MOTT MACDONALD

Cambridge South Station: Strategic Outline Business Case

13 November 2017

Department for Transport

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Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	06/11/17	PC / MH	CJ	CJ	Draft for client review
B	13/11/17	PC / MH	CJ	CJ	Final

Document reference: 378389CS | 01 | B

Information class: Standard

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Executive summary

Introduction

This document presents the Strategic Outline Business Case (SOBC) for a new rail station, Cambridge South, serving the internationally significant Cambridge Biomedical Campus and Southern Fringe development areas of Cambridge. The purpose of an SOBC is to set out the need for intervention, provide suggested or preferred solutions, and present evidence for a decision to be made on whether to proceed with a scheme.

The SOBC is structured around the five case model for transport business cases, with a focus on the Strategic and Economic Cases at this early stage of scheme development.

To meet the long term operational requirements of the rail network, including the proposed East West Rail project, the overall scheme is expected to comprise:

- Four-tracking the West Anglia Main Line between Shepreth Junction (Great Shelford) and the existing four track section to the south of Cambridge station.
- Reconstruction of the A1134 Long Road bridge to allow for four-tracking.
- A new station at Cambridge South with four platform faces, formed by two island platforms.
- Grade separation at Shepreth Junction to provide for future East West Rail requirements.

Other non-rail transport solutions have been considered, and will continue to be considered, for the Cambridge Southern Fringe. However, a new rail station is judged to be the option that will have the greatest impact in meeting the objectives and in unlocking the area's economic growth potential.

Strategic Case

The Cambridge Biomedical Campus is expected to become an integral part of the UK life sciences industry, housing the largest concentration of biomedical expertise in Europe by 2020. Excellent transport provision will be required to allow the highly skilled workforce and visitors to travel to the campus, from within the 'Golden Triangle' life sciences cluster and other national and international locations.

The Southern Fringe is identified in the Cambridge Local Plan as an 'area of major change' in which approximately 3,300 new homes will be provided. The development will be integrated with the adjacent Biomedical Campus, which by the mid-2020s could be home to more than 15% of all employment within Cambridge.

As a unique development of national and strategic importance to the UK, the Department for Transport is taking the lead in promoting and developing a transport solution for the Cambridge Biomedical Campus and surrounding development area. The intention is to create the right conditions for businesses to invest for the long term.

Opportunities and aspirations, existing and anticipated future transport problems, and the policy context of the area have been analysed to develop appropriate **objectives** for a solution:

1. Increase public transport connectivity between the Cambridge Biomedical Campus and international gateways, in recognition of its international significance.
2. Improve sustainable transport access to housing, services, and employment within the Cambridge Southern Fringe and Biomedical Campus area, to fulfil existing and future demands.
3. Minimise highway congestion associated with the Southern Fringe and Cambridge Biomedical Campus by increasing the mode share for sustainable transport modes.
4. Reduce reliance on central Cambridge transport infrastructure for serving the Southern Fringe and Biomedical Campus.
5. Be capable of integrating with and enhancing the opportunities presented by Thameslink and East West Rail, to support development of the Biomedical Campus as part of the Golden Triangle life sciences cluster.

Four public transport options have been assessed against the objectives, and for deliverability, financial affordability and stakeholder acceptability risks. Cambridge South station is likely to be one of the most challenging options in terms of both deliverability and financial affordability, but it is expected to provide the greatest benefits. It is also expected to be the most acceptable option for key stakeholders, delivering a significant uplift in public transport provision.

A high level wider economic impact assessment has forecast that, in the medium term, £1.7 million GVA per annum (2015 prices) linked to committed developments at Cambridge Biomedical Campus and the Southern Fringe can be attributed to Cambridge South station. This GVA forecast represents additionality.

In the longer term, 118 new jobs per annum linked to growth that is not yet committed might be attributable to Cambridge South station. The extent to which these jobs are additional to the UK economy is not known at this stage.

Economic Case

The Economic Case has been prepared using methods that are appropriate for an early stage of scheme development, using available datasets, WebTAG and PDFH to monetise benefits where possible.

Cambridge South is expected to represent **Low-Medium value for money**, with an initial BCR of 1.3 and an adjusted BCR of 1.5. However, this is highly sensitive to a range of factors, including:

- The increased journey time experienced by the large number of through passengers who will now have to stop at the new station. This reduces scheme value for money substantially even though the journey time increase is only slight.
- The proportion of capital expenditure which is apportioned to the Cambridge South scheme rather than East West Rail. For example, reducing capital expenditure by £40-45 million compared to the 'central case' increases the initial BCR to above 6.0.
- The proportion of capital expenditure that is funded by the private sector. For example, the initial BCR could be increased to 2.0 with around 23% of the capital expenditure funded by the private sector.

Monetised benefits associated with measures other than the main station infrastructure for Cambridge South have not been claimed in this SOBC, as it would be more appropriate to

apportion these to the business case for the central section of East West Rail. The costs for these infrastructure measures should also be apportioned to East West Rail. Detailed benefits and cost apportionment work will be required in advance of the Outline Business Case.

The proposed infrastructure works, such as four-tracking and grade separation at Shepreth Junction, have the potential to reduce rail journey times and to offset the time penalty associated with an additional station call. However, the journey time impacts of these measures cannot be quantified at this early stage of scheme development. It may be useful for Network Rail to consider whether and how the new infrastructure could be specified to mitigate the time penalty from the additional station call.

Overall value for money is summarised in the table below.

Assessment type	Estimate	Comments
Net Present Value (NPV)	£10.0 million	This NPV is for the 'initial BCR'.
Initial BCR	1.3	Includes monetised benefits for journey time savings, accident savings, reduced greenhouse gas emissions, noise and air quality benefits.
Adjusted BCR	1.5	Includes an additional £9 million (2010 prices discounted to 2010) agglomeration benefits.
Qualitative assessment	Moderate Beneficial	Wide range of social, economic, and environmental benefits. Large beneficial option value impacts. Moderate beneficial journey quality and access to services impacts. Slight adverse impacts for landscape, historic environment, and biodiversity, all primarily related to infrastructure measures required for East West Rail. Wider economic (GVA) additionality estimated at £1.7 million per annum (2015 prices) in the medium term.
Key sensitivities	High risk	Value for money is highly sensitive to levels of capital expenditure, the time penalty for through-passengers, and assumptions on how much development will be reliant on the new station.
VfM category	Low-Medium	Additional agglomeration and qualitative benefits could be significant enough to increase the VfM category to Medium.

Financial Case

The order of magnitude cost range identified for the scheme is £175 million to £350 million (Q1 2017 prices) including Optimism Bias. These costs are expected to cover all scheme elements including infrastructure that would provide for East West Rail.

Ongoing operating and maintenance costs associated with the scheme are likely to include station operating and maintenance costs, and the net increase in maintenance and renewals for additional infrastructure. A proportion of maintenance and renewals costs for additional infrastructure will need to be allocated to East West Rail.

Given the private sector interest in the scheme, a range of funding options exists.

In advance of submitting an Outline Business Case the following will be required:

- A detailed cost estimate and expenditure profile;
- More detailed consideration of scheme cost apportionment between Cambridge South and East West Rail; and
- Funding source investigation to identify the most suitable combination of sources.

For the next stage of scheme development (to Outline Business Case), a £10 million funding package has been agreed in principle.

Commercial Case

The outline Commercial Case raises the following key points:

- Scheme procurement is considered to be commercially viable, as this is a conventional rail station and infrastructure project.
- A preliminary specification has been produced. A full output-based specification will need to be presented with the Outline Business Case.
- A range of procurement options exists for station infrastructure delivery. Regardless of the procurement approach adopted, it is likely that a rail franchise operator would be designated as the Station Facility Operator.
- The range of procurement options available for the rail line infrastructure improvements is more limited, as the upgraded infrastructure would need to be managed and maintained by Network Rail as part of the UK rail network.
- The train services calling at the new station will be provided by the franchise operators that run services along the line on which the station is located. Service levels can be included within the franchise specifications at the next franchise renewal date.

Management Case

Key points from the preliminary Management Case are:

- Several new stations have been delivered across the UK rail network in recent years. The Cambridge South scheme is therefore a conventional scheme type.
- The programme needs to combine the Department for Transport's business case requirements, with Network Rail's GRIP process. The anticipated station opening date is 2025.
- Programme dependencies include continued successful growth and development at the Cambridge Biomedical Campus, industry timescales in relation to planning and technical approvals, time taken to secure a suitable funding package, and the Greater Anglia franchise retendering due for completion in 2025.
- The SOBC stage is being led by the Department for Transport. Following SOBC sign-off, a governance structure will need to be established, which will evolve as the scheme is developed.
- Quality will be assured by adherence to Network Rail's GRIP process.
- A Communications Plan will be developed in advance of Outline Business Case submission. A crucial area of communication will be in relation to the A1134 Long Road bridge reconstruction, requiring collaboration with Cambridgeshire County Council to identify suitable diversion routes and minimise disruption during temporary road closures
- Key risks have been identified in relation to the funding package, ground conditions, local environmental impacts (landscape, heritage, and biodiversity), East West Rail requirements, land availability, and growth at the Biomedical Campus. Following SOBC sign-off a Risk Management Strategy and risk register will be prepared and kept up-to-date throughout the remainder of the scheme's development.

1 Introduction

This document presents the Strategic Outline Business Case for a new rail station, Cambridge South, serving the Southern Fringe and Cambridge Biomedical Campus development areas of Cambridge. The new station would form a key component of the overall transport solution.

1.1 Context

Cambridge is one of the UK's most successful, fastest growing and most productive cities. The city has a thriving hi-tech and biotechnology cluster of approximately 1,000 companies, with a further 400 additional companies providing services and support to the primary cluster. The growth in industry has taken place largely since the 1960s and has been referred to as the 'Cambridge Phenomenon'[1]. Cambridge is also part of the internationally recognised life sciences cluster in the South East of England, the 'Golden Triangle', comprising Oxford, Cambridge, London and the areas between[2].

Cambridge is critical to the UK's long term economic plan, which seeks to improve productivity and international competitiveness. The city helps the UK economy to compete on the international stage, attracting high calibre knowledge-based individuals to fill skills gaps and increase economic growth.

The next major phase of rapid growth in Cambridge is taking place within the Southern Fringe, incorporating substantial residential development, and the adjacent Cambridge Biomedical Campus. By 2020, the Cambridge Biomedical Campus is expected to house the largest concentration of biomedical expertise in Europe, including an international conference centre and high capacity hotel. Over the next four years alone, 3,750 new jobs are expected to be created. The new housing developments across the Southern Fringe will comprise around 4,000 new homes between 2011 and 2031, of which approximately one third have already been constructed.

The Southern Fringe and Biomedical Campus development is expected to enable significant economic growth. Although this success will depend in part on having excellent national and international transport links.

1.2 Scope of this Strategic Outline Business Case (SOBC)

This Strategic Outline Business Case (SOBC) is for a new rail station, Cambridge South, to serve the internationally significant Cambridge Biomedical Campus and Southern Fringe development area. The purpose of an SOBC is to set out the need for intervention, provide suggested or preferred solutions, and present evidence for a decision to be made on whether to proceed with a scheme[3].

In line with Department for Transport requirements, this SOBC:

- Defines the scope of the proposed scheme;
- Makes the case for change (the Strategic Case), confirming how the scheme fits with national, regional and local objectives;

[1] http://www.cambridgephenomenon.com/phenomenon/

[2] Life Sciences Industrial Strategy – A report to the Government from the life sciences sector, Professor John Bell, August 2017.

[3] The Transport Business Cases, Department for Transport, January 2013.

- Outlines options and carries out an initial sift;
- Presents evidence on expected impacts, stating the assumptions made (the Economic Case); and
- Outlines the likely costs, governance structures, delivery programme, assurance arrangements, and key stakeholders for the scheme (in the Financial, Commercial, and Management Cases).

In common with most SOBCs, and reflecting the early stage of scheme development, the primary focus of this document is on the Strategic and Economic Cases.

1.3 The Scheme

Based on early stage (pre-GRIP) operational feasibility work undertaken by Network Rail and train operating companies in 2017, the Cambridge South scheme is expected to comprise the following key infrastructure measures:

- Four-tracking a 2.3-mile section of the West Anglia Main Line between Shepreth Junction (Great Shelford) and the existing four track section to the south of Cambridge station. This includes associated signalling, switches and crossings, and additional overhead line equipment.
- Reconstruction of the A1134 Long Road (road over rail) bridge to allow for four-tracking.
- A new station at Cambridge South with four platform faces, formed by two island platforms.
- Grade separation at Shepreth Junction to provide for future East West Rail requirements.

Together these measures are expected to meet the long term operational requirements of the rail network and services in the Cambridge area, avoiding introducing new operational constraints.

The new station at Cambridge South will include a footbridge and lifts, waiting shelters and ticket purchasing facilities, lighting and other security measures, and a drop-off / pick-up area outside the station entrance. The anticipated station opening date is 2025.

Due to the close proximity of the major Southern Fringe housing developments and proximity of two of Cambridge's five official park and ride sites (at Trumpington and Babraham Road), a car park will not be provided at Cambridge South station. This will avoid attracting additional car trips, which have neither an ultimate origin or destination in the Southern Fringe.

The proposed station location is shown in **Figure 1**, on the West Anglia Main Line between the major new housing and employment development sites within the Southern Fringe.

Other non-rail transport solutions have been considered, and will continue to be considered, for the Cambridge Southern Fringe. However, as demonstrated in this SOBC, a new rail station is judged to be the option that will have the greatest impact in meeting the objectives set and in unlocking the area's economic growth potential.

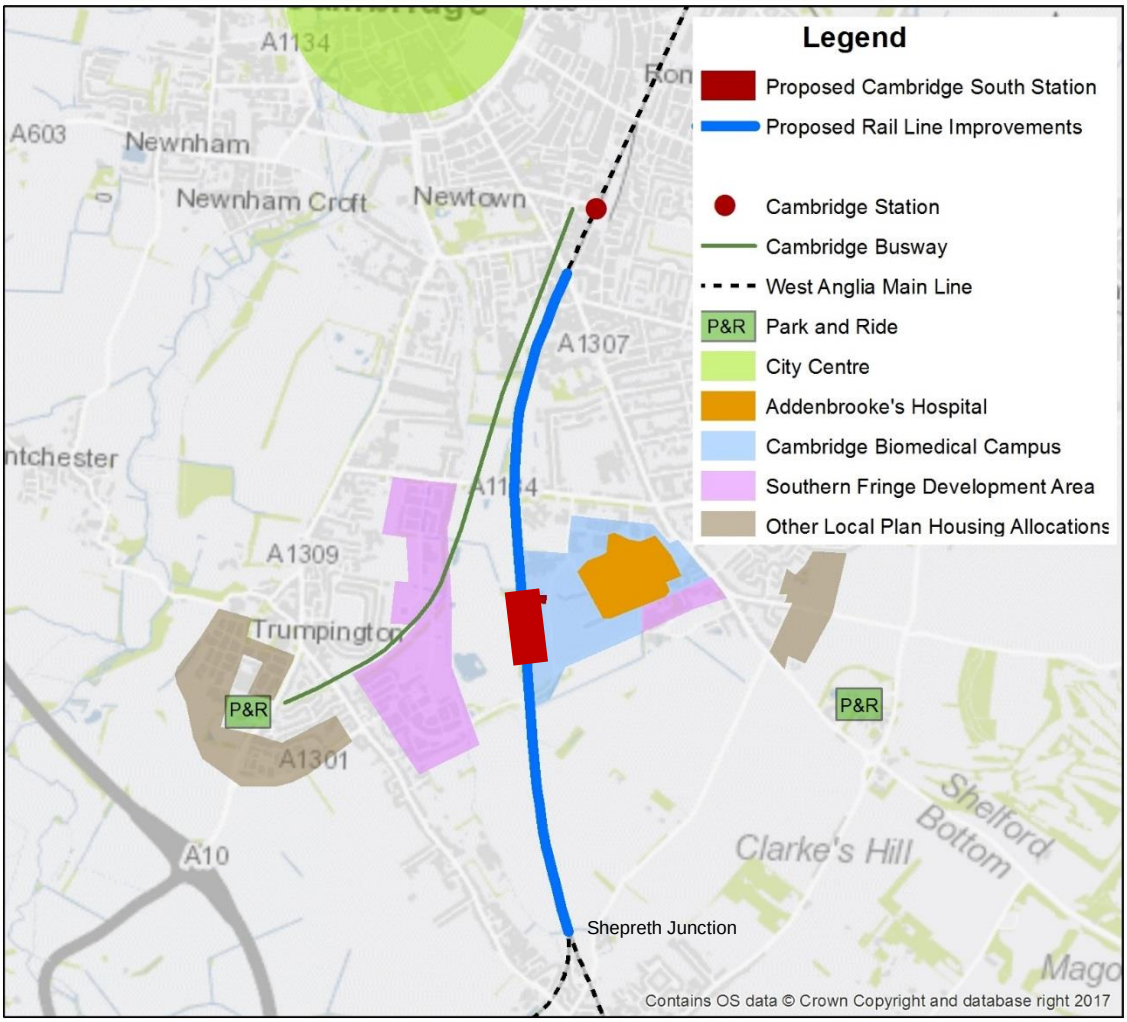
1.4 Document Structure

The remainder of this SOBC is structured around the five case model for transport business cases:

- Section 2 presents the **Strategic Case**, considering the 'case for change', including expected wider economic benefits, policy context, scheme objectives, discussion of alternative options, and key influences on the scheme.

- Section 3 sets out the **Economic Case**, identifying the range of economic, environmental, social, and public accounts impacts that are expected to arise from the scheme, and therefore the scheme's anticipated value for money.
- Section 4 presents the initial **Financial Case**, including anticipated expenditure and potential funding sources.
- Section 5 contains an outline of the **Commercial Case** for procuring the scheme and the passenger services that would serve Cambridge South.
- Section 6 contains the **Management Case**, including an indicative programme, and commentary on governance, quality assurance, communications, and risk management.

Figure 1: Proposed Cambridge South station location



Source: Mott MacDonald

2 Strategic Case

The purpose of the Strategic Case is to demonstrate the need for the scheme. It considers the 'case for change', including expected wider economic benefits, the policy context, scheme objectives, alternative options to meet the objectives, and key influences on the preferred scheme option.

2.1 Business Strategy

The Government intends to continue investing in transport infrastructure across the UK, in support of an industrial strategy for post-Brexit Britain which creates the right conditions for businesses to invest for the long term. Achieving economic growth and improved living standards are key objectives for Government.

The 2017 Transport Investment Strategy command paper, prepared by the Department for Transport, states that through investment the Department must seek to:

- Create a more reliable, less congested and better-connected transport network that works for the users who rely on it;
- Build a stronger, more balanced economy by enhancing productivity and responding to local growth priorities;
- Enhance our global competitiveness by making Britain a more attractive place to trade and invest; and
- Support the creation of new housing.

Promoting investment in transport infrastructure within the Cambridge Southern Fringe is therefore aligned entirely with the Department's Transport Investment Strategy. Investment in this area responds to local growth priorities, will help to enhance the internationally significant Cambridge Biomedical Campus, and will support major residential development.

The Biomedical Campus is a unique development for the UK. Attracting and retaining skills and investment in the biomedical field will be critical to the UK's new industrial strategy. A reliable, well connected and effective transport network will be essential to the success of the Biomedical Campus. As a development of such national and strategic significance, the Department is taking the lead in promoting and developing a transport solution.

2.2 The Case for Change

2.2.1 Opportunities and Aspirations

Cambridge Biomedical Campus

Addenbrooke's Hospital to the south of Cambridge is a major employment centre and a renowned teaching hospital linked to Cambridge University. Surrounding the hospital is the emerging Cambridge Biomedical Campus. At present approximately 17,250 people are employed across the hospital and campus area, with this figure expected to rise by 3,750 to approximately 21,000 by 2021[4]. Papworth Hospital is currently in the process of relocating to the Biomedical Campus, with a new 310-bed specialist cardiac facility expected to open in 2018.

[4] Estimate provided to Department for Transport by Addenbrooke's Hospital, October 2017.

By 2020, the Cambridge Biomedical Campus is expected to house the largest concentration of biomedical expertise in Europe, including an international conference centre and high capacity hotel. Strong employment growth is anticipated to continue as the campus develops. Based on the current employment growth trajectory, the number employed could reach almost 27,000 by the early 2030s.

Given the nature of the biomedical industry, excellent transport provision will be required so that the highly skilled workforce and visitors are able to travel to the campus.

Life Sciences Industrial Strategy[5]

Cambridge Biomedical Campus is expected to become an integral part of the UK life sciences industry. The industry is a key economic sector for the UK, generating £64 billion turnover and employing more than 233,000 people. The health life sciences industry also achieves high productivity compared to many other industrial sectors.

The UK Life Sciences Industrial Strategy aims to put the UK in a world-leading position to take advantage of the health technology trends of the next 20 years. The strategy includes efforts to maintain scientific strength and international competitiveness, encourage growth of companies in the sector, support industry collaboration with the NHS, make the best use of data and digital tools, and to ensure the sector has a strong supply of skilled people.

The UK has an internationally recognised life sciences cluster known as the Golden Triangle, which comprises Oxford, Cambridge and London and the area between. It houses four of the world's top twenty universities (three in the top ten), four top ten medical sciences faculties in the world and some of the world's largest research institutes. Many international pharmaceutical companies wish to be located close to the most successful universities for biomedicine. For example, AstraZeneca is currently constructing a new global research and development centre in Cambridge, at which they expect to employ 2,000 staff. The Golden Triangle cluster also contains substantial science infrastructure and a large number of small and medium-sized life sciences companies. Cambridge alone has over 200 biotech companies and the largest array of science infrastructure in the cluster.

Core recommendations of the Life Sciences Industrial Strategy point to the need for government and industry to work together to ensure the right infrastructure is in place to support life science cluster and network growth. This includes transport into and across clusters.

Attracting a highly skilled workforce

A successful biomedical science base in UK will require highly skilled workers. Potential disruption associated with Brexit could lead to some loss of talent from the sector. Therefore 'creating an opportunity to bring very high-level talent into the country over the next five years is important'[6].

Growth of the Cambridge Biomedical Campus will help to attract a highly skilled workforce. Accompanying investment in transport infrastructure will be required to provide national and international connectivity for businesses and their employees.

[5] Life Sciences Industrial Strategy – A report to the Government from the life sciences sector, Professor John Bell, August 2017

[6] *Ibid.*

Area of Major Change

The Cambridge Local Plan[7] identifies the Southern Fringe as an 'area of major change' in which extensive development is to take place over the 2011-2031 plan period. The vision for the Southern Fringe is 'to create attractive, well-integrated, accessible and sustainable new neighbourhoods for Cambridge.' The Southern Fringe development comprises approximately 3,300 new homes (plus additional housing in adjacent sites and sites outside the City boundary in South Cambridgeshire) during the plan period.

The Southern Fringe development will be integrated with the adjacent Cambridge Biomedical Campus, which by the mid-2020s could be home to more than 15% of all employment within the Cambridge City boundary[8].

East West Rail

East West Rail is a major rail infrastructure project with preparatory work well underway for both the committed and proposed route sections. It is expected to connect Oxford, Milton Keynes, Bedford, Cambridge and further into East Anglia. East West Rail is being planned in three sections – West, Central, and East. The Central section connecting Bedford to Cambridge, which is proposed rather than committed at present, is expected to use the West Anglia Main Line between Shepreth Junction and Cambridge, passing through the Cambridge Southern Fringe. This will provide an opportunity for people to access direct rail services from Cambridge to destinations across the Golden Triangle.

Thameslink Programme

Fundamental changes to timetables along the West Anglia Main Line are expected in 2018, when Cambridge is connected into the Thameslink network. New services will allow direct access between Cambridge and London Gatwick airport, as well as a range of other destinations, via central London.

2.2.2 Problems Identified

The scale and type of growth taking place within the Southern Fringe and Cambridge Biomedical Campus necessitates excellent transport infrastructure. A range of existing and future transport problems have been identified and are summarised in this sub-section:

- Indirect public transport connectivity to international gateways;
- Indirect public transport accessibility, with a dependence on public transport infrastructure within central Cambridge;
- Highway congestion and associated environmental concerns; and
- Parking availability.

Indirect Connectivity to International Gateways

International connectivity will be important to the success of the Cambridge Biomedical Campus, as it is intended to attract a highly skilled workforce from around the world. Even with new Thameslink rail services, public transport access to major airports will be constrained and journey times increased by the need to travel via Cambridge station, as summarised in Table 1.

[7] Cambridge Local Plan 2014: Proposed Submission, July 2013

[8] Nomis official labour market statistics estimate that in 2016 there were 101,000 employee jobs within the Cambridge City area.

Table 1: Public transport access to major international gateways in 2020

Gateway	Public transport journey legs	Number of interchanges
London Heathrow	• Cambridge Busway Addenbrooke's Hospital to Cambridge station. *Interchange*. • Thameslink rail service Cambridge to Farringdon. *Interchange.* • Elizabeth line (Crossrail) service to Heathrow.	2
London Stansted	• Cambridge Busway Addenbrooke's Hospital to Cambridge station. *Interchange*. • Rail Cambridge to Stansted Airport.	1
London Gatwick	• Cambridge Busway Addenbrooke's Hospital to Cambridge station. *Interchange*. • Thameslink rail service Cambridge to Gatwick Airport.	1

Source: Mott MacDonald

Indirect Public Transport Accessibility

The majority of public transport trips with an origin or destination in the Southern Fringe or Cambridge Biomedical Campus will need to travel via central Cambridge. Furthermore, all rail trips will need to route via Cambridge station. Given the scale of development proposed over the next 10-15 years this arrangement would be likely to place considerable pressure on Cambridge station, leading to significant overcrowding issues.

An indirect public transport journey which requires an interchange between modes (rail / bus) is also likely to discourage greater use of public transport among those who would otherwise choose to travel by private car.

Highway Congestion and Environmental Concerns

The rural nature of Cambridgeshire means that commuting journeys are currently dominated by private car use (estimated at 42.2% in the 2011 census). Only 2.5% of working age residents currently commute by train. As a result, highway congestion is a significant problem for Cambridge with:

- Congestion on all radial routes into Cambridge during the morning peak period and in both directions during evening peak periods. Routes in the Southern Fringe area that are particularly affected are:
  - A1134 Hauxton Road / High Street from M11 Junction 11.
  - A1307 Babraham Road
- Peak period congestion on all main roads within the Cambridge City boundary.
- Congestion on trunk and primary routes towards Cambridge in the morning peak period, and away from Cambridge in the evening peak period, affecting the A10 from Ely, A14 from Huntingdon, and the A428 / A1303 route from St Neots in particular.
- Evening peak period congestion on Addenbrooke's Road and on other local routes surrounding the Biomedical Campus, including Shelford Road and Long Road.

The congestion issues that already exist around the Biomedical Campus are concerning, as this will almost certainly be exacerbated by continued employment growth. The sustainable transport offer will need to be increased considerably in order to mitigate this issue.

As well as causing delays to transport users, highway congestion across Cambridge will continue to lead to local air quality concerns. In 2005 Cambridge City Council declared an Air Quality Management Area (AQMA) covering the entire city centre. The southern boundary to the AQMA is approximately 1 mile north of the Biomedical Campus. Any large increase in traffic flow associated with the Biomedical Campus would therefore have the potential to affect emissions levels within the AQMA.

Parking Availability

In recognition of the congestion and environmental issues associated with high levels of private car use, parking availability at the Cambridge Biomedical Campus is currently constrained and will continue to be constrained as the area develops. However in order for parking constraints to deliver the desired outcome of reduced car use, without affecting overall development viability, alternative sustainable forms of transport must be available and need to be attractive to use.

2.2.3 Impact of Not Changing

Taking into account the current opportunities, aspirations, and issues and without further significant investment in public transport infrastructure within the Southern Fringe and Cambridge Biomedical Campus, the following impacts are likely:

- Increased pressure on an already constrained Cambridge station, as all rail tips associated with the Southern Fringe and Biomedical Campus route through the main city centre station.
- Increased levels of highway congestion on radial routes, and local routes throughout the Southern Fringe, and for longer periods of the day. Increased congestion is likely to reduce the attractiveness and viability of later development phases.
- Accessibility problems for employees based at the Biomedical Campus, due to highway congestion, constrained parking availability, and indirect public transport journeys.
- Increased emissions and reduced air quality within the Cambridge AQMA.

Together these problems have the potential to affect the ability for businesses at the Biomedical Campus to retain their highly skilled and globally mobile employees, and ultimately the success of the entire Biomedical Campus.

Supporting the workforce with good connectivity between key employment and residential sites will continue to be important for Cambridge's current and future economic competitiveness on an international scale. This is likely to increase in importance as competitor cities around the world enhance their transport networks and may become more favoured as places to live by talented workers, and places to invest by global and high-tech businesses.

2.3 Policy Context

Any investment in transport infrastructure at the Southern Fringe and Cambridge Biomedical Campus needs to align with national, regional, and local policy and strategy. Alignment with national (Department for Transport) objectives is outlined in Section 2.1. Key relevant points identified in regional and local policy and strategy documents are set out in this sub-section.

Greater Cambridge Greater Peterborough Enterprise Partnership Strategic Economic Plan (SEP)

The SEP, which was revised in 2016, seeks to generate a £2.8bn per annum uplift in GVA, by delivering 70,000 new jobs and 50,000 new dwellings. The Cambridge Biomedical Campus and the Cambridge Southern Fringe development will contribute to achieving these targets. These developments require sustainable access, although it is acknowledged that the road network already experiences significant peak period congestion.

Without targeted investment in sustainable transport measures, the economic growth benefits of the Southern Fringe and Biomedical Campus are unlikely to be realised. The SEP therefore proposed further consideration of a new station to serve Addenbrooke's Hospital and the Biomedical Campus, as part of East West Rail.

Greater Cambridge City Deal (GCCD)

The City Deal emerged from the SEP process and is a deal with Government that will enable a new wave of innovation-led growth by investing in infrastructure, housing and skills, thereby addressing housing shortages and high congestion levels. By investing in infrastructure the City Deal will ensure that Greater Cambridge can deliver the current growth identified in the Local Plans and that the conditions are in place to deliver post-2031 growth. The growth strategy will require a transport network that addresses congestion and public transport capacity issues, to help stimulate further economic growth.

The four strategic objectives of the GCCD are to:

- **Create and retain investment** to nurture the conditions necessary to enable the potential of Greater Cambridge to create and retain the international high-tech businesses of the future.
- **Target business investment supporting the Cambridge Cluster** to the needs of the Greater Cambridge economy by ensuring those decisions are informed by the needs of businesses and other key stakeholders such as the universities.
- **Improve connectivity and networks** between clusters and labour markets so that the right conditions are in place to drive further growth.
- **Attract and retain skills** by investing in transport and housing whilst maintaining a good quality of life, in turn allowing a long-term increase in jobs emerging from the internationally competitive clusters and more university spin-outs.

Cambridge Local Plan

The Cambridge Local Plan (2014) sets out the way in which the development needs of Cambridge will be met during the 2011 to 2031 period. Compared to the previous growth strategy, greater emphasis is placed on mitigating transport impacts. Policy 5 (strategic transport infrastructure) states that Cambridge City Council will support a range of sustainable transport interventions. In particular, by promoting sustainable transport and access for all to and from major employers, education and research clusters, hospitals, schools and colleges.

Investment in sustainable transport infrastructure within the Cambridge Southern Fringe can contribute towards the following Local Plan strategic objectives:

- New development will contribute to the vision of Cambridge as an environmentally sustainable city, where it is easy for people to make a transition to a low carbon lifestyle… (strategic objective 1).
- New development will promote and support economic growth in environmentally sustainable locations, facilitating innovation and supporting Cambridge's role as a world leader in higher education, research, and knowledge-based industries… (strategic objective 10).
- New development will be located to help minimise the distance people need to travel, and be designed to make it easy for everyone to move around the city and access jobs and services by sustainable modes of transport (strategic objective 13).

South Cambridgeshire Local Development Plan

The South Cambridgeshire Local Plan, which covers the area immediately to the south of the Cambridge Biomedical Campus, contains six key objectives. Investment in sustainable transport infrastructure to serve the Southern Fringe and Biomedical Campus can contribute to two of these:

- To support economic growth by supporting South Cambridgeshire's position as a world leader in research and technology based industries, research, and education; and supporting the rural economy.

- To maximise potential for journeys to be undertaken by sustainable modes of transport including walking, cycling, bus and train.

Cambridgeshire Local Transport Plan (LTP) 2011-2031

Investment in sustainable transport infrastructure in the Southern Fringe area aligns well with the current LTP, which sets out challenges associated with tackling road congestion in Cambridgeshire and the resultant socio-economic and climate change problems. These challenges include:

- Reducing the length of commute and the need to travel by private car.
- Making sustainable modes of transport a viable and attractive alternative to the private car.

More specifically, the LTP identified the need for a new rail station at Cambridge South.

Transport Strategy for Cambridge and South Cambridgeshire (TSCSC), 2014

The TSCSC identifies a longer-term opportunity for a new rail station at Cambridge South. This is part of an overall strategy that aims to 'strengthen the employment hubs and high-tech clusters in Cambridge and South Cambridgeshire, and in the surrounding towns, by making movement between them straightforward and convenient'. The strategy also seeks to reduce reliance on the private car.

2.4 Objectives

2.4.1 Scheme Objectives

A set of scheme objectives has been established to guide option assessment for a significant investment in sustainable transport infrastructure within the Cambridge Southern Fringe. The objectives take account of the opportunities, aspirations and problems identified. They are also aligned to national, regional and local policy and strategy.

The scheme will need to:

1. Increase public transport connectivity between the Cambridge Biomedical Campus and international gateways, in recognition of its international significance.
2. Improve sustainable transport access to housing, services, and employment within the Cambridge Southern Fringe and Biomedical Campus area, to fulfil existing and future demands.
3. Minimise highway congestion associated with the Southern Fringe and Cambridge Biomedical Campus by increasing the mode share for sustainable transport modes.
4. Reduce reliance on central Cambridge transport infrastructure for serving the Southern Fringe and Biomedical Campus.
5. Be capable of integrating with and enhancing the opportunities presented by Thameslink and East West Rail, to support development of the Biomedical Campus as part of the Golden Triangle life sciences cluster.

2.4.2 Measures for Success

For each objective at least one indicator is proposed to allow the success of the scheme that is delivered to be measured over time, as shown in Table 2. The first three indicators and the final indicator in the table can be measured by desk-based analysis, while the mode share and routeing indicators will require employee survey data to be collected.

Table 2: Proposed success indicators

Proposed indicator	Relating to objective
End to end public transport journey times between the centre of the Biomedical Campus and London Heathrow, Gatwick, and Stansted airports (with and without the scheme)	1 – connectivity to international gateways
Total population within a specific public transport journey time band (to be defined) from the centre of the Southern Fringe development and the centre of the Biomedical Campus (with and without the scheme)	2 – sustainable transport access
Total capacity of all public transport services arriving into the Southern Fringe and Biomedical Campus area during the AM peak hour (with and without the scheme)	2 – sustainable transport access
Journey to work % mode shares for Biomedical Campus employees (before and after scheme implementation)	3 – minimise highway congestion
Estimated % of Biomedical Campus journeys to work by public transport that travel via central Cambridge during the AM peak period, including Cambridge station (before and after scheme implementation)	4 – reduce reliance on Cambridge city centre transport infrastructure
Time taken (minutes) to access Thameslink and East West Rail service (if delivered) from the centre of the Southern Fringe development area and the centre of the Biomedical Campus.	5 – integrating and enhancing Thameslink and East West Rail opportunities

Source: Mott MacDonald

2.5 Option Assessment

2.5.1 Potential Options

A shortlist of four feasible public transport options has been considered for meeting the objectives set out in Section 2.4.1:

- **Busway service enhancement**: Increased service frequency and capacity on Cambridge Busway routes that serve Addenbrooke's Hospital, the Biomedical Campus and the busway towards Trumpington Park and Ride.
- **New longer distance direct bus or coach services**: Operating between the Biomedical Campus and other urban centres within the Cambridge travel to work area, such as Bury St Edmunds, Ely, Huntingdon, and St Neots.
- **New Cambridge South rail station and associated rail line improvements**: Located on the West Anglia Main Line, between the Southern Fringe development area and the Cambridge Biomedical Campus.
- **Expanded Park and Ride sites**: Larger car parks and increased bus service capacities at Trumpington and Babraham, with Babraham services operating a loop around the Biomedical Campus.

The four options have been scored against the scheme objectives, along with additional viability and acceptability criteria, in Section 2.5.2.

2.5.2 Option Sifting

Each of the options has been scored against the scheme objectives using a seven-point scale – large, moderate, slight beneficial / adverse, or neutral. The options have also been awarded a red, amber or green rating for deliverability, financial affordability, and stakeholder acceptability risks. This sifting method follows the principles set out in Step 6 of the WebTAG transport appraisal process.

Option scores are shown in Table 3. Further information on stakeholder opinion, which has informed the stakeholder acceptability rating, is provided in Section 2.8.3.

Table 3: Option Scoring

Option	1 – international connectivity	2 – sustainable transport access	3 – highway congestion	4- City centre reliance	5 – integrating with other schemes	Deliverability (risk level)	Financial affordability (risk level)	Stakeholder acceptability (risk level)
Busway service enhancement	Slight beneficial	Moderate beneficial	Slight beneficial	Neutral	Neutral	Low	Low	Medium
New longer distance direct bus or coach services	Moderate beneficial	Moderate beneficial	Slight beneficial	Moderate beneficial	Neutral	Low	Medium	Medium
New Cambridge South rail station & associated line improvements	Large beneficial	Large beneficial	Moderate beneficial	Large beneficial	Large beneficial	Medium	Medium / High	Low
Expanded Park and Ride sites	Neutral	Slight beneficial	Slight adverse	Slight beneficial	Neutral	Medium	Low	Medium

Source: Mott MacDonald

Key points to note from Table 3 are:

- A new Cambridge South rail station would connect the Biomedical Campus directly to international airports including London Stansted and London Gatwick, via the rail network. Long distance coach services could also be beneficial, but only if direct services were provided from multiple airports to the Biomedical Campus. The other options would not lead to a noticeable benefit for international travellers.
- All options improve sustainable transport accessibility, but Cambridge South station is rated above other options because it represents a substantial upgrade in provision.
- Three of the four options would help to minimise highway congestion associated with the development areas. However, Park and Ride expansion received an adverse rating as this would be likely to encourage higher traffic volumes in the Southern Fringe area.
- To effectively reduce reliance on central Cambridge transport infrastructure, the scheme must provide direct access to the Biomedical Campus from the national transport network. Long distance coach services could contribute to this. Cambridge South station would contribute the most by connecting the Southern Fringe area to London and in future the East West Rail link could connect the area to other parts of the Golden Triangle.
- The Cambridge South station proposal is designed to integrate with and complement the Thameslink and East West Rail schemes. The other options have less of an ability to integrate with these major investment programmes.
- Deliverability risk is considered to be higher for options requiring a significant level of new infrastructure.
- A new rail station is expected to present the greatest financial affordability risk as the most expensive option.

2.5.3 Preferred Option

Cambridge South station has the potential for large beneficial impacts aligned to four of the five objectives. It therefore achieves the highest rating.

Cambridge South station is likely to be one of the most challenging options in terms of both deliverability and financial affordability, but it will be the most acceptable option for key stakeholders as it delivers a significant uplift in public transport provision for the Southern Fringe and Biomedical Campus.

2.6 Geographic Scope

The geographic scope of works for the preferred option, a new station at Cambridge South and associated rail line improvements, extends over a 2.3-mile section of the West Anglia Main Line between Shepreth Junction (Great Shelford) and the existing four track section to the south of Cambridge station. Works will be required to the track, signalling and overhead line equipment and will also increase the footprint of the rail corridor.

The benefits associated with a new station at Cambridge South are expected to be experienced in the following areas:

- In the immediate vicinity of the Southern Fringe development area and Biomedical Campus, as a result of increased public transport mode share and reduced private car use.
- At Cambridge rail station, as many trips will be abstracted to the new station, reducing overcrowding issues.
- At settlements along the rail corridor to the north and south, as anyone travelling to the Biomedical Campus will find it easier to use the train. Associated rail line improvements to the south of Cambridge might also improve overall journey time reliability along the rail corridor.

2.7 Wider Economic Impacts

A high level wider economic impact assessment has been undertaken in line with HM Treasury Green Book principles and the Homes and Communities Agency's Additionality guidelines. The assessment measures the potential stimulus to economic activity attributable to Cambridge South station, by estimating the consequential employment, Gross Value Added (GVA)[9] and investment benefits that would otherwise not have arisen. Further details are provided in the technical note in **Appendix D**.

The analysis shows that £4.8 million GVA per annum (2015 prices) can be supported at the Cambridge Biomedical Campus, taking account of induced impacts and additionality. In the medium term, £1.7 million GVA per annum (2015 prices) linked to committed developments at Cambridge Biomedical Campus and the Southern Fringe can be attributed to Cambridge South station. These GVA forecasts represent additionality, removing the impacts of estimated job displacement from elsewhere.

In the longer term, **118 new jobs per annum linked to growth that is not yet committed might be attributable to Cambridge South station**. However, the extent to which these jobs are additional to the UK economy is not known at this stage.

[9] Gross Value Added is measure of contribution to the economy from goods and services produced in a defined sector or area.

2.8 Strategic Influences

2.8.1 Constraints

The most significant constraint that will impact on the preferred option is the capacity of the existing rail network to the south of Cambridge. In order to deliver a new station at Cambridge South and to allow sufficient numbers of trains to call at the new station, without impacting on the reliability of current and proposed rail services along the West Anglia Main Line, line capacity improvements will need to be delivered. These improvements will address the pinch-point that would otherwise exist between Cambridge and Shepreth Junction (Great Shelford).

The proposed Cambridge South scheme includes the following measures to address future rail line constraints:

- Four-tracking a 2.3-mile section of the West Anglia Main Line between Shepreth Junction and the existing four track section to the south of Cambridge station. This includes associated signalling, switches and crossings, and additional overhead line equipment.
- Reconstruction of the A1134 Long Road (road over rail) bridge to allow for four-tracking.
- Grade separation at Shepreth Junction to provide for future East West Rail requirements.

A further constraint will be access to the rail line for construction works. Land surrounding the proposed station location is currently under development, which may restrict available access points for plant and machinery. Land either side of the rail line south towards Shepreth Junction is primarily used for agricultural purposes, which may require access rights across private land to be negotiated for the four-tracking construction works. Furthermore, the Shelford Cycleway runs adjacent to the rail line between Addenbrooke's Road and Shepreth Junction. This cycle route will need to be retained as part of the scheme design.

2.8.2 Interdependencies

The success and financial viability of a new station at Cambridge South will be dependent on continued successful growth and development at the Cambridge Biomedical Campus, to attract sufficient passenger demand. However, this is deemed low risk due to the extent of the existing development, works already on site, and further committed development.

The proposed new station is also dependent on sufficient space being safeguarded within the development area, and adjacent to the rail line, to allow for station construction and suitable access routes.

2.8.3 Stakeholders

The key stakeholders in the proposed new station are:

- Local authorities – Cambridgeshire County Council as the local transport authority, and Cambridge City Council and South Cambridgeshire District Council as the local planning authorities.
- Greater Cambridge Partnership, as the local delivery body for the City Deal with Government. The Partnership includes the three local authorities, University of Cambridge, and the Greater Cambridge Greater Peterborough Local Enterprise Partnership.
- Organisations that will invest in the Cambridge Biomedical Campus, including AstraZeneca, Cambridge University Hospitals NHS Foundation Trust, The MRC Laboratory of Molecular Biology, and Papworth Hospital NHS Foundation Trust.

- Cambridge Ahead, a business and academic member group dedicated to the successful growth of Cambridge and its region in the long-term.
- England's Economic Heartland, the emerging sub-national partnership of local authorities and local enterprise partnerships for the Oxfordshire – Milton Keynes – Cambridgeshire corridor, for whom transport is a key priority.

The local authorities have identified the opportunity for a new rail station at Cambridge South as part of their transport strategies – Cambridgeshire Local Transport Plan 2011-2031, and the Transport Strategy for Cambridge and South Cambridgeshire (TSCSC) 2014.

Cambridge University NHS Foundation Trust has a vision to be one of the best academic healthcare organisations in the world and as such requires good accessibility to specialist staff and visiting experts, who may travel long distances. The Trust has made great progress in encouraging sustainable travel by staff, but has ambitions to improve levels of public transport use among visitors. As a Major Trauma Centre and a centre of excellence for specialist services, patients and visitors travelling from a wide area would benefit from a direct connection to the rail network. Papworth Hospital has previously stated that the new station would help with the delivery of their sustainable transport goals for patients and staff.

The MRC Laboratory of Molecular Biology anticipates significant further growth in staff and visitor numbers. They have previously given support to the idea of a new station, stating that it is already challenging for existing staff to get to the Campus. A direct rail service would also improve connectivity with other organisations along the Cambridge-London corridor as it develops, such as the newly opened Crick Institute in London.

Cambridge Ahead supports the idea of a new railway station at Addenbrooke's to serve the growing Biomedical campus.

At present there are not considered to be any potential conflicts between key stakeholders.

2.9 Strategic Case Summary

The importance of improved transport networks and connectivity to support economic growth and development in Cambridge is clear. In particular, the Cambridge Biomedical Campus is of national significance and it is therefore essential that it is served by an efficient transport network that provides international connectivity, as well as promoting a quality of life that will allow the Biomedical Campus and Southern Fringe area to compete internationally as a place to live, work and invest.

The Strategic Case has identified the key existing and future problems for the transport network in the Southern Fringe and Biomedical Campus area and generated a series of five specific objectives for public transport investment. A new Cambridge South station is judged to best meet the objectives set and have the strongest strategic case.

A high level wider economic impact assessment has forecast that, in the medium term, £1.7 million GVA per annum (2015 prices) linked to committed developments at Cambridge Biomedical Campus and the Southern Fringe can be attributed to Cambridge South station. This GVA forecast represents additionality.

In the longer term, 118 new jobs per annum linked to growth that is not yet committed might be attributable to Cambridge South station. However, the extent to which these jobs are additional to the UK economy is not known at this stage.

3 Economic Case

The Economic Case identifies the range of economic, environmental, social, and public accounts impacts that are expected to arise from the scheme, and therefore demonstrates the scheme's anticipated value for money.

3.1 Overview

3.1.1 Options Appraised

The preferred option for investing in public transport infrastructure within the Cambridge Southern Fringe and Biomedical Campus development area, as identified in the Strategic Case, is to construct a new station at Cambridge South. The scheme would include associated rail line improvement works, including four-tracking between Cambridge and Shepreth Junction, and grade separation of Shepreth Junction to allow for future East West Rail services.

A single station and rail service stopping pattern has been defined for SOBC appraisal purposes. Based on previous timetable feasibility work undertaken for Network Rail, the working assumption is that the new station would be served by four trains per hour in each direction, with one stop per hour made by each of the following services:

- London Kings Cross/St Pancras to Kings Lynn fast service, which would operate non-stop to Cambridge South and then call at all stations to Kings Lynn via Cambridge, Ely, and Downham Market [operated as part of the combined Thameslink, Southern & Great Northern franchise]
- London Kings Cross/St Pancras to Cambridge / Cambridge North stopping service via Hatfield, Stevenage, and Letchworth Garden City [operated as part of the combined Thameslink, Southern & Great Northern franchise]
- London Liverpool Street to Cambridge North semi-fast service calling at Tottenham Hale, Cheshunt, Broxbourne, Harlow Town, Bishops Stortford, Audley End, and Whittlesford Parkway [operated as part of the Greater Anglia franchise]
- Stansted Airport to Norwich via Cambridge / Cambridge North, Ely, Thetford, and Wymondham [operated by combining the Stansted-Cambridge and Cambridge-Norwich services as part of the Greater Anglia franchise]

Fundamental changes to timetables are expected in 2018 when Cambridge is connected into the Thameslink network. The London Kings Cross services are likely to be recast, with some of these diverted to London St Pancras and extended across London via Farringdon and London Blackfriars through to south London, Surrey and West Sussex (including Gatwick Airport and Brighton). The analysis in this SOBC is based on a version of the post-Thameslink upgrade timetable (December 2018) provided by Network Rail.

The proposed stopping pattern for Cambridge South would provide a combined total of three services per hour to London and three services per hour to the recently opened Cambridge North station.

3.1.2 Appraisal Assumptions

In appraising the proposed Cambridge South station, a number of scheme-specific and wider area (background) assumptions have been made, as set out in this sub-section.

Scheme-specific

- The new station will open in 2025 following a three to four year construction period.
- Cambridge South station will be served by four trains per hour in each direction (further details provided in Section 3.1.1).
- Car parking will not be provided at the station or in the immediate vicinity – Cambridge South can therefore not be used as a Park and Ride location. The catchment area for new rail users at Cambridge South is therefore limited to 2km.
- Through-passengers on trains that call at Cambridge South will incur a time penalty due to the requirement for existing services to slow down, stop at, and accelerate from the new station. A time penalty of 90 seconds is assumed, based on a high level RouteRunner test. Further detail is provided in the demand forecasting technical note (**Appendix B**).
- Passenger demand for Cambridge South station will comprise existing rail users (switching from Cambridge station) and new rail users. A proportion of new users are assumed to switch from private car, ranging from 21% to 35% depending on journey origin and destination, based on factors set out in the WebTAG Databook[10].

Background assumptions

Background assumptions relating to employment and housing growth on development sites surrounding the proposed Cambridge South station site are based on information contained within the Cambridge Local Plan and information provided by Addenbrooke's Hospital:

- Between 2017 and 2031 approximately 3,000 additional houses are to be constructed within development sites across the Southern Fringe and adjacent areas, of which approximately 2,400 (80%) will be constructed on the Clay Farm development site immediately west of the rail line and all within 1 mile of the proposed new station.
- Over the next four years (2017-21) approximately 3,750 additional jobs will be based at Addenbrooke's Hospital and the Cambridge Biomedical Campus, representing a growth rate of approximately 940 additional jobs per year.
- Assuming a slightly lower job growth rate over the following ten years then between 2021 and 2031 an additional 5,900 jobs will be based on the Biomedical Campus. Total additional jobs estimated over the 2017-31 period is therefore 9,650, bringing the total number of employees based at the Biomedical Campus to an estimated 27,000 by 2031.
- 20% (1,180) of the additional jobs during the 2021-2031 period are assumed to be reliant on Cambridge South station delivery[11]. Without the new station, highway congestion is assumed to act as a limiting factor on the Biomedical Campus. The transport user benefits associated with the new station are therefore excluded from the core appraisal scenario for these 1,180 jobs, as these jobs would otherwise not exist or would exist elsewhere. However, the rail fare revenue benefit associated with the additional jobs is included.
- The Cambridge Biomedical Campus, including Addenbrooke's Hospital and the relocated Papworth Hospital, will account for approximately 15% of all jobs across the Cambridge City local authority area by the end of the Local Plan period (2031).

[10] WebTAG Databook October 2017 release v1.8.2, Table A5.4.5 – Car Diversion Factors by Flow Category.

[11] This assumption has been agreed with the Department for Transport.

- Background growth in housing and employment, and therefore growth in trips, relating to the rest of Cambridge, is assumed to be in line with forecasts contained in the National Trip End Model (NTEM)[12].
- Forecast growth for external rail trips that pass through Cambridge are based on Network Modelling Framework (NMF) forecasts for the Thameslink, Southern & Great Northern, and Greater Anglia franchise areas. These forecasts take account of known timetable improvements.

By 2025, the cumulative impact of employment and population growth across Cambridge is estimated to increase demand by 33% for non-London journeys, and 37% for journeys to or from London. Further detail is provided in the demand forecasting technical note (**Appendix B**).

3.1.3 Appraisal Methodology

Forecasting passenger demand and assessing the benefits of new rail stations can be complex, and ideally requires a variable demand transport model to allow a full analysis of the extent to which existing rail passengers will switch between stations, and whether non-rail users will choose to switch modes. However, full variable demand modelling is not always appropriate at the early stage of scheme development as it can be costly and time consuming.

A proportionate passenger demand forecasting methodology has been adopted for this SOBC. Full details are provided in the demand forecasting technical note (**Appendix B**). The adopted method uses a combination of the rail industry's MOIRA model, available trip matrices from the Cambridge Sub Regional Model (CSRM) owned by Cambridgeshire County Council, and a bespoke spreadsheet demand model.

The demand forecasting and benefits appraisal approach can be summarised as follows:

- Define Do-Minimum and Do-Something scenarios for forecasting purposes, taking account of proposed housing and employment developments in close proximity to the proposed station, background growth, rail service stopping patterns, and access/egress times to Cambridge and Cambridge South stations from surrounding areas.
- Use the RouteRunner software to estimate the increased journey time for trains calling additionally at Cambridge South (estimated to be 90 seconds). Use MOIRA to estimate the change in generalised journey times for through passengers as a result of this increased journey time and the effect on rail demand and revenue. Adjust MOIRA outputs to account for passengers who would switch from Cambridge to Cambridge South, future rail passenger growth, and to disaggregate by ticket and user type (for economic appraisal).
- Estimate the proportion of people whose journey would start or end within the 2km catchment of Cambridge South and who would choose to switch from Cambridge station, using CSRM base year highway trip matrices as a relative proxy for trip distribution. This forms the initial passenger demand estimate.
- Adjust the forecast passenger demand at Cambridge South to allow for new rail trips, where people have switched from other modes or are making entirely new trips, using demand elasticities contained in the Passenger Demand Forecasting Handbook (PDFH).
- Adjust the forecast passenger demand further to allow for growth associated with major housing and employment developments within the station catchment.
- Estimate the change in generalised journey time by user type, taking account of changes to station access/egress times, and in-vehicle journey time. Apply standard WebTAG monetary

[12] Obtained using TEMPRo version 7.2 datasets for Cambridge City and South Cambridgeshire local authority areas for 2017-31.

values and appraisal procedures to estimate the benefit in present values over the 60-year appraisal period.

- Estimate the reduction in car vehicle-kilometres as a result of mode shift to rail and apply WebTAG marginal external cost values[13] to represent congestion reduction and environmental benefits over the 60-year appraisal period.

3.2 Scheme Performance Overview

Based on the demand forecasting work undertaken for this SOBC, Cambridge South station is forecast to be used by approximately **1.8 million passengers per year** within the first few years after scheme opening. Approximately 70% of these passengers (1.3 million per year) would otherwise have used Cambridge Station, while the remaining 30% (0.5 million per year) are expected to be new rail passengers. New rail passengers include people making completely new trips that would otherwise not have been made, trips that have transferred from the private car, and trips generated as a result of development that is reliant on the new station.

Passengers travelling to and from London are expected to make up more than half of passengers using the new Cambridge South station.

The number of passengers forecast to be abstracted from Cambridge station is likely to represent around 10% of Cambridge station's annual patronage. This is reasonable given that by the mid-2020s Cambridge Biomedical Campus could be home to more than 15% of all employment within the Cambridge City boundary.

Previous analysis undertaken by a third party in 2016, as part of a New Stations Fund application for Cambridge South[14], forecast total passenger numbers of approximately 1.4 million per year by 2026. Total passenger numbers forecast in this SOBC are therefore comparable to previous work.

The estimated 90-second increase in journey times for trains calling additionally at Cambridge South has a substantial impact on the economic appraisal. Approximately 9 million passenger journeys per year pass along the West Anglia Main Line where Cambridge South station is to be located, and around half of the trains carrying these passengers would call additionally at the new station. This is equivalent to a loss of approximately 6.75 million minutes' worth of travel time each year and reduces scheme value for money substantially, even though the increased journey time to individual passengers is only slight.

At this early stage, the extent to which the proposed additional rail line infrastructure work will benefit eventual train journey times is unknown. The impact on the Economic Case of reduced journey time penalties has therefore been assessed in sensitivity tests (Section 3.4), should the infrastructure work enable the increased journey time to be offset.

3.3 Appraisal Summary

3.3.1 Appraisal Summary Table

The economic, environmental, social and public accounts impacts of the proposed Cambridge South station are summarised in a standard WebTAG Appraisal Summary Table (AST) in **Appendix A**. Additional information is provided in Sections 3.3.2, 3.3.3, 3.3.4, and 3.3.5, structured around the AST impact sub-categories.

[13] TAG Unit A5.4 – Marginal external costs

[14] The New Stations Fund application was unsuccessful as infrastructure requirements identified by Network Rail and train operating companies (such as four-tracking and Shepreth Junction grade separation) had not been taken into account as part of the scheme.

Monetised assessment outputs for a single 'central case' scenario are presented in the WebTAG standard Transport Economic Efficiency (TEE), Public Accounts (PA), and Analysis of Monetised Costs and Benefits (AMCB) tables in Appendix C. Sensitivity tests are summarised in Section 3.4.

3.3.2 Economic Impacts

Business users

Monetised journey time benefits for business users using Cambridge South station are forecast to be approximately £24 million (central case, 2010 prices discounted to 2010) over the 60-year appraisal period. However, these benefits are offset by the time disbenefit that is forecast to arise from a much large number of business users who would incur a small journey time increase from trains calling additionally at Cambridge South.

Journey time benefit offsetting occurs across business users as a whole, but not to such a great extent for commuting and other users (as outlined in Section 3.3.4), due to WebTAG business user distance-based values of time. The majority of passengers who benefit from improved access at Cambridge South are on trips of up to 100km, with London based trips accounting for the majority of this. The journey time benefits to business users are therefore valued at £10-£16 per hour (2010 prices and values). However passengers travelling through and calling at the new station, who receive a slight disbenefit, are both more likely to be business passengers, and more likely to be on long distance trips. This again attracts a higher value of time.

Overall there is a benefit for business users due to additional externality benefits associated with mode shift from private car to rail, reducing congestion and secondary environmental impacts.

The estimated 90-second time penalty incurred by business users passing through the station reduces the monetised benefit from £24 million to a net monetised benefit to business users of £3 million (central case, 2010 prices discounted to 2010) over the 60-year appraisal period. Proposed infrastructure works, such as four-tracking and grade separation at Shepreth Junction, have the potential to reduce rail journey times and to offset the time penalty associated with an additional station call. At this early stage the impact of these other works cannot be quantified.

Journey time reliability impact on business users

Journey time reliability refers to variations that transport users are unable to predict. For rail services this includes punctuality issues, where train arrival and departure times are later than scheduled, and reliability problems caused by service cancellation.

The twin track section of line between Cambridge and Shepreth Junction is used intensively, with trains regularly timetabled to operate at close to the 3-minute minimum planning headway. This means that a minor delay to an individual service can lead to knock-on impacts that delay a wider range of services along the lines into London.

Four-tracking the rail line between Cambridge and Shepreth Junction will allow for a new station to be delivered at Cambridge South. It has the potential to improve rail service reliability by removing an existing pinch-point and provides infrastructure required for East West Rail.

The journey time reliability impact has not been assessed at this stage, consistent with other rail SOBCs.

Regeneration

The development area surrounding the proposed new station is not designated as a regeneration area under any specific UK or EU regeneration programmes. Neither does the development area suffer from major transport accessibility constraints (when all modes are considered). For these reasons a regeneration impact assessment is not considered necessary.

Wider impacts

WebTAG identifies three categories of wider impact – agglomeration, output change in imperfectly competitive markets, and tax revenues arising from labour market impacts.

Agglomeration, where economic activity is concentrated in a particular area, can increase as a result of transport network improvements. A new station at Cambridge South is likely to enhance the agglomeration effects of the Cambridge Biomedical Campus, by bringing firms across the Golden Triangle closer to each other and their labour markets. As the scheme is located within a core Functional Urban Area, as defined within TAG Unit A1.2, agglomeration benefits are expected to be significant.

At SOBC stage the agglomeration impacts have not been formally estimated using the methods set out in WebTAG. However, agglomeration benefits typically add at least 10% to the overall user travel time benefits of a scheme. For Cambridge South users this will be equivalent to £9 million (central case, 2010 prices discounted to 2010) over the 60-year appraisal period.

Due to the nature of scheme and the types of businesses and organisations locating in the Cambridge Biomedical Campus, benefits associated with output change in imperfectly competitive markets are unlikely to be significant and have not been assessed. Labour market impacts have also not been assessed at this stage.

A high level assessment of wider economic impacts associated with increased employment and Gross Value Added (GVA)[15] within the Cambridge Biomedical Campus, as a result of the potential economic stimulus provided by the new station, has been undertaken. The outputs are summarised in the Strategic Case (Section 2.7). In the medium term, £1.7 million GVA per annum (2015 prices) linked to committed developments at Cambridge Biomedical Campus and the Southern Fringe can be attributed to Cambridge South station. This GVA figure represents additionality, removing the impacts of estimated job displacement from elsewhere.

3.3.3 Environmental Impacts

The environmental assessments set out in this sub-section are based on a high level desktop assessment only. Further work will be required at the Outline Business Case stage.

Noise

In the short term, noise levels will increase during the construction period. The primary sources of noise annoyance will occur during the station construction phase, potentially affecting properties in the Southern Fringe and premises within the Biomedical Campus. Noise annoyance will also occur during track works between Cambridge station and the Long Road bridge, potentially affecting properties on Sedley Taylor Road and student accommodation alongside the rail line.

In the longer term, noise impacts associated with station operation are expected to be *Neutral*. Rail service frequencies are not being increased as part of this scheme and road traffic flows

[15] Gross Value Added is measure of contribution to the economy from goods and services produced in a defined sector or area.

will be lower with the scheme than without, due to mode shift from the private car to rail. While the new station will have a drop-off / pick-up area, a car park is not being provided.

Construction and operational noise assessments will be required at a later stage of scheme development due to the close proximity of residential properties to proposed works.

Air quality

In the short term, heavy construction plant emissions on site will increase air pollution. If the increase in HGV movements is 100 or more vehicles per day then the scheme will need to be subject to an Air Quality Assessment. Another source of increased air pollution will be from traffic congestion while the Long Road bridge is being reconstructed, as a temporary road closure and diversion are likely to be required.

In the longer term, air quality impacts associated with station operation are expected to be *Slight Beneficial*, as a result of mode shift from private car to rail. The scheme is forecast to remove approximately 1.2 million vehicle-kilometres per year from the road network one year after scheme opening, increasing each year.

Greenhouse gases

The scheme's impact on greenhouse gas emissions is expected to be *Slight Beneficial*, as a result of mode shift from private car to rail. Forecast greenhouse gas emissions reductions have a monetised value of £0.5 million (central case, 2010 prices discounted to 2010).

Landscape

Once constructed, the proposed station is likely to have little visual impact from the north, east and south as it is encompassed by commercial buildings and road overbridges. The greatest potential visual impact of the station would occur from the west, where private dwellings are currently being constructed as part of the Southern Fringe development. However views from private dwellings are expected to be dominated by new commercial buildings on the Biomedical Campus.

In terms of the landscape character and local land use surrounding the station site, the introduction of further infrastructure is unlikely to be a key issue due to surrounding developments. However, a landscape assessment will be required as part of planning permission application, and will provide further details of visual impact.

The proposed grade separation of Shepreth Junction could lead to visual impacts for some properties in Great Shelford, depending on scheme design. Appropriate screening measures may need to be incorporated.

Overall the landscape impact is currently assessed as *Slight Adverse*.

Townscape

The townscape impact is expected to be *Neutral*.

Historic environment

There are three Grade II listed buildings within 200 metres of the proposed works. A heritage specialist will need to be consulted to determine how the setting of these structures may be affected.

There is one Scheduled Monument adjoining the existing tracks, currently listed in the English Heritage record as a 'site revealed by aerial photography west of White Hill Farm' with archaeological remains. The Scheduled Monument is likely to be directly impacted by the rail

link works. Natural England should be contacted to provide further information on the site. Application for Scheduled Monument Consent will be required before works can be carried out either above or below ground level and a full heritage impact assessment will be required at this location.

Overall the historic environment impact is expected to be *Slight Adverse*.

Biodiversity

Cambridgeshire County Council has designated non-statutory 'Local Sites' of importance for nature conservation. One of these Local Sites is the Triangle North of Long Road between the Cambridgeshire Guided Busway and the West Anglia Main Line. This site qualifies as a County Wildlife Site due to the presence of Nationally Scarce spreading hedge-parsley and as a City Wildlife Site for calcareous and neutral grassland. Consultation with Cambridge City Council and a Phase 1 Habitat survey is recommended prior to works along the rail line at this location and to Long Road bridge.

To allow clearance for two additional electrified tracks under Long Road, reconstruction of the road bridge will be required. The overbridge sits within deciduous woodland (a Habitat of Principal Importance) which extends along the A1134 and south along the rail line to form the perimeter of Long Road Sixth Form College. It is assumed that some limited tree felling will be required. A Phase 1 Habitat Survey should be undertaken in this woodland to determine the presence of nesting birds or bat roost potential. Further surveys may then be required (depending on the findings of the initial assessment) prior to felling.

A Phase 1 Habitat Survey will also be required due to the presence of numerous species elsewhere within the local area. This is to include a search for signs of protected species, species of principal importance and biodiversity action plan species and an assessment of the presence of habitats with the likelihood to support these species. Kingfisher, Tawny Owl, Common Toads, grass snake, water voles, water shrew and otter have been recorded at Nine Wells Local Nature Reserve, 60 metres east of the rail line to the south of Addenbrooke's Road.

The primary concern will be the short term impact of construction on habitats. The use of floodlighting during construction alongside increased noise and vibration form heavy plant will likely disturb roosts and foraging.

A Construction Environmental Management Plan (CEMP) will need to set out plans for the management of construction lighting. Station lighting, once in operation, may also disturb the foraging of bats if they are present in the area. Sympathetic lighting design will be required for the operational site in order to prevent light spill onto sensitive foraging and roost areas.

Overall the biodiversity impact is expected to be *Slight Adverse*.

Water environment

The Nine Wells Local Nature Reserve (LNR) and Local Geological Site (LGS) is located 60 metres east of the existing track and covers approximately 12,300 square metres. It was designated in 2005 as it is the site of several chalk springs and the source of the Hobson Conduit. Ecological surveys will be required and appropriate measures should be taken at the site to prevent groundwater contamination of the chalk springs and to prevent impacts on the status of the waterbody.

The Environment Agency's floodplain map for the site and surrounding area shows that the site itself lies within Flood Zone 1 defined as little or no flood risk at all with a <0.1% chance of flooding from rivers in any one year. Hobson's Brook and Addenbrooke's ditch lie within Flood Zone 3, defined as having a 1 in 100 or greater annual probability of flooding although this is

unlikely to have impact on the proposed development or station due to its proximity to numerous drainage ditches in the locality.

Overall the water environment impact is expected to be *Neutral*.

3.3.4 Social Impacts

Commuting and other users

Cambridge South station is forecast to provide significant journey time benefits to commuting and other (non-business) users, with a total estimated monetised benefit of approximately £55 million (central case, 2010 prices discounted to 2010) over the appraisal period.

Approximately 80% of the forecast benefits arise from rail passengers switching from Cambridge to Cambridge South station, achieving in-vehicle and access / egress time savings, as Cambridge South station is more convenient for either their trip origin or trip destination. A further 10% of the forecast benefits arises from new rail passengers transferring from other modes.

The remaining 10% of the forecast benefits relates to externality benefits associated with mode shift from private car to rail, reducing congestion for other road users and reducing secondary environmental impacts in the local area.

As explained in Section 3.3.2, the increased journey time incurred by passengers on trains calling additionally at Cambridge South does not have as great an impact on commuter and other user benefits when compared to business users. This is due to differences in values of time contained in WebTAG.

Journey time reliability impact on commuting and other users

The expected journey time reliability benefit for commuting and other (non-business) users will be similar in nature to the benefit for business users. Further detail is provided in Section 3.3.2.

Physical activity

The proposed station at Cambridge South is expected to encourage increased walking and cycling as part of a public transport journey, where new rail users have transferred from the private car. Based on demand forecasts, increased physical activity will have the potential to benefit approximately 700 people per day[16].

A slight decrease in physical activity may occur among people who would otherwise have walked or cycled from Cambridge station. There will be no change in physical activity for those who would otherwise have travelled on Cambridge Busway services between Cambridge station and the Southern Fringe development area or Biomedical Campus.

On balance the physical activity impact is expected to be *Slight Beneficial*.

Journey quality

Journey quality benefits are expected to arise for three key groups of people:

- New rail users who have switched from private car to rail will benefit from reduced traveller stress and frustration associated with congested roads and oversubscribed parking at the Biomedical Campus.

[16] Demand forecasts are for 500,000 new rail trips per year. Assuming each trip is part of a round trip then this represents 250,000 individuals per year, or approximately 700 individuals per day.

- Rail users who continue to use Cambridge station will benefit from reduced pressure on the station and reduced station overcrowding. Approximately 10% of passengers who would be using Cambridge station are expected to transfer to Cambridge South.
- Cambridge Busway users between Trumpington and Cambridge station will be less likely to experience service overcrowding.

The journey quality impact is expected to be *Moderate Beneficial*.

Accidents

A slight reduction in road accidents is forecast as a result of mode shift from road to rail and therefore a reduction in vehicle-kilometres travelled on the road network. A monetised benefit of £1.0 million (2010 prices discounted to 2010) over the 60-year appraisal period is forecast, based on applying WebTAG marginal external cost values[17]. *Slight Beneficial* impact.

Security

The scheme is not expected to give rise to a change in personal security. The overall security impact is assessed as *Neutral*.

Access to services

A new station at Cambridge South will provide improved direct accessibility to Addenbrooke's Hospital for those without access to private transport, particularly for people travelling from outside the Cambridge area. The new station will also improve access to services outside the Cambridge area for people living in the Southern Fringe.

The access to services impact is assessed as *Moderate Beneficial*.

Personal Affordability

The scheme is expected to lead to a slight reduction in the cost of travel for many people, particularly for those who would otherwise have needed to travel by rail and bus to reach the Cambridge Biomedical Campus / Addenbrooke's Hospital. These people would need to purchase a rail ticket only, which for Cambridge South is assumed to be the same price as travelling to Cambridge station.

The affordability impact is assessed as *Slight Beneficial*.

Severance

Assuming that suitable provision is made for pedestrians and cyclists during any closure of the Long Road bridge, the scheme is not expected to increase or reduce severance in the short or long term. The overall severance impact is assessed as *Neutral*.

Option and non-use values

An option value is the willingness-to-pay to preserve the option of using a transport service for trips not yet anticipated or currently undertaken by other modes, over and above the expected value of any such future use. A non-use value is the value that is placed on the continued existence of a service regardless of any possibility of future use by the individual in question[18].

Cambridge South will provide a new transport option for more than 3,000 households within the Southern Fringe development area as well as in the existing Trumpington community. In line with TAG Unit A4.1 the option and non-use value can be assessed as *Large Beneficial*.

[17] TAG Unit A5.4 – Marginal external costs

[18] Definitions provided in TAG Unit A4.1 (Social Impact Appraisal)

3.3.5 Impact on Public Accounts

Cost to broad transport budget

The scheme proposed in this SOBC (as described in Section 1.3) includes major infrastructure measures which are required, and which will provide significant benefits, for other future rail schemes including East West Rail. For example, four-tracking south of Cambridge and grade separation at Shepreth Junction are expected to be key enabling measures for the central section of East West Rail.

One of the main reasons for delivering the additional infrastructure measures alongside Cambridge South station would be to ensure that all measures required on the same section of rail line are delivered as part of one project. This will avoid further disruption to passengers and Cambridge South station operation only a few years later.

Monetised benefits associated with measures other than the main station infrastructure for Cambridge South have not been claimed in this SOBC, as it would be more appropriate to apportion these to the business case for the central section of East West Rail. Similarly, the costs for these infrastructure measures should also be apportioned to East West Rail. Detailed benefits and cost apportionment work will be required in advance of any Outline Business Case for Cambridge South.

Based on information supplied by Network Rail, the cost for all infrastructure measures to be delivered along the Cambridge to Shepreth Junction line section is likely to be in the range £175 million to £350 million (Q1 2017 prices) including Optimism Bias. In discussion with the Department for Transport, 95% of the lower range costs (which is approximately 50% of the upper range costs) have been apportioned to the Cambridge South scheme for initial economic appraisal purposes.

For the 'central case' scenario presented in this SOBC, capital expenditure apportioned to Cambridge South is £166 million (current prices) including 66% Optimism Bias (£100 million excluding Optimism Bias).

The Present Value of Costs (PVC) for Cambridge South has been estimated by:

- Converting the apportioned capital expenditure of £166 million including Optimism Bias to the Department for Transport's standard 2010 price base;
- Profiling expenditure over a four year construction period 2021-2025;
- Converting a high level estimate of station operating costs of £141,000 per year (including 41% Optimism Bias) to the standard 2010 price base and adding these to the expenditure profile for the full 60-year appraisal period;
- Discounting the 2010 prices in future years using the standard discount rates set out in WebTAG;
- Converting the 2010 discounted prices to market prices; and
- Subtracting forecast net additional fare revenues (2010 discounted prices), transferred from the train operating companies to central government, to offset scheme costs.

Over the 60-year appraisal period, the new station is expected to generate just over £83 million (2010 prices discounted to 2010) in additional fare revenue to the rail network. This excludes existing passengers who switch from Cambridge station to Cambridge South, as they are assumed to pay the same fare for their trip.

Headline economic appraisal outputs for the 'central case' scenario are summarised in Table 4. WebTAG standard Transport Economic Efficiency (TEE), Public Accounts (PA), and Analysis of Monetised Costs and Benefits (AMCB) tables are provided in **Appendix C**.

Table 4: Headline economic appraisal outputs

Indicator	Estimate
Present Value of Benefits (PVB)	£46.8 million
Present Value of Costs (PVC)	£36.8 million
Net Present Value (NPV)	£10.0 million
Benefit to Cost Ratio (BCR)	1.3

Source: Mott MacDonald

Indirect tax revenues

The PVB shown in Table 4 includes a £12 million (2010 prices discounted to 2010) loss of indirect tax revenues, due to mode shift to rail and therefore reduced fuel sales for private cars.

3.4 Sensitivity Tests

A range of alternative economic appraisal tests have been undertaken to understand the sensitivity of the appraisal to different assumptions. Sensitivity results are shown in Table 5.

Table 5: Sensitivity tests summary

Test	PVB (£ million)	PVC (£ million)	BCR
Central case	46.8	36.8	1.3
Capital expenditure			
£75 million + 66% Optimism Bias (£125m)	46.8	7.5	6.2
£125 million + 66% Optimism Bias (£208m)	46.8	66.1	0.7
Capital expenditure (with target BCR 1.5)			
£95 million + 66% Optimism Bias (£158m)	46.8	31.2	1.5
Private sector funding (with target BCR 1.5)			
14% of capital expenditure	30.0	20.0	1.5
Private sector funding (with target BCR 2.0)			
23% of capital expenditure	20.0	10.0	2.0
Time penalty for through-passengers			
1 minute	62.2	31.4	2.0
0.5 minutes	82.0	23.7	3.5
0 minutes	101.9	16.0	6.4
Development sensitivity			
No development reliant on station delivery	51.4	75.0	0.7
No further development growth post-2031	41.1	47.5	0.9
WebTAG sensitivities			
High values of time	66.0	36.8	1.8
Low values of time	27.7	36.8	0.8
Passenger growth capped 10 years from now, shortly after scheme opening (2027)	33.3	70.2	0.5
Passenger growth capped 30 years from now, or 20 years after scheme opening (2047)	49.6	21.3	2.3

Source: Mott MacDonald

3.5 Value for Money Statement (Economic Case Summary)

The Economic Case has been prepared using methods that are appropriate for an early stage of scheme development, using available datasets, WebTAG and PDFH to monetise benefits where possible.

The overall value for money of Cambridge South station is based on a combination of the monetised and qualitative assessments, as summarised in Table 6. While the initial BCR of 1.3 is indicative of a low value for money scheme, the extensive range of additional economic and social benefits justifies a higher value for money category.

Cambridge South is therefore expected to represent **Low-Medium value for money**. However it should be noted that this is highly sensitive to a range of factors, as demonstrated by the sensitivity tests undertaken. Key factors are:

- The increased journey time experienced by the large number of through passengers who will now have to stop at the new station. This reduces scheme value for money substantially, even though the increased journey time to individual passengers is only slight.
- The level of development at the Biomedical Campus during the 2021-31 period which is assumed to be reliant on the new station. If all jobs growth can be delivered without a new station then the BCR reduces to below 1.0. If considerably more than 20% of additional jobs are reliant on the new station then the BCR would be expected to increase significantly.
- The proportion of capital expenditure which is apportioned to the Cambridge South scheme rather than East West Rail:
  - An additional £40-45 million capital expenditure apportioned to Cambridge South compared to the 'central case' reduces the initial BCR to below 1.0.
  - Reducing capital expenditure by £40-45 million compared to the 'central case' increases the initial BCR to above 6.0.
  - To increase the initial BCR from 1.3 to 1.5, apportioned capital expenditure would need to reduce to approximately £158 million (2017 prices) including 66% Optimism Bias. This is a 5% reduction in capital expenditure apportionment compared to the 'central case'.
- Based on capital expenditure of £166 million (current prices) including 66% Optimism Bias, the proportion of capital expenditure that is funded by the private sector will affect the initial BCR as follows:
  - The initial BCR could be increased from 1.3 to 1.5 with around 14% of the capital expenditure (approximately £23 million) funded by the private sector.
  - The initial BCR could be increased to 2.0 with around 23% of the capital expenditure (approximately £38 million) funded by the private sector.

Monetised benefits associated with measures other than the main station infrastructure for Cambridge South have not been claimed in this SOBC, as it would be more appropriate to apportion these to the business case for the central section of East West Rail. For this reason, the costs for these infrastructure measures should also be apportioned to East West Rail. Detailed benefits and cost apportionment work will be required in advance of the Outline Business Case for Cambridge South.

The proposed infrastructure works, such as four-tracking and grade separation at Shepreth Junction, have the potential to reduce rail journey times and to offset the time penalty associated with an additional station call. However, the journey time impacts of these measures cannot be quantified at this early stage of scheme development. It may be useful for Network Rail to consider whether and how the new infrastructure could be specified to mitigate the time penalty from the additional station call.

Table 6: Value for money summary

Assessment type	Estimate	Comments
Net Present Value (NPV)	£10.0 million	The NPV indicates by how much the benefits of the scheme exceed the costs. This NPV is for the 'initial BCR'. This NPV is also the same as the NPPV (Net Present Public Value).
Initial BCR	1.3	Includes monetised benefits as shown in the Analysis of Monetised Costs and Benefits (AMCB) table: economic efficiency (journey time savings); accident savings; reduced greenhouse gas emissions; noise and air quality benefits.
Adjusted BCR	1.5	Includes an additional £9 million (2010 prices discounted to 2010) agglomeration benefits.
Qualitative assessment	Moderate Beneficial	Wide range of social, economic, and environmental benefits. Large beneficial option value impacts. Moderate beneficial journey quality and access to services impacts. Slight beneficial air quality, greenhouse gas, accident, physical activity, and affordability impacts. Slight adverse impacts for landscape, historic environment, and biodiversity, all primarily related to infrastructure measures required for East West Rail rather than specifically for Cambridge South. Wider economic (GVA) additionality estimated at £1.7 million per annum (2015 prices) in the medium term.
Key sensitivities	High risk	Value for money is highly sensitive to levels of capital expenditure, the time penalty for through-passengers, and assumptions on how much development will be reliant on the new station.
VfM category	Low-Medium	Additional agglomeration and qualitative benefits could be significant enough to increase the VfM category to Medium.

Source: Mott MacDonald

4 Financial Case

At SOBC stage, the Financial Case sets out anticipated expenditure and potential funding sources. Detailed cost estimates and funding sources would need to be confirmed as part of the next business case stage, Outline Business Case.

4.1 Introduction

Department for Transport business case guidance[19] identifies the expected level of detail for each of the five cases (Strategic, Economic, Financial, Commercial, Management) at each business case stage. At the SOBC stage, two requirements are identified for the Financial Case:

- Outline the approach being taken to assess affordability; and
- Outline the budget and funding cover for the project.

Detailed cost estimates are required as part of the next stage, the Outline Business Case, along with confirmed funding sources.

4.2 Scheme Affordability

To inform the initial economic appraisal (presented in the Economic Case of this SOBC), an order of magnitude cost range for Cambridge South Station and associated line improvements has been identified by the Department for Transport. This cost range draws on information provided by Network Rail regarding the outturn costs of other rail schemes.

Cost range information, along with other elements of this SOBC, will inform the overall affordability assessment to be undertaken by the Department for Transport. If a decision is made to progress the scheme then more detailed cost estimates will need to be prepared as part of the Outline Business Case.

4.3 Scheme Costs

4.3.1 Investment Cost Summary

The order of magnitude cost range identified for the scheme is **£175 million to £350 million** (Q1 2017 prices) including Optimism Bias. These costs are expected to cover all scheme elements as listed in Section 1.3, including infrastructure that would provide for future East West Rail requirements, such as Shepreth Junction grade separation.

The majority of the scheme costs would be incurred during construction, which is anticipated to take place over the 2021 to 2025 period. However, a proportion would be incurred before construction begins, to cover project development through the various business case and Network Rail Guide to Rail Investment Project (GRIP) stages.

In advance of submitting an Outline Business Case the following will be required:

- A detailed cost estimate and expenditure profile; and
- More detailed consideration on how scheme costs should be apportioned between Cambridge South and East West Rail.

[19] The Transport Business Cases, January 2013

4.3.2 Ongoing Operating and Maintenance Costs

Ongoing operating and maintenance costs associated with the scheme are likely to include:

- Station operating and maintenance costs, to cover the new four-platform station with footbridges and lifts, waiting shelters, ticket purchasing facilities, lighting and security provision.
- Maintenance and renewals for additional infrastructure, including additional track, structures and overhead line equipment. However, a proportion of these costs will need to be allocated to East West Rail rather than Cambridge South. There may also be some future infrastructure renewals savings as a result of this investment.

Although more than 1.8 million passengers per year are forecast to use the station, it is unlikely to be staffed. This is because it is expected to act predominantly as an 'attractor' or destination station, with trips attracted to the Cambridge Biomedical Campus. Its role as a destination station will be further reinforced by the absence of any car parking facilities, other than a drop-off / pick up area. The need for ticket purchasing advice or travel advice to be provided by a member of station staff will therefore be limited.

At this stage of scheme development the impact on train operating costs is unknown, although impacts are expected to be minimal because:

- The dominant passenger movements associated with Cambridge South are expected to be in the reverse direction to the current Cambridge to London peak movements, minimising any requirement for additional rolling stock to meet passenger demand; and
- The additional time taken to call at Cambridge South is not expected to impact on the number of train sets required.

For economic appraisal purposes, a high level estimate of £141,000 per year (including 41% Optimism Bias) has been included to cover ongoing operating and maintenance costs.

More detailed cost estimates will be required at the Outline Business Case stage.

4.4 Funding Sources

Previous analysis undertaken by a third party in 2016, as part of a New Stations Fund application for Cambridge South[20], highlighted the private sector interest in this scheme. A range of funding options therefore exists for both construction and ongoing station operating and maintenance costs.

Availability of the following funding sources will need to be investigated alongside Outline Business Case development:

- Direct funding from Government departments, potentially as part of an amended City Deal with the Greater Cambridge Partnership;
- Local contributions from local authorities as part of Local Transport Plan and development area transport strategy implementation;
- Community Infrastructure Levy (CIL) funds to be raised from developers in future by Cambridge City Council;
- Direct private sector funding from Biomedical Campus developers and occupiers, whether monetary or through land provision;

[20] The New Stations Fund application was unsuccessful as infrastructure requirements identified by Network Rail and train operating companies (such as four-tracking and Shepreth Junction grade separation) had not been taken into account as part of the scheme.

- Tax increment financing, where increased tax receipts resulting from economic growth are hypothecated for project funding purposes;
- Land value capture, whereby a proportion of the increased land value on surrounding development land resulting from the new station is captured rather than passing as windfall. Land value capture is essentially a method of extracting a financial value from user benefits that have been capitalised into land values; and
- Revenue contributions from train operating companies as a proportion of additional fare revenues collected.

It is anticipated that the final funding arrangement will involve a combination of some of the above sources.

Sensitivity tests undertaken as part of the economic appraisal indicate the levels of private sector contribution required to increase the initial BCR to 1.5 (medium value for money) or 2.0 (high value for money), based on capital expenditure of £166 million (current prices) including 66% Optimism Bias:

- The initial BCR could be increased from 1.3 to 1.5 with around 14% of the capital expenditure (approximately £23 million) funded by the private sector.
- The initial BCR could be increased to 2.0 with around 23% of the capital expenditure (approximately £38 million) funded by the private sector.

For the next stage of scheme development (to Outline Business Case), a £10 million funding package has been agreed in principle. This includes £5 million from the Department for Transport and £5 million in total from AstraZeneca, the Cambridgeshire and Peterborough Combined Authority, and the Greater Cambridge Partnership. Funding will provide for further engineering design, survey and appraisal work required to understand the case for investment.

4.5 Financial Case Summary

The order of magnitude cost range identified for the scheme is £175 million to £350 million (Q1 2017 prices) including Optimism Bias. These costs are expected to cover all scheme elements including infrastructure that would provide for future East West Rail requirements.

Ongoing operating and maintenance costs associated with the scheme are likely to include station operating and maintenance costs, and the net increase in maintenance and renewals for additional infrastructure. A proportion of maintenance and renewals costs for additional infrastructure will need to be allocated to East West Rail.

Previous analysis undertaken by a third party in 2016, as part of a New Stations Fund application for Cambridge South, highlighted the private sector interest in a new station at Cambridge South. A range of funding options therefore exists for both construction and ongoing station operating and maintenance costs.

In advance of submitting an Outline Business Case the following will be required:

- A detailed cost estimate and expenditure profile, for capital costs and ongoing operating, maintenance and renewals costs;
- More detailed consideration on how scheme capital and maintenance costs should be apportioned between Cambridge South and East West Rail; and
- Funding source investigation to identify the most suitable combination of sources.

For the next stage of scheme development (to Outline Business Case), a £10 million funding package has been agreed in principle.

5 Commercial Case

At SOBC stage, the Commercial Case should demonstrate that there are appropriate ways in which the scheme can be procured. This includes the likelihood of existing rail services being scheduled to serve the new station in future.

5.1 Introduction

The scheme to be procured is a conventional rail station and infrastructure project, for which the construction industry is capable of delivering within a competitive procurement environment if required. Scheme procurement is therefore considered to be commercially viable.

This Commercial Case sets out the outputs that are likely to be required from some form of competitive procurement, and the procurement options that exist.

5.2 Outline Output-based Specification

The following outputs are likely to be required:

- A new station at Cambridge South with four platforms, suitable and compliant means of crossing between platforms, waiting shelters, ticket purchasing facilities, lighting and other security measures, and a drop-off / pick-up area outside the station entrance.
- Suitable access routes between local highways, footways and cycleways, and the station entrance.
- Doubled line capacity on the 2.3-mile section of the West Anglia Main Line between Shepreth Junction and the existing four track section to the south of Cambridge station. This includes new railway tracks, signalling, switches and crossings, and additional overhead line equipment.
- Reconstruction of bridges where required to cater for increased line capacity. At this stage one road over rail bridge has been identified for reconstruction (A1134 Long Road).
- Grade separation of Shepreth Junction to provide for future East West Rail requirements.
- Service level of four trains per hour in each direction, with at least three trains per hour to London, and direct trains to London Gatwick and London Stansted Airports.

The above specification is preliminary. A full output-based specification will need to be presented with the Outline Business Case.

5.3 Procurement Options

A range of procurement options exists for station infrastructure delivery, including (in order of decreasing client involvement):

- Traditional contract, where design and construction procurement are separated;
- Emerging cost contract (a form of management contract);
- Design and Build;
- Design, Build, Operate, and Maintain (this is not suitable for the line infrastructure elements, as the scheme is part of an existing Network Rail operational route); and
- Engineering Procurement and Construction (turnkey design and build) contract.

A variety of Public Private Partnership (PPP) arrangements also exist, including concessions and Private Finance Initiatives (PFI). Previous analysis undertaken by a third party in 2016, as part of a New Stations Fund application for Cambridge South, identified PPP as a suitable approach. This was in relation to the new station only and did not include other line infrastructure works.

Regardless of the procurement approach adopted, it is likely that a rail franchise operator (train operating company) would be designated as the Station Facility Operator (as with Cambridge North station which opened in May 2017).

The range of procurement options available for the rail line infrastructure improvements is more limited, as the upgraded infrastructure would need to be managed and maintained by Network Rail as part of the UK rail network.

The train services calling at the new station will be provided by the franchise operators that run services along the line on which the station is located. The working assumption is that services will be operated by both the combined Thameslink, Southern & Great Northern franchise, and the Greater Anglia franchise. Both franchises are due to be retendered before the end of the proposed station opening year, in 2021 and 2025 respectively. Service levels for Cambridge South can therefore be included within the franchise specifications.

5.4 Commercial Case Summary

The following key points are raised in this outline Commercial Case:

- Scheme procurement is considered to be commercially viable, as this is a conventional rail station and infrastructure project.
- A preliminary specification has been produced. A full output-based specification will need to be presented with the Outline Business Case.
- A range of procurement options exists for station infrastructure delivery. Regardless of the procurement approach adopted, it is likely that a rail franchise operator would be designated as the Station Facility Operator.
- The range of procurement options available for the rail line infrastructure improvements is more limited, as the upgraded infrastructure would need to be managed and maintained by Network Rail as part of the UK rail network.
- The train services calling at the new station will be provided by the franchise operators that run services along the line on which the station is located. Service levels can be included within the franchise specifications at the next franchise renewal date.

6 Management Case

At SOBC stage, the Management Case includes an indicative programme, and commentary on governance, quality assurance, communications, and risk management.

6.1 Introduction

This Management Case is preliminary in nature and will need to be developed as the scheme is progressed through the business case and Network Rail GRIP stages. Department for Transport business case guidance[21] identifies the most important areas of the Management Case at SOBC stage as:

- Providing evidence of similar projects that have been successful;
- Describing the proposed project governance structure; and
- Identifying key assurance and approval milestones.

6.2 Evidence of Similar Projects

In recent years, several new stations have been delivered across the UK rail network. Many of these have been funded through the two rounds of the Department for Transport's New Station Fund.

The new stations comprise a range of station types, locations, promoters, and delivery approaches. Examples of stations serving major business areas or new developments include:

- Cambridge North, which opened in May 2017, serving the Cambridge Science Park and Cambridge Business Park.
- Kirkstall Forge, which opened in June 2016, to serve a new mixed use development site.
- Cranbrook, which opened in December 2015, to serve a new town development.
- Oxford Parkway, which opened in October 2015, to serve north Oxford. This station is on the proposed route of East West Rail (western section).

6.3 Project Programme

6.3.1 Milestones

An indicative programme between SOBC submission and station opening, showing key milestones, is provided in Table 7. The programme combines the Department for Transport's three stage business case requirements, with Network Rail's GRIP process.

The next business case stage, Outline Business Case, can only be completed once GRIP 3 has been completed. GRIP 3 culminates in a single engineering solution being selected. The Full Business Case stage requires GRIP 5 to be complete, with a robust engineering design and definitive time, cost, resource and risk estimates.

Procurement stages are not included in Table 7 at this stage, as the timescales depend on the procurement options selected.

The anticipated station opening date is 2025.

[21] The Transport Business Cases, January 2013

Table 7: Indicative programme

Milestone	Indicative date
SOBC sign-off	End 2017
GRIP 1-2 development (output definition / feasibility)	Early-mid 2018
GRIP 3 (option selection)	Late 2018-2019
Outline Business Case completion	Mid 2019
GRIP 4 (single option development) completion	Early-mid 2020
GRIP 5 (design development) completion	Early 2021
Full Business Case completion	Mid 2021
Construction commences	Late 2021
Substantial completion	Mid 2025
GRIP 6-7 (construction / test / commission, and scheme handback)	Mid-late 2025
Station open	End 2025
GRIP 8 (project close-out)	2026

Source: Mott MacDonald

6.3.2 Programme Dependencies

The success and financial viability of a new station at Cambridge South will be dependent on continued successful growth and development at the Cambridge Biomedical Campus, to attract sufficient passenger demand. However, this is deemed low risk due to the extent of the existing development, works already on site, and further committed development. An anticipated opening date of 2025 will also reduce the risk of insufficient demand existing, as there will have been substantial development site build-out and occupation by time the station opens.

Although not dependent on the Thameslink programme or East West Rail, the new station would provide infrastructure required for these other projects. Costs and benefits will need to be apportioned to East West Rail as the Cambridge South scheme is developed. The service stopping pattern for the station will be dependent on the new timetables introduced as part of the Thameslink programme.

Other key programme dependencies include:

- Industry timescales in relation to statutory permissions (such as planning approval or a Transport and Works Act order), technical approvals, rail possession planning, and timetable planning;
- Securing an appropriate funding package; and
- The station opening date might also be linked to Greater Anglia franchise retendering, due for completion in 2025.

6.4 Governance Arrangements

The SOBC stage is being led by the Department for Transport, with SOBC development support from Mott MacDonald. The Department for Transport is also currently acting as scheme promoter.

Following SOBC sign-off, a governance structure will need to be established for progressing GRIP 1-3 and the Outline Business Case stage through 2018 and 2019. The governance structure will depend in part on the scheme promoter, funding arrangements and procurement approaches to be adopted. The structure will therefore evolve as the scheme is developed.

The governance structure following SOBC sign-off is expected to include the following organisations:

- Department for Transport;
- Network Rail;
- Cambridgeshire County Council as the local transport authority;
- Greater Cambridge Partnership, representing the three local authorities, University of Cambridge, and the Greater Cambridge Greater Peterborough Local Enterprise Partnership;
- Greater Anglia, and Thameslink, Southern & Great Northern franchise operators;
- Land owners for the proposed station site;
- Cambridge Biomedical Campus representatives;
- Key funding organisations, including private sector interests; and
- Consultant advisors.

As the scheme is progressed, the governance structure will need to evolve to include design and construction contractors, as determined by the procurement processes selected.

6.5 Quality Assurance

Quality will be assured by adherence to Network Rail's GRIP process, ensuring sign-off is obtained on each stage before progressing to the next. The GRIP process is designed to minimise the risks associated with projects that amend or renew the operational railway, and other projects where Network Rail investment approval is required.

The GRIP stages are identified in Table 7.

Appendix E sets out the assurance process adopted in preparing this SOBC.

6.6 Communications Strategy

As identified in Section 2.8.3, there is considerable stakeholder support for a new station at Cambridge South. However, this does not negate the need for a Communications Plan, to encourage proactive communication with local business and residential communities, Members of Parliament, media enquiries, and other interested parties.

A crucial area of communication will be in relation to the likely temporary closure of the A1134 Long Road bridge for reconstruction works. This section of road does not form part of the Strategic Road Network although it has an important role as part of the Cambridge ring road. All works will need to be planned in collaboration with Cambridgeshire County Council as local highway authority, so that suitable diversion routes can be identified and disruption minimised.

A Communications Plan will be developed in advance of Outline Business Case submission. The Plan will identify a main point of contact for enquiries. During the intervening period, the Department for Transport will act as the main point of contact.

6.7 Risk Management

Risk management is a structured approach to identifying, assessing, and responding to risks that arise during a project. It is important to identify key risks at an early stage in scheme development.

The following key risks have been identified to date:

- Identifying an appropriate and affordable funding package for a scheme which is expected to cost in the region of £175 million to £350 million (Q1 2017 prices).
- Site-specific risks such as challenging ground conditions, including contamination, poor drainage. Local topographic information supplied previously by Network Rail has indicated that ground conditions may be challenging. Ground investigation surveys will need to be conducted at GRIP 3.
- Programme delays resulting from environmental impact concerns, including:
  - Outcomes of any Application for Scheduled Monument Consent (for rail line works to the south of Cambridge South);
  - Concerns raised by Phase 1 Habitat Surveys; and
  - Concerns raised by Great Shelford residents in relation to Shepreth Junction grade separation.
- Agreeing the requirements for East West Rail provision, as the central section of this project is not yet committed.
- Sufficient space being safeguarded within the Cambridge Biomedical Campus development area, and adjacent to the rail line, to allow for station construction and suitable access routes.
- The need for continued successful growth and development at the Cambridge Biomedical Campus, to attract sufficient passenger demand.

Following SOBC sign-off a Risk Management Strategy and risk register will be prepared and kept up-to-date throughout the remainder of the scheme's development. Risks will need to be allocated to appropriate risk owners as part of Strategy development.

6.8 Management Case Summary

The Management Case for Cambridge South station is preliminary in nature and based on information currently available (as at November 2017). It is therefore subject to review and amendment as the scheme is progressed.

Key points from the preliminary Management Case are:

- Several new stations have been delivered across the UK rail network in recent years. The Cambridge South scheme is therefore a conventional scheme type.
- The programme needs to combine the Department for Transport's business case requirements, with Network Rail's GRIP process. The anticipated station opening date is 2025.
- Programme dependencies include continued successful growth and development at the Cambridge Biomedical Campus, industry timescales in relation to planning and technical approvals, time taken to secure a suitable funding package, and the Greater Anglia franchise retendering due for completion in 2025.

- The SOBC stage is being led by the Department for Transport. Following SOBC sign-off, a governance structure will need to be established, which will evolve as the scheme is developed.
- Quality will be assured by adherence to Network Rail's GRIP process.
- A Communications Plan will be developed in advance of Outline Business Case submission. A crucial area of communication will be in relation to the A1134 Long Road bridge reconstruction, requiring collaboration with Cambridgeshire County Council to identify suitable diversion routes and minimise disruption during temporary road closures.
- Key risks have been identified in relation to the funding package, ground conditions, local environmental impacts (landscape, heritage, and biodiversity), East West Rail requirements, land availability, and growth at the Biomedical Campus. Following SOBC sign-off a Risk Management Strategy and risk register will be prepared and kept up-to-date throughout the remainder of the scheme's development.

Appendices

A. Appraisal Summary Table
B. Technical Note – Demand Forecasting Methodology
C. TEE, PA, AMCB Tables
D. Technical Note – Wider Economic Benefits
E. SOBC Quality Assurance

A. Appraisal Summary Table

Appraisal Summary Table

Date produced:	03	11	2017

Contact:	
Name	
Organisation	DfT
Role	Promoter/Official

Name of scheme:	Cambridge South station
Description of scheme:	New rail station on West Anglia Main Line to serve Cambridge Southern Fringe and Cambridge Biomedical Campus. The station will have four platform faces (formed from two islands), footbridge and lift, shelters, ticket purchasing facilities.Station to be served by 4tph per direction. Accompanying line improvement works include four-tracking between Cambridge and Shepreth Junction, Long Rd bridge reconstruction, signalling, S&C.

Impacts		Summary of key impacts	Assessment			
			Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	£24 million journey time benefits for business users who benefit from access / egress and in-vehicle time savings from using the new station are offset by the small time penalty incurred by a much larger number of through business users who are on trains now calling at the new station. Overall benefit to business users due to additional externality benefits (reduced congestion, accident and environmental impacts) associated with mode shift from private car to rail. Net increase in fare revenues to train operating companies assumed to pass to government as part of franchise agreement.	**Value of journey time changes(£)** £2.6m **Net journey time changes (£)** 0 to 2min: Not assessed; 2 to 5min: Not assessed; > 5min: Not assessed	N/A	£2.6 million *(£24 million benefit offset by through passenger time penalty)*	Not assessed
	Reliability impact on Business users	Four-tracking Cambridge to Shepreth Junction has the potential to improve rail service reliability by removing an existing pinch-point and provide infrastructure required for East West Rail.	Impact not quantified / monetised - costs and benefits to be apportioned to East West Rail central section.	N/A	Not monetised	
	Regeneration	Area surrounding new station not designated as a regeneration area under any programmes.	N/A	N/A	N/A	
	Wider Impacts	Agglomeration benefits expected at Biomedical Campus. Not formally assessed, taken as 10% of Cambridge South user travel time benefits. Wider economic impacts from increased employment and GVA assessed separately (£1.7m GVA pa attributed to station medium term, 118 jobs per annum long term).	Not assessed	N/A	£9 million	
Environmental	Noise	Short term increase during construction period affecting development areas. No impact longer term - rail frequencies not increased, no car park provided, mode shift private car to rail.	Not assessed	Neutral	<£0.1 million	Not assessed
	Air Quality	In short term heavy construction plant emissions increase air pollution. Slight improvement longer term due to mode shift from private car to rail.	1.2 million veh-kms removed from road network in 2026, increasing each year.	Slight Beneficial	<£0.1 million	Not assessed
	Greenhouse gases	Slight reduction in greenhouse gas emissions due to mode shift from private car to rail.	Change in non-traded carbon over 60y (CO2e): - Change in traded carbon over 60y (CO2e): -	Slight Beneficial	£0.5 million	
	Landscape	Station visible from new residential developments, but views likely to be dominated by surrounding land uses. Potential visual impact of grade separated Shepreth Jn for properties in Great Shelford.	N/A	Slight Adverse	Not monetised	
	Townscape	No townscape impact expected.	N/A	Neutral	N/A	
	Historic Environment	Likely impact on Scheduled Monument west of White Hill Farm when line is expanded to 4-tracks. Potential impact on three Grade II listed buildings within 200m of rail line.	N/A	Slight Adverse	N/A	
	Biodiversity	Sympathetic lighting design required to avoid disturbing foraging bats. Construction, especially related floodlighting and vibration, may have a short term impact on habitats (to be managed using CEMP). Works adjacent to a designated Local Site (County / City Wildlife Site). Potential impact on Nine Wells LNR, 60m to east. Phase 1 Habitat Surveys required.	N/A	Slight Adverse	N/A	
	Water Environment	Mitigation measures required to prevent groundwater contamination of chalk springs / Hobson Conduit. Site lies within Flood Zone 1 - little or no flood risk.	N/A	Neutral	N/A	
Social	Commuting and Other users	£65 million journey time benefits for commuting and other users who benefit from access / egress and in-vehicle time savings from using the new station, partly offset by the small time penalty incurred by users who are on trains now calling at the new station. Additional externality benefits (reduced congestion, accident and environmental impacts) associated with mode shift from private car to rail.	**Value of journey time changes(£)** £54.8m **Net journey time changes (£)** 0 to 2min: Not assessed; 2 to 5min: Not assessed; > 5min: Not assessed	N/A	£54.8 million	Not assessed
	Reliability impact on Commuting and Other users	Four-tracking Cambridge to Shepreth Junction has the potential to improve rail service reliability by removing an existing pinch-point and provide infrastructure required for East West Rail.	Impact not quantified / monetised - costs and benefits to be apportioned to East West Rail central section.	N/A	Not monetised	
	Physical activity	Increase in people walking or cycling to rail stations instead of driving their entire journey. Possible reduction in walking and cycling trips between the Southern Fringe and Cambridge city centre among those who would otherwise have walked or cycled.	Potential benefit to approx. 700 people per day	Slight Beneficial	Not monetised	
	Journey quality	Reduced traveller stress / frustration due to congested roads and oversubscribed parking at Biomedical Campus (for new rail users switching from private car to rail). Reduced overcrowding at Cambridge station (for rail users who continuing to use Cambridge station). Cambridge Busway users between Trumpington and Cambridge station less likely to experience service overcrowding.	Potential benefits for more than 20,000 people per day.	Moderate Beneficial	Not monetised	
	Accidents	Slight reduction in accidents possible due to mode shift from private car to rail.	1.2 million veh-kms removed from road network in 2026, increasing each year.	Slight Beneficial	£1.0 million	Not assessed
	Security	Good design and lighting will promote a high level of personal security, but overall no change in levels of personal security anticipated.	N/A	Neutral	N/A	Not assessed
	Access to services	Will provide improved direct accessibility to Addenbrooke's Hospital for those without access to private transport, particularly if travelling from outside the Cambridge area. Will also improve access to services outside the Cambridge area for people living in the Southern Fringe.	N/A	Moderate Beneficial	N/A	Not assessed
	Affordability	Slight reduction in travel cost for many people, particularly those who would otherwise have travelled by rail and bus.	N/A	Slight Beneficial	N/A	Not assessed
	Severance	No impact on severence expected.	N/A	Neutral	N/A	Not assessed
	Option and non-use values	Provides a new transport option for more than 3,000 households within the Southern Fringe development area and the existing Trumpington community	N/A	Large Beneficial	Not monetised	
Public Accounts	Cost to Broad Transport Budget	For central case scenario: PVC £36.8 million (taking account of capital expenditure, ongoing maintenance, and additional fare income passed to government).	PVC: £36.8 million (central case) BCR: 1.3 (central case)	N/A	PVC £36.8 million	
	Indirect Tax Revenues	Reduced indirect tax revenues due to reduced sales, as a result of mode shift from private car to rail.	Loss of indirect tax revenue: £12 million	N/A	- £12 million	

B. Technical Note – Demand Forecasting Methodology

MOTT MACDONALD

Technical Note

Project:	Cambridge South Station: Strategic Outline Business Case		
Our reference:	378389CS01	**Date:**	3rd November 2017
Prepared by:	A. Gillies-Smith	**Approved by:**	C. Judge
Subject:	Appendix B: Demand forecasting model - methodology, inputs and assumptions		

1 Introduction

A forecasting model has been constructed for estimating demand for the proposed Cambridge South station. As well as being capable of forecasting demand, the model also has the functionality to evaluate the amount of revenue received by the station and the effect on passenger consumer surplus (benefit/penalty).

The methodology in the model is designed to evaluate two markets. The first of these markets is existing passengers who use Cambridge station. A proportion of these passengers will switch to using Cambridge South, whereas the remaining passengers will continue to use Cambridge. The benefit or penalty which these passengers receive depends upon which station they would use.

The second of these markets are new passengers to rail, which are either abstracted from other modes or are newly generated rail trips. These passengers are attracted to rail due to the improved station access and egress resulting from the new Cambridge South station.

To focus the analysis on core geographical markets serving the existing Cambridge station and which are likely to experience demand switching to Cambridge South, sixteen stations have been identified: Audley End, Bishops Stortford, Downham Market, Ely, Hitchin, Kings Lynn, Letchworth, Littleport, London termini, Meldreth, Royston, Stansted Airport, Stevenage, Tottenham Hale, Waterbeach and Whittlesford.

2 Impact of Cambridge South

Opening Cambridge South will have an impact on passengers using Cambridge station as either an origin/destination or travelling through the station. Better access/egress times to the south of Cambridge may result in existing users of Cambridge station switching to use Cambridge South.

This will have an impact on demand and revenue at both stations. Those choosing to switch will receive an improvement in consumer surplus due to reduced access/egress time. Depending on where these passengers are travelling to/from, they will also receive either a reduction or increase in in-vehicle time which reflects a change in consumer surplus. However, for those passengers which are travelling through Cambridge South station, it is assumed that they will incur a travel time penalty, which reflects a deterioration in consumer surplus.

New users are likely to be attracted to using the station due to better access/egress with rail travel. These passengers may be abstracted from other modes or they may reflect newly generated trips. For these new passengers, there will be a change in consumer surplus from improved access/egress times.

2.1 Existing Passengers

In the demand forecasting and benefit appraisal methodology, the impact on passengers travelling through Cambridge South is estimated. The increase in travel time influences passenger demand, revenue and passenger consumer surplus.

2.1.1. Travel through Cambridge South

Passengers travelling through Cambridge South but not using the station, will incur a time penalty due to the requirement for existing services to slow down, stop at, and accelerate from the new stop. A two minute in-vehicle time penalty has been applied to the timetable in MOIRA and the effect on generalised journey time (GJT), demand and revenue has been extracted[1].

Four adjustments have been applied to the MOIRA output before the effects have been quantified. Firstly, it is assumed that any passengers switching to use Cambridge South rather than Cambridge station will not incur the penalty. Hence, the do-minimum and do-something demand for the relevant stations is adjusted to reflect this change in demand.

Secondly, the two minutes additional travel time has been revised down to ninety seconds which is based on a Route Runner assessment by Mott MacDonald. MOIRA does not allow the use of half minutes in the input. For this second adjustment, the difference in GJT between the do-minimum and do-something extracted from MOIRA is factored by 0.75 for each station pairing. Hence, the do-something GJT is also adjusted.

The third adjustment is to disaggregate the demand into business, commuting and other journeys. The demand is split by ticket type using the factors in Table 1 (from PDFH v5.1).

Table 1: Journey Purpose Splits by Ticket

Market	Full			Reduced			Season		
	Bus.	Com.	Oth.	Bus.	Com.	Oth.	Bus.	Com.	Oth.
From London (journey length, minutes)									
0-20	20%	65%	16%	22%	33%	45%	6%	84%	10%
21-50	33%	51%	16%	27%	27%	46%	5%	90%	5%
51-100	63%	23%	15%	34%	20%	45%	6%	89%	5%
101-140	82%	6%	12%	46%	12%	42%	16%	73%	12%
141-180	70%	13%	17%	45%	8%	47%	31%	14%	55%
181-270	55%	11%	34%	42%	10%	48%	31%	14%	55%
270+	18%	5%	77%	18%	5%	77%	18%	5%	77%
To London (journey length, minutes)									
0-20	9%	70%	21%	10%	48%	42%	5%	84%	11%
21-50	16%	62%	22%	15%	41%	44%	5%	87%	8%
51-100	31%	44%	25%	23%	33%	45%	7%	83%	10%
101-140	47%	23%	30%	28%	22%	50%	12%	66%	22%
141-180	43%	22%	36%	33%	13%	54%	31%	14%	55%
181-270	48%	12%	40%	36%	12%	52%	31%	14%	55%
270+	18%	5%	77%	18%	5%	77%	18%	5%	77%

[1] Based on analysis undertaken in the RouteRunner software, trains which call at Cambridge South would reach their destination around 90 seconds later as a result of this additional stop. However MOIRA only allows timings to be entered to the nearest minute. A time penalty of 2 minutes has therefore been applied in MOIRA.

Market	Full			Reduced			Season		
Non-London (journey length, minutes)									
0-20	9%	70%	21%	10%	48%	42%	5%	84%	11%
21-50	31%	44%	25%	23%	33%	45%	7%	83%	10%
51-100	31%	44%	25%	23%	33%	45%	7%	83%	10%
101-140	47%	23%	30%	28%	22%	50%	12%	66%	22%
141-180	43%	22%	36%	33%	13%	54%	31%	14%	55%
181-270	48%	12%	40%	36%	12%	52%	31%	14%	55%
270+	18%	5%	77%	18%	5%	77%	18%	5%	77%

Source: Mott MacDonald, information obtained from PDFH v5.1.

The fourth and final adjustment is to grow demand to the assumed first full year after opening (2026). Hence, the demand is factored using average rates of growth assumed for Cambridge (15%), South Cambridgeshire (22%) and external stations (22%), depending upon the combination of the station-station pairing (i.e. Cambridge-London would use the average of Cambridge and external growth). The factors for Cambridge and South Cambridgeshire are based on TEMPro jobs and population growth, while the factors for external stations are based on passenger growth forecasts provided by the Department for Transport for the Greater Anglia, and Thameslink, Southern & Great Northern franchises.

As changes in the demand, revenue and GJTs are quantified for through travel using MOIRA, the change in consumer surplus incurred by these passengers is simply estimated using the rule-of-a-half (WebTAG, 2017). For through travellers, the change in consumer surplus through applying this rule is equated to half of the do-minimum and do-something demand from MOIRA estimated for through travel, multiplied by the change in GJT between each scenario. The formula is applied for each station-station pairing and by business, commuting and other journey purposes.

$$GJTPenalty = \left(\frac{Pax_{DM}+Pax_{DS}}{2}\right).(GJT_{DM} - GJT_{DS})$$

2.2 Travel to/from Cambridge South

In the second stage of the forecasting appraisal methodology, the impact of the new station on passenger access/egress to the railway network is assessed. This includes the effects of existing users switching to use the new station and demand either abstracted from other modes or newly generated demand because of reduced access/egress time to the railway network.

2.2.1 Impact of Access/Egress Times on Existing Rail Users

The decision for existing users of Cambridge station to use Cambridge South is evaluated based on relative access/egress costs to/from the respective stations. For simplicity, it is assumed that access and egress costs are equivalent for any given station.

Access/egress costs to Cambridge and Cambridge South stations are estimated for trips to/from eleven Cambridge Sub Regional Model (CSRM) zones surrounding the proposed site of the new station. Two zones have been excluded (on top of the eleven used) from the assessment as they reflect bus park and ride sites which could distort the forecasting.

It is assumed that passengers access Cambridge or Cambridge South station based on lowest generalised cost. The construction of the generalised cost to drive to each station is estimated using the following formula in which in-vehicle time (IVT) is weighted by an access/egress penalty (w) from PDFH v5.1, plus fuel costs $(Fuel)$ and parking charges $(Parking)$. Fuel and parking charges are converted to generalised minutes

using values of time (VoT), with the generalised cost for business, commuting and other users estimated separately.

$$AccessCost_{Car} = w.IVT_{Car} + \frac{Fuel}{Vot}.60 + \frac{Parking}{VoT}.60$$

In-vehicle time for car travel is estimated for each of the zones in the Cambridge South catchment area to/from other stations using online journey planners. The time is weighted by 1.3 for rail park and ride, to reflect that passengers place a higher weighting on access/egress than IVT. The unweighted access/egress time, along with drive distance from online mapping sources is also used to estimate car fuel costs based on the following formula in which fuel consumption parameters are applied to average speed (v) (WebTAG, 2017). These parameters are provided in Table 2.

$$FuelConsumption = \frac{a}{v} + b + c.v + d.v^2$$

Table 2: Car fuel consumption (l/km)

Fuel	a	b	c	d
Diesel	0.473257	0.059795	-0.000568	0.000004
Petrol	1.081515	0.042518	-0.000079	0.000002

Source: Mott MacDonald

Fuel consumed per kilometre is converted into a cost per km by multiplying fuel consumed by the resource and duty costs per litre, as well as including VAT for non-business travellers. The costs per litre to apply this estimation are as in Table 3.

Table 3: Fuel cost (p/l) – 2017 prices

Fuel	Resource	Duty	VAT
Diesel	31.93	58.64	20%
Petrol	29.97	58.64	20%

Source: Mott MacDonald

A weighted average for a typical car user is then estimated using the proportion of diesel and petrol-engine cars. As electric cars are excluded from the analysis, the WebTAG parameters have been adjusted to assume that the entire car market uses either petrol (46.6%) or diesel (53.4%).

Parking charges are assumed to be £5, which is half of the weekday cost to park at Cambridge Station. The assumption of half of the cost is applied to each direction of a round trip to avoid having different access and egress costs at both stations. It is assumed that the cost to park close (as Cambridge South will not provide a car park) to Cambridge South Station will be equivalent to parking in central Cambridge.

The value of time is applied in the relationship to convert monetary values for fuel and parking costs into generalised minutes. The values are extracted from WebTAG in 2017 prices and are presented in Table 4:

Table 4: Values of Time (2017 prices)

Purpose	Resource	Perceived	Market
Business	£29.82	£29.82	£35.48
Commuting	£10.17	£12.10	£12.10
Other	£4.64	£5.52	£5.52

Source: Mott MacDonald

Walking access/egress costs are estimated as below, in which the time taken to walk between the station and each zone is extracted from online journey planners and weighted by 2.0 (PDFH v5.1)

$$Access\&Egress_{Walk} = w.IVT_{Walk}$$

Between each zone and either Cambridge or Cambridge South, the access/egress costs are compared. For any zone which the costs are lower to use Cambridge South than the existing Cambridge station, it is assumed that these passengers will switch to use the new station. Otherwise, they will remain using the existing Cambridge station.

This decision criteria requires an understanding of how many passengers using the existing Cambridge Station are within the Cambridge South catchment zones. The proportion of passengers travelling to/from each of the catchment zones, relative to the wider catchment for Cambridge station, is estimated using the CSRM outputs. Due to the availability of disaggregated zonal data within short timeframes, highway rather than rail or public transport demand matrices have been used as a broad estimate for this distribution.

To control for the use of highway matrices rather than public transport matrices to form the distribution, it is assumed that the distribution of demand into the Cambridge station catchment can only originate within 2km of a station at the origin end of the journey. It is also assumed that the distribution of demand to Cambridge or Cambridge South must be within 800 metres of the destination station. These distributions are estimated for business, commuting and other travellers.

The distribution of passengers within each catchment zone is used to determine a proportion of demand between each station-station pairing which originates or terminates within the Cambridge South catchment relative to the wider Cambridge station catchment. The amount of demand per zone is then multiplied by the decision criteria for passengers to switch from Cambridge to Cambridge South.

As this demand is existing rail demand it is assumed, using the rule-of-a-half method, that passengers switching will receive the full benefit of reduced access/egress times. In the formula, the benefit is equal to the number of passengers switching multiplied by the change in access/egress times (AT).

$$AccessSaving_{Switching} = Pax_{Switching}.(AT_{Cambridge} - AT_{South})$$

Each passenger switching to Cambridge South station will also be incurring a different in-vehicle time to their previous journey undertaken to/from Cambridge station. It is assumed that these passengers incur either a ninety second penalty or benefit depending upon whether they are travelling north or south of Cambridge station respectively. The rule-of-a-half is again applied to capture the change in consumer surplus incurred by passenger in-vehicle time changes. This applies to both existing users switching and new rail users (as explained in Section 2.2.2):

$$GJTPenalty_{Switching} = \left(\frac{Pax_{Switching} + Pax_{Generated}}{2}\right).(IVT_{DM} - IVT_{DS})$$

2.2.2 Impact of Access/Egress Times on New Rail Users

The reduction in access/egress time to the rail network for passengers within the Cambridge South catchment area is forecast to result in new rail users. These new rail users are either abstracted from other transport modes or reflect newly generated travel demand.

To estimate the impact on demand, the PDFH v5.1 relationship between new demand and access/egress times is applied. In the generated demand relationship, the number of passengers that have switched from Cambridge to Cambridge South station is used as a base level of demand. The demand is multiplied by an index function which relates the change in travel time (T) due to the reduction in access/egress time to the

GJT for passengers before the change. An elasticity of demand with respect to GJT (g) is applied to the index function, taking a value of -1.25.

$$GeneratedDemand_{South} = Pax_{Switching}.[1 + ((T_{South} - T_{Cambridge})/GJT_{Cambridge})]^{g}$$

In the abstracted demand function applied to this study, only access time is included in the travel time construction. This is because the egress time is estimated to be equivalent to the access time. The weights applied are 1.3 for car and 2.0 for walk.

$$T_j = GJT_j + w_a.AT_j$$

It is assumed that 21% of demand from the South-East to London is abstracted from car, 24% to the South-East from London and 35% of all other demand is abstracted from car (WebTAG, 2017). The remainder of demand is assumed to be generated.

These new rail users are assumed to receive a consumer surplus impact from changes in GJT and access/egress time. The change in GJT relates to passengers either incurring or saving in-vehicle time depending upon whether they travel between Cambridge and Cambridge South or avoid this section. The rule-of-a-half for a GJT penalty is used, where new users are assumed to receive half of the benefit.

New users also receive half of the benefit from reduced access/egress time, which is expressed as in the formula below.

$$AccessSaving_{GeneratedDemand} = \frac{Pax_{Generated}}{2}.\left(AT_{Cambridge} - AT_{South}\right)$$

3 Cambridge South Catchment Area Development

On top of the background growth applied to the demand output from MOIRA, the number of passengers switching from Cambridge Station to Cambridge South is adjusted to reflect development growth in the new station catchment area. The development growth is applied net of background growth to avoid double-counting. The net is calculated using high level information provided by the Department for Transport on expected jobs growth within the Cambridge Biomedical Campus, and household growth in the area based on information contained in the Cambridge Local Plan 2014, relative to TEMPro background forecasts between 2017 and 2026.

An elasticity of 1.0 is applied for population and employment growth (PDFH v5.1), except for employment growth for journeys to/from London. For such station pairings, an elasticity of 1.13 is applied. The cumulative impact of employment and population growth in the study area is estimated to increase demand by 33% for non-London journeys and 37% for journeys to/from London. However, as 20% of the additional jobs post-2021 are assumed to be reliant on Cambridge South station delivery[2], growth rates are adjusted to affect the 80% of jobs that are not expected to be reliant on the new station. The remaining 20% is used to grow generated demand.

Growth in demand which arises due to new development within the catchment area is excluded from the access/egress and GJT penalty/saving net benefit calculations for Cambridge South users. This is to avoid accounting for benefits/disbenefits which generated demand is not believed to receive or incur.

[2] This assumption has been agreed with the Department for Transport.

C. TEE, PA, AMCB Tables

Economic Efficiency of the Transport System (TEE)

Non-business: Commuting	**ALL MODES**		**ROAD**	**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**	**Passengers**	**Passengers**	
Travel time	28,653,285		2,577,336		26,075,948	
Vehicle operating costs						
User charges					-	
During Construction & Maintenance						
COMMUTING	28,653,285	*(1a)*	2,577,336	-	26,075,948	

Non-business: Other	**ALL MODES**		**ROAD**	**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**	**Passengers**	**Passengers**	
Travel time	26,135,785		4,509,500		21,626,285	
Vehicle operating costs						
User charges					-	
During Construction & Maintenance						
NET NON-BUSINESS BENEFITS: OTHER	26,135,785	*(1b)*	4,509,500	-	21,626,285	

Business								
User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time	2,624,123			4,024,953			- 1,400,830	
Vehicle operating costs								
User charges							-	
During Construction & Maintenance								
Subtotal	2,624,123	*(2)*		4,024,953			- 1,400,830	
Private sector provider impacts						**Freight**	**Passengers**	
Revenue	83,238,212						83,238,212	
Operating costs	-						-	
Investment costs	-						-	
Grant/subsidy	- 83,238,212						- 83,238,212	
Subtotal	-	*(3)*				-	-	
Other business impacts								
Developer contributions		*(4)*						
NET BUSINESS IMPACT	2,624,123	*(5) = (2) + (3) + (4)*						

TOTAL		
Present Value of Transport Economic Efficiency Benefits (TEE)	57,413,193	*(6) = (1a) + (1b) + (5)*

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

Public Accounts (PA) Table

	ALL MODES TOTAL		ROAD INFRASTRUCTURE	BUS and COACH	RAIL	OTHER
Local Government Funding						
Revenue						
Operating Costs						
Investment Costs						
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT		*(7)*				
Central Government Funding: Transport						
Revenue						
Operating costs	2,803,429				2,803,429	
Investment Costs	117,250,005				117,250,005	
Developer and Other Contributions	-					
Grant/Subsidy Payments	- 83,238,212				- 83,238,212	
NET IMPACT	36,815,222	*(8)*	-	-	36,815,222	-
Central Government Funding: Non-Transport						
Indirect Tax Revenues	12,183,032	*(9)*	930,196		11,252,837	
TOTALS						
Broad Transport Budget	36,815,222	*(10) = (7) + (8)*				
Wider Public Finances	12,183,032	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and ‘Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values in 2010 prices and values.

Analysis of Monetised Costs and Benefits

Noise	72,697	*(12)*
Local Air Quality	8,056	*(13)*
Greenhouse Gases	501,983	*(14)*
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	1,024,935	*(17)*
Economic Efficiency: Consumer Users (Commuting)	28,653,285	*(1a)*
Economic Efficiency: Consumer Users (Other)	26,135,785	*(1b)*
Economic Efficiency: Business Users and Providers	2,624,123	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	- 12,183,032	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	46,837,831	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*

Broad Transport Budget	36,815,222	*(10)*
Present Value of Costs (see notes) (PVC)	36,815,222	*(PVC) = (10)*

OVERALL IMPACTS		
Net Present Value (NPV)	10,022,609	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	1.27	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

D. Technical Note – Wider Economic Benefits

MOTT MACDONALD

Technical Note

Project:	Strategic Outline Business Case (SOBC) proposed Cambridge South rail station		
Prepared by:	A Wallin	**Date:**	1/11/2017
Approved by:	S Cox	**Checked by:**	P Griffin
Subject:	Wider Economic Benefits		

1 Introduction

In this technical note, we provide a high-level analysis of the potential economic impacts of development around the proposed Cambridge South station. Through understanding the land allocations in the surrounding area, including the nearby Cambridge Biomedical Campus, we identify the employment and residential development potential for sites and the impact that the new station would be likely to have in making these sites more attractive for development.

1.1 Scheme objectives

The proposed Cambridge South station would serve the area south of the city, including Addenbrooke's Hospital and Cambridge Biomedical Campus. The Biomedical Campus is expected to house the largest concentration of biomedical expertise in Europe by 2020, enabling significant regional economic growth. The proposed station will also serve the Southern Fringe housing development which, when completed, will comprise 3,300 new homes to the west of the station site. We understand that the station is likely to be served by four trains per hour, with rail services connecting Cambridge South directly to central London, and Stansted Airport, and in the future would connect into East West Rail to serve the Oxford – Milton Keynes – Cambridge corridor.

2 Economic growth context

The UK's long term economic plan, besides focusing on reducing the public deficit, looks at delivering supply side reforms, including investment in infrastructure, necessary to improve long-term productivity growth[1]. In 2016, Britain was forecast by the Organisation for Economic Co-operation and Development (OECD) to be the fastest growing major advanced economy this year[2]. However, the outlook for the global economy has declined and in advanced economies there are growing concerns about productivity growth, high debt levels and deflationary risks. The UK is not immune to global slowdowns and shocks, which reinforce the importance of long term supply-side investments and ensuring the growth of competitive and sustainable economic activity (namely innovation-led sectors).

Cambridge is one of the UK's most successful cities where economic success, high quality of life and quality of place are inextricably linked[3]. In 2016, Cambridge was ranked as the most vibrant place to live and work in

[1] HM Treasury (2016) 2016 Budget

[2] OECD, Interim Economic Outlook, September 2016

[3] Cambridge City Council (2014) Cambridge Local Plan – Draft Submission Plan

England according to Grant Thornton's Vibrant Economy Index, which takes into account measures including: prosperity; inclusion and equality; community; well-being, and opportunity[4].

The thriving hi-tech and biotech industry, which has developed since the 1960s and is known as the 'Cambridge Phenomenon', accounts for 17.3% of employment in Greater Cambridge and boasts one of the highest concentration of Nobel prize winners in the world[5]. Cambridge is one of the UK's fastest-growing and most productive cities and is integral to the UK's long term economic plan which seeks to improve productivity and international competitiveness. It helps the UK to compete globally, attracting high value jobs and net economic growth through internationally mobile employees in knowledge-based industries. Cambridge overachieves in all key economic areas with low unemployment (in June 2017, 3.6% of Cambridge residents were unemployed, compared to 4.6% for Great Britain[6]), a competitive structured economy, and high levels of knowledge intensive activities (as of June 2017, 12.9% of Cambridge's workforce was engaged in Professional, Scientific and Technical Activities compared to 8.6% for Great Britain)[7].

Despite this economic success, Cambridge faces supply-side threats to its economic growth, as evidenced by increasing congestion and rising house prices, both directly influenced by a lack of housing supply. Cambridge's success is founded upon the connectivity across the city and its surrounds that has allowed wide networks to develop and facilitated a culture of cooperation and cross-fertilisation between entrepreneurs, businesses, and academia. The infrastructure of the area therefore needs to support the area's actual and potential pace of growth and the opportunities that exist to continue growing an advanced economy and competing on the international stage.

2.1 Policy and planning review

The **Greater Cambridge City Deal**[8] (GCCD) aims to enable a new wave of innovation-led growth by investing in infrastructure, housing and skills across Cambridge. This will address housing shortages and transport congestion bottlenecks in order to support and facilitate the continued growth of the Cambridge Phenomenon. The City Deal aims to deliver the sustainable growth that is identified in the two Local Plans[9]:

- 44,100 jobs; and
- 33,500 dwellings.

As part of the assurance framework, Greater Cambridge authorities will prioritise projects that deliver against the following four strategic objectives of the GCCD:

- **Create and retain investment** to nurture the conditions necessary to enable the potential of Greater Cambridge to create and retain the international high-tech businesses of the future.
- **Targeted business investment supporting the Cambridge Cluster** to the needs of the Greater Cambridge economy by ensuring those decisions are informed by the needs of businesses and other key stakeholders such as the universities.
- **Improve connectivity and networks** between clusters and labour markets so that the right conditions are in place to drive further growth.

[4] Grant Thornton (2016) 'Vibrant Economy Index'

[5] Using EEFM Baseline Forecast 2014 data. Relates to Greater Cambridge core high-tech and biotech industry as can be best defined in the data as encompassing telecoms, computer related activity, research & development, and business services.

[6] ONS Annual Population Survey (2017)

[7] ONS Business Register and Employment Survey (2017)

[8] Greater Cambridge City Deal (2014) available at: https://www.scambs.gov.uk/sites/default/files/documents/Greater_Cambridge_City_Deal_Document.pdf

[9] **Please note: The original figures and those stated in the City Deal document with government are 45,000 jobs and 33,480 homes, which were the figures in the draft Local Plans at the time. Given the amendments to the Local Plans, currently in submission, these figures now stand at 44,100 jobs and 33,500 new dwellings.*

- **Attract and retain skills** by investing in transport and housing whilst maintaining a good quality of life, in turn allowing a long-term increase in jobs emerging from the internationally competitive clusters and more university spin-outs.

A Cambridge South station will contribute to all of these strategic objectives, as it would provide the necessary conditions for Cambridge to flourish. By improving connectivity with the proposed station, new and existing high-tech businesses in both southern Cambridge and the city centre, including the Cambridge Biomedical Campus in southern Cambridge, will be able to attract and retain a skilled workforce from across the region.

The growth targets within the GCCD come from the Local Plans[10] which set out the planning frameworks to guide the future development of Greater Cambridge over 2011-2031. The Plans were informed by various documents[11] which provided the basis for the population, employment and housing growth targets.

Overall, the total growth over the planning period (2011-2031) was established as an additional 44,100 jobs and 33,500 dwellings in Greater Cambridge, based on a projected population growth of 65,000 people. This translates in business floorspace terms to a net demand for 213,200m^2 of additional floorspace and approximately 20,460 B-use jobs. Considering the existing stock of employment land only (not considering the quality or suitability), particularly in southern Cambridge, demonstrates that Greater Cambridge has the land availability to support the targets of both this planning period and growth ambitions post-2031.

Table 1: Cambridge and South Cambridgeshire - development levels 2011-2031

	Housing		Employment			
	Population change (persons)	Dwellings	Total jobs	B-use jobs	Additional net B-use floorspace	Employment land supply
Cambridge	27,000	14,000	22,100	8,800	70,200 m2	12.0 ha
South Cambridgeshire	38,000	19,500*	22,000	11,800-12,000	143,000m2	80.3 ha
Greater Cambridge	65,000	33,500	44,100	20,600	213,200m2	92.3 ha

Source: Cambridge Local Plan and South Cambridgeshire Local Plan and Employment Land Review update, 2012. B Employment Land Review Update, 2012, p.7. * The housing figure for South Cambridgeshire following inspection has been modified by the council to 19,500 from 19,000 and is currently in consultation.

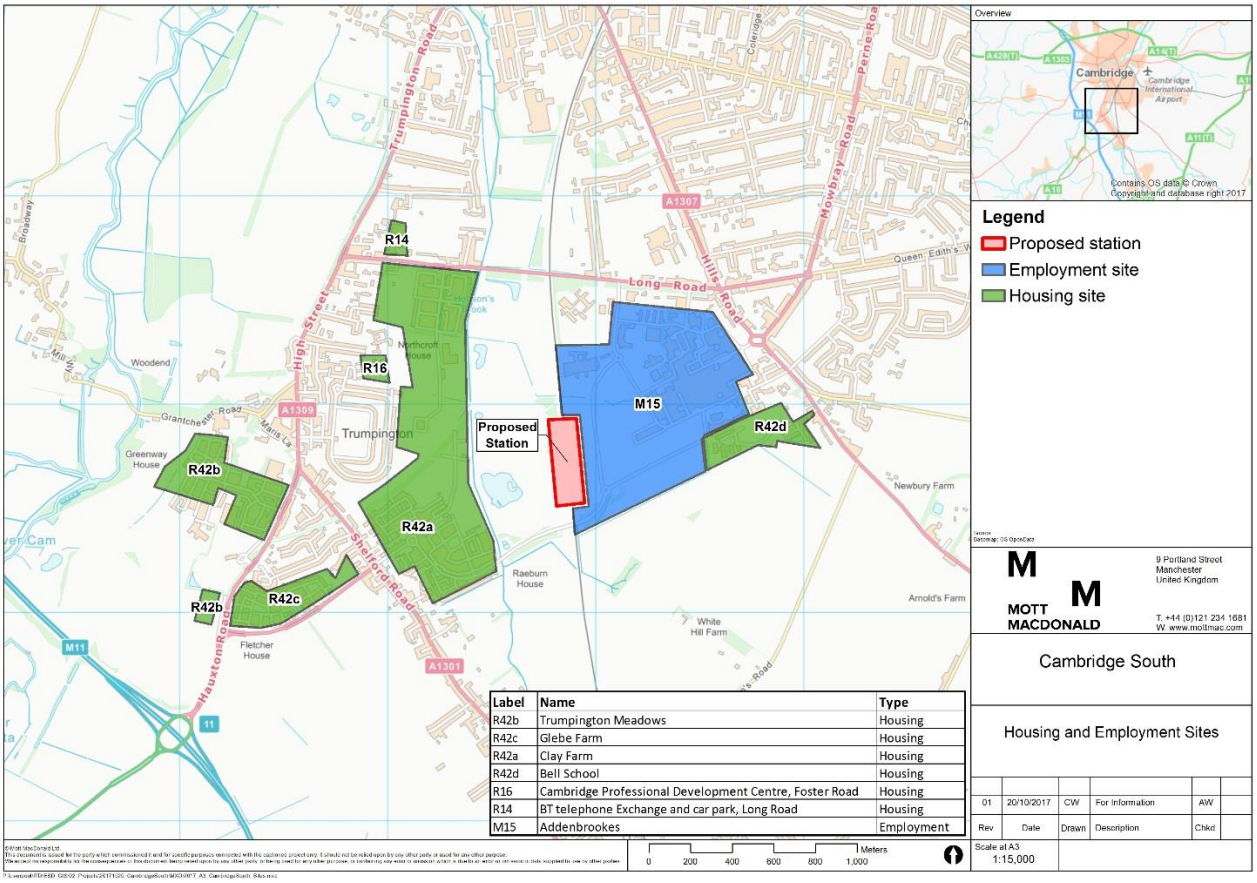
The proposed station at Cambridge South would support employment and housing development land to be brought forward, helping to fulfil the need for development land around the city.

The employment and housing development sites close to the proposed Cambridge South station are shown on the map below.

[10] Cambridge Local Plan 2014 and South Cambridgeshire Local Plan 2014, Proposed Submissions, July 2013

[11] Strategic Housing Land Availability Assessment (SHLAA), August 2013 and the Employment Land Review Update and Review of Selective Management Employment Policies, SQW with Savills, July 2012. The projections within the SHLAA are informed from the following technical paper - Population, Housing and Employment Forecasts Technical Report, Cambridgeshire County Council Research and Performance Team, April 2013

Figure 1: Development sites around the proposed South Cambridge station



Source: Mott MacDonald, based on Cambridge Local Plan 2014: Proposed Submission

2.2 Cambridge Biomedical Campus

The Cambridge Biomedical Campus, located in southern Cambridge near to the proposed station site, is one of the largest centres of health science and medical research in the world and the largest such centre in Europe. Managed by the University of Cambridge, the site is funded by organisations including the Cambridge University Hospitals NHS Foundation Trust, the Wellcome Trust, Cancer Research UK, the UK government's Medical Research Council and has National Institute for Health Research Biomedical Research Centre status. It is an accredited UK academic health science centre (Cambridge University Health Partners) and home to Addenbrooke's Hospital and the university's medical school. The nearby Papworth Hospital is due to relocate to the site in 2018.

The expansion of the Campus is taking place in two phases. Phase 1 comprises 70 acres of which one third will accommodate Cambridge University Hospitals, with the remaining two thirds for commercial and other uses. All of the Phase 1 land has now been allocated and construction of several sites has started. In February 2017, the developer (Liberty and Countryside) submitted an application for outline planning consent for Phase 2 which comprises an additional 14 acres of land which was ring-fenced for future development by the local authority in 2009[12].

[12] Cambridge Biomedical Campus 'Masterplan and new buildings' available at: http://cambridge-biomedical.com/about-the-campus-2/masterplan-2/

To reflect this planned growth, access to the Campus has been significantly enhanced with the opening of two new roads leading to and from the M11 motorway (Addenbrooke's Road and Francis Crick Avenue). A new multi-storey car park opened last year and a state-of-the-art energy centre is also planned[13].

There is also a drive to increase sustainable methods of transport to the Campus. A Campus-wide Travel Transport and Sustainability working group has been set up to ensure that the Campus is established as a recognised centre of excellence in the provision of environmentally sustainable physical and social infrastructure for the benefit of the campus partners as well as the local community. All partners are currently working towards outcomes of an updated and fully integrated Campus-wide travel plan which will be supported by organisation-specific plans. Among the current projects of the group is assessing feasibility studies for a new train station at the Campus[14].

2.3 Summary

There is strong support for Cambridge South station from local policy and planning documentation and the station supports all of the key objectives outlined in the GCCD. The Cambridge Biomedical Campus is already a centre of excellence and will require strategic transport improvements to continue along its positive trajectory.

3 Economic benefits of employment site

3.1 Introduction

In this section, we identify and quantify the potential economic benefits of the development at the employment site identified in Figure 1. This site forms part of the development around Addenbrooke's hospital and is Phase 2 of the Cambridge Biomedical Campus. The details of the site are shown on the table below.

Table 2: Employment development site

Site name	Use	Net floorspace (sq m)
CBC Phase 2	Research and development, clinical, sui-generis and higher education	75,000 sqm

Source: Cambridge Biomedical Campus – Phase 2

3.2 Methodology

The quantitative economic analysis of land utilisation has been undertaken using Mott MacDonald's proprietary Transparent Economic Assessment Model (TEAM) to assess high level economic impacts. TEAM (as summarised in the figure below) is a versatile tool designed to calculate the economic impact of proposed infrastructure intervention and policy measures. It has been designed by experts in economics, economic development and regeneration and is in-line with HM Treasury Green Book principles and Homes & Communities Agency's (HCA) Additionality guidelines. The tool measures the potential stimulus to economic activity within an impact area (in this case southern Cambridge) from interventions by estimating the consequential employment, salary, GVA and investment benefits that would otherwise not have arisen.

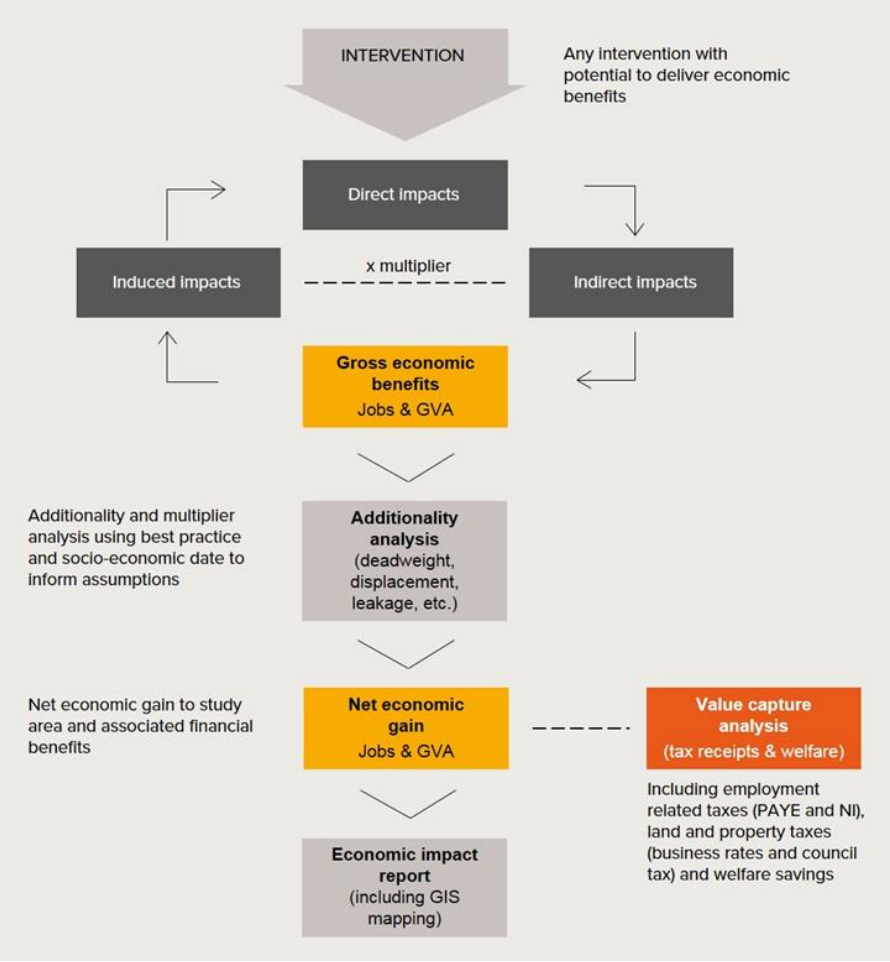
The findings from our research have been used to deliver a high-level run of TEAM. The assumptions we have used are detailed below, followed by the findings from this economic assessment. At each stage of our

[13] Cambridge Biomedical Campus 'Masterplan and new buildings' available at: http://cambridge-biomedical.com/about-the-campus-2/masterplan-2/

[14] Cambridge Biomedical Campus 'Travel' available at: http://cambridge-biomedical.com/working-together/

analysis we have endeavoured to produce conservative estimates. The data used is based on 2015 figures from the UK Office for National Statistics (ONS).

Figure 2: TEAM methodology



Source: Mott MacDonald

The potential economic benefits of the development site identified have been assessed using TEAM through the following steps:

- Calibrating the model with the key site details as outlined in Table 2.
- Calculation of **direct** economic impacts through feeding the proposed uses by size through TEAM to calculate the direct effects of the sites in terms of employment and economic output (measured by GVA) of the sites being fully developed.
- **Indirect** and **induced** effects of the sites being developed from those supported further down the supply chain and employment and activity supported by the incomes of those directly or indirectly employed (through consumption multiplier effects).

3.2.1 Assumptions

The key assumptions used in our analysis for the site are set out in Table 3.

Table 3: Assumptions used in TEAM calculation

Effect	Level	Justification
Displacement	25%	At this point, it is not known whether any of the activity on the site will be relocated from elsewhere within Cambridge. However, the speculative development at the site indicates that there is demand for these development sites and jobs in the area and the future residents of the adjacent residential sites will likely benefit from the employment opportunities. As such, while there are expected to be some displacement effects, this will be to a limited extent and a figure of 25% has been assigned, in accordance with guidance from the HCA Additionality Guide 2014[15].
Leakage	60%	In Cambridge, 60% of those working in the area live outside of the boundary. The leakage set reflects this. This is based on Travel to Work (TTW) data from the 2011 UK census.
Deadweight	50%	Given the demand for employment space at the Campus, it is considered very likely that many of the jobs and GVA generated by these developments would be created without the station at some stage. However, the construction of the station is likely to accelerate development. Accordingly, a medium figure of 50% for deadweight has been selected.
Composite multiplier	1.29	The knock-on multiplier effects within the economy from: • Supply linkages due to purchases made as a result of the intervention and further purchases associated with linked firms along the supply chain (indirect effects). • Indirect or induced effects associated with local expenditure as a result of those who derive incomes from the direct and supply linkage impacts of the intervention. A composite multiplier of 1.29 has been applied, in accordance with guidance from the HCA Additionality Guide 2014 which states that this level is suitable when assessing B1 interventions in a local area. This multiplier models the indirect and induced economic impacts. This composite multiplier includes a supply linkage multiplier and a consumption multiplier. The supply linkage multiplier is *"due to purchases made as a result of the intervention and further purchases associated with linked firms along the supply chain"*[16]. The consumption multiplier is *"associated with local expenditure as a result of those who derive incomes from the direct and supply linkage impacts of the intervention"*[17].
GVA per worker (2016 prices)	£53,772	GVA figures have been calculated based on applying GVA per worker data for research and development jobs at a Cambridge level which allows an estimate of the potential gross GVA impacts.
Occupancy rate	75%	An occupancy rate of 75% has been applied.
Employment density	50m² of GEA/FTE	This is the assumption that one FTE job is generated for every 50m² of employment space, in Gross External Area for **B1b** land use (research and development). This assumption is based on the HCA Employment Density Guide 2015.

Source: Mott MacDonald

3.3 Findings

The potential economic impacts of the Cambridge Biomedical Campus Phase 2 are displayed below, based on the full development of the site and the assumptions regarding occupancy and additionality (detailed above). Across the site and including multiplier effects, a total of **92 net additional jobs** could be supported which could deliver **£4.8m GVA per annum** once the site is fully developed and occupied. This is shown in Table 4 below.

Table 4: Economic impacts calculated using TEAM

Site	Jobs		GVA per annum (£m)	
	Gross direct	**Total net**	**Gross direct**	**Total net**
CBC Phase 2	478	92	25.7	4.8

Source: Mott MacDonald

[15] 'Homes & Communities Agency (2014) 'Additionality Guide', page 30, available at:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/378177/additionality_guide_2014_full.pdf

[16] Ibid., page 33.

[17] Ibid., page 33.

Discussion with the Department for Transport (DfT) has suggested that 20% of the economic benefits arising from Campus development might be attributed to the proposed station. This would mean that **19 net additional jobs** could be attributed to the station, delivering approximately **£1.0m GVA per annum**. Further work could refine this high-level assessment but overall, we conclude that the station will have a positive effect on the site's economic development.

3.4 Projected growth

The number of jobs at the Biomedical Campus are projected to grow by 3,750 in the next four years (2017-2021). We understand that this growth is largely based on the planned and proposed Phase 1 and Phase 2 developments (including growth at Addenbrookes hospital and the relocation of Papworth hospital) at the campus discussed above.

Beyond 2021 and through to 2031, high level growth forecasts indicate that approximately 590 jobs per annum will be created at the campus[18]. Given all the allocated land is expected to have been developed by this stage, we understand that this growth would come from the consolidation of operations and increased occupancy rates across the existing and completed buildings in the campus.

It is likely that such increases in occupancy would not be feasible without improved transport connections for the campus. As noted above, the DfT guidance estimates that 20% of economic benefits, including jobs growth on the site, would not happen without the proposed Cambridge South station. It can therefore be inferred that growth of approximately **118 jobs per annum** at the Cambridge Biomedical Campus between 2021-2031 can be attributed to the proposed South Cambridge station.

4 Economic benefits of housing sites

4.1 Introduction

In this section, we quantify the potential economic benefits that may arise following the development of the housing sites identified in Figure 1. These sites are shown in the table below.

Table 5: Housing sites

Name	Size (ha)	Outstanding dwellings to be constructed (as of December 2016)
Trumpington Meadows	15.50	166
Glebe Farm	9.79	0
Clay Farm	60.69	1,336
Bell School	7.61	249
Cambridge Professional Development Centre, Foster Road	1.49	67
BT telephone Exchange and car park, Long Road	2.01	55
TOTAL		**1,873**

Source: Annual Monitoring Report 2016

4.2 Temporary construction benefits

The construction of these sites will have temporary economic impacts in terms of jobs and economic output (GVA). Whilst the jobs generated by the construction of the sites will only persist during the construction

[18] Based on a total of 9,650 jobs growth between 2017-2031, of which 5,890 will be after 2021. Mott MacDonald have not sought to test or verify these forecasts.

period, they are likely to have a substantial impact on the local economy, with some impacts persisting in the longer term. Construction related expenditure, including local construction costs (or expenditure) directly on site through spending on goods, services and labour, plus the wider indirect costs in the construction supply chain across the intervention areas overall would generate further expenditure in related and unrelated industries. This acts as a boost to the local and national economy and makes investment in construction particularly powerful in fuelling expansion in the economy.

These indirect jobs are part of the wider economic impact of the construction projects across the local regional economy and are 'knock on' economic effects generated by the construction project. These 'knock on' effects include:

- Indirect benefits created in the construction supply chain across the intervention areas, via the procurement of goods and services that enable housing to be constructed; and
- Induced benefits resulting from employees (both those directly employed and in the supply chain) spending their wages within each of the intervention areas.

Increased numbers of jobs and activity in the intervention area will have significant positive impacts on economic growth in the region. We note however, that many of these benefits will only be fully realised if goods and services are procured locally.

The value of the temporary construction impacts can be assessed using data on local salaries, origin destination statistics and percentage of cost spent on salaries, and standard assumptions about construction costs.

The construction phase will also trigger some negative impacts for the area surrounding the sites. For example, during construction it can be assumed that there will likely be additional noise pollution affecting residents in affected areas, there may be disruption to the road network and there may be issues in terms of access. However, these negative impacts can be mitigated with careful planning to ensure there is minimal disruption on the roads and transport network. The potential cost of these negative impacts has not been estimated as part of this assessment.

The economic impact arising from the construction of the residences at the sites are calculated using an estimate for capital expenditure (CAPEX) of construction.

In line with employment attribution, we have also attributed 20% of housing development to the station. Our calculations therefore consider 375 of the total 1,873 dwellings which can still be accommodated but where construction has not yet started. At this time, we have not calculated the construction impacts which would arise as a result of constructing the road improvements since we have insufficient information on the CAPEX figures.

4.2.1 Findings

By applying a standard assumption of £100,000 of CAPEX per house as a construction cost[19], the temporary employment impacts of constructing the attributed dwellings (375) can be modelled. The findings are shown below.

Table 6: Construction impacts of housing developments

Construction phase impact	Value	Formula	Source
Construction cost for 375dwellings	£37,500,000	(a)	Assumption of £100,000 CAPEX per dwelling, for 375 dwellings
% of cost spent on salaries	26.35%	(b)	Annual Business Survey, ONS, 2014 (construction sector)
Salary expenditure	£9,870,480	(c)=(a)*(b)	Calculation
Average mean salary	£37,598	(d)	Annual Survey of Hours and Earnings, ONS, 2016 (Full time mean wages in construction sector)
Direct job years supported	263	(e)=(c)/(d)	Calculation
1 FTE=10 employment years	10	(f)	Best practice assumption
Direct jobs supported	**26**	**(g)=(e)/(f)**	**Calculation**
Leakage	60%	(h)	Origin destination statistics, ONS
Net direct FTEs	**10**	**(i)=(g)-((g*(h))**	**Calculation**
Composite multiplier of 1.29	0.29	(j)	HCA Additionality Guide 2014, p.35
Indirect & induced jobs	**3**	**(k)=(j)*(i)**	**Calculation**
Total net jobs supported	**13**	**(l)=(k)+(i)**	**Calculation**
Average GVA per worker for construction	£50,737	(m)	Regional Accounts and Workforce jobs - July 2016, ONS
Total GVA supported	**£681,289**	**(n)= (l)*(m)**	**Calculation**

Source: Mott MacDonald

Taking the average annual salary figure in the East of England construction sector for the latest year available, 2016 (£37,598), the direct salary expenditure will support approximately 263 direct job years. Given in standard guidance one “permanent” full-time equivalent (FTE) job is equal in regeneration effect to 10 job-years, in total, the job-years are equivalent to around 26 FTE jobs being directly created from the construction of these dwellings. Adjusting this to account for 60% leakage, we estimate that approximately 10 FTE direct jobs could be supported through the construction of the 375 dwellings. When considering indirect and induced jobs and leakage levels, a further 3 jobs are supported. Therefore, **approximately 13 jobs** and **£0.68m GVA** could be attributed to the construction of the 375 dwellings which may not be brought forward but-for the proposed Cambridge South station.

4.3 Property related taxes

The development of the six housing sites shown in Table 5 will contribute towards taxes generated from the land use changes including Council Tax from the housing development. Using the above estimates for 375 dwellings, we have estimated the amount of Council Tax revenue that would be generated.

We have based our calculations on the following assumptions:

- Average house price of £401,356 for the open market sales element (using 2015 average house price for Cambridge).
- Council tax bands by house value and band rates for Cambridge.

[19] Industry estimate from major UK housebuilder.

This residential land, if developed, is estimated to provide **£681,289 per annum** of housing-related Council Tax revenue. Considering the attribution guidance provided by DfT, this revenue is unlikely to be generated without development of the proposed Cambridge South station.

5 Summary

The importance of improved transport networks and connectivity to support economic growth and development in Cambridge is highlighted in local policy documents including the GCCD and Local Plans for Cambridge and South Cambridgeshire. The proposed Cambridge South station reflects the overarching policy objectives and, more specifically, has the potential to significantly contribute to developing sites around the Cambridge Biomedical Campus. The Campus, which is key to economic growth in Cambridge and the wider region, is already an internationally recognised centre of excellence and will continue to grow in future, as global companies such Astra Zeneca move to the site and the region's hospitals are consolidated in the area.

The forecast growth requires strategic transport improvements, especially as congestion in Cambridge is already recognised as a problem. While it is likely that the next phase of development at the Campus (Phase 2) will go ahead without the station, discussions with the DfT indicate that approximately 20% of future developments might be reliant on a new station.

The proposed station will support the GCCD strategy by providing new transport links between areas of population and employment growth within Greater Cambridge, thereby addressing congestion and public transport issues to help stimulate further economic growth[20]. There are a number of key routes by which the proposed station will contribute towards this, namely:

- By supporting **business investment and growth** – better connectivity and capacity for the future (through lower congestion and investment in long term infrastructure) to enhance the investment prospects of the corridor area and potentially result in quicker development along the corridor at the key growth sites.
- By supporting **labour market mobility** – journey time savings will improve labour market mobility as journeys to work become more efficient. This will improve the connectivity between key employment sites and labour markets. Ultimately, this will benefit both the workforce, who can access more opportunities, as well as employers, who can access a wider labour market.
- By contributing to the **positive image and perceptions of Greater Cambridge –** high quality and efficient infrastructure promotes a positive image of Greater Cambridge as a place to live, invest and do business. Helping to tackle congestion, by promoting alternatives to the private car, contributes to a higher quality of life through reduced severance, improved air quality, reductions in road safety concerns etc. These help to sustain and improve attributes that have played a crucial role in the city's success to date.
- By contributing towards **future development and growth –** significant development is planned around the station which is likely to only increase as time progresses, especially as Greater Cambridge has the quantum of employment land supply, and the demand therefore, to support further growth. Options that could provide higher capacity in the future and which provide possible upgrades for the future will represent an investment for longer term economic growth. In practice, there may be scope for both further accelerated development through infrastructure investment prior to 2031 and/or an increased rate of growth post-2031.

[20] GCCD, UK Government, p.3

Based on the land use information provided in Cambridge City Council's Local Plan, the following outputs were generated by Mott MacDonald's TEAM. The results of our quantitative assessment for Phase 2 at Cambridge Biomedical Campus are:

- A total of 92 net additional jobs could be supported which could deliver £4.8m GVA per annum once the site is fully developed and occupied.
- With a 20% level of attribution, this would mean that **19 net additional jobs** could be attributed to the station, delivering almost **£1.0m GVA per annum**.

Based on jobs growth forecasts for 2021-31 and the DfT suggestion that 20% of the proposed developments might be reliant on Cambridge South station, it can be inferred that growth of approximately **118 jobs per annum** at the Cambridge Biomedical Campus between 2021-2031 can be attributed to the proposed station.

The development of housing sites identified near the proposed station would also provide economic benefits through construction and tax revenues. These estimates are outlined below:

- **13 jobs and £0.7m GVA pa** in construction benefits could be attributed to the proposed station.
- **£0.68m p.a.** in Council Tax revenues could be attributed to the proposed station.

E. SOBC Quality Assurance

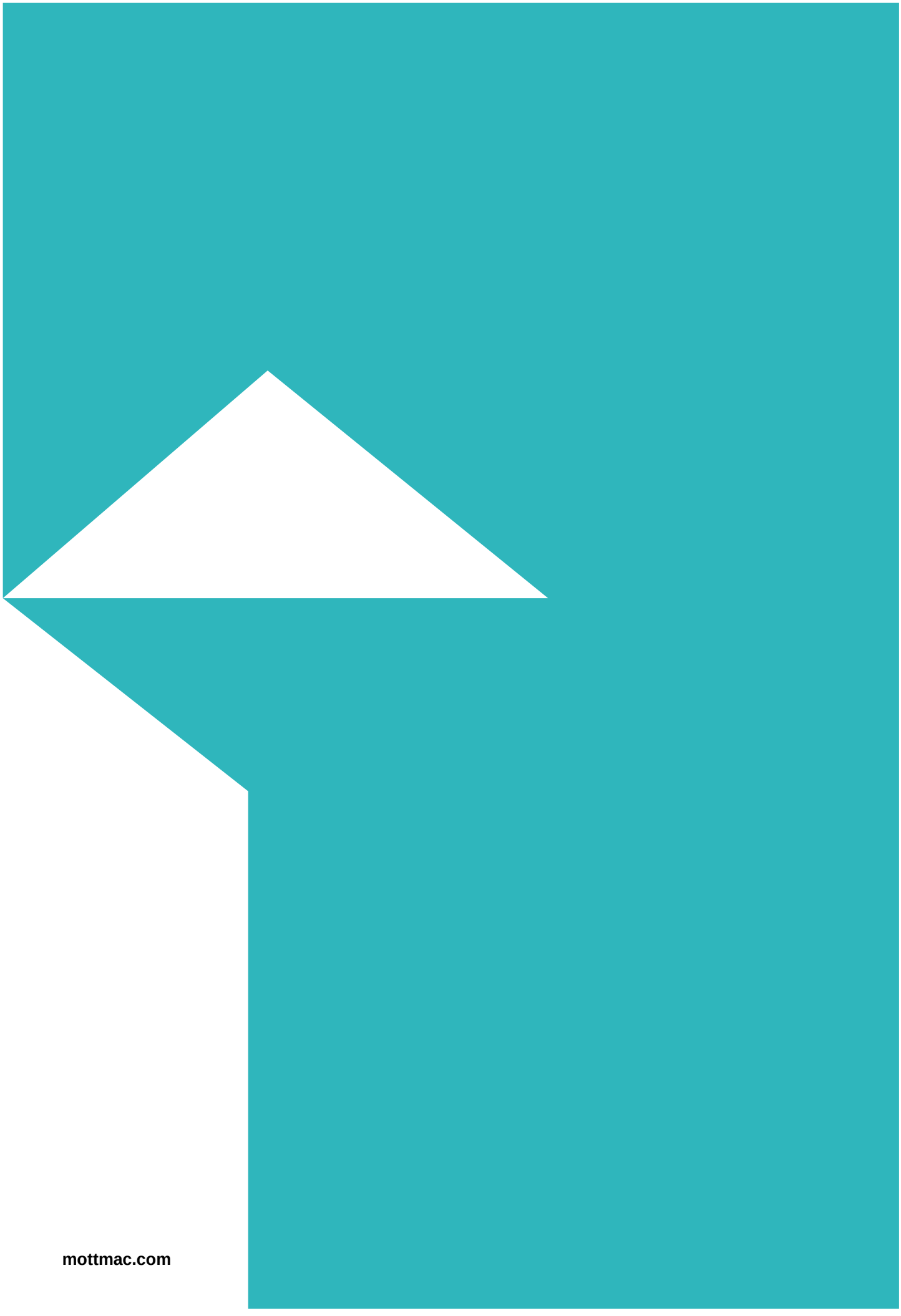
Assurance Statement

The work to develop the Cambridge South SOBC has been subject to our Quality Assurance (QA) process, developed originally by Mott MacDonald and its supply chain partners to support the development of the Economic Case for HS2. Our QA process is reviewed and updated regularly, most recently following the conclusion of our input to the East Coast Enhancements Programme Outline Business Case.

The core principle of this process is that analysis, models and written deliverables are reviewed by a qualified individual other than the author of the work. Reviewers consider the following categories of issues:

- **Assumptions** – whether the key assumptions made are plausible and well-evidenced.
- **Methodology** – whether the methodology undertaken is consistent with WebTAG.
- **Calculations** – whether there are errors or simplifications in the calculations made, and the materiality of these issues.
- **Model inputs** – whether inputs are consistent across models, and whether the model inputs are representative of the intention for the options tested. This area of our QA process has been updated recently following our East Coast work.
- **Reporting** – whether the reporting is clear, unambiguous and an accurate reflection of the model outputs.

Our work programme Technical Lead and their nominated Assurance Manager review the Quality Assurance which has been undertaken, as well as the key forecasts and conclusions, before completed deliverables are issued to the client.



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