for 2026 by time period;
- Calculation of user purpose split, as per TAG proportions as presented in Table 5.4;
- Calculation of the cost of reliability based on the time incurred and the relevant VoT;
- Comparison of the DM and DS cost of reliability across the defined services; and
- Calculation of benefits over 60-year appraisal period (2024-2083) based on consistent reliability savings and discounted to 2010 prices.

It is acknowledged that the scale of reliability savings is likely to increase over time based on increases in highway congestion. However, the assessment is based on the application of observed reliability information, as reliability is not included within the modelling approach.

Table 6.2: CSET Phase 2 Reliability Service Assumptions

ID	Service	Average Lateness (mm:ss)	Reliability Ratio
1	CIt7	01:12	0.08
2	13/13A/X13	02:15	0.19
3	CSET Phase 2	00:28	0.05
	Savings CSET-13 Services	**01:46**	**-0.14**
	% Saving CSET/13 Services	**-79%**	**-74%**

Source: Mott MacDonald

Table 6.3 below presents the calculated monetised reliability benefit for the proposed CSET Phase 2 service, based on the applied methodology. The assessment identifies the potential for an economic benefit approaching £7million over the 60-year appraisal period if all users experience the full improvement in reliability identified above.

However, some users making journeys to or from central Cambridge, where the CSET services will operate on-road after reaching the end of the existing Busway, or shorter journeys, are not expected to experience the full level of improved reliability attributed to the provision of the segregated route. A conservative assumption of 50% has therefore been applied to generate an additional PVB of £3.4m, representing an average reliability saving per journey of approximately 1 minute.

Table 6.3: CSET Phase 2 Monetised Reliability Benefit Preferred Option (Brown)

Reliability Benefit	Percentage	(Present Value Benefit) PVB*	Average Lateness Saving (mm:ss)
Maximum Benefit	100%	£6,884	01:46
Applied Benefit	**50%**	**£3,442**	**00:53**

Source: Mott MacDonald Notes *PVB – 60-year, 2010 prices, discounted

7 Wider Economic Benefits

During the INSET appraisal process the five shortlisted options were qualitatively appraised against the following Wider Economic Benefits criteria:

- Supporting development and employment sites;
- Number of new homes supported;
- Number of new jobs created;
- GVA uplift;
- Land value uplift; and
- Increase in job catchments area.

Due to the relatively constrained geographic scope of the options there was no significant difference between the options, in fact, with the exception of the “Increase in Job Catchment Area” criteria, none of the routes could reasonably be distinguished from one another in terms of Wider Economic Benefits (WEBs) and as such all the options scored equally positively (+3) against all criteria. Positive scores were noted on the basis that the scheme could have the ability to support the long-term success of the Cambridge Biomedical Campus which is anticipated by a Mott MacDonald 2018 study to deliver 10,000 net additional jobs over the next 15-20 years.

For the “Increase in Job Catchment Area” criteria results ranged between 91,352 and 98,470 people, a bandwidth of 7,118 people. This bandwidth was then split into equal ranges of 1017 over the 7 possible INSET scores (-3 to +3). This meant all options, except for Purple, scored +3. Purple scored -3 as the Travel Hub site is more remotely located from both Granta Park and the Babraham Research Campus. This evaluation process is documented in Appendix A: OAR, document reference 403394-MMD-BCA-00-RE-BC-0024.

The result was that under the WEBs appraisal no one preferred option could be identified as Brown, Pink, Blue and Black options all scored equally favourably; the Purple option was however clearly identified as the least favourable option under this area of appraisal and this is reflected in the INSET scores shown in the Final Option Shortlist INSET Results table within Section 19 of the Strategic Case, document reference 403394-MMD-BCA-00-RP-BC-0247. This is covered in further detail in Appendix A: OAR, document reference 403394-MMD-BCA-00-RE-BC-0024.

Although no preferred option could be identified through the application of a WEBs appraisal alone, the Brown option has been taken forward as the preferred option based on INSET appraisal and consultation feedback. As such a more detail WEBs appraisal of the Brown option and the potential benefits it can generate is presented here. Full details can be found in Appendix H: Wider Economic Impacts Report, document reference 403394-MMD-BCA-00-RP-BC-0289.

7.1 Assessment Process (TEAM)

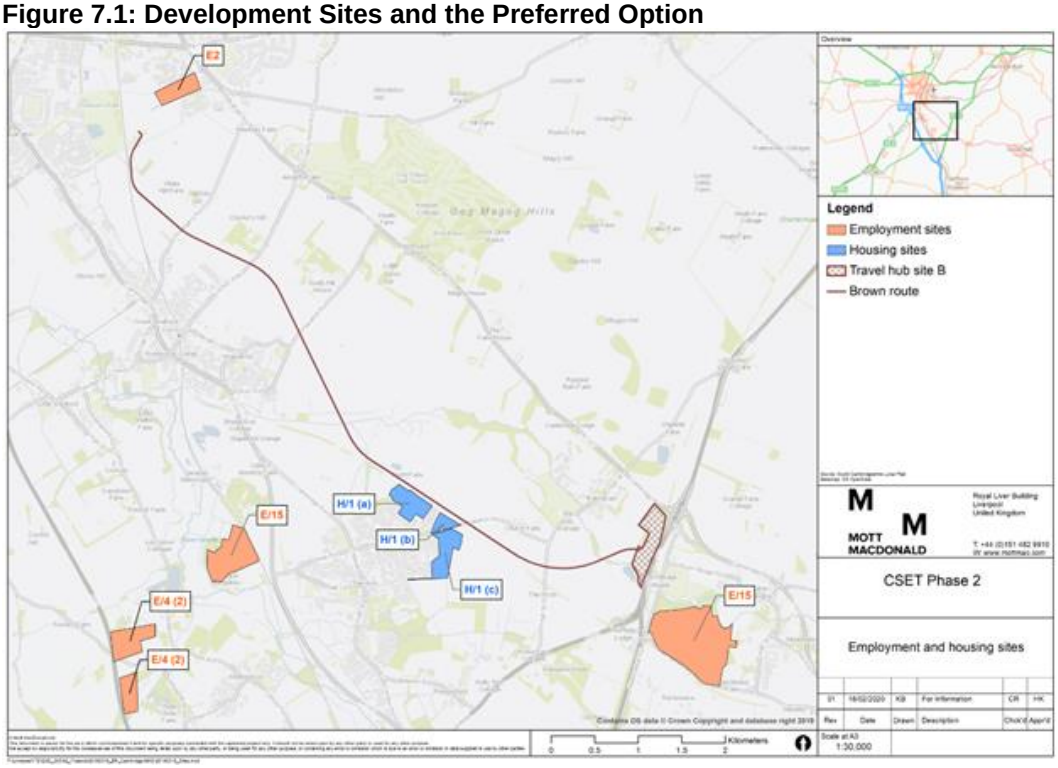
The potential for the preferred option to support the development of commercial and residential land in close proximity to the route has been assessed in line with TAG Unit A2.3. The assessment found that no sites were directly dependent on the scheme. This is partially as a result of the development context within Cambridge, where demand for commercial and residential sites in areas close to Cambridge city centre and key sites such as Granta Park is high, leading to many sites coming forward without public sector intervention.

As no sites are deemed to be dependent, it is not possible to attribute the development of any site, whether commercial or residential, to the project. On this basis, there are no quantifiable wider economic benefits from land-use change that can be directly attributed to the delivery of the project. Notwithstanding the above, in terms of establishing the strategic context to the scheme, it is worthwhile to demonstrate the scale of future development sites in the South East Cambridgeshire area in terms of jobs, Gross Value Added (GVA) and land value uplift.

The economic benefits of the commercial developments in terms of gross jobs and GVA have been assessed using Mott MacDonald's Transparent Economic Assessment Model (TEAM). TEAM assesses the core economic benefits of the associated land-use changes relating to jobs and GVA. The model uses Office of National Statistics (ONS) datasets alongside bespoke local area analysis, in this case for the South Cambridgeshire District Council to inform specific assumptions.

TEAM has been applied to only quantify the gross economic impact of the development of site E/4 (2) in Pampisford because, as discussed above, no sites are considered to be dependent to this scheme. This site is shown together with other employment and housing sites in Figure 7.1.

Figure 7.1: Development Sites and the Preferred Option



Source: South Cambridgeshire District Council

The potential economic benefits of the development site are calculated through the following steps:

- Inputting of key site details into TEAM including the development footprints and land uses; and
- Calculation of economic impacts through feeding the proposed uses by size through TEAM to calculate the gross direct effects of the development site in terms of employment and economic output (measured by GVA) once fully developed. These are calculated using land use assumptions relating to development footprints, land uses, occupancy rates and employment densities to convert land use to jobs. The GVA is then calculated using GVA per worker aligned to the jobs created.

7.2 Assumptions Used

The assumptions used in this appraisal are set out in Table 7.1.

Table 7.1: Assumptions Used

Assumption	Justification
GVA per worker (2017 prices adjusted to 2010 prices) – £45,537.	GVA figures have been calculated based on applying GVA per worker data across the whole economy at a regional level, which is East of England, the latest data is from 2017, which puts GVA per worker at £51,303. This has been adjusted to 2010 prices using the HMT GDP deflators. This produces a value of £45,537 of GVA per FTE.
Plot ratio – 40%	As the site information was provided in hectares, a standard assumption of 40% was applied to estimate the proportion of the site on which usable employment floorspace will be built.
Occupancy rate – 75%	An occupancy rate of 75% accounts for the possibility that the site will not be occupied to full capacity. This provides a conservative estimate of the likely wider economic benefits of the scheme as the actual sites could be more fully occupied if the scheme is well received by investors, developers and potential occupiers.
Employment density – B1 average – 12m^2/FTE	The site was identified for use as B1 office. As the HCA (now Homes England) Employment Density Guide (2015) provides a range of B1 employment densities, an average employment density of 12m² of Net Internal Area (NIA)/Full Time Equivalent (FTE) job was taken. - This is the assumption that one full-time equivalent (FTE) job is generated for every 12m² of B1 employment space in NIA. This conservative assumption has been used to demonstrate the economic impact of a range of potential B1 office uses, rather than focussing on only one B1 use, which could significantly impact the reliability of the assessment if incorrect. These assumptions are based on the HCA Employment Density Guide 2015.

Source: Mott MacDonald

7.3 Results

This analysis found that Site E/4 (2) could accommodate approximately 404 gross jobs, producing around £18m of gross GVA per annum, in 2010 prices, as shown in Table 7.2 below.

Table 7.2: TEAM results

Site	Gross Jobs	Gross GVA Per Annum, £m (2010 prices)
E/4 (2) Pampisford	404	£18m

Source: Mott MacDonald

As stated above, this impact is not attributable to the scheme, but serves to demonstrate the value of supporting sites in this area.

7.4 Land Value Impact of Residential Land

The value of residential allocations H/1 (A and B) in Sawston shown in Figure 7.1 have been assessed at a gross level using a Land Value Uplift (LVU) methodology, in line with guidance from the Ministry of Housing, Communities and Local Government (MHCLG)[8]. The assessment of land value uplift of the residential land allocation has been based on VOA benchmark data, demonstrating the impact of the land changing use from its current use (agricultural and industrial land) to its proposed use (residential). The land use values are provided by MHCLG and have been adjusted from their 2017 price base to the 2010 price required by TAG, so as to be consistent with the wider appraisal. The conversion of land values is shown in Table 7.3.

Table 7.3: Adjusted Land Values

Metric Category	Metric	Value	Price Year	Source
Land values	Industrial (brownfield) Cambridge per ha	£875,000	2017	MHCLG, Land value estimates for policy appraisal 2017, https://www.gov.uk/government/publications/land-value-estimates-for-policy-appraisal-2017
	Agricultural (greenfield) land value Greater Cambridge and Peterborough LEP per ha	£21,000	2017	MHCLG, Land value estimates for policy appraisal 2017, https://www.gov.uk/government/publications/land-value-estimates-for-policy-appraisal-2017
	Residential South Cambridgeshire per ha	£5,300,000	2017	MHCLG, Land value estimates for policy appraisal 2017, https://www.gov.uk/government/publications/land-value-estimates-for-policy-appraisal-2017
Deflator to 2010	GDP deflator - to adjust 2017 values to 2010	88.76	Indexed to 2017/18	ONS, GDP Deflators, Spring statement, 2018
Deflated land values (2010)	Industrial (brownfield land) LCR 2010 prices per ha	£776,644	Adjusted to 2010	Mott MacDonald calculation
	Agricultural (greenfield) land value GCP LEP 2010	£18,639	Adjusted to 2010	Mott MacDonald calculation
	Residential South Cambridgeshire /per ha 2010 prices	£4,704,244	Adjusted to 2010	Mott MacDonald calculation

Source: Mott MacDonald/MHCLG

Applying these values at a gross level to the sites produces the following output in Table 7.4.

Table 7.4: Gross Land Value Uplift of Residential Sites

Site	H/1(a)	H/1(b)	H/1(c)	Combined
Current use	Industrial	Agricultural	Agricultural	-
Size (ha)	10.7	3.64	11.64	25.98
current value per ha (2010 prices)	£776,644	£18,639	£18,639	
Current land value (2010 Prices)	£8,310,091	£67,848	£216,963	£8,594,902
Future use	Residential	Residential	Residential	
Residential land value (2010 prices) Per ha	£4,704,244	£4,704,244	£4,704,244	
Future value of site (residential) (2010 prices)	£50,335,406	£17,123,447	£54,757,395	£122,216,248
Uplift in land value (gross)	£42,025,315	£17,055,599	£54,540,432	£113,621,346

Source: Mott MacDonald

[8] See MHCLG (formerly DCLG) Appraisal Guide, 2014

The analysis found that the total gross land value uplift associated with the change of use of the three residential sites in this area is approximately £113m.

7.4.1 Conclusion of Wider Economic Benefits Analysis

In summary it was found that the development of the three residential sites and single employment site identified in the South Cambridgeshire Local Plan (2018)[9] could produce:

- Approximately 404 gross jobs and £18m of gross GVA per annum; and
- A single uplift in land values of approximately £113m.

Although the sites identified in the area around the CSET scheme were assessed as **not being dependent on the scheme**, the scheme can still support the wider development of South Cambridgeshire. CSET will provide additional transport capacity that will enable people to access key sites at either end of the CSET route.

The development of sites across this area are likely to further increase demand on the road network along the A1307 and nearby roads. The greater use of the road network in this area is likely to increase congestion and journey times, resulting in greater transport costs for users and greater levels pollution in the local area. This could lead to further developing being inhibited by the need to address capacity issues on the road network which is unlikely to be funded by private sector developers.

Accordingly, CSET provides public transport access to key sites across the area of South Cambridgeshire, enabling the growth of sites in this area to be supported by this access and helping to prevent this growth overburdening the local road network. Although these sites are not dependent on CSET to come forward, the future growth of these sites can be directly supported by this scheme in the future through the sustainable public transport access provided to a number of key sites by this scheme.

[9] https://www.scambs.gov.uk/planning/local-plan-and-neighbourhood-planning/the-adopted-development-plan/south-cambridgeshire-local-plan-2018/

7.5 Level 2 Wider Economic Benefits

The WEBs assessment has not identified directly attributable developments and associated Level 3 benefits. Nevertheless, the assessment methodology establishes a clear approach to the monetisation of Level 2 benefits which are calculated in accordance with TAG Unit A2-1 as set out within Section 2 based on a fixed land use. This approach captures benefits for agglomeration, tax revenues arising from labour market impacts, and output change in imperfectly competitive markets.

The approach is based on the duplication of the proportion of the total Level 1 benefits (Journey Time, MEC and Reliability) as specified within Table 7.5.

The WEBs Level 2 assessment identifies a potential additional PVB of **£9.2m** for the Preferred option.

Table 7.5: CSET Phase 2 Level 2 Benefits Preferred Option (Brown)

ID	Impact	PVB	%	Method
1	Agglomeration and labour supply	£8,478m	92%	14% of All Level 1 Benefits (£60.5m)
2	Output change in imperfectly competitive markets	£728m	8%	10% of Business only Level 1 Benefits (£7.2m)
	Total Level 2 PVB	**£9,206m**	**100%**	

Source: Mott MacDonald Notes *PVB – 60-year, 2010 prices, discounted

8 Environmental Impacts

8.1 Introduction

A series of environmental issues have been assessed as part of the INSET options assessment. A full description of the environmental assessment works and the detailed worksheets completed are included in Appendix G: Environmental Appraisal Report (document reference: 403394-MMD-ENV-00-RP-EN-0353).

The appraisal of options was undertaken in accordance with the DfT's TAG Unit 3A guidance by specialists in the following topics:

- Air Quality;
- Biodiversity;
- Greenhouse Gases;
- Historic Environment;
- Landscape;
- Noise; and
- Water.

Those environmental impacts that are able to be monetised as part of the economic appraisal for the preferred option include air quality, greenhouse gases and noise. The results of these assessments are included in Section 5 of this Economic Case. The other environmental impacts feed into the VfM statement and have been assessed in a qualitative and non-monetised manner using TAG appraisal worksheets.

8.2 Air Quality

A quantitative assessment of the effect on air quality has been carried out to inform the overall Benefit Cost Ratio of each option. This assessment followed the TAG Unit A5-4 Marginal External Costs (MEC) to derive Net Present Values (NPVs) related to air quality as reported in Section 5.

The proposed project and associated air quality study area lies within the boundaries of Cambridge City Council (CCC) and South Cambridgeshire District Council (SCDC) areas. Baseline air quality information was obtained from a variety of sources including local authorities, national networks monitoring sites and other published sources. The closest Air Quality Management Area (AQMA) to the air quality study area is approximately 2.3km north of the Cambridge Biomedical Campus.

The assessment was undertaken considering the following key aspects:

- Existing baseline conditions – risk of exceedances of air quality objectives & EU limit values;
- Number of properties affected, and;
- Potential changes in traffic data.

The Cambridge City AQMA was designated by CCC in 2004 as a result of air quality in the city exceeding the annual mean NO2 objective. SCDC has also designated an AQMA along the A14 which is located 6.6km north west of the five options, this AQMA was designated in 2008 for

exceeding both the annual mean NO2 objective and the daily mean PM10 objective. Monitoring data was obtained from surveys undertaken by CCC and SCDC in 2016 to 2018.

SCDC Orchard monitoring station, at Orchard Park Primary School, located approximately 7.1km north of the scheme, is considered representative of the conditions likely to occur in the study area. The results show that NO2 and PM10 concentrations were well below the annual and 1-hour means objectives in July 2019. SCDC's 27 diffusion tube monitoring sites within the district show that NO2 concentrations were well within the national objectives between 2015 to 2018.

Defra provides estimates of background pollution concentrations for NOX, NO2, PM10 and PM2.5 across the UK for each one-kilometre grid square for every year from 2017 to 2030. The data shows background concentrations are within the relevant objectives in 2019 i.e. air quality is good in the study area.

There is no scheme specific monitoring available, although air quality monitoring will be carried out to inform the EIA baseline of the Brown Option and Travel Hub Site B.

The existing pollutant concentrations along the Brown Option and Travel Hub Site B are likely to be below the relevant air quality objectives and EU limit values.

The receptors included within the qualitative assessment were those where the annual mean air quality objectives are applicable for the protection of human health and are within 200m of the scheme option. The receptors include residential properties, educational facilities, hospitals and prisons.

A qualitative assessment of the options was carried out to determine how the options could differ in their impact on air quality. The Brown Option is not expected to have a significant impact on changes in traffic flows on the surrounding road network that would cause significant changes to air quality. Changes in traffic on the local road network have the potential to decrease along the A1307 due to the increased provision of public transport. It would be expected that there would be an increase in traffic on the local road network approaching Travel Hub Site B. These changes in traffic have the potential to cause marginal improvements and deterioration in air quality but not large enough to be significant.

It was concluded that the Brown Option and Travel Hub Site B would have a **neutral effect** on air quality.

8.3 Biodiversity

Biodiversity was assessed following the TAG Unit A3 Environmental Impact Appraisal guidance using the information collected from field surveys in 2018 and additional information from the Cambridge and Peterborough Environmental Records Centre.

The ecological features that occur within a 'Zone of Influence' (ZoI) for a proposed development were investigated.

For the Brown Option there is one international site designated for bats within 30km of the options, this is the Eversden and Wimpole Woods Special Area of Conservation (SAC) approximately 10.5km to the west. The Alder Carr Site of Special Scientific Interest (SSSI), located approximately 1.5km to the south east of the Brown Option.

The Brown route avoids sites protected for ecological purposes. The following habitats have been identified within the options footprint:

- Semi-improved neutral grassland (Priority habitat on the Cambridgeshire and Peterborough HAP);
- Improved grassland;
- Broadleaved semi-natural woodland (Habitat of Principle Importance (HPI) and Priority habitat on the Cambridgeshire and Peterborough HAP);
- Scattered trees;
- Arable (Priority habitat on the Cambridgeshire and Peterborough HAP);
- Species rich and species poor hedgerows; (HPI and Priority habitat on the Cambridgeshire and Peterborough HAP) and;
- Standing and running water (HPI and Priority habitat on the Cambridgeshire and Peterborough HAP).

There are known protected species potentially supported by the habitats within the Brown Option footprint.

The assessment of the Brown Option between CBC and Sawston identified a potential **slight adverse** impact to barbastelle bats from the SAC as there could be an impact to loss of habitat connectivity, commuting routes and foraging grounds.

More locally, a low number of vehicles along the route (i.e. it is not a major road) and the hours of operation are unlikely to significantly overlap with activity times for bats which will reduce the risk of collision with bats species and reduce light spill for sensitive species such as barbastelle. The Brown Option therefore has been assessed as **slight adverse** for bats species.

Nine Wells Local Nature Reserve (LNR) is located 80m from the Brown option, and over 7km from Travel Hub Site B (which would not have an impact on the LNR). Due to the proximity of the route to the LNR, potential impacts from airborne pollution (whilst non-electric vehicles used the route) may cause a **slight adverse** impact upon the LNR.

The Shelford – Haverhill Disused Railway (Pampisford) County Wildlife Site (CWS) is located 500m from Travel Hub Site B and 185m south of the Brown option, due to the distance from the travel hub and it being unlikely for significant changes in airborne pollutants to arise from the route, a **neutral impact** is anticipated. The River Granta is within 200m of Travel Hub Site B and also crosses all but one of the options in two locations. The route alignment is not expected to impact the CWS as the design will avoid any direct impact.

There will be a **slight adverse** impact on the semi-improved neutral and improved grassland, arable, scattered trees, running and standing water and broadleaved semi-natural woodland due to the loss and fragmentation of habitats, with a **moderate adverse** impact upon hedgerows due to loss and severance. Through loss and severance of habitats, the scheme has to potential of a **slight adverse** impact on Species of Principal Importance (SPI).

The overall summary assessment score is **moderate adverse** due to the slight adverse impact anticipated on foraging and commuting bats and the loss and severance of hedgerows.

8.4 Greenhouse Gases

Government has commitments to see reductions in carbon (and other greenhouse gases) which require a step change in transport using vehicles. The scheme is a key part of the strategy to achieve such modal shift by providing high quality public transport. The TAG appraisal does not consider construction impacts but assesses operational impacts.

Greenhouse Gases (GHG) have been assessed following the semi-quantitative TAG Unit A3 Environmental Impact Appraisal with regards to GHG emissions associated specifically with the operational phase of the scheme. A quantitative assessment of the GHG effect of the scheme options to inform the overall Benefit Cost Ratio of each option has followed the TAG Unit A5-4 Marginal External Costs (MEC) to derive Net Present Values (NPVs) related to greenhouse gas. This is reported in Section 5.

Using the route information and maps, a qualitative assessment was also undertaken using professional judgement on the impact the options would have on traffic flows and GHG emissions.

During operation the carbon footprint of the scheme will be minimised with the intention to use low carbon or electric vehicles on the route. This would reduce GHG emissions throughout the operating lifetime of the Brown route and Travel Hub Site B.

The qualitative assessment concluded that none of the options has a significantly different impact on GHG. There are opportunities to reduce carbon for the Brown route. The embedded carbon and slight delay in some local roads accommodate passing public transport vehicles could increase carbon slightly but the modal shift to low carbon public transport is likely to balance (and potentially outweigh) any minor increase in greenhouse gases on local roads.

It was concluded that for the Brown option the greenhouse gases impact would effectively be **neutral**.

8.5 Historic Environment

The appraisal follows the TAG Unit 3A Environmental Impact Appraisal guidance. This appraisal has used the following sources:

- The National Heritage List for England (NHLE) maintained by Historic England for details of nationally designated heritage assets;
- Cambridgeshire Historic Environment Record (CHER) for information on locally listed parks and gardens and conservation areas;
- The CHER for records pertaining to all non-designated heritage assets (both below and above ground), previous archaeological events, secondary sources;
- The Archaeology Data Service has been searched for relevant archaeological fieldwork grey literature reports and publications; and
- A search was undertaken on relevant planning applications (which contained historic environment information) held by the CCC and SCDC.

The route section between Addenbrookes and West of High Street, Babraham crosses the channel that connects Nine Wells springs to Hobson Conduit which is a protected heritage asset. There are no other direct impacts on any listed buildings or other protected sites from the route section of the Brown Option. However, there are a number of listed buildings which could have their setting affected by the route section of which the most significant are:

- Nine Wells Monument (NHLE 1127825);
- Dovecote at Granhams Farm (NHLE 133068);
- Stapleford Hall (NHLE 1331071); and
- Church Farmhouse (NHLE 1331134).

The Brown route would have no direct physical impact on the scheduled Cropmarks site west of White Hill Farm. However, associated archaeological remains are known to extend beyond the scheduled area and into the area of the proposed route, to the south of Nine Wells. This would cause a **slight impact** to the asset from alteration to the context of the asset.

There would be **slight impact** through alteration to the setting/context of the Babraham Conservation Area, as the movement of vehicles along the route during its operation may be visible along the Babraham Avenue from Babraham Hall.

There would be a **slight impact** on Middlefield House, which is a Grade II* Listed Building, through alteration to its setting and context of the asset. The route and crossing of the Granta would be visible from the asset along the garden avenue. This would slightly urbanise the rural view from the house impacting on how the asset is appreciated. The impact is only lessened by the distance from the asset. The movement along the scheme would also be visible.

The construction of the Brown route would have a **large impact** on prehistoric and Roman remains. These remains would predominantly be of low, local or medium, regional value, however, the remains associated with Granhams Farm moated site (an asset of potential schedulable quality), may be of national significance. In addition, Hobson's Conduit, which is fed by a stream that crosses the proposed route near Nine Wells is of national significance.

The Brown route and Travel Hub Site B would impact on the former post medieval cut channel at Bourn Brook. This would result in a **large impact** on assets likely to be of low value.

The construction of the Brown route would cause an impact on a cropmarks complex to the south of Babraham. This would result in a **large impact** on assets likely to be of low to moderate value.

There is a high potential for previously unrecorded archaeological remains to be present within the footprint of the route. This would result in a **large impact** on assets likely to be of low to moderate value from the Brown route and Travel Hub Site B.

In summary, **a major adverse impact is predicted to unknown archaeological remains** due to the construction of the option. Where remains are present, they will be removed by necessary excavations. There are known archaeological remains of regional (and potentially national) significance with the footprint of the proposed option.

8.6 Landscape

Landscape impacts were assessed following the TAG Unit 3A Environmental Impact Appraisal guidance taking into account the landscape character of the area, registered parks and gardens, conservation areas and visual effects of the proposed options. Site visits were undertaken in 2019 during summer and winter to identify the landscape character and the potential visibility of scheme from the surrounding area.

The Brown route alignment and Travel Hub Site B lies within the River Granta Valley Landscape Character Assessment (LCA). The Granta Valley, south and south east of Cambridge, has the low lying, gentle topography typical of river valleys. Key to its character are the tree-lined river and the arable fields, pastures and water meadows on the fertile soils of the valley. The River Granta is a County Wildlife Site for much of its length.

The River Granta Valley LCA is partly in the Green Belt. The Brown route and Travel Hub Site B lies within the South Cambridgeshire Green Belt, apart from the 200m of the route within the Cambridge Biomedical Campus.

The Brown route between Cambridge and Sawston would impact the landscape of farmland and vegetation along the route. Vehicles moving across the rural landscape and through the River Granta valley would introduce uncharacteristic movements into views from residential properties, roads and PRoW that cross the landscape (particularly across the low lying valley associated with the river) and, to varying degrees, from Magog Down and the Gog Magog Hills, north of the scheme.

The Brown route in this area would be at the same level as current ground surface. The route would be unobtrusive in all but close views from roads and Public Rights of Way (PRoW). However, there would be filtered views of the operating vehicles from residential properties on the southern edge of Cambridge, the north-eastern edge of Great Shelford, the northern-eastern edge of Stapleford; the eastern edge of Sawston and on the south-eastern edge of Babraham.

The Brown Option would result in **adverse impacts** due to the introduction and operation of the scheme and associated travel hub into the farmed landscape between Cambridge and Sawston.

The route option from Sawston to the Travel Hub would have similar impacts on landscape and views.

The Brown Option and Travel Hub Site B would replace arable fields with pavement for the public transport route and non-motorised user path, lighting in places, signage, bus halts and infrastructure including a one-story building on the travel hub. This would introduce urbanising elements into a rural setting. The travel hub would also occupy parts of three separate fields, adversely affecting the pattern of the landscape. The travel hub would be clearly visible from PRoW 12/4 and in filtered views from dwellings on the south-eastern boundary of Babraham. The travel hub would be lit at night, affecting the night-time landscape character of the rural area between Babraham and the A11 (although there is lighting on the A11/A1307 junction roundabout). The movement and noise generated by the travel hub and the vehicles operating along the route would reduce tranquillity.

The overall impact on landscape is **moderate adverse impact**.

8.7 Noise

A quantitative assessment of the effect on noise has been carried out to inform the overall Benefit Cost Ratio of each option. This assessment followed the TAG Unit A5-4 Marginal External Costs (MEC) to derive Net Present Values (NPVs) related to noise as reported in Section 5.

The assessment of noise has also been carried out using a qualitative appraisal for OAR purposes. At the time of the appraisal detailed forecast traffic data was not available to complete a full quantitative TAG assessment for all scheme options. The appraisal considers noise impacts due to health effects for each proposed scheme option during the operational phase of the scheme only. The impacts of noise from construction are not considered within the scope of this appraisal as this is not required under the TAG guidance.

The Brown Option is in a horizontal alignment for the majority of the route which is in a rural setting. There are a limited number of sensitive receptors along the route as a result, but the route will pass near to some residential properties in places. The Brown Option is not expected to result in substantial changes to traffic flows on the surrounding road network in relation to noise, and therefore impacts would be localised to areas around the scheme route which are in general sparsely populated. Where the new route passes noise sensitive receptors, such as those near Stapleford and Sawston, noise from public transport is likely to be audible at the nearest properties.

Noise effects will likely be most apparent in the rural areas where existing ambient noise levels are low. Existing noise sources such as the rural road network, the A1307, A11, A505 and the railway line are likely to predominate for receptors near these locations and significant impacts arising from the scheme are unlikely to result.

New sources associated with Travel Hub Site B, including traffic movements within hub boundaries, is unlikely to be significant at the nearest noise sensitive properties due to the distance these are from the hub location. Noise associated with the hub operations can be reduced through design and inclusion of mitigation (bunds or acoustic barriers for example) where necessary.

The Brown Option and Travel Hub Site B would result in **minor adverse** impacts.

8.8 Water

Water was assessed following the qualitative TAG Unit A3 Environmental Impact Appraisal with regards to the value of water resource features that occur in the study area, based on their quality, scale, rarity and substitutability.

The Brown Option would not affect the conveyance of groundwater that provides drinking water in the area, or baseflow to the River Granta. The low permeability car park surface of the selected travel hub will not change recharge or conveyance of groundwater as the total area of any the development is very small in relation to the overall groundwater catchment in the area. In addition, any rainfall running off the site would be collected through the drainage system and discharged locally, thereby causing negligible loss to the catchment overall.

The Brown route cross the River Granta twice. There are no underground structures intended for any travel hub sites, and footings from any river crossing would only have minor impacts on groundwater flow at a very localised level. The design of any river crossing would have to ensure there was no loss of flood storage and no increase in flood risk to adjoining land or downstream of any river crossings.

The Brown route would have a neutral impact on the agricultural surface water abstraction on the River Granta east of Babraham as it should not prevent this abstraction continuing. The route crosses two Source Protection Zones (SPZ); SPZ2 and SPZ3 associated with the two public abstractions near Babraham and one abstraction in Sawston. The nature of the infrastructure and traffic levels on the route would not create a risk to groundwater within the SPZ2 and SPZ3.

Travel Hub Site B has a total footprint that extends into the River Granta flood zones 2 and 3 south east of Babraham. However, the layout would not require car parking infrastructure in the flood zones (the footprint in the flood zone is likely to be used for landscape planting). A drainage strategy and design for the travel hub site would be designed to best SuDS practice.

The level of traffic along the public transport route would not be high enough to generate any significant contamination risks from the public transport vehicles. The design of travel hub drainage and drainage along the approved route will take into account the need to prevent runoff and spillages (likely to be very minor) from having any significant impact on groundwater quality. The travel hub's drainage design will specifically include features to intercept potentially contaminating substances arising from the parking areas (e.g. from fuel and hydraulic leaks, tire and brakes wear and tear) such as the use of vegetated drainage basins.

The overall impact on water resources arising from The Brown route and Travel Hub Site B are therefore considered to be **negligible**.

8.9 Summary of Environmental Appraisal

Table 8.1 below presents a summary of the TAG worksheet of the Brown option and Travel Hub Site B. This includes a short description of the overall impact, an assessment of the magnitude of the potential impact and a rating.

Table 8.1: Summary of Overall Environmental Impact

Disciplines	Overall potential impact	Overall potential effect
Air quality	This option is unlikely to result in significant changes to the baseline conditions. The changes in air quality from this option are judged to be de minimis.	Neutral
Biodiversity	In summary, there would be an overall moderate adverse effect on biodiversity as a result of the Brown Option and Travel Hub Site B. The proposed works, without appropriate mitigation, have the potential to adversely affect bats, otters, water voles, reptiles, badgers, barn owls, white-clawed crayfish, great crested newts, invertebrates nesting birds and other species and habitats of principle importance, Nine Wells LNR, River Granta CWS and Shelford - Haverhill Disused Railway (Pampisford) CWS through the loss, fragmentation and isolation of habitats. Bats using Eversdean and Wimpole Woods SAC will have a slight adverse effect though potential barriers to dispersal and severance of commuting routes. The scheme would not present any significant adverse effects on the integrity of SSSIs.	Moderate adverse
Impact on Green Belt	The Brown route passes through the South Cambridgeshire Green Belt along a similar route as the other options. The Brown route goes to Option B Travel Hub which also sits within the Green Belt. This is likely to have a moderate adverse effect as arable fields will be changed into car parks.	Moderate adverse

Greenhouse Gases	During the scheme's operation, as with those junction's further north, all new junctions would be at-grade and signalised with priority for public transport vehicles which will increase local GHG emissions marginally. As the site could provide parking for up to 2,800 cars this combination of Travel Hub will enable the greatest possible modal shift due to having the largest capacity. However, there is a potential for increased emissions by traffic on local roads waiting for vehicles on the route to pass crossings, but this will be offset by gains achieved through modal shift in transport.	Neutral
Historic Environment	In summary a major adverse impact is predicted to unknown archaeological remains within the proposed option area through the construction of the option. Where remains are present, they will be removed by necessary excavations. There are known archaeological remains of regional (and potentially national) significance within the footprint of the proposed option.	Major adverse
Landscape	In conclusion, the Brown Option would result in moderate adverse impacts due to the introduction and operation of a Travel Hub and access roads into arable fields albeit adjacent to the large A1307/A11 grade separated junction. There would be a loss of farmland and some vegetation. Street lighting and vehicles would be introduced into an unlit area on the rural-urban fringe. The extensive proposed landscape mitigation would, in time, screen and integrate the car park and access roads into their landscape setting, however vehicles using the access would remain noticeable in the landscape.	Moderate adverse
Noise	This Option is unlikely to result in significant changes in traffic and associated noise using the existing road network. Noise effects will likely be most apparent in the rural areas where existing ambient noise levels are low. Existing noise sources are likely to predominate for receptors in these locations and significant impacts are unlikely to result. Noise from traffic within the Option B Travel hub is unlikely to be significant at the nearest noise sensitive properties and can be reduced through design and inclusion of mitigation where necessary. With this Option there is scope to provide mitigation to reduce noise effects from new noise sources along the route and at Option B Travel Hub.	Minor adverse
Water	Insignificant impact on water resources as no direct impacts on any water features other than crossing of River Granta which will require design to be compliant with statutory requirements to have zero increase in flood risk. An SPZ2 and SPZ3 are crossed by route but traffic load is light and not a risk to groundwater quality.	Neutral

9 Social Impacts Appraisal

9.1 Introduction

Although not a part of the formal assessment criteria described in Appendix A: OAR, document reference 403394-MMD-BCA-00-RE-BC-0024, a Social Impact (SI) Appraisal was conducted for the five shortlisted options. A SI appraisal covers the human experience of a transport system and its impact on social factors not considered as part of economic or environmental appraisals. The eight social impacts that should be considered as part of a SI appraisal are:

- Accidents;
- Physical activity;
- Security;
- Severance;
- Journey quality;
- Option and non-use values;
- Accessibility; and
- Personal affordability.

Not all eight impacts are always assessed for every scheme, as some may not always be relevant, however in this instance all eight were deemed relevant and scoped in, in accordance with methods prescribed in TAG Unit A4.1.

Each relevant SI was then assessed on a seven-point scale of beneficial, adverse or neutral impacts, with a score then input into the Appraisal Summary Table (AST). The seven-point scale for SI is set out in Table 9.1.

Table 9.1: SI Assessment Scoring Basis

Assessment	
Large beneficial	✓✓✓
Moderate beneficial	✓✓
Slight beneficial	✓
Neutral	-
Slight adverse	×
Moderate adverse	××
Large adverse	×××

Source: Mott MacDonald based on TAG Unit A4.1 and A4.2

9.2 Results

The results of the SI Appraisal for the five shortlisted options are shown in Table 9.2. It can be seen across all options that there will be largely beneficial social impacts, with ‘option and non-use values’ bringing about the largest benefits due to the large potential catchment area. Personal affordability impacts bring about the only neutral impacts.

Table 9.2: Social Impact Appraisal Summary Scores for Scheme Options

	Travel Hub Site A	Travel Hub Site B		Travel Hub Site C	
	Purple	**Brown**	**Pink**	**Black**	**Blue**
Accidents	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial
Physical activity	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial
Security	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial
Severance	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial
Journey quality	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial
Option and non-use values	Large beneficial	Large beneficial	Large beneficial	Large beneficial	Large beneficial
Accessibility	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Slight beneficial
Personal affordability	Neutral	Neutral	Neutral	Neutral	Neutral

Source: Mott MacDonald

Overall, all five shortlisted scheme options are very similar and as such all options score the same in respect of all impacts. Further information on the SI appraisal can be found in Appendix I: Social Impact Appraisal Report, document reference 403394-MMD-BCA-00-RP-BC-373.

10 Distributional Impacts Appraisal

10.1 Introduction

While the SI appraisal looks at the social impacts of the schemes on the whole population, a number of those impacts are further assessed as part of the Distributional Impacts (DI) Appraisal which looks at the impact of the schemes on vulnerable population groups, and whether any impacts are proportionate. The eight distributional impacts are as follows:

- User benefits;
- Noise;
- Air Quality;
- Accidents;
- Security;
- Severance;
- Accessibility; and
- Affordability.

A screening process was then undertaken to determine the relevance of the impacts to the scheme in question to see if they should be scoped in or out. The screening process considered whether there were expected positive or negative impacts on specific social groups, (shown in Table 10.1), as to whether any potential negative impacts can be designed out and whether any positive or negative impacts are sufficiently minor and socially and/or spatially dispersed, such that a full DI appraisal is disproportionate to the potential impacts.

As the five shortlisted schemes are broadly similar in that the route deviates slightly in a relatively small area and the three potential travel hubs are located relatively close to each other, they were either scoped in or out together. In this case Noise and Air Quality were scoped out as initial assessments due to the lack of detailed modelling data required to be able to assess distributional impacts.

The social groups that were assessed for each distribution impact are displayed in Table 10.1.

Table 10.1: Scope of Socio-demographic Analysis

Social Group (tick indicated analysis required for each impact)	Distributional Impacts							
	User benefits	Noise	Air quality	Accidents	Security	Severance	Accessibility	Affordability
Income distribution	✓	✓	✓				✓	✓
Children: proportion of population aged under 16		✓	✓	✓	✓	✓	✓	
Young people: proportion of population aged between 16 and 25				✓			✓	
Older people: proportion of population aged 70 and over		✓		✓	✓	✓	✓	
Proportion of population with a disability					✓	✓	✓	
Proportion of population of Black, Asian and Minority Ethnic (BAME) origin					✓		✓	
Proportion of households without access to a car						✓	✓	
Carers: proportion of households with dependent children							✓	

Source: Department for Transport (Dec 2015) TAG Unit A4.2 Distributional Impact Appraisal

Each DI that was scoped in was then assessed on a seven-point scale of beneficial, adverse or neutral impacts, with a score then input into the Appraisal Summary Table (AST). The seven-point scale for DI appraisal is set out in Table 10.2.

Table 10.2: Distributional Impact Scale

Impact	Assessment
Beneficial and the population impacted is significantly greater than the proportion of the group in the total population (>5%)	Large beneficial
Beneficial and the population impacted is broadly in line with the proportion of the group in the total population (-5% - 5%)	Moderate beneficial
Beneficial and the population impacted is smaller than the proportion of the group in the total population (<-5%)	Slight beneficial
There are no significant benefits or disbenefits experienced by the group for the specified impact	Neutral
Adverse and the population impacted is smaller than the proportion of the population of the group in the total population (<-5%)	Slight adverse
Adverse and the population impacted is broadly in line with the proportion of the population of the group in the total population (-5% - 5%)	Moderate adverse
Adverse and the population impacted is significantly greater than the proportion of the group in the total population (>5%)	Large adverse

Source: Mott MacDonald based on TAG Unit A4.1 and A4.2

The summary assessment scores for the DI appraisals can be seen in Table 10.3 below. Across all options, the DIs are broadly beneficial though adverse severance impacts are brought about as a result of permanent severance impacts in the areas surrounding the proposed travel hub. It is expected that the location of the travel hub will sever movements in surrounding residential locations and to key employment sites such as Babraham Research Campus and Granta Park.

The population within the study areas for the majority of the social groups is broadly in line with the national comparator figure. As the five scheme locations are almost identical, there is very little variance in the population within each indicative 1km study area. At Full Business Case (FBC) stage, should more detailed modelling become available, the study areas will become more refined. In this case the proportion of impacted population could change and subsequently scorings could change.

Table 10.3: Distributional Impact Appraisal Summary Scores for Scheme Options

	Travel Hub Site A	Travel Hub Site B		Travel Hub Site C	
	Purple	**Brown**	**Pink**	**Black**	**Blue**
User benefits	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial
Noise	Scoped out	Scoped out	Scoped out	Scoped out	Scoped out
Air Quality	Scoped out	Scoped out	Scoped out	Scoped out	Scoped out
Accidents	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial
Severance	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial
Security	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial
Accessibility	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial	Moderate beneficial
Personal affordability	Neutral	Neutral	Neutral	Neutral	Neutral

Source: Mott MacDonald

Further information on the DI appraisal can be found in Appendix J: Distributional Impact Appraisal Report, document reference 403394-MMD-BCA-00-RP-BC-374. In conclusion, no preferred option can be identified from either the SI or DI appraisal alone.

11 Impact on Public Accounts

This chapter sets out the costs of the options that are captured in the appraisal and explains the costs included and how they are manipulated following TAG guidance to provide Present Value of Costs (PVC). First the capital cost is presented for all options and then the whole life costs (maintenance and renewals) associated with the proposed projects. The risk allowance for each option is presented and then the inflation and optimism bias assumptions are explained. The costs are brought together, adjusted and discounted for inclusion in the cost benefit analysis.

11.1 Baseline Capital Costs

Cost estimates have been prepared by quantity surveyors from Mott MacDonald. The detailed breakdown of construction cost estimation is presented in in Appendix K: Project Costs Breakdown, document reference 403394-MMD-BCA-00-RP-BC-0372. Key assumptions are outlined below:

- **Construction costs**: Costs have been calculated based on the current level of design for all the construction works and activities;
- **Preparation costs:** This consists of all project management, consultant support and agent authority fees to cover the elements of survey requirements, preliminary design, public consultation, public inquiry, and the costs of obtaining statutory orders;
- **Statutory Undertakings**: Costs to divert or protect existing Statutory Undertakers' equipment affected by the works; and
- **Land Costs:** Costs have been calculated for the purchase of areas of permanent land take. Costs have also been considered for temporary land required for construction as working areas or compounds. Allowance has been made for General Disturbance, Injurious Affection, Severance and Loss Payments.

The risk adjusted cost estimates are presented in Table 11.1, which mirrors Table 2.2 in the Financial Case. This details the capital costs for the preferred option, divided into construction, design, project management, statutory undertakers, land, and inflation costs. Costs are inclusive of the P80 risk allowance and it is these costs that the economic appraisal has been based on.

Table 11.1: Preferred Option Risk Adjusted Capital Costs

Cost Item	Cost (£) Q2 2020 prices	Cost (£) Outturn Prices[10]
Construction	68,676,000	68,676,000
Design	9,546,000	9,546,000
Project Management	12,547,000	12,547,000
Environmental Mitigation	2,936,000	2,936,000
Statutory undertakings	12,543,000	12,543,000
Land Costs	11,450,000	11,450,000
Inflation	£93,000	12,207,000
TOTAL	**£117,790,000**	**129,905,000**

Source: Mott MacDonald

[10] As reported in Financial Case, document reference 403394-MMD-BCA-00-RP-BC-0293

11.2 Risk and Optimism Bias

In accordance with defined cost assumption guidelines, the capital costs contain defined risk contingency based on P80 (25%) or P90 (29%) and additional risk identified as Optimism Bias.

Table 11.2 presents a range of cost scenarios based on variants of these defined assumptions, with the core cost equates to **£85.65m** in 2010 prices inclusive of 15% Optimism Bias.

Table 11.2: CSET Phase 2 Preferred Option Cost Scenarios

ID	Cost Scenario	Optimism Bias	Price	Cost (£m)	% Base
Base	**Original Capital Cost**		**Q2 2020**	**£117.79**	
Core	**P80 Risk (25%) + OB (15%)**	**15%**	**2010 Prices**	**£85.65**	**-27%**
Test 1	P80 Risk (25%) + OB (44%)	44%	2010 Prices	£107.25	**-9%**
Test 2	P90 Risk (29%) + OB (15%)	15%	2010 Prices	£88.39	**-25%**

11.3 Whole Life Cost Estimates

For this assessment operational and maintenance costs have been excluded from the Economic Case. This is based on the assumption that the revenue will offset the ongoing operating and maintenance costs of the service and infrastructure.

11.4 Preferred Option Present Value Costs (PVC)

Based on the inclusion of the risk contingency and optimism bias, as previously outlined the defined Present Value Cost (PVC) for the CSET Phase 2 preferred option is £85.65m.

11.5 Public Accounts

The total impact on public accounts is estimated to be **£89.08m** (2010 prices), as shown in Table 11.3, all of which is a cost to local government. Note for the economic appraisal all funding costs and maintenance costs for the scheme were allocated to local government. No funding costs have been allocated to central government.

Table 11.3: Public Accounts – Preferred Option

Origin	Cost Type	(£,000 2010 Prices)	
Local Government Funding	Revenue	£0	
	Operating Costs	£0	
	Investment Costs	£85,650	
	Developer and Other Contributions	£0	
	Grant/Subsidy Payments	£0	
	NET IMPACT	**£85,650**	*(7)*
Central Government Funding: Transport	Revenue	£0	
	Operating costs	£0	
	Investment Costs	£0	
	Developer and Other Contributions	£0	
	Grant/Subsidy Payments	£0	
	NET IMPACT	**£0**	*(8)*
Central Government Funding: Non-Transport	Indirect Tax Revenues	£3,433	*(9)*
Totals	Broad transport Budget	**£85,650**	*(10) = (7) +*
	Wider Public Finances	£3,433	*(11) = (9)*
	NET TOTAL	**£89,083**	

Source: Mott MacDonald

The scheme generates a reduction in fuel consumption which leads to a decrease in indirect tax revenues leading to an increase overall costs within the public accounts.

It should be noted that the costs in the Total Impact on Public Accounts in Table 11.3 is lower than the risk adjusted Capital Costs in Table 11.1 as the figures in the Public Accounts table are expressed as Present Values of Costs (PVC) in 2010 prices, discounted. The difference between the two figures is accounted for by the following adjustments, which are also listed in the Assumptions section (5.2) of the Economic Case:

- Costs have been uplifted by a Market Price Factor of 1.19;
- Costs have then been modified by GDP deflator from 2020 to 2010; and
- Costs have been discounted to 2010 prices to arrive at a figure for the PVC.

The Market Price Factor adjustment, deflation and discounting to 2010 prices are in accordance with DfT TAG guidance for Cost Benefit Analysis and HM Treasury Green Book principles. The driver for this is to enable the economic performance of schemes to be compared on a consistent basis at national level.

In comparison, the Financial Case, from which Table 11.1 has been extracted, presents the forecast outturn capital cost of the scheme including risk contingency and an allowance for future inflation up to the years in which the costs are forecast to be incurred.

11.6 Transport Economic Efficiency Table (TEE)

Table 11.4 presents the Transport Economic Efficiency (TEE) table for the CSET Phase 2 preferred options based on the defined Level 1 benefits including; journey time, marginal external costs (MEC) and reliability benefits, as previously outlined.

The table identifies that the primary source of benefits is “Other” users (57%), which is a key characteristic of a public transport service which operates throughout the day and weekend.

Business users represent a small proportion of the overall benefits at 12%.

In summary, the TEE table user benefits profile is considered representative of a public transport intervention.

Table 11.4: CSET Phase 2 TEE Table – Preferred Option

TEE – (2010 prices, discounted £m)	PVB	%
1. Total Users - Commute (£m)	£18.60	31%
2. Total Users - Business (£m)	£7.28	12%
3. Total Users - Other (£m)	£34.68	57%
Total User Trips - Period (£m)	**£60.56**	**100%**

Source: Mott MacDonald

12 Value for Money

The Value for Money (VfM) statement for the CSET Phase 2 project takes into consideration all appraisal and assessment work undertaken to date to arrive at the emerging scheme that is shown to present the best VfM. This takes into account the monetised impacts versus the project costs presented as a Benefit to Cost Ratio (BCR), as well as the findings from any qualitative and non-monetised assessments.

The approach to the assessment of VfM of City Deal schemes, as set out in the City Deal Assurance Framework, reflects this by stating that projects with a BCR less than 2:1 may still be considered for funding if they can demonstrate a compelling case for investment based on meeting the objectives of the City Deal. These include, for example, unlocking barriers to growth, delivering wider economic benefits, environmental and social benefits. As long as the project provides a robust evidence base with a proportionate level of quantitative and qualitative analysis to demonstrate that the project represents good VfM and can meet the policy objectives of the City Deal, these do not need to be included in the central benefit-cost analysis.

12.1 Analysis of Monetised Costs and Benefits

The Benefit to Cost Ratio (BCR) is an indication of the return on public sector investment in a project. The BCR is the ratio of the Present Value of Benefits (PVB) over the Present Value of Costs (PVC) and indicates how much benefit is obtained for each unit of cost. Based on an assessment of the benefits and costs of each option an initial assessment of the CSET Phase 2 project's VfM has been calculated and is presented in Table 12.1, that includes an initial BCR (established monetised impacts) and an adjusted BCR (evolving monetised impacts) as appraised.

Table 12.1: Analysis of Monetised Costs & Benefits (AMCB)[11] – Level 1 Preferred Option

(2010 Prices, discounted)	Total Value	Journey	MEC	Reli
Noise	**£0**	-	£0	-
Local Air Quality	**£81**	-	£81	-
Greenhouse Gases	**£1,287**	-	£1,287	-
Journey Quality	**£0**	-	£0	-
Physical Activity	**£0**	-	£0	-
Accidents	**£3,051**	-	£3,051	-
Economic Efficiency: Consumer Users	**£18,316**	£14,846	£2,188	£1,35
Economic Efficiency: Consumer Users (Other)	**£33,800**	£25,205	£6,840	£1,96
Economic Efficiency: Business Users and Providers	**£7,141**	£6,000	£1,050	£124
Wider Public Finances (Indirect Taxation	**-£3,433**	-	-£3,433	-
Present Value of Benefits (PVB)	**£60,557**	**£46,050**	**£11,064**	**£3,44**
Broad Transport Budget	**£0**	**76%**	**18%**	**6%**
Present Value of Costs (PVC)	**£85,652**			
OVERALL IMPACTS				
Net Present Value (NPV)	**-£25,095**	NPV=PVB-PVC		
Benefit to Cost Ratio (BCR) – Level 1	**0.71**	BCR=PVB/PVC		

Source: Mott MacDonald

[11] 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.

12.2 Value for Money Statement

The VfM categories defined by the DfT and used by GCP are set out in Table 12.2.

Table 12.2: DfT VfM Categories

VfM Category	Implied by…
Very High	BCR greater than or equal to 4
High	BCR between 2 and 4
Medium	BCR between 1.5 and 2
Low	BCR between 1 and 1.5
Poor	BCR between 0 and 1
Very Poor	BCR less than or equal to 0

Source: Department for Transport Value for Money Framework

The monetised Level 1 economic benefits (based on transport modelling outcomes, including journey time savings, marginal external costs (MEC) & reliability benefits) show that the scheme produces an **initial Benefit to Cost Ratio** (BCR) of **0.71** from a PVB of **£60.5m** and a cost to public accounts of **£85.6m**

According to DfT guidance and criteria the BCR of **0.71** yields poor VfM, based on Level 1 benefits

12.3 Level 2 Adjusted BCR

Following the completion of the Level 1 benefits assessment as previously outlined, a further consideration is the impact of the defined Level 2 benefits on the VfM.

The WEB Level 2 assessment has identified an additional £9.2m PVB as outlined within Table 7.5. Table 12.3 below presents the impact of including these Level 2 benefits within the VfM case, which equates to an increase of the BCR by 15% to **0.81.** The scheme VfM status remains Poor, however Level 2 benefits are a noticeable contribution.

Table 12.3: CSET Phase 2 – Adjusted BCR including Level 1 & Level 2 Benefits

Benefit (2010 Prices, discounted)	Value	%
Level 1 PVB	£60,557	87%
Level 2 PVB	£9,206	13%
Total PVB	**£69,762**	**100%**
Total PVC	**£85,652**	
BCR Level 1 & 2	**0.81**	**VfM Poor**
% Level 2	**15%**	

12.4 Appraisal Summary Table

The Appraisal Summary Table (AST) presented below provides details of the overall impacts of the scheme. These include both qualitative and quantitative benefits.

Appraisal Summary Table	CSETs A1307 Phase 2	Site B	BRN	

Impacts		Summary of key impacts	Assessment					
			Quantitative				Qualitative	Monetary £(NPV)
Economy	Business users & transport providers	The CSET Phase 2 provides alternative travel option for business users to utilise to travel into Cambridge and key employments centres all the corridor. Overall business travellers are a smaller proportion of overall travel, particularly bus based, therefore the monetised benefit is slight, due the the low level of business traveller on Public Transport	Value of journey time changes(£)	£6,000			Slight Benefit	£6,000
			Net journey time changes (£)					
			0 to 2min	2 to 5min	> 5min			
			-	-	£6,000			
	Reliability impact on Business users	P&R service provides reliable travel times of commuter and other trips to/from Cambridge. Economic impact of these reliability savings have not been assessed.	Not assessed in detail				Slight Benefit	-
	Regeneration	The P&R service provides a alternative high quality travel option which supports regeneration along the corridor. Specific regeneration sites are not identified in the assessment.	Not assessed in detail				Slight Benefit	-
	Wider Impacts	The P&R service provides a alternative high quality travel option which provides improved accessibility to key employment centres Cambridge, Biomedical Campus, Babraham Research Centre and Granta Park. The scheme is designed to support wider economic benefits but it is difficult to attribute these directly to the scheme.	Not assessed in detail				Slight Benefit	-
Environmental	Noise	The A1307 service operates as a segregated service within a rural environment. Based on the MEC approach, the distance saving for the scheme on a Rural A road equates to no impact on Noise. Minor localised benefits are likely for key receptors along the service corridor and parallel routes.	Assessed through the MEC approach				Neutral	£0
	Air Quality	The P&R service generates a reduction in distance travelled by private car which is converted to a very minor benefit through the MEC process. This is due to the key impact being a Rural A road.	Assessed through the MEC approach				Neutral	£81
	Greenhouse gases	The P&R service generates a reduction in distance travelled by private car which is converted to a slight benefit through the MEC process.	Change in non-traded carbon over 60y (CO2e)	-			Slight Benefit	£1,287
			Change in traded carbon over 60y (CO2e)	-				
	Landscape	The scheme would result in moderate adverse impacts due to the introduction and operation of a Travel Hub and access roads into arable fields albeit adjacent to the large A1307/A11 grade separated junction. There would be a loss of farmland and some vegetation	N/A				Moderate Adverse	-
	Townscape	N/A	N/A				N/A	-
	Historic Environment	A major adverse impact is predicted to unknown archaeological remains within the proposed option area through the construction of the option. Where remains are present, they will be removed by necessary excavations	N/A				Major Adverse	-
	Biodiversity	The proposed works, without appropriate mitigation, have the potential to adversely affect bats, otters, water voles, reptiles, badgers, barn owls, white-clawed crayfish, great crested newts, invertebrates nesting birds and other species and habitats of principle importance,	N/A				Moderate Adverse	-
	Water Environment	Insignificant impact on water resources as no direct impacts on any water features other than crossing of River Granta which will require design to be compliant with statutory requirements to have zero increase in flood risk.	N/A				Neutral	-

Appraisal Summary Table	CSETs A1307 Phase 2	Site B	BRN	

Impacts		Summary of key impacts	Assessment				
			Quantitative			Qualitative	Monetary £(NPV)
Social	Commuting and Other users	The CSET Phase 2 proposal is principally the provision of a high quality & frequent P&R service betw een Cambridge and key employment centres. The P&R service is primarily designed to provide a reliable service operating throughout the day, resulting in benefits for commuters and other users. In addition the service operators at w eekends. The service provides siginficantly improved public transport connectivity and serive to On-Route locations, Sw aston, Stapeford and Great Shelford generating substainal benefits.	Value of journey time changes(£) £40,051 Net journey time changes (£) 0 to 2min: - / 2 to 5min: - / > 5min: £40,051			Medium Benefit	£40,051
Social	Reliability impact on Commuting and Other users	P&R service provides reliable travel times of commuter and other trips to/from Cambridge. Economic impact of these reliability savings has been addressed based on observed current performance, w ith a segregated busw ay provide noticeable improvement in public transport reliability.	Not assessed in detail			Slight Benefit	£3,442
Social	Physical activity	P&R service encourages the adoption of sustainable travel to access/egress the service. This impact has not been assessed in detail as part of this assessment.	Not assessed in detail			Slight Benefit	-
Social	Journey quality	The bus segregated service is a high quality & frequent service w ith noticeable improvements in journey quality. This has not moneitised as part of this assessment. How ever, by design the proposed vehicle w ill be a notieable improvement in additional to the segregated travel experience.	Not assessed in detail			Medium Benefit	-
Social	Accidents	P&R service reduces the net distance travelled by private car and specifically the number of vehicles along the A1307 corridor. The accident benefit has been calculated based on the distance saving through the MEC approach.	Assessed through the MEC approach			Slight Benefit	£3,051
Social	Security	Increased surface expansion could result in more users being able to park in a secure location. The proposed travel hubs and PT route w ill benefit from good levels of both formal and informal security, including CCTV systems and passive surveillance from w orkers and other users	N/A			Moderate Beneficial	-
Social	Access to services	The scheme aims to improve accessibility and connectivity in South East Cambridge, though for those residents w ho are currently limited by no access to a car, these limitations w ill still exist. Cambridge is the major centre of employment and services and this scheme aims to better link residents to these services and activities	N/A			Slight Beneficial	-
Social	Affordability	There are no expected personal affordability impacts as a result of any of the five scheme options. Parking at the travel hubs w ill be free of charge and the cost of bus services into the centre is expected to be in line w ith costs on the rest of the netw ork across Cambridge	N/A			Neutral	-
Social	Severance	There w ill be severance impacts as a result of the location of the travel hub and along the route at various points. Pedestrian journeys in the area betw een Babraham and New market Road w ill likely become longer and less attractive w hile journeys at points along the proposed route w ill still be able to be made, w ith some hindrance resulting in slightly longer journey times.	N/A			Moderate Adverse	-
Social	Option and non-use values	The addition of the public transport route from Haverhill, via the travel hub and onw ards into Cambridge w ould give option values to approximately 40,000 households. Services running at eight per hour betw een the travel hub and Cambridge and a further tw o betw een Granta Park and Cambridge and tw o betw een Haverhill and Cambridge w ould give local residents a number of options for accessing the service and therefore better connect local tow ns and villages to services	N/A			Large beneficial	-
Public Accounts	Cost to Broad Transport Budget	Transport budget based on capital cost (CAPEX Only). Service is identified as revenue generating. Revenue is excluded from the assessment.	Cost based on CAPEX only			-	£85,652
Public Accounts	Indirect Tax Revenues	Project generates a mode transfer to a P&R service and an overall reduction in distance travelled. This results in a reduction in fuel consumption and fuel tax generation.	Assessed through the MEC approach			-	-£3,433

13 Sensitivity Tests

A number of sensitivity tests have been carried out around the preferred option. The purpose of the sensitivity tests is to understand if the intervention being proposed is still value for money given alternative cost assumptions and demand levels driven by higher growth scenarios. The sensitivity tests can be grouped into the following categories:

- Sensitivity around scheme costs for the preferred scheme – investigating the impact of different levels of optimism bias and risk contingency allowance; and
- Sensitivity around alternative growth scenarios – looking at the impact of higher demand growth, in line with that reported in the Cambridgeshire & Peterborough Independent Economic Review (CPIER).

13.1 Sensitivity to Scheme Costs

Two sensitivity tests have been carried out to assess the sensitivity of the scheme to different assumptions surrounding scheme costs. These relate to:

- The level of optimism bias; and
- The treatment of risk.

Both these tests have been carried out under the core scenario and the high growth scenario.

13.1.1 Optimism Bias

TAG A1-2 presents guidance on determine the appropriate level of optimism bias to apply to scheme costs. This is dependent on the nature of the scheme and its status in the scheme development process. The preferred scheme has been assessed based on the guidance included in TAG A1-2, which results in optimism bias of 15% being applied, commensurate with a local authority scheme at OBC stage.

It is important to examine the impact of a range of other possible levels of optimism bias on the cost estimates reported in the TEE and PA tables. To address this a sensitivity has been carried out assuming an optimism bias level of 44%, which is the appropriate level for a local authority scheme at SOBC stage. The scheme costs with an optimism bias of 44% are shown in Table 13.1, as test 1, with corresponding impact on the BCR.

13.1.2 Treatment of Risk

Risk in this context refers to identifiable factors that may impact on scheme costs, leading to over- or under-spends. Risk adjusted costs were used in the economic appraisal for the preferred option. For the core base costs, a risk value based on P80 was applied, meaning there is an 80% likelihood that the project will be delivered within budget. For the purpose of this sensitivity test the P90 costs have been used representing a 90% likelihood that the project will be delivered within budget. The scheme costs based on a P90 estimate are shown in Table 13.1, as test 2, with corresponding impact on the BCR.

13.2 Alternative Growth Sensitivity Test

One sensitivity test has been carried out to assess the sensitivity of the scheme to different assumptions surrounding future growth. This is based on the CPIER findings that Cambridge is expected to achieve growth greater than that set out in the adopted Local Plans.

CSRM2 (D-series) was developed with three future year scenarios, known as the Foundation Case (2026 FC, 2031 FC and 2036 FC), of which 2026 and 2036 have been used in testing the various options for CSET Phase 2. The Foundation Case represents a scenario which is consistent with the Local Plans for the four Local Authority Districts covered by CSRM2 (Cambridge City, South Cambridgeshire, Huntingdonshire and East Cambridgeshire). As such it is constrained to the levels of growth and locations contained in published and proposed plans.

However, since the Local Plans were published, actual growth has differed in terms of the rate and locations in which it is occurring. In addition, there is the potential for overall employment growth to be greater in the period to 2031 than projected in the Local Plans, particularly in the Cambridge area, as noted in the CPIER interim report.

An alternative future growth scenario was therefore developed, nominally called 'High Growth' (HG), to represent a revised pattern and rate of growth across the modelled area. In addition to revised employment and dwelling forecasts, the HG forecasts also included academies and other private schools.

The impact of this HG alternative scenario on the scheme's VfM has been tested, with a greater level of demand and therefore associated benefit evaluated. The results are shown as Tests 3A, 3B and 3C in Table 13.1.

13.3 Sensitivity Test Results

The sensitivity test economic results are presented for the 5 scenarios in Table 13.1 below.

It can be seen from the above that the application of the sensitivity tests under both Core and High Growth scenarios have relatively little impact on VfM status, which remains "**Poor**" under all scenarios. However, in terms of the BCR there is a 17% uplift in the comparable High Growth scenario (Test 3A) relative to the Core scenario, showing that the BCR is sensitive to increases in demand. In this scenario the BCR is approaching a neutral **1.00** with further benefits or cost reductions moving the VfM towards the "Low" classification under these conditions.

Table 13.1: Preferred Option – Economic Appraisal Sensitivity Tests (£m, 2010 prices)

Scenario	Core	Test 1	Test 2	Test 3A	Test 3B	Test 3C
		Core			High Growth	
Cost Assumptions	**P80 Risk (25%) + OB (15%)**	**P80 Risk (25%) + OB (44%)**	**P90 Risk (29%) + OB (15%)**	**Core**	**Test 1**	**Test 2**
Level 1 PVB	**£60.6**	£60.6	£60.6	£70.8	£70.8	£70.8
Level 2 PVB	**£9.2**	£9.2	£9.2	£10.8	£10.8	£10.8
Total PVB	**£69.8**	**£69.8**	**£69.8**	**£81.7**	**£81.7**	**£81.7**
PVC	**£85.7**	**£107.3**	**£88.4**	**£85.7**	**£107.3**	**£88.4**
NPV	**-£15.9**	**-£46.7**	**-£27.8**	**-£14.8**	**-£36.4**	**-£17.6**
Level 1 BCR	**0.71**	**0.56**	**0.69**	**0.83**	**0.66**	**0.80**
Adjusted BCR (Lv1&2)	**0.81**	**0.65**	**0.79**	**0.95**	**0.76**	**0.92**
VfM Category	**Poor**	**Poor**	**Poor**	**Poor**	**Poor**	**Poor**
% Difference from Adjusted Core		**-20%**	**-3%**	**17%**	**-7%**	**13%**

Source: Mott MacDonald OB = Optimism Bias

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