Oxford to Cambridge Expressway Strategic Study

Stage 3 Report

Department for Transport

highways england

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Executive Summary

Study Background

The first Road Investment Strategy (RIS 1) set a strategic vision for the continued development and improvement of the Strategic Road Network. To support this, it identified six strategic studies to help inform the development of RIS 2 (2020-2025). One of these is the Oxford to Cambridge Expressway Strategic Study. Its aim is to investigate the case for linking existing roads and creating an Oxford to Cambridge Expressway, which would create a high-quality east-west link between Oxford and Cambridge, via Bedford and Milton Keynes.

The Oxford-Milton Keynes-Cambridge region is one of the most significant growth corridors in the country. The local authorities within the study area are planning for substantial job and housing growth to support the continued economic development of the region. An Expressway could help unlock strategic growth sites including along the Knowledge Spine (Science Vale to Bicester), within Aylesbury Vale, Milton Keynes, Bedford and St Neots, Cambourne and Bourne Airfield along the A428 corridor.

Within the study area, Oxford, Milton Keynes and Cambridge are three of the fastest growing, most innovative and productive functional economic areas in the UK with key strengths in the 'Knowledge Economy'. The strong economic performance of these urban areas is due in part to the excellent transport connectivity with London via well-established radial road and rail links. The strong links with London combined with each location's own intrinsic assets including, world class universities and research institutions, high profile businesses, well qualified labour force and pro-economic growth policies have ensured these locations have delivered strong economic growth for the UK.

However, there is currently poor east-west connectivity, resulting in Oxford, Milton Keynes and Cambridge being better connected to London than each other. As a result the degree of interaction between these economies is restricted. Investment in strategic east-west transport connectivity could change this, potentially creating a single knowledge-intensive functional economic area to support the continued growth of the region. An Expressway could bring knowledge-intensive firms closer together, creating larger labour and product markets, and boost technology and knowledge spill overs.

An Oxford to Cambridge Expressway would positively contribute to growth at three levels.

National

- Provide an attractive and efficient route for strategic car and freight movements between the East of England, South West England and South Wales, releasing pressure on the alternative M25 and M5-M42-M6 corridors; and
- Support the continued economic growth of the region by improving transport connectivity between 'high tech clusters', potentially creating a single fully functioning knowledge-intensive corridor.

Regional

- Improve links between local communities and businesses along the route including Didcot-Oxford-Bicester (A34), Buckingham-Milton Keynes-Bedford (A421) and St Neots-Cambourne-Cambridge (A428) thus enhancing important commuter routes between jobs and homes;
- Provide an important regional function linking key employment sites and growth areas such as the Science Vale, Bicester, Milton Keynes and Cambridge with surrounding labour pools; and
- Provide connectivity into regional service centres for leisure, tourism and access to amenities.

Local

- Sections of the Expressway would have positive impacts in their own right, including local access between homes, jobs and services;
- Support the delivery of key local growth sites; and
- Address local transport issues, for example congestion on the A34 around Oxford.

Expressway Options

Following the establishment of the case for intervention, a long-list of options was identified that had the potential to improve east-west connectivity in the corridor. Options were developed from the evidence base in the Stage 1 Report[1] and on the basis of feedback from stakeholders on intervention concepts gathered during the study workshops. In total 36 options were identified covering road, rail, local access, behaviour change and public transport interventions.

The long list of options were then appraised using a bespoke Strategic Assessment tool and sifted using the Department for Transport's (DfT) Early Assessment and Sifting Tool (EAST) which compares the Strategic, Economic, Managerial, Financial and Commercial case for each option. The EAST sifting process identified three Expressway options (Figure 0-1) as well as other complementary measures.

[1] https://www.gov.uk/government/publications/oxford-to-cambridge-expressway-strategic-study-interim-report

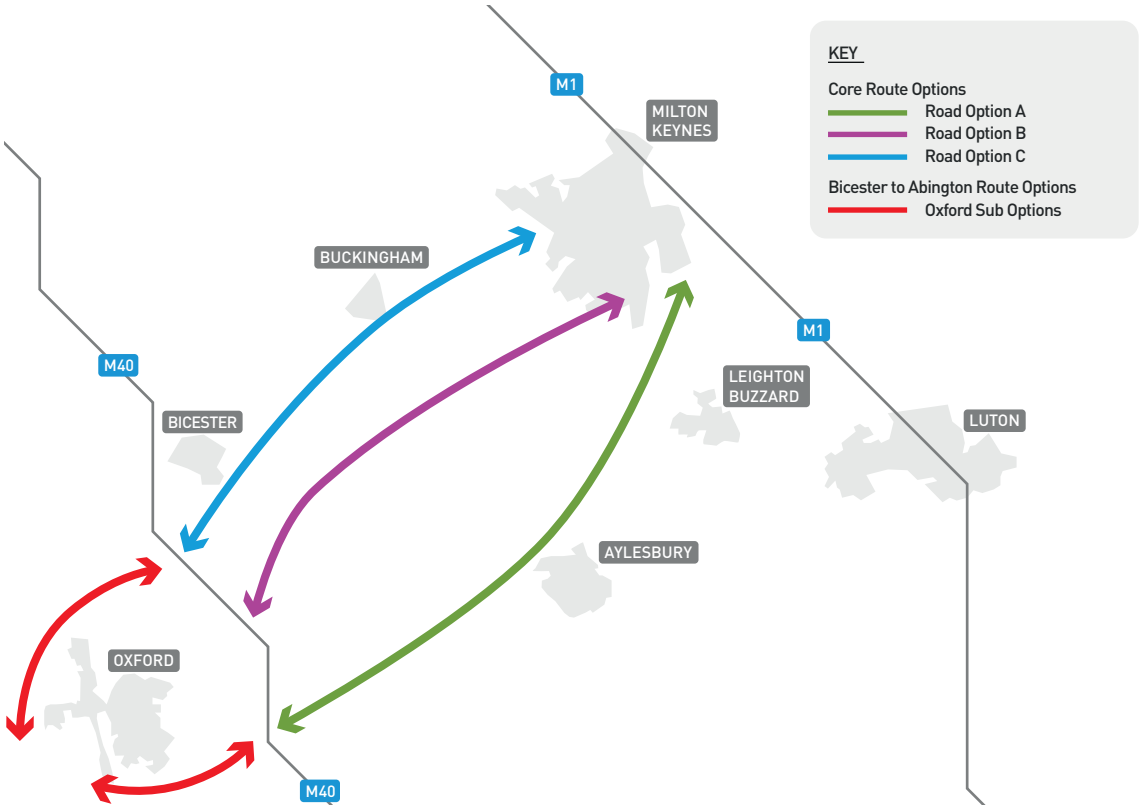


Figure 0-1: Short Listed Expressway Options

Figure 0-1 shows the short listed Expressway routes are via Aylesbury (Option A), the East-West Rail (EWR) corridor (Option B) or the existing A421 corridor (Option C). The options include on and off-line improvements and a number of sub-options in order to route around Oxford. All three Expressway options include conversion of sections of the A34, A421, A428 and A1 to Expressway standard to complete the route between the M4 and A14/M11. Each Expressway option would form part of a package of transport measures including EWR, route technology, integration with rail interchange hubs and local access and mobility measures (including non-motorised users).

Next Steps

The initial assessment work of the three short listed Expressway options has shown that the benefits are promising enough to take them forward to the next stage of assessment. The next stage of this study will undertake a more detailed qualitative and quantitative assessment of the short listed Expressway schemes.

1. Study context

1.1.1 The Oxford to Cambridge Expressway[2] Study is a strategic study which has been commissioned by the Department for Transport (DfT) and undertaken on their behalf by Highways England. The requirement for this study was set out in the Road Investment Strategy (RIS 1) published in December 2014, which announced a programme of a six strategic studies to explore options to address some of the Strategic Road Network's (SRN) emerging challenges including:

Oxford to Cambridge Expressway

- The broad arc from Oxford-Milton Keynes-Cambridge includes some of the UK's most successful, productive and fastest growing functional economic areas. Existing east-west road and rail connections between these knowledge-intensive economies are notably poor. There is no continuous and direct dual carriageway or rail link between Oxford, Milton Keynes and Cambridge creating a significant infrastructure barrier that risks constraining economic growth.
- An east-west Expressway would complement East West Rail (EWR) and support the continued growth and attractiveness of the corridor as a place to live and work. An east-west Expressway would provide network resilience, improved local, regional and strategic connectivity and support the delivery of planned growth across the corridor.
- This study examines the case for creating an Expressway to connect the towns and cities of the 'Brain Belt' together. It also considers enhancements to existing roads along the route, including the A34 around Oxford. This study takes into account work already planned including EWR.

1.1.2 The Oxford to Cambridge Expressway Strategic Study interacts with two other RIS 1 strategic studies: M25 South-West Quadrant and A1 East of England (from the M25 to Peterborough) as well as the EWR scheme being progressed by Network Rail. There is a strong interrelationship between all three RIS 1 studies and with EWR, in terms of addressing east-west connectivity across the corridor and supporting growth.

1.1.3 The study team has actively engaged with a wide range of stakeholders including England's Economic Heartland (EEH) Strategic Alliance, who have identified this study as one of its strategic priorities. EEH recognises greater economic benefit can be achieved by investing in the transport system on a wider strategic basis than at the individual county level.

1.1.4 Discussions with the study areas Local Enterprise Partnerships (LEPs), County Councils and Local Planning Authorities have also established strong support for investment in strategic transport infrastructure that improves east-west connectivity, which is viewed as vital to supporting housing and economic growth in their respective regions.

[2] An Expressway is an A-road that is as well-designed as a motorway and is able to offer the same standard of journey to users. At a minimum, Expressways will be largely or entirely dual carriageway standard roads that are safe, well-built and resilient to delays, have junctions that are largely or entirely grade separated, include modern safety measures and construction standards and technology to manage traffic and provide better information to drivers (RIS 1, December 2014).

2. Study Objectives and Scope

2.1 Study objectives

2.1.1 The strategic objective of the Oxford to Cambridge Expressway study is to investigate the case for linking existing roads and creating an Oxford to Cambridge Expressway, which would provide a high quality strategic east-west road link between Oxford and Cambridge via Bedford and Milton Keynes, improving connectivity, building network resilience and supporting economic growth. The study objectives are summarised in Table 2-1.

Study Objectives	
1	Review previous study work, relevant available data, and current investment plans to understand current performance and constraints of the existing road infrastructure, and confirm the strategic case for considering further investment.
2	Identify feasible options for improving and/or providing new road links within the study area that improve east-west connectivity to create an Expressway standard route between Oxford, Milton Keynes and Cambridge.
3	Understand the benefits and impacts resulting from the provision of a new strategic east-west corridor, to further inform the strategic and economic case for investment in new road infrastructure in the study area. The benefits assessment will consider congestion relief, reliability, safety, and environmental outcomes of constructing a new strategic east-west route. The study will consider a range of individual and combined investment proposals.
4	Understand the wider socio-economic benefits that result from the strategic transport options, including improved economic productivity, investment and employment benefits.
5	Have reference to and reflect wherever possible the key findings of the proposals being developed by other studies in the south including EWR, M25 Southwest Quadrant, High Speed 2 (HS2) and the A1 East of England strategic study to understand the interdependencies between the potential options arising from this study and the other strategic transport proposals. This study will have reference to and include: ■ Understanding the implications of the timing and phasing of potential schemes; and ■ Identification of opportunities for synergy or optimal sequencing of major road and rail works involved in, and options for mitigating strategic risks arising from, major complex projects being undertaken within the same functional geography potentially within the same Road Period.

2.2 Study scope

2.2.1 The geographical scope of the study area focuses on the broad arc from Junction 13 of the M4 to Oxford, Milton Keynes, Bedford and Cambridge. An area map of the approximate geographical scope of the study area is shown in Figure 2-1.

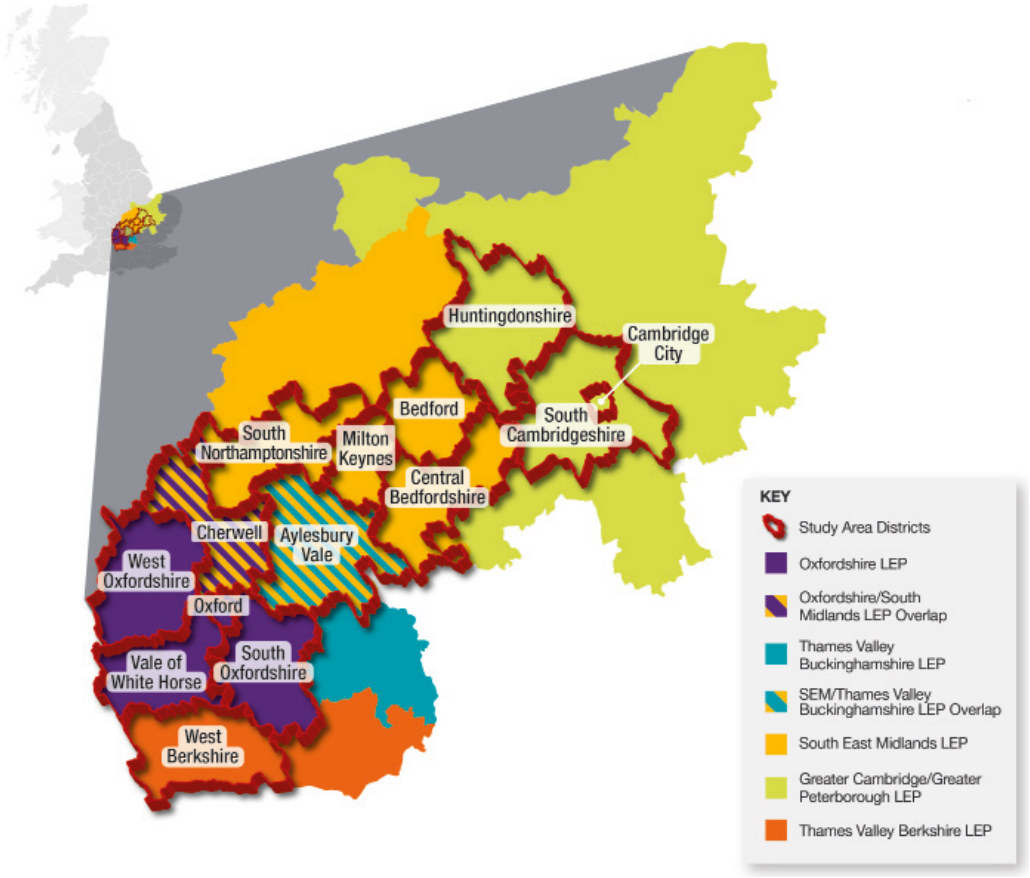


Figure 2-1: Study Area Map

3. Strategic case for intervention

3.1 Introduction

3.1.1 The strategic case for an Oxford to Cambridge Expressway is based on the analysis of the existing east-west road route performance, stakeholder feedback, the form and function of the region's economy and the growth aspirations of the corridor. The analysis considers how an Oxford to Cambridge Expressway could positively contribute to growth at the national, regional and local levels.

3.2 Existing transport infrastructure

3.2.1 The SRN is one of the country's most important pieces of economic infrastructure. As the backbone of the UK transport system, the SRN carries more than 30% of all road journeys and more than 65% of all road freight journeys[3]. Congestion on the SRN costs the economy £2 billion per year in lost time[4]. The SRN provides important national functions including the movement of freight and therefore its safe and efficient operation is vital to the country's economic performance.

Oxford to Cambridge corridor

3.2.2 Currently there is no direct dual-carriageway standard route between Oxford, Milton Keynes, Bedford and Cambridge. The most direct road route linking these locations is via the A34 (via Oxford), the M40-A43 or the A41-A4421 (via Bicester), the A421 (via Buckingham, central Milton Keynes and Bedford), the A1 and the A428 (via St Neots). The majority of the route (A34, M40, A43, A1(M) and A428) form part of the national SRN (maintained and operated by Highways England). The A41, A4421 and A421 are maintained and operated by the local highway authorities including Oxfordshire, Northamptonshire, Buckinghamshire and Milton Keynes.

Economic influence of the existing strategic transport network

3.2.3 Historically the SRN and national rail network has developed in response to the economic influence of London and has not kept pace with the changing economic geography and increasing national economic significance of the regions within the study area. In relation to the study area, the existing infrastructure is strongly radial in orientation (Figure 3-1) with all of the principal road and rail connections including the M40, M1, A1(M), M11, Great Western Railway, Chiltern Railway, Midlands Mainline, West Coast Main Line, Thameslink, East Coast Main Line and West Anglia Main Line routing broadly north-south.

3.2.4 Figure 3-1 shows these strategic radial links through the study area provide good connectivity into London, towards the Midlands and the North, but east-west connectivity is poor. As a result Oxford, Milton Keynes and Cambridge have better connections into London than each other. Patterns of economic growth and connectivity within the study area have therefore been heavily influenced by London (a substantial labour market, knowledge hub and focus of government and commerce). Economic growth and connectivity has focused along these well-established radial corridors, rather than an east-west axis.

[3] DfT Road Traffic Statistics
[4] Road Investment Strategy: for the 2015/16-2019/20 Road Period, Department for Transport, December 2014

3.2.5 A good example is the development of Bioscience clusters, the relationship between Cambridge and Oxford is in contrast to that between either of these cities and London. Stevenage Bioscience Catalyst (SBC) is located on the Glaxo Smith Kline site, midway between Cambridge and London, and it is well connected to both (particularly by rail). Both the University of Cambridge and University College London have established a physical presence at SBC demonstrating the importance of the existing radial infrastructure. There is nothing of this nature on the east-west axis between Cambridge and Oxford.

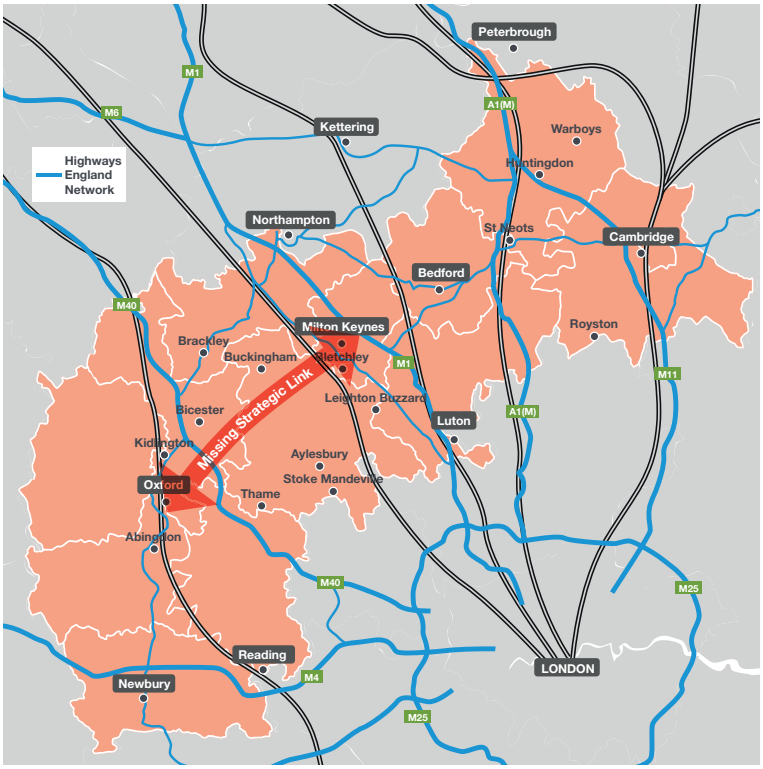


Figure 3-1: Existing Strategic Road and Rail Routes

Strategic transport movements

3.2.6 The lack of east-west rail and road connectivity results in strategic movements (including freight from the south and eastern ports) routing via London (M25 orbital route) or the Midlands (M5-M42-M6-A14). These strategic movements lead to pressure on these corridors reducing the resilience of the SRN. The lack of east-west rail connectivity and resultant long and unattractive journey times via London discourage east-west journeys to be made by public transport.

3.2.7 There are five committed RIS 1 schemes within the study area which go some way to addressing existing problems along the corridor. The five relevant committed RIS 1 schemes are:

- A14 Cambridge to Huntingdon (north-south);
- A428 Black Cat to Caxton Gibbet (east-west);
- M11 Junctions 8 to 14 Technology Upgrade (north-south);
- A34 Oxford Junctions (primarily north-south); and
- A34 Technology Enhancements (north-south).

3.2.8 The A428 scheme would form part of the Oxford to Cambridge Expressway. The scheme will complete the dualling of the A428 resulting in a continuous dual carriageway standard route from Cambridge to Milton Keynes. However, a strategic gap in the SRN will remain from the M1 to the M40 (Figure 3-1).

Inter-regional movements

3.2.9 The poor east-west regional connectivity limits the interaction between regions within the study area. For example Figure 3-2 shows that the main travel to work catchments for Oxford, Milton Keynes and Cambridge. Figure 3-2 shows there are limited overlaps in the catchment areas constraining the number of locations where people can live and work within the study area. For example very few people currently live in Milton Keynes and work in Cambridge or Oxford.

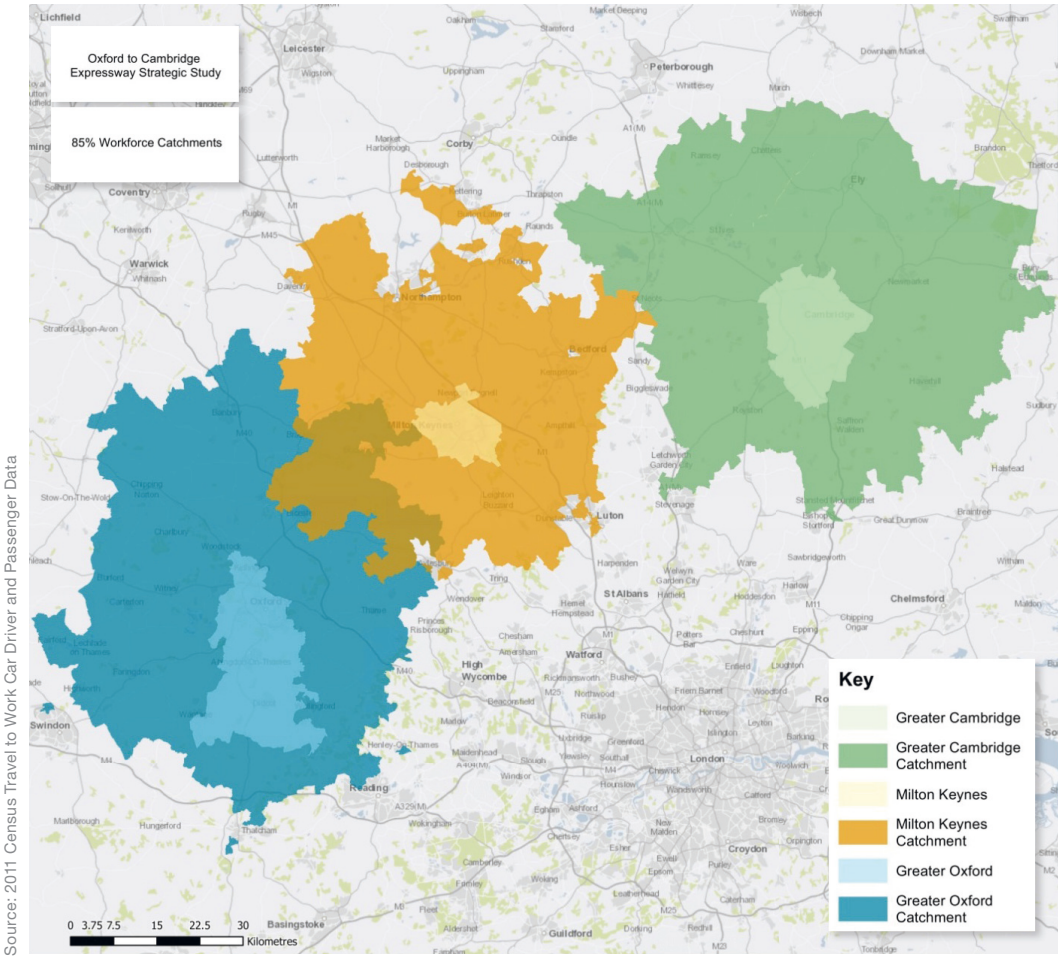


Figure 3-2: Existing Journey to Work Catchment Areas – Key Regional Centres

Local access

3.2.10 Sections of the existing east-west route perform important local access functions, providing connectivity into key local employment areas and between the main urban centres within the corridor: examples of the important local functions of the existing route are provided below.

A34: Oxford's Knowledge Spine

3.2.11 The A34 corridor connects the Science Vale with Oxford and the Bicester growth area. This 'Knowledge Spine' is vital for the continued economic growth of Oxfordshire; failure to tackle constraints on the A34 will restrict growth in this nationally important knowledge-intensive cluster. Significant delays occur at the Milton, Marcham, Hinksey Hill, Peartree and M40 Junction 9 interchanges. Traffic growth in conjunction with major planned development will result in further worsening of network performance. Modelling work commissioned by Oxfordshire County Council in 2013[5] found that the A34 around Oxford to the M40 is forecast to be operating overcapacity by 2029. The increased intensity of the link congestion will result in increased speed variability and incident frequency.

A421: Aylesbury Vale

3.2.12 The A421 (from the A43 to the M1) provides an important local function for commuting between Buckingham and Milton Keynes. The A421 provides a key east-west link within the Aylesbury Vale district as well as providing local access through central Milton Keynes.

3.2.13 The A421 through Aylesbury Vale is a single carriageway road with multiple at-grade junctions. The route standard results in low average vehicle speeds, particularly during the peak travel periods. Aylesbury Vale and Milton Keynes growth plans include a number of important housing sites along the A421 corridor including at Buckingham, Winslow, Milton Keynes Western Expansion Area, Tattenhoe Park, Kingsmead South, Oxley Park and Newton Leys. In the absence of any upgrade these housing sites will increase traffic flows on the A421, intensifying existing levels of congestion.

3.2.14 Modelling work commissioned by Buckinghamshire County Council in 2015[6] shows that link capacity issues along the A421 could intensify by 2031, particularly in the PM peak which will lead to increased rat-running through Newton Longville, Whaddon and the Horwoods. The evidence shows that the existing A421 route capacity will constrain local housing delivery in Aylesbury Vale and Milton Keynes if improvements are not provided.

A428: Cambridgeshire

3.2.15 The single carriageway section of the A428 between the A1 Black Cat Roundabout and Caxton Gibbet suffers significantly from congestion in the peak travel periods. The route forms an important commuter route between St Neots and Cambridge as well as supporting planned growth in Cambourne and Bourne Airfield. The committed RIS 1 scheme will address the constraints on this section of the route.

5 A34 Oxfordshire Route Based Strategy Baseline Statement, Oxfordshire County Council, September 2013
6 A421 Corridor Transport Study Buckingham to Milton Keynes, Jacobs, September 2015

3.3 Economic assets

3.3.1 The regions that make up the study area have strong economies that contain significant intrinsic economic assets that have been key drivers of growth to date.

Competitive regions at the forefront of the UK growth ambitions

3.3.2 The five LEP regions, Thames Valley Berkshire (TVB), Oxfordshire (OxLep), Buckinghamshire Thames Valley (BTV), South East Midlands (SEMLep) and Greater Cambridge Greater Peterborough (GCGP), within the study area are successful economies that contribute significantly to the national growth agenda. Figure 3-3 provides a comparative analysis of the performance of the UK LEPs against key indicators of economic performance, investment attractiveness and growth capability.

3.3.3 Figure 3-3 shows that the six LEP regions (Northamptonshire LEP is reported separately as the data pre-dates its amalgamation with SEMLep) have performed strongly in a number of key economic indicators demonstrating that they have been competitive locations for attracting inward investment.

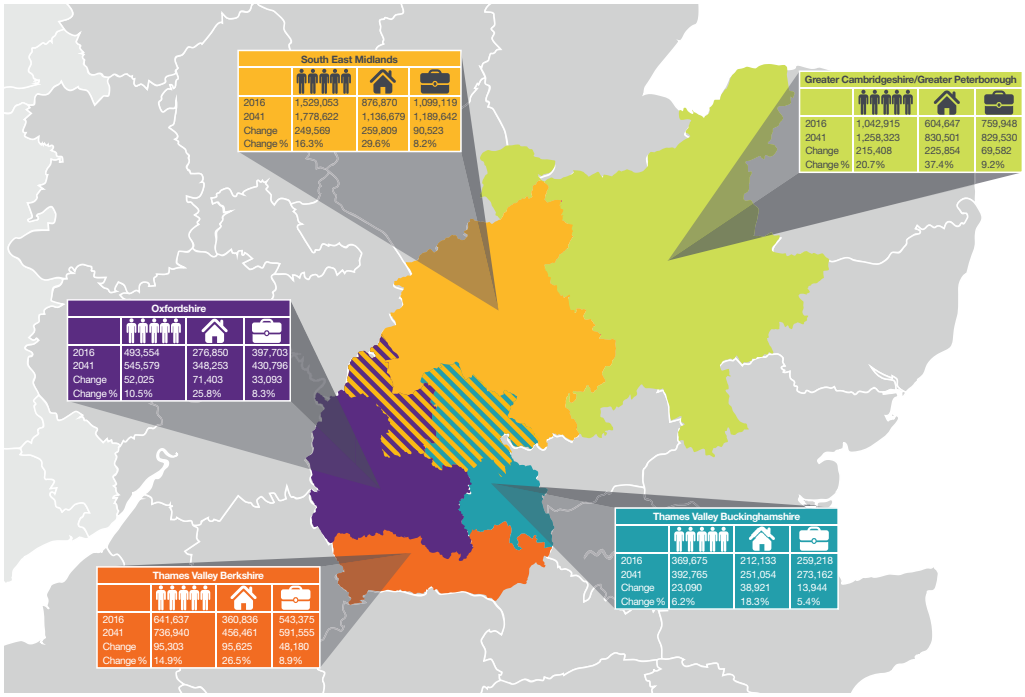
3.3.4 The LEP regions within the study area provide an attractive location for investment due to the well-educated labour force and relatively high levels of entrepreneurship and innovation. Within the corridor, TVB, OxLep, BTV, SEMLep and GCGP feature regularly in the UK top 10 for productivity, annual growth, qualifications, enterprises and innovation. Given the above evidence, the LEP regions with the study area are well placed to lead the economic recovery and help drive the national growth agenda.

Sources: Gross Value Added (GVA) for Local Enterprise Partnerships, Office for National Statistics, February 2016; Review of Local Enterprise Partnership area economies in 201; Annual Population Survey, Local Enterprise Partnerships, Nomis 2004 to 2015; The LEP Network; UK Business Counts – Enterprises, Local Enterprise Partnerships, Nomis 2015.

Figure 3-3: LEPs Economic Performance, Opportunities and Threats

The region's growth potential

3.3.5 The five LEPs within the corridor have the characteristics to suggest there is potential for continued economic growth. Figure 3-4 shows that the five LEPs are planning for substantial levels of new housing and jobs. The scale of the planned housing, job and subsequent population growth provide a clear indication of the economic opportunity and challenges within the corridor.



Source: TEMPRO V7 Planning Data

Figure 3-4: LEPs Growth Capability

The corridor's 'Fast Growth' Cities

3.3.6 Cities are key drivers of local, regional and national economic growth. There is considerable variation in the economic performance of cities across the UK, with some locations in a stronger position to grow in the future than others.

Economic assets of Cambridge, Oxford and Milton Keynes

3.3.7 Oxford, Milton Keynes and Cambridge all have very significant intrinsic economic assets of their own that are generating economic growth in their particular spatial context as well as benefiting from the close proximity and connectivity to London.

3.3.8 Oxford, Milton Keynes and Cambridge are three of the UK's fastest growing and most successful locations which perform strongly in a range of economic performance indicators. The three locations are characterised by high wage/ low welfare and highly productive economies which are key drivers of long-term economic growth.

3.3.9 Oxford, Milton Keynes and Cambridge have strong economies due to their high employment rates compared to the UK national average. The highest levels of employment occur within South Cambridgeshire and South Oxfordshire where a range of towns and villages, popular with commuters, and the 'out-of-town' Science Parks, are located.

3.3.10 Oxford, Milton Keynes and Cambridge have strengths in high value, highly innovative knowledge-based economies. All three locations rank in the top 10 UK Cities[7] for innovation. Cambridge is by far the most innovative, with 101.9 patents per 100,000 people compared to a UK average of 3.6. Oxford is ranked 8th (8.9 patents per 100,000 residents) and Milton Keynes 9th (8.5 patents per 100,000 residents).

3.3.11 The strong performance of Oxford, Milton Keynes and Cambridge has been driven by their ability to attract new companies to the area and enable existing companies to expand. The ability to attract knowledge-based businesses puts these three locations in a strong position to grow in the future. Within the corridor Milton Keynes is ranked third nationally for number of business start-ups per 10,000 population with 75.4[8]. The number of business start-ups in Milton Keynes is twice the national average.

3.3.12 In both Oxford and Cambridge, the world class knowledge-based assets are linked with their higher education institutions and major research organisations and benefit from a well-developed infrastructure for the commercialisation of science and technology (through Innovation Centres, Science Parks and networks of investors). Both Cambridge and Oxford also have outstanding heritage assets which attract tourists from around the world and therefore act as major economic drivers.

3.3.13 In all three locations, major investments have been made by government in knowledge-based assets in addition to the universities. These include the Satellite Applications Catapult at Harwell (near Oxford), the Transport Systems Catapult in Milton Keynes, and the Babraham Research Campus in Cambridge. All three locations have also attracted high profile businesses with significant supply chains and with a sizeable local presence including, Oxford Instruments, Oxford University Press, Prodrive, Red Bull Racing and ARM.

3.3.14 What makes these locations particularly attractive is the relatively large share of employment in high skilled jobs which typically provide high salaries. In both Cambridge and Oxford, the resident labour force is on average very well qualified and is bolstered (in part because of the universities) by outstanding workforce from around the world (particularly in science and technology).

3.3.15 In Oxfordshire, Cambridgeshire and Milton Keynes, there has been a strong appetite for growth, with local political and businesses leaders putting in place policies which have encouraged development and have attracted significant investment to make this possible. In particular, Milton Keynes is benefiting from a large and growing stock of housing that is relatively inexpensive (when compared to London, Cambridge and Oxford).

3.3.16 A good example of the attractiveness of these locations is AstraZeneca, who are expected to open a new global headquarters and Research & Development facility in Cambridge in 2017, home to an estimated 2,000 employees. AstraZeneca cite the importance of collaborative working, knowledge sharing and Cambridge's deep labour market of highly-skilled workers for their decision to relocate to the city.

7 Cities Outlook 2016, Centre for Cities
8 Cities Outlook 2016, Centre for Cities

3.4 Investment in east-west connectivity

3.4.1 Given the important economic assets identified in the study area, the crucial question concerns what more could be achieved if east-west connectivity was significantly improved. The analysis of the influence of the existing transport network and the intrinsic economic assets of the study area provides the evidence that east-west transport investment could help address existing transport issues, trigger positive changes to the economic connectivity of the region and help unlock its full economic potential.

3.4.2 Figure 3-5 shows that the shortlisted Expressway options would provide connectivity between key knowledge-intensive employment locations which tend to be located outside the main built-up areas. Key growth areas including the Knowledge Spine in Oxfordshire, Aylesbury Vale, southwest Milton Keynes and the Science and Business Parks located to the north and south of Cambridge would be well connected by the Expressway.

3.4.3 Figure 3-5 also shows that EWR would deliver high quality public transport connectivity between the urban centres of Oxford, Milton Keynes, Bedford (committed) and potentially onwards to Cambridge and the east in the longer term. This scheme will benefit people commuting and accessing central employment locations and services.

3.4.4 EWR and the Expressway have the potential to be complementary strategic transport schemes that will improve public transport connectivity between urban centres and road connectivity between the knowledge-intensive clusters respectively.

Improved local access

3.4.5 The Expressway could address longstanding local constraints in Oxfordshire by reducing the strategic function of the A34 around Oxford, 'freeing-up' the route for local traffic and bus services to access locations along the Knowledge Spine. The expressway would support the delivery of planned growth which is focussed along the Knowledge Spine from Bicester through to the Science Vale (Didcot, Harwell and Culham), providing improved connectivity between these key local growth areas.

3.4.6 Reduced congestion along the A34 corridor would improve the quality of life for local residents. There are residential properties located along the A34 corridor including the section through Botley which is subject to an Air Quality Action Area, which would directly benefit from reduced congestion and delays.

3.4.7 The Expressway scheme could help unlock growth in Aylesbury Vale and Milton Keynes by providing increased road capacity and connectivity between Milton Keynes, Buckingham, Bicester and Oxford. The additional road capacity could also support the delivery of committed and aspirational growth along this important section of the growth corridor.

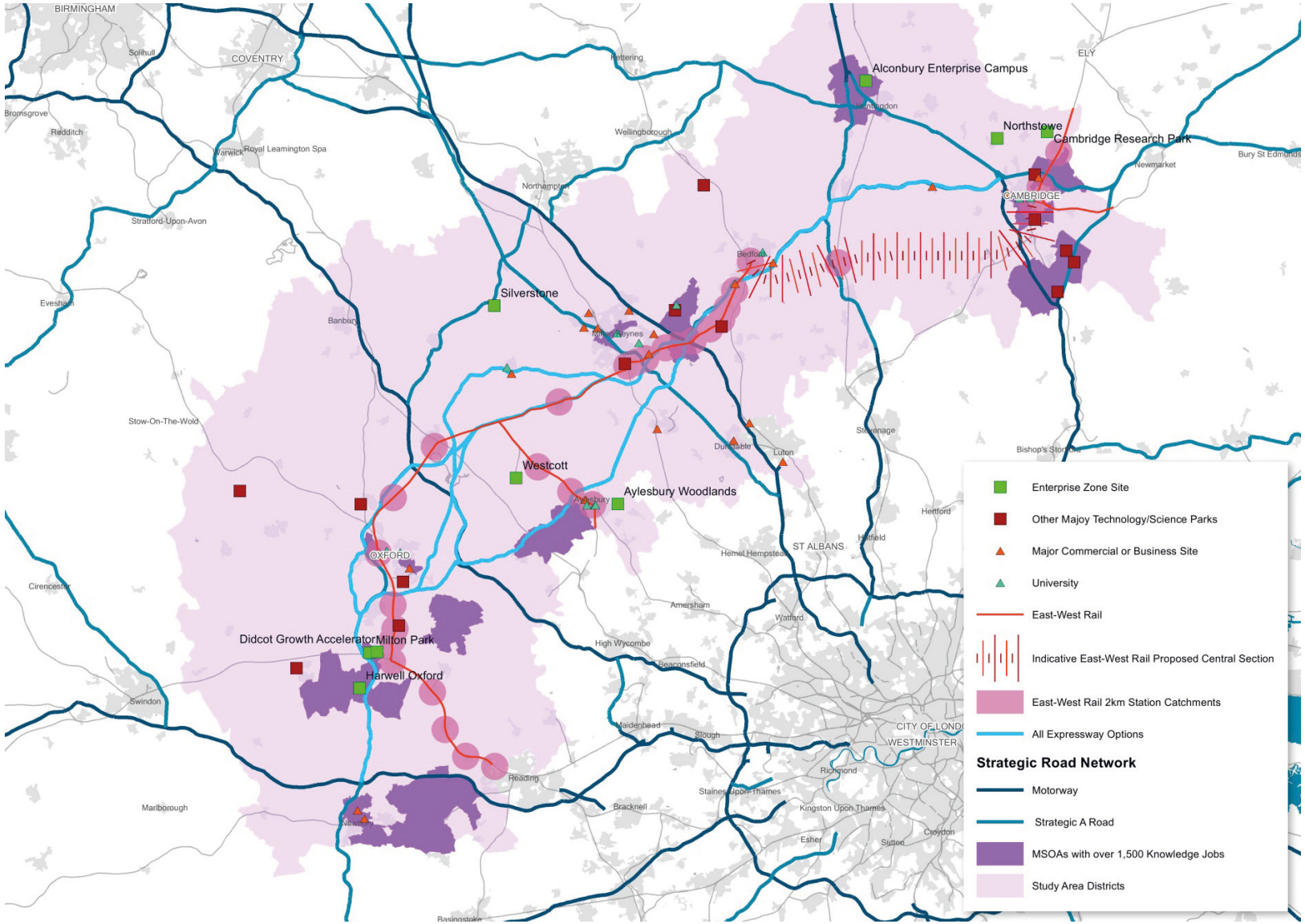


Figure 3-5: Enhancing Connectivity between Knowledge-Intensive Locations

Wider economic benefits

3.4.8 The five LEP regions have key strengths in a wide range of nationally important specialisms including information technology, advanced manufacturing, scientific research, life sciences and pharmaceuticals that are clustered across the study area. These sectors benefit disproportionately from closer economic proximity. Wider economic benefits are likely to be substantial along the corridor due to significant local and longer distance journey time saving improvements between a number of large economic centres, where the 'effective density' of firms and workers is greatest.

3.4.9 For example, the economies of Oxfordshire and Cambridgeshire have many similarities, in particular the high incidence of bioscience and tech-based activities. Both locations are regarded as high-tech clusters in their own right. They are highly specialised and both attract very talented people internationally. However, the degree of functional connectivity between them is very limited, with few examples of companies operating in both clusters.

3.4.10 An Oxford to Cambridge Expressway would deliver substantial journey time savings along the entirety of the corridor, significantly improving business linkages within the study area. Biotechnology firms located within the Cambridge Science Park and Oxford Science Vale, would benefit from improved opportunities for collaboration and knowledge-sharing, increasing the corridor's international competitiveness and attracting high-value firms from abroad.

3.4.11 The central part of the study area between Cambridge and Oxford has long been a focus for advanced manufacturing/engineering and contain some significant assets, not least Cranfield University. However, the extent to which the science-based specialisms of Cambridge and Oxford interact with the more applied expertise and the manufacturing/engineering capability of the central area is questionable. There are some links, but it is a long way from a fully functioning industrial ecosystem. This suggests there is underlying latent potential.

3.4.12 Improvements in east-west transport connectivity could induce changes in private investment (dynamic clustering) and hence the location of economic activity, with locations affected by transport improvements typically becoming more attractive for private investment. Firms located elsewhere in the country (and overseas) will observe both the reduction in transport costs and increase in productivity delivered by the transport interventions, and potentially relocate to the region.

3.4.13 An Expressway intervention would bring the nationally important innovative and knowledge-intensive industries and world leading universities closer together, providing agglomeration benefits, creating larger labour and product markets, and boost technology and knowledge spill overs. This delivers additional benefits through raising productivity in the regional economy above and beyond that expected from the direct user benefits of a transport intervention. Improved east-west connectivity would help deliver the continued economic growth of the LEP regions and provide more sustainable, inclusive growth across the corridor.

Addressing the socio-economic corridor challenges

3.4.14 The evidence shows that individually and collectively the study area regions make a substantial contribution to the UK economy. These successful locations are well placed to continue to grow if the key challenges of increased pressure on transport infrastructure, demand for local housing and skills shortages can be addressed.

3.4.15 The strong economic and population growth across the region has resulted in increasing demands on the existing transport infrastructure and housing supply. Rising congestion, journey times and housing unaffordability threatens further economic growth. These constraints reduce the attractiveness of the study area as a place to live and work. The knowledge-intensive industries operate on the global stage, reduced attractiveness of the region could impact on the UK economy as a whole if businesses chose to locate outside the UK.

3.4.16 High house prices make it increasingly difficult for employers to attract and retain staff and attract new businesses. Oxford has the greatest affordability issues of any city in the UK, with average house prices more than 16.2 times the average wage, closely followed by Cambridge (15.9 times[9]). Cambridge has also experienced the highest house price growth (12.5% 2014-2015) with an average house price of £469,600. Milton Keynes also ranks in the UK top 10 with a house price growth of 7.6% 2014-2015.

3.4.17 Both Cambridge and Oxford are constrained by Green Belt designations resulting in both housing markets operating under substantial pressure. The area around Milton Keynes is less constrained in terms of development. The Expressway could alleviate some of the housing pressures facing both Cambridge and Oxford by improving connectivity to the central area.

3.4.18 Addressing housing affordability constraints requires the delivery of strategic housing sites in the corridor. Delivering strategic housing sites will place significant additional pressure on the transport network, in particular at locations of existing congestion such as the A34, A421 and A428 if large-scale investment in strategic transport infrastructure is not provided.

3.4.19 Investment in an Expressway and EWR could accelerate the delivery of strategic housing sites (including at Bicester, Science Vale, southwest Milton Keynes and Aylesbury Vale) and potentially unlock aspirational levels of growth in the corridor. Failure to deliver substantial housing growth will reduce the attractiveness and affordability of the region to businesses and residents.

3.4.20 The Expressway would help support the highly productive urban areas by helping to address some of these economic challenges. An Expressway and EWR would reduce congestion and capacity issues on local commuter routes (A34, A421 and A428), unlock local housing sites and improve connectivity between skilled people and important employment centres and thus support local economic growth in key urban areas within the study area including Oxford, Bicester, Buckingham, Aylesbury (depending on the Expressway route option), Milton Keynes, Bedford, St Neots and Cambridge.

9 Cities Outlook 2016, Centre for Cities

3.5 Summary

3.5.1 The evidence shows that Oxford, Milton Keynes, Cambridge and the wider LEP regions within the corridor are economic powerhouses of the UK economy with key strengths in knowledge-intensive industries, supported by a well-educated workforce.

3.5.2 In order to maximise the region's future contribution to the UK economy the lack of strategic east-west transport connectivity must be addressed to enable reduced business costs, improved access to labour and markets, economies of scale and agglomeration and continue to attract inward investment in a competitive national and international marketplace.

3.5.3 Expressway and EWR interventions are critical to overcoming the existing local, regional and national infrastructure deficits, connecting skilled people with jobs, linking employment clusters and creating an efficient national transport network grid that enables future regional housing and jobs growth to be delivered in way the supports the efficient movement of goods and people. Expressway and EWR interventions will ensure that a lack of transport connectivity and capacity does not prevent the region from successfully competing in the global marketplace and providing resilience for the UK economy.

4. Transport case for intervention

4.1 Introduction

4.1.1 This section of the report summarises the route standard, function, operation and corridor growth challenges to demonstrate the transport case for the Oxford to Cambridge Expressway.

4.2 Route standard

4.2.1 The most direct east-west road route across the study area linking Oxford, Milton Keynes and Cambridge is approximately 108-111 miles in length (depending on the route via the M40 or via Bicester). The route is of variable standard and quality which affects journey speeds, reliability and accident rates. A number of sections of the existing route are contrary to modern SRN standards (Figure 4-1 to Figure 4-5).

A34 Botley

Along this section of the A34, there are a number of residential properties in close proximity to the A34.

This section includes a 50 mph speed limit and is an Air Quality Action Area.

A34 Botley

There are a number of direct access points onto the A34 from local housing areas, particularly between the A420 Botley Interchange and the A423 Hinksey Hill Interchange.

Figure 4-1: Existing Constraints on the Primary East-west Route: A34

A43

From the M40 to the A421 dual carriageway has local at-grade access junctions.

A41/A4421

The A41 is a dual carriageway to the outskirts of Bicester, but not Expressway standard owing to direct accesses onto it including roundabout junctions with the B4030 and the town centre; and

The A4421 is a single carriageway with eight roundabouts to negotiate around Bicester and direct access at multiple points along the route in addition to the formal roundabouts.

Figure 4-2: Existing Constraints on the Primary East-west Route: A43 and A41/A4421

A421 Tingewick

From the A43 to Milton Keynes, the A421 is predominately a single carriageway route with regular at-grade junctions.

A421 Buckingham

The A421 routes around the south side of Buckingham and includes four at-grade roundabout junctions.

Figure 4-3: Existing Constraints on the Primary East-west Route: A421 from A43 to Milton Keynes

A421 Milton Keynes

The A421 through Milton Keynes is an urban dual carriageway road and has significant local at-grade access junctions including 14 roundabouts from Snelshall Street to the Kingston Roundabout.

A421 Milton Keynes

The A421 urban dual carriageway through central Milton Keynes provides an important local access function as well as supporting strategic through traffic.

Figure 4-4: Existing Constraints on the Primary East-west Route: A421 Milton Keynes

A428

From the A1 Black Cat Roundabout to Caxton Gibbet, the single carriageway road has regular at-grade access junctions.

A428

The A428 includes three at-grade roundabout junctions between the Great North Road and Cambridge Road that provide local access into St Neots.

A428

East of St Neots the A428 continues a single carriageway standard road to the Caxton Gibbet roundabout. On this section of the A428 there are a series of priority controlled at-grade local access junctions.

Figure 4-5: Existing Constraints on the Primary East-west Route: A1 and A428

4.2.2 The existing east-west route that directly connects Oxford, Milton Keynes and Cambridge comprises sections of dual carriageway, single carriageway and urban dual carriageway of variable standards, speeds and access standards. The A428 Black Cat to Caxton Gibbet scheme will address the constraints, creating a dual-carriageway standard route from Cambridge to Milton Keynes; however a strategic gap in the SRN will remain between Milton Keynes and Oxford.

4.3 Route function

4.3.1 The existing east-west route performs important national, regional and local functions. A summary of the main functions are provided in Figure 4-6.

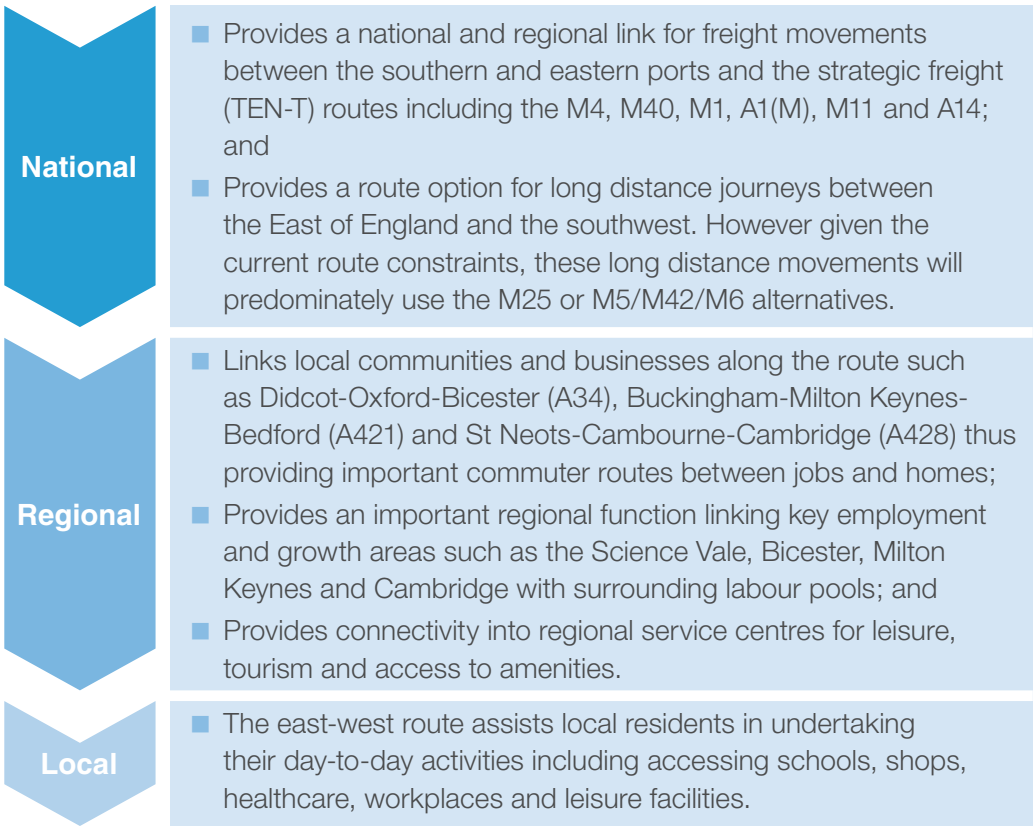


Figure 4-6: Role of the Primary East-west Route

4.3.2 The existing east-west route provides connectivity to the SRN including the M4, M40, M1, A1(M), M11 and A14. Sections of the east-west route therefore perform important strategic freight functions, providing connectivity to national (TEN-T) freight routes as well as connections towards the southern and eastern ports via the A34 and A14 respectively.

4.3.3 In particular, the A34 within the study area accommodates relatively high freight movements which are likely to continue to increase as the southern ports have aspirations to expand along with the economy as a whole. Time savings, shorter distances and more reliable journeys are critical for freight operators and have a direct impact on their operating costs.

4.3.4 The existing east-west route currently provides a limited strategic function, with a low number of movements using the route to travel between the M4 and M11/A14 (end-to-end) due to the existing journey times and the variable route standard. Long distance movements between the East of England and southwest predominately route via the M25 or the M6-M5 corridors which provide a higher standard and more reliable journey.

4.3.5 The existing east-west route therefore predominantly serves regional and local functions including linking home and jobs. There are a number of communities along the route that have substantial commuting flows into the main towns and cities including Didcot, Abington, Oxford, Bicester Buckingham, Milton Keynes, Bedford and Cambridge.

4.4 Public transport alternatives

4.4.1 There are limited public transport alternatives to east-west car travel within the corridor. The corridor has good radial links into London and the north, but there is no direct rail link between Oxford, Milton Keynes and Cambridge resulting in long and unattractive journey times via London, Coventry or Leicester. The EWR scheme will address this in the medium to long term and will improve the public transport accessibility for communities along the proposed route.

4.4.2 The committed EWR scheme will connect Oxford, Milton Keynes (via Bletchley) and Bedford. Studies are also being undertaken to assess the possibility of connecting Bedford to Cambridge via Sandy. This will create a continuous east-west rail connection which will allow for travel between the study corridor urban centres without the need to pass through London. There is also scope to travel between East Anglia and the South West and Wales on this route.

4.4.3 Reinstating the former 'Varsity Line' will enhance public transport connectivity between the main urban centres within the corridor (Oxford, Milton Keynes, Bedford and Cambridge) providing benefits to local residents and employees living and working within the station catchment areas. The Oxford to Cambridge Expressway would complement EWR, providing enhanced east-west road connectivity between the key growth areas within the corridor.

4.4.4 The main communities along the east-west route are currently connected by the X5 Coach service. The existing service provides a relatively high end-to-end journey time from Oxford to Cambridge and vice versa of approximately 3 hours 40 minutes. However, the service does provide an important commuter link between local communities including St Neots-Cambridge, St Neots-Bedford, Bedford-Milton Keynes and Buckingham/Bicester-Oxford.

4.4.5 Sections of the existing east-west route (A34, M40, A421 and A1) are also used by a wide range of local, regional and national bus and coach services. Traffic congestion along the route, particularly during peak travel periods has a direct negative impact on bus journey times and bus journey time reliability. Improvements to the route that reduce delays and congestion would therefore provide direct benefits to existing bus and coach users.

4.5 Route performance

4.5.1 Sections of the existing east-west road route are congested during peak travel periods. This results in journey time delays which are predicted to worsen in the future as the existing road infrastructure comes under additional pressure from travel demand generated by housing and job growth. Delays as a result of increased congestion will be a cost borne by businesses, reducing business efficiency, productivity, access to markets and labour pools and reducing the attractiveness of the corridor to inward investment. Increased congestion impacts on resident's access to services and the local environment in which they live and travel.

Route congestion

4.5.2 Trafficmaster data analysis shows that end-to-end vehicle journeys from Oxford to Cambridge currently take between 2 hours 15 minutes to 2 hours 25 minutes in the weekday peak morning and evening travel periods. Compared to overnight journey times (when network conditions are typically free flowing), peak period congestion adds 20-30 minutes on to the overall journey time. The main congestion hotspots on the route are summarised in Figures 4-7 and 4-8 for the AM and PM peak hours respectively.

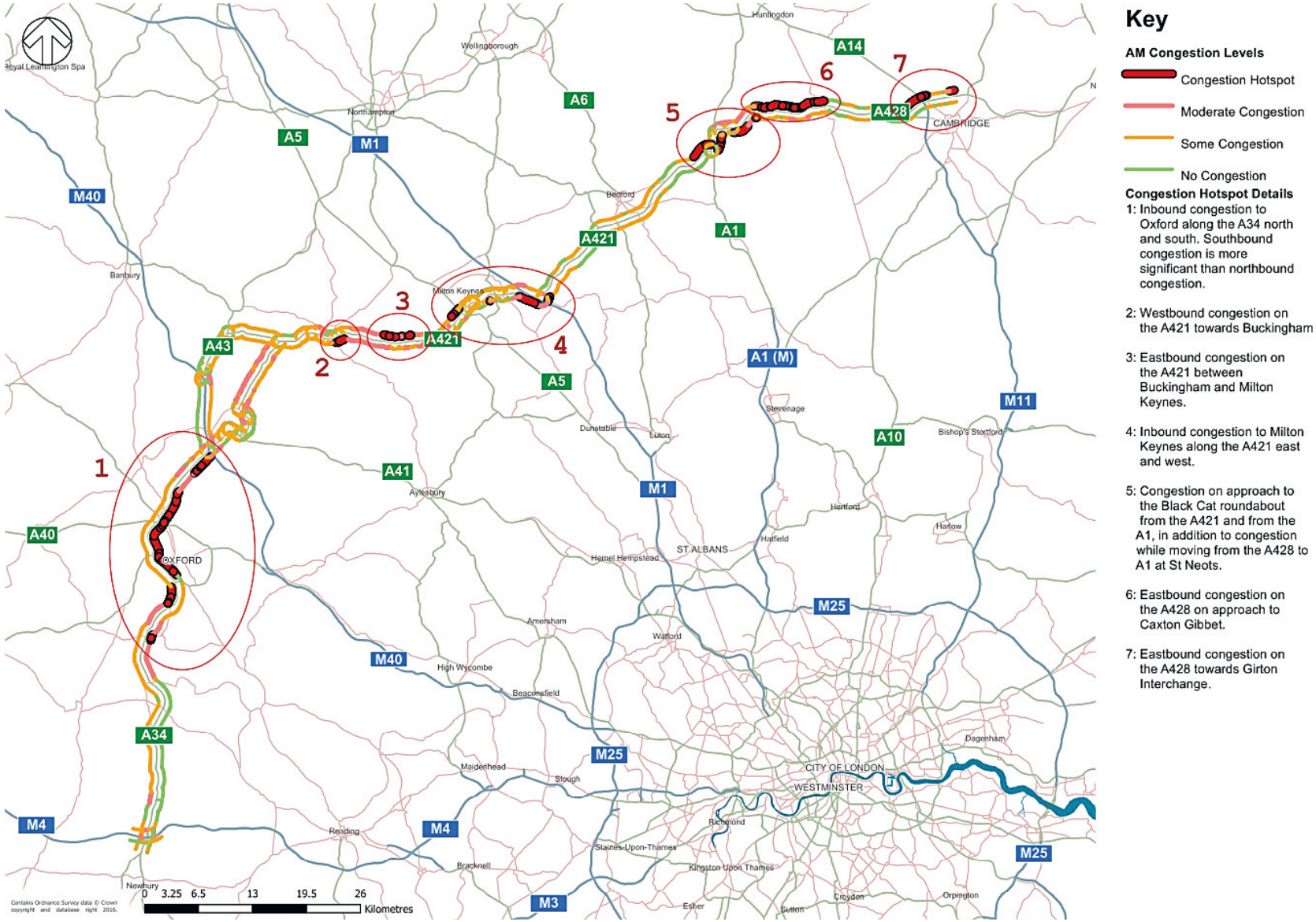


Figure 4-7: AM Peak Hour – Route Congestion Hotspots

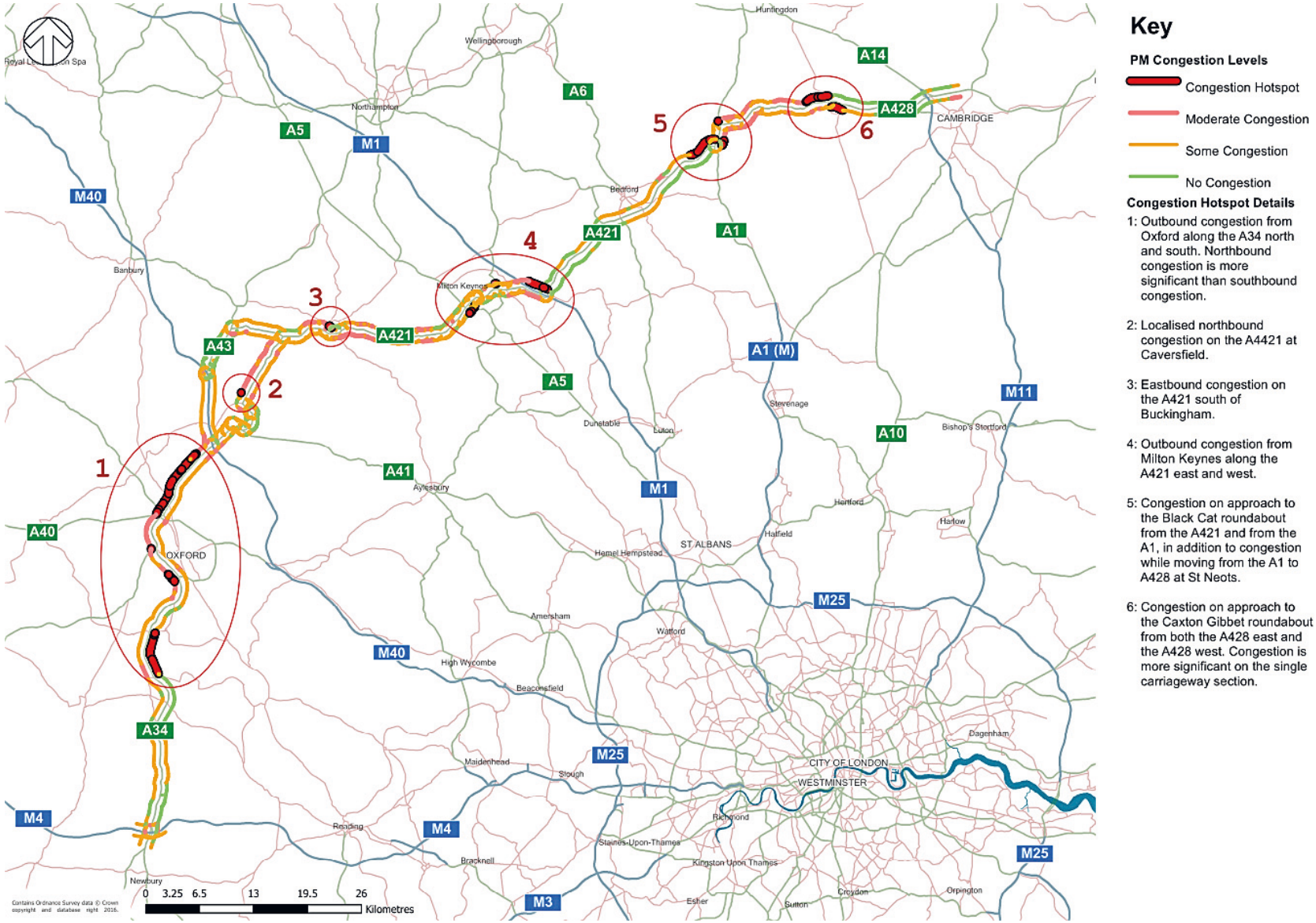


Figure 4-8: PM Peak Hour – Route Congestion Hotspots

Journey reliability and average vehicle speed

4.5.3 The levels of traffic, road standards and quality of the single carriageway sections on the east-west route affect journey speeds and reliability. Highways England data shows that existing SRN sections within the study area suffer from journey time reliability issues including the A1 approaches to the Black Cat Roundabout, the single carriageway section of the A428 and the A34 on approach to the Science Vale and around Oxford.

4.5.4 To demonstrate the impact of the variable route standard, average AM peak vehicle speed analysis has been undertaken using Trafficmaster data. Figure 4-9 shows that sections of the east-west route have relatively low average speeds compared to the existing speed limit as a result of peak period congestion and the existing road standard, including the A34 between Oxford and Bicester, A421 through Buckingham and Milton Keynes and the A428 from St Neots to Caxton Gibbet.

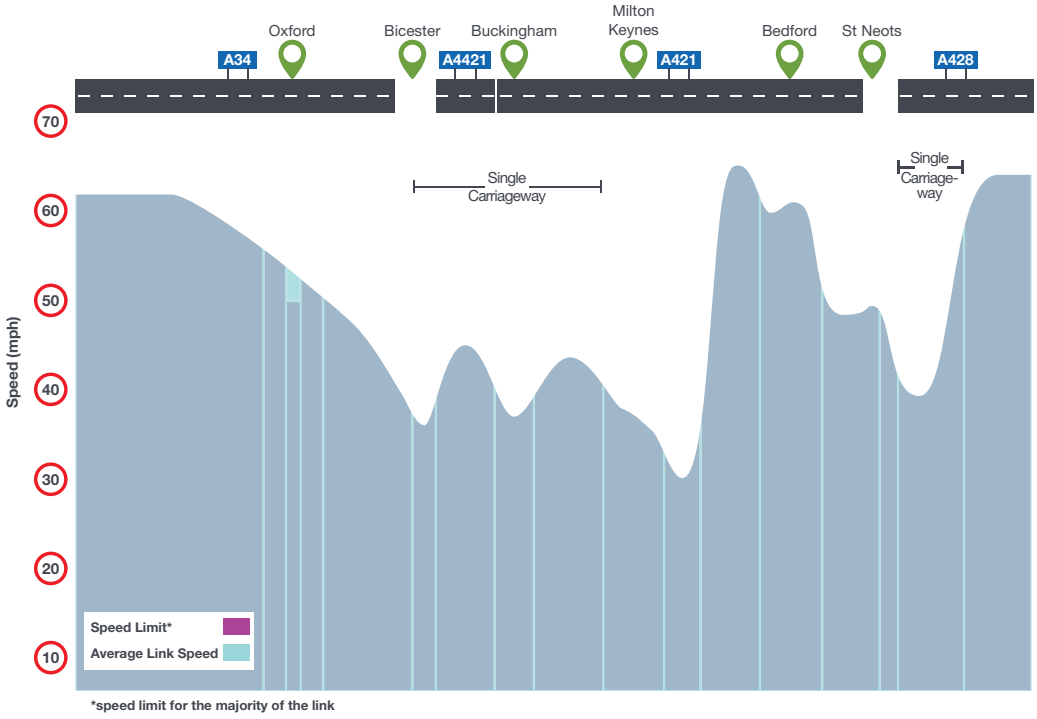


Figure 4-9: AM Peak Speed Variability on the existing East-West Route

Route capacity

4.5.5 Sections of the route are currently operating close to or at capacity during the peak travel periods. By 2035 traffic flows on the route are forecast to increase by up to 40% which could result in the following sections of the route operating over capacity if no enhancements are provided:

- A34, south of Oxford, around the western side of Oxford and to the M40;
- M40, Junction 9 to 10;
- A421 single carriageway east of the A4421;
- A421 Expressway between Bedford and Milton Keynes; and
- A428 single carriageway section.

4.6 Summary

4.6.1 There is a lack of strategic east-west transport connectivity within the broad arc from Oxford-Milton Keynes-Cambridge (the study area). Currently the most direct east-west road route through the study area is via the A34 (around Oxford), M40/A43 or A41/A4421 (via Bicester), A421 (via Buckingham), A1 and A428 (via St Neots).

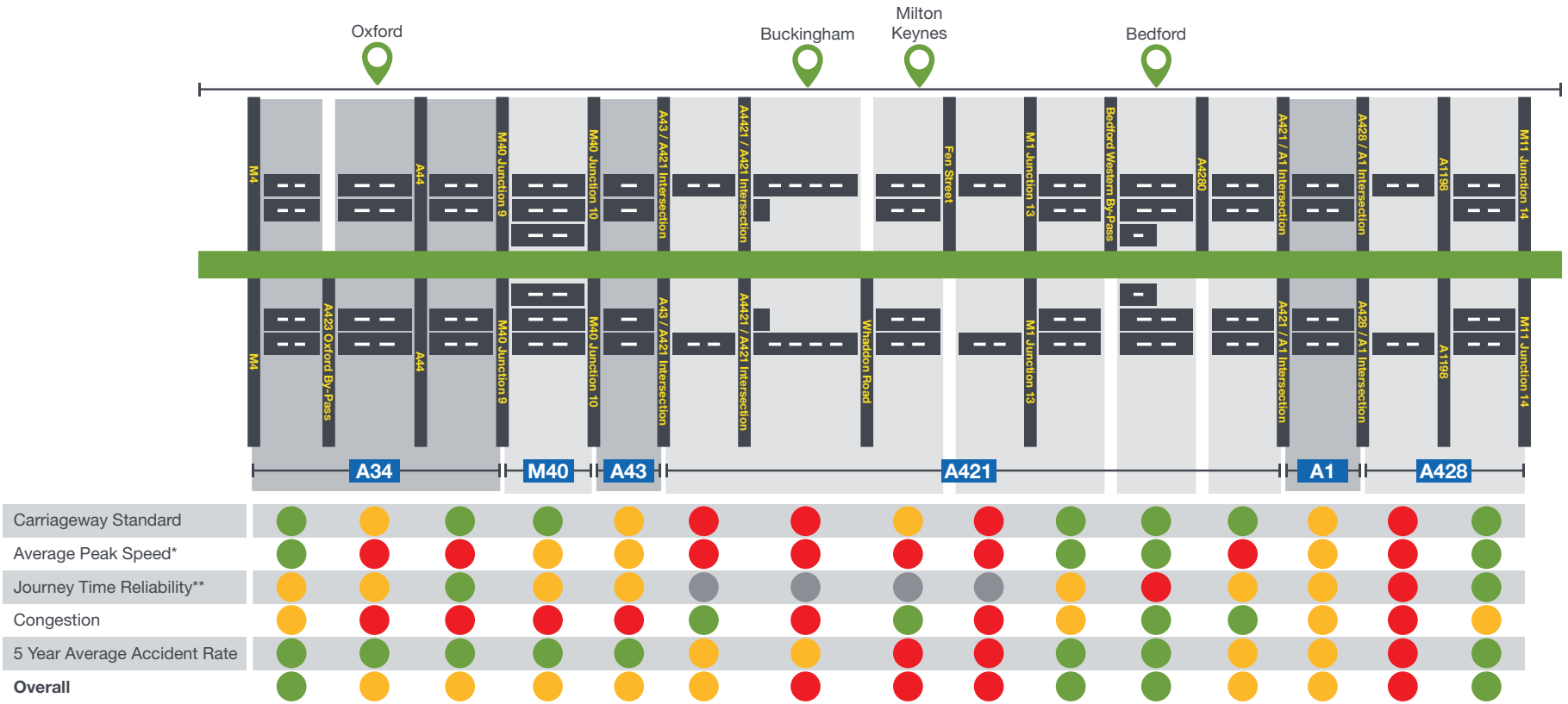
4.6.2 Sections of the existing primary east-west route provide important national and regional freight functions (A34) and provide access to the SRN network including the M40, M1, A1(M), A14 and M11. Sections of the existing primary east-west road also provide important regional and sub-regional functions, linking communities along the route with the main employment and service centres.

4.6.3 The existing roads are of variable standard, including sections of single carriageway (A421 and A428) and urban dual carriageway through central Milton Keynes. The variable road standard affects the capacity, reliability, resilience, safety (Figure 4-10) and attractiveness of the existing east-west route to local, regional and strategic movements.

4.6.4 Sections of the A34, A421 and A428 suffer from congestion caused by both link and junction capacity issues which inhibit their local, regional and strategic functions, resulting in rat-running through local towns and villages and constraints to the delivery of key development sites.

Network Performance Diagram

Carriageway Standard	Expressway	Dual (At-Grade)	Single (At-Grade)
Average Peak Speed	Avg > 86% of limit	Avg 85-76% of limit	Avg < 75% of limit
Journey Time Reliability	> 81% of journeys on time	71-80% of journeys on time	< 70% of journeys on time
Congestion	RFC: 0-0.84	RFC: 0.85 - 1.00	RFC: 1.00 +
5 Year Average Accident Rate	0 - 19 Killed of Seriously Injured Accidents per Billion Vehcile KMs	20 - 34 Killed of Seriously Injured Accidents per Billion Vehcile KMs	35 + Killed of Seriously Injured Accidents per Billion Vehcile KMs



*Based on AM Peak Speeds

** The A421 does not form part of the Strategic Road Network and therefore Highways England journey time reliability data is not available for this section of the route

Figure 4-10: Route Performance Summary

5. Development of options

5.1 Option generation and assessment

5.1.1 Stage 1 of the study established the economic and transport case for investment. Stage 2 of the study involved the identification and initial assessment of a number of options to address the lack of east-west connectivity between Oxford, Milton Keynes and Cambridge. The process is set out below in Figure 5-1.

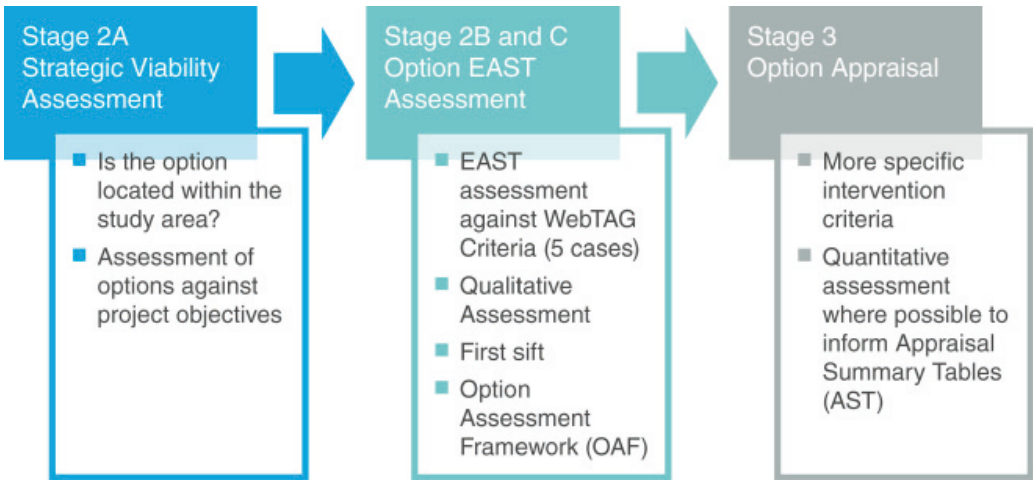


Figure 5-1: Option Sifting and Appraisal

5.1.2 Options were developed from the evidence base in the Stage 1 Report and on the basis of feedback from stakeholders on intervention concepts gathered during project workshops. The first step was to develop a long list of options and then to undertake option sifting. A long list of 36 options was identified covering road (15 options), rail (3 options), technology (6 options) local access (3 options), behaviour change (6 options) and high quality public transport interventions (3 options).

5.1.3 The long list of options were initially appraised at a high level using a bespoke Strategic Assessment Tool against six strategic objectives summarised in Table 5-1.

Theme	Description	Metric
Connectivity	Provide an east-west strategic transport package of measures that delivers enhanced connectivity through faster, safer and more reliable connections across the corridor in the broad arc from Oxford to Cambridge via Milton Keynes.	■ Reduced severance; ■ Strategic transport connectivity between functional economic areas; ■ Improved accessibility by all modes of travel; and ■ Improved safety.
Economic Growth	Build on the ambition to unlock the economic potential in the corridor by facilitating strategic growth to the benefit of the UK economy through increased employment, housing and productivity.	■ Unlock/support economic and employment growth; ■ Unlock/support population and housing growth; and ■ Support efficient movement of freight.
Skills and Accessibility	Promote accessibility and wider socio-economic benefits, by improving access to job opportunities at key employment centres, developments, and at education, leisure, health and retail facilities whilst creating wider employment opportunities.	■ Improved accessibility to centres of employment; ■ Improved access to services and urban centres; and ■ Reduced severance.
Planning for the Future	Reduce traffic on local roads to improve the environment for communities and contribute to better safety, security and health whilst promoting sustainable transport modes.	■ Improved safety; ■ Congestion and traffic reduction; ■ Improved journey time reliability; and ■ Increased active travel.
Environment	Improve quality of life and provide a healthy, natural environment, reducing congestion and supporting sustainable travel modes and promoting equality and opportunity.	■ Improved air quality; ■ Impact on natural environment; and ■ Impact on historical built environment.
Innovation	Apply innovative technology wherever possible to support the sustainable planning, construction and operation of the transport measures.	■ Opportunity to include technology; and ■ Employ innovative construction measures.

Table 5-1: Intervention-Specific Transport Objectives

5.1.4 Each of the 36 long-listed options were assessed against the six strategic objectives based on the scoring provided in Table 5-2.

Score	Description
7	Large Beneficial
6	Moderate Beneficial
5	Slight Beneficial
4	Neutral
3	Slight Adverse
2	Moderate Adverse
1	Large Adverse

Table 5-2: Strategic Assessment Scoring

5.1.5 The initial sift involved scoring each of the identified interventions against the study objectives identified in Stage 1 of the study and the extent to which they tackle each of the problems also identified in Stage 1.

5.1.6 The scoring adopted a qualitative approach which also considered whether the long-listed interventions could be delivered as part of a package of measures. The initial Strategic Appraisal against the scheme objectives resulted in an average score being produced for each intervention. The strategic assessment showed that:

- **Road:** The road options scoring ranged from moderate adverse to moderate beneficial depending on the option. The highest scoring strategic Expressway road schemes were a route via Aylesbury followed by a multi-modal EWR corridor;
- **Rail:** EWR scored highly (moderate beneficial);
- **Technology:** All the Technology Options scored well (moderate beneficial), particularly against the skills and access planning for the future, environment and innovation objectives. However these measures would need to form part of a wider package of measures to deliver the study area wide objectives;
- **Local Access:** The local access options score well (slight to moderate beneficial) against the objectives but the implementation of local access strategies and Urban Mobility Plans would need to form part of a wider package of measures to deliver the study area wide objectives;
- **Behaviour Change:** The behaviour change options score relatively well (slight beneficial) due to their low environmental impact and potential for innovation and improving connectivity, however these measures would need to form part of a wider package of measures to deliver the study area wide objectives; and
- **High Quality Public Transport:** These options score well (slight to moderate beneficial) against the objectives but would not be sufficient to deliver the study area objectives in isolation.

5.1.7 The long list of options were then scored using DfT's Early Assessment and Sifting Tool (EAST) which assesses the Strategic, Economic, Managerial, Financial and Commercial case of each option. EAST was completed in accordance with the associated guidance using evidence gathered within Stage 1 to inform the scoring of the interventions in each EAST category. The purpose of the initial sift of the long list of options was to discard those options which would not satisfy the objectives or would not be likely to pass key viability, feasibility and acceptability criteria. The EAST appraisal shows that:

- **Road:** The three short listed options performed favourably against the other road options, with strong strategic and economic growth cases;
- **Rail:** EWR with improved local rail access both compare favourably with strategic and economic growth cases;
- **Technology:** All the Technology Options are predicted to result in comparatively low levels of strategic impact in isolation and would therefore need to form part of a wider package of intervention measures;
- **Local Access:** All the Local Access Options are predicted to result in comparatively low levels of strategic impact in isolation and would therefore need to form part of a wider package of intervention measures;
- **Behaviour Change:** All the Behaviour Change Options are predicted to result in comparatively low levels of strategic impact in isolation and would therefore need to form part of a wider package of intervention measures; and
- **High Quality Public Transport:** These options have a good fit with Government policy but are not predicted to fully deliver the strategic objectives of the study including supporting economic growth and strategic connectivity across the study area.

5.2 Short listed Expressway options

5.2.1 The EAST sifting process identified that both the Expressway options and EWR performed comparatively well against the long-list of options for the following criteria:

- Fit with national and local objectives;
- Scale of impact;
- Economic Growth; and
- Expected Value for Money.

5.2.2 The shortlisted options are shown in Figure 5-2 and summarised below.

[10] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/4475/east-guidance.pdf
[11] https://www.gov.uk/government/publications/oxford-to-cambridge-expressway-strategic-study-interim-report

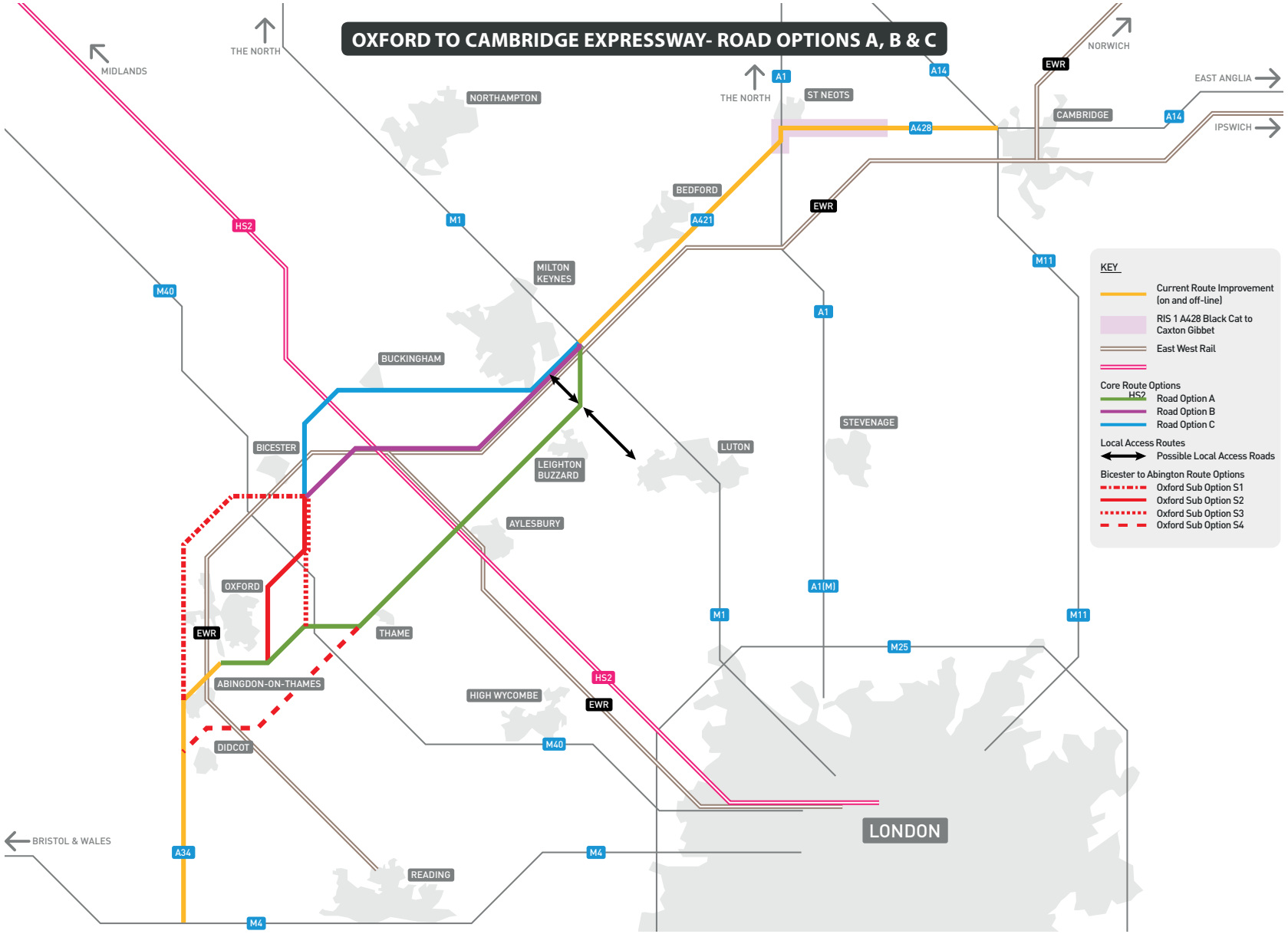


Figure 5-2: Shortlisted Intervention Options

5.2.3 Figure 5-2 shows the short listed Expressway routes are via Aylesbury (Option A), the East-West Rail (EWR) corridor (Option B) or the existing A421 corridor (Option C). The options include on and off-line improvements and a number of sub-options in order to route around Oxford. All three Expressway options include conversion of sections of the A34, A421, A428 and A1 to Expressway standard to complete the route between the M4 and A14/M11. Each Expressway option would form part of a package of transport measures including EWR, route technology, integration with rail interchange hubs and local access and mobility measures (including non-motorised users).

5.2.4 Table 5-3 summarises the length of each of the Expressway options shown in Figure 5-2. The central section is the new section of the route from the A34 south of Oxford to the A421 at the M1. The central section includes a combination of new Expressway construction and existing road widening (and or carriageway improvements).

Road Option	Route Total	Central Section		
		New Construction	Widening / Improvements	Total Length
A	95 (153)	29 (47)	11 (17)	40 (64)
B-S1	98 (158)	30 (48)	16 (26)	46 (74)
B-S2	96 (155)	42 (67)	0 (0)	42 (67)
B-S3	99 (159)	37 (60)	6 (10)	43 (70)
C-S1	103 (166)	22 (36)	29 (46)	51 (82)
C-S2	102 (164)	30 (49)	17 (26)	47 (75)
C-S3	104 (167)	26 (42)	23 (37)	49 (79)

Table 5-3: Expressway Route Option Distances in Miles (brackets Kilometres)

5.3 Corridor transport intervention package

5.3.1 The shortlisted Expressway options would form part of a wider package of transport measures for the corridor (Table 5-4). The Expressway options have been divided into three packages, with non-road elements common to each expressway route option. The shortlisted options include consideration of all modes of travel across the corridor.

Package A	Package B	Package C
Option A - Expressway Southern Route	Option B – Expressway Central Route following broad alignment of EWR	Option C – Expressway Northern Route
Expressway Options A, B and C include the upgrade of the A34, A421, A1 and A428 to Expressway standard.		
East West Rail – maximising choice for journeys in the corridor and beyond		
Technology – utilising current Expressway technology standards and consideration of the future role of technology for improving journeys by all modes		
Rail Integration – maximising interchange between all modes, including road and rail		
Local access / mobility – complementary measures as part of existing regional transport plans, such as City Deal and devolution		
Non-motorised users – ensuring Expressway options include measures for cycling, walking and equestrians		

Table 5-4: Transport intervention package options

East West Rail

5.3.2 An Oxford to Cambridge Expressway and EWR would deliver complementary strategic east-west transport connectivity. EWR therefore forms an essential component of the transport intervention package for the corridor. The Expressway would provide strategic connectivity between the M4, M40, M1, A1(M) and M11 and provide an attractive and efficient route for freight and long-distance trips and enhanced connectivity between key local and regional growth areas including the Knowledge Spine, Milton Keynes and the Cambridge Business and Science Parks.

5.3.3 EWR will provide a public transport option between the key urban areas within the study area (Oxford, Bicester, Milton Keynes, Bedford and potentially onwards to Cambridge). This scheme is essential to support growth in these urban areas and improve access into and between the central retail and business locations.

Technology

5.3.4 The Expressway's opening year is currently modelled as 2031. It is clear that within this time period there will be multiple advances in technology that could be fitted or if necessary retro-fitted within the lifespan of the Expressway.

5.3.5 During this time period we can expect increasing use of electric cars and possibly Fuel Cell (hydrogen) vehicles, which infrastructure will need to support with fixed point refuelling or stretches of roadway incorporating inductive charging capabilities.

5.3.6 The way traffic information is transferred to the road user is also advancing. Road and traffic-related information is already important to drivers – both provided from the infrastructure on signs and, increasingly, through in-vehicle devices providing routing guidance, advice and travel information (including about other modes). The trend of more in-vehicle information may develop such that some roadside signage can be retired, rather as roadside telephones have been largely replaced by personal mobile phones.

5.3.7 In the long-term consideration will need to be given to the substantial and potentially disruptive issues of vehicle connectivity and automation and the impact that they will have on the traffic environment, both in smart cities and smart corridors. Connectivity and automation are widely expected to increase safety and throughput when fully introduced, but there will be many issues for road users and for road operators during the long transition period. Platooning of heavy trucks is likely to be trialled on UK roads over the next few years and, if successful and useful, could transform how many key link roads operate.

5.3.8 The effect of many more closely-spaced axles on the road pavement is an area for further study. Ad-hoc platooning of individual vehicles (for example, as a form of connected cruise control) could also be one of the ways in which more automated vehicles would make use of the road space. Perhaps lane markings will become more important in the near term to support automated vehicles but may, ultimately, not be required at all.

Rail integration

5.3.9 Within the corridor the potential of rail interchanges needs to be maximised, in particular to ensure EWR directly supports the planned levels of growth in the corridor. Public transport hubs maximise interchange opportunities by all modes of travel, encourage modal shift and provide sustainable locations for high-quality, dense residential and employment development.

5.3.10 There are significant benefits to encouraging development around new and existing interchange hubs, including the effective use/re-use of private and public sector land in highly sustainable locations to secure the wider regeneration and growth of local areas.

5.3.11 Transport interventions in the corridor could be supported by providing higher density developments around public transport interchanges. EWR provides new opportunities for developments around rail interchanges and increased opportunities at existing rail interchanges. This complementary transport package will help deliver a range of housing needs. This package would therefore provide local benefits by delivering housing to support the fast growing economies in the towns and cities located along the corridor.

5.3.12 This approach is already evident with the allocation of the Cambridge Northern Fringe East site within the Cambridge and South Cambridgeshire Local Plans. This area currently consists of brownfield land and low grade industrial uses. With the delivery of the Cambridge North station, this area has the potential to be developed into a high density residential and employment site, supporting the delivery of planned growth in Cambridge.

Local access/mobility

5.3.13 Local access and mobility complimentary measures will be delivered by local highway authorities and their partner organisations.

Non-Motorised Users

5.3.14 The development of the Expressway options will fully consider the provision of appropriate facilities for pedestrians, cyclists and equestrians. The Stage 1 report identified the locations where existing Public Rights of Way (PROW) and the National Cycle Network interact with the existing east-west route. The Expressway route options will support the needs of non-motorised users by providing appropriate and improved facilities.

5.3.15 This package could contribute to the development of safe, comprehensive and high quality cycling and PROW networks. The Expressway options will include safe and segregated crossing facilities that support the creation of comprehensive and coherent networks. This package would be delivered in consultation with a range of partners and stakeholders including the County Councils, Unitary Authorities and Sustrans. There is also potential to integrate with the Milton Keynes to Bedford Canal.

5.3.16 These complementary measures could have a positive impact on communities by maintaining or improving walk and cycle connections, ensuring that routes are attractive, safe and accessible. This package will help support travel by active modes and potentially encourage modal shift from car to walking and cycling for local journeys.

6. Economic Case

6.1.1 This section of the report summarises the estimated scheme costs along with the benefits an Oxford to Cambridge Expressway could deliver.

6.2 Scheme Costs

6.2.1 Cost estimates have been produced for the shortlisted Expressway options. These are order of magnitude costs only and reflect the strategic nature of the options and outline route detail at this stage of the study. These are cost estimates based at 2014 prices.

Shortlisted Expressway Option	Base cost (plus uncertainty and project risk)*
Option A	£3,452
Option BS1	£3,035
Option BS2	£3,297
Option BS3	£3,366
Option CS1	£3,216
Option CS2	£3,481
Option CS3	£3,514

* Assumes the Expressway is open to traffic in 2031

Table 6-1: Order of Magnitude Scheme Costs in £ Millions

6.2.2 Further work will be undertaken to refine these cost estimates as the study progresses to the next stage of scheme development.

6.3 Scheme Beneficiaries

6.3.1 An Oxford to Cambridge Expressway would support the travel needs and provide benefits to of a broad cross-section of beneficiaries including:

- Freight industry: The main benefit of the Expressway to local, regional and national freight movements would be reduced journey times, more reliable journeys and reduced congestion which is critical for freight operators and have a direct impact on their operating costs;
- Business travellers: Business travellers would benefit from journey time savings and increased journey reliability, significantly improving business linkages along the length of the corridor, resulting in improved opportunities for collaboration, knowledge-sharing and increasing the attractiveness of the corridor to inward investment;
- Commuters: Commuters would benefit significantly from journey time savings during the peak travel periods due to reduced congestion and delays. The Expressway opens up new opportunities for commuters to live and work in a broader range of locations within the corridor creating a single functional economic area and supporting the growth of key employment areas;

- Leisure travellers: People accessing tourist destinations in the southwest, south wales, East of England and within the study area itself would benefit from improved access to the SRN network and strategic route through the study area;
- Local Communities: Villages, towns and cities within the study area would benefit from the improved accessibility that the Expressway could provide to jobs, services and local amenities. Communities within the corridor would also benefit from reduced traffic congestion including the A34 corridor, central Milton Keynes and Thame and Aylesbury (Option A). Reduced traffic congestion provides positive environmental benefits for local communities, including improved air quality and reduced noise and incident frequency; and
- Knowledge-Intensive sectors and the wider economy: The Expressway could deliver substantial agglomeration benefits along the corridor due to improvements in accessibility to and between a number of large economic centres. The Expressway scheme would connect the high performance functional economic areas of Oxford, Milton Keynes and Cambridge and their wider hinterlands. Significant journey time improvements associated with a scheme would expand commuting catchment areas and spread agglomeration benefits over a wider area. Expressway interventions could induce changes in private investment and hence the location of economic activity, with locations affected by transport improvements typically becoming more attractive for private investment. The relocation of economic activity is likely to lead to productivity benefits, as firms benefit from locations which better serve their customers and with better access to labour, skills and suppliers. Over time, employees may also relocate in order to benefit from the new employment opportunities presented, leading to further agglomeration benefits and subsequent impacts upon the pattern of travel for both employees and businesses.

6.3.2 All potential users of the Expressway would benefit from reduced journey times, more reliable journeys, improved route safety and network resilience. The Expressway, in conjunction with EWR and the complementary measures of route technology, local access improvements and non-motorised user improvements would provide a step-change in east-west connectivity across the corridor generating benefits and opportunities for existing and future local residents. All route options would support the continued growth of the corridors highly successful, innovative and productive economy and thus maintain its high contribution to the UK as a whole.

6.4 Option performance

Scheme impact on journey times

6.4.1 An initial assessment of the shortlisted Expressway options has been undertaken using the AM peak hour Trafficmaster data. A summary of the initial estimated journey time savings are provided in Table 6-2.

Option	M4 Chievely to M1 (Milton Keynes)		M1 Milton Keynes to Girton Interchange		M4 Chievely to Girton Interchange	
	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound
2015 Base	01:39:30	01:35:26	00:45:30	00:47:56	02:25:00	02:23:22
Option A	00:57:39	00:56:07	00:36:01	00:36:43	01:33:41	01:32:50
Option B-S1	00:59:15	00:57:38	00:36:01	00:36:43	01:35:16	01:34:21
Option B-S2	00:59:03	00:57:31	00:36:01	00:36:43	01:35:05	01:34:14
Option B-S3	01:01:00	00:59:28	00:36:01	00:36:43	01:37:01	01:36:11
Option CS1	01:03:47	01:02:11	00:36:01	00:36:43	01:39:48	01:38:53
Option C-S2	01:03:59	01:02:28	00:36:01	00:36:43	01:40:01	01:39:11
Option C-S3	01:05:56	01:04:25	00:36:01	00:36:43	01:41:57	01:41:08

Table 6-2: Estimated Journey Time (Base Year and Scheme Options)

6.4.2 The initial assessment suggests that that journey savings in the range of 44-51 minutes could be achieved between the M4 Chievely and the Girton Interchange in the AM peak period. The main journey time savings are predicted between the M4 and the M1, with an Expressway predicted to result in 31-42 minutes of savings depending on the option and direction of travel. The A428 dualling is predicted to result in 9-11 minutes of journey time savings in the AM peak period, depending on the travel direction. This initial analysis shows that an Expressway could result in substantial end-to-end journey time savings, along with significant benefits between Oxford and Milton Keynes and Milton Keynes and Cambridge.

Frieght movements

6.4.3 The Stage 1 study identified that the A34 performs an important strategic freight function and the SEMLep region has key strengths in distribution and logistics. Congestion on the existing road network is therefore a significant cost to hauliers and the efficient movement of goods through and from within the study area.

6.4.4 HGV traffic is forecast to increase by an average of 22% between 2014 and 2041[12], which will put increasing strain on the already congested east-west route. The GB Freight Model has been used to assess the potential benefit of an Expressway intervention on strategic freight movements.

6.4.5 The freight modelling demonstrates that the Expressway could attract HGVs to the route, with up to 1.3 million HGVs per year forecast to use the new route in 2041. Figure 6-1 shows the predicted impact of an Expressway intervention on HGV movements. The routes coloured blue are predicted to benefit from a reduction in HGV movements and the routes coloured red would attract an increase in HGV movements.

12 www.gov.uk/government/publications/road-traffic-forecasts-2015

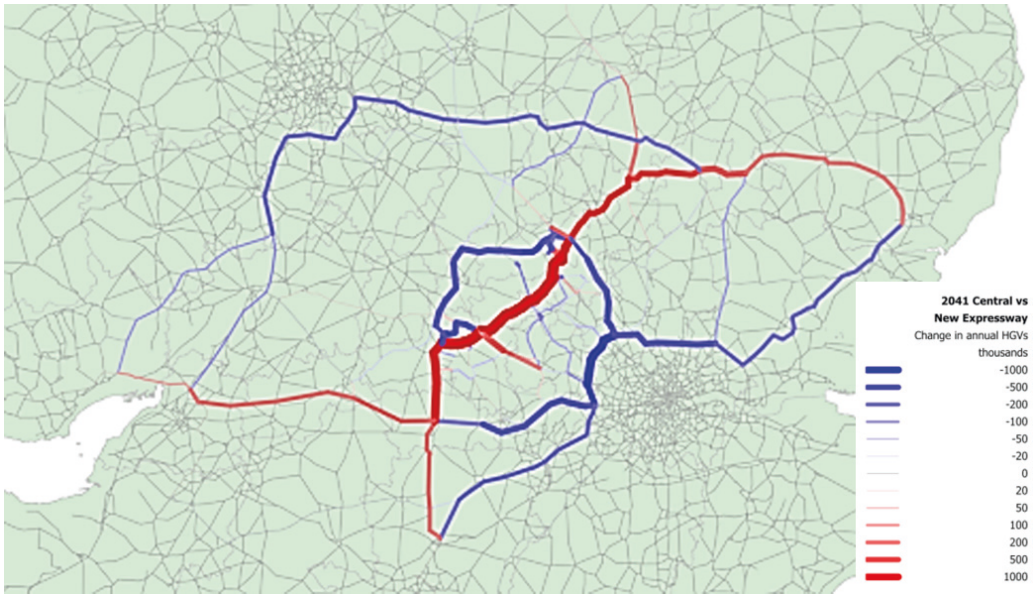


Figure 6-1: Change in 2041 HGV Movements due to Expressway Intervention

6.4.6 Figure 6-1 shows that the GB Freight Model predicts that an Expressway route would provide an attractive freight route that could provide relief to a number of existing routes including:

- The existing Oxford to Milton Keynes route (A34–M40–A43– A421) with a predicted reduction of 260,000 HGV movements per year on the A43 and significant reductions in HGV movements on the A421 through Milton Keynes;
- The M25 from Junction 16 to 17, with a predicted reduction of 524,000 HGV movements per year; and
- The M42 from Junction 2 to 3, with a predicted reduction in 163,000 HGV movements per year.

6.4.7 The GB freight modelling demonstrates that the Expressway could provide substantial national, regional and local freight benefits. Strategic connectivity between the south and eastern posts would be improved, connectivity between companies would be enhanced (increasing the efficiency of deliveries in the corridor) and congestion on the existing east-west route would be reduced, improving journey times for local freight movements in and out of existing and planned distribution centres.

6.4.8 It has been estimated that the freight user benefits (cost saving for hauliers) due to the Expressway intervention amounts to £19.5m per year in 2041 (in 2016 prices). These cost savings are likely to be a conservative estimate as they do not include a representation of the reduction in congestion.

Labour catchments and mobility

6.4.9 The Expressway would improve east-west connectivity between communities resulting in increased labour mobility and catchment areas. This could benefit employers by increasing the catchment of skilled workers living within reasonable commuter distances of key employment areas. Analysis has been undertaken using TRACC Visography, 2011 Census and National Transport Model planning data to estimate the number of people in 2041 aged 16 to 64 (excluding students and the retired) within 45 minutes' drive time of key corridor locations with and without Expressway Option B (Table 6-2).

Destination	Existing Worker Catchment	Option B Worker Catchment	Diff	% Change
Cambridge Science Park	791,114	865,639	+74,525	+9.3%
Milton Keynes	1,844,004	2,228,388	+384,384	+20.8%
Aylesbury	1,993,112	2,116,029	+122,917	+5.7%
Central Bicester	1,081,150	1,421,384	+350,234	+30.5%
Oxford Science Park	1,112,945	1,582,672	+469,727	+39.9%
Harwell Science and Innovation Centre	1,392,438	1,459,986	+67,548	+4.8%

Table 6-2: Predicted Change in Workers within 45 Minutes' drive time of Key Corridor Locations in 2041

6.4.10 Table 6-2 shows that an Expressway intervention could have a substantial impact on labour market catchments, for example by 2041 an additional 384,000 people are predicted to be brought into a 45 minute drive time of Milton Keynes, 470,000 more into the Oxford Science Park catchment, 350,000 more into the Bicester catchment and 123,000 more into an Aylesbury catchment.

6.4.11 A schematic diagram showing the potential change in Oxford, Milton Keynes and Cambridge 45 minute peak drive time catchments is provided in Figure 6-3. Currently there is limited commuting between these three functional economic areas. With an Expressway in place there is potential for a much stronger relationship between these three key locations, demonstrated by the significant overlapping of 45 minute drive-time catchments. Of particular significance, the Science Vale is predicted to be within 45 minutes' drive time of the western edge of Milton Keynes, Oxford is predicted to be within 45 minutes' drive time of Milton Keynes and the eastern edge of Milton Keynes within 45 minutes' drive time from the Cambridge Science Park. Key growth areas in Oxford, Milton Keynes and Cambridge should therefore significantly benefit from an Expressway intervention.

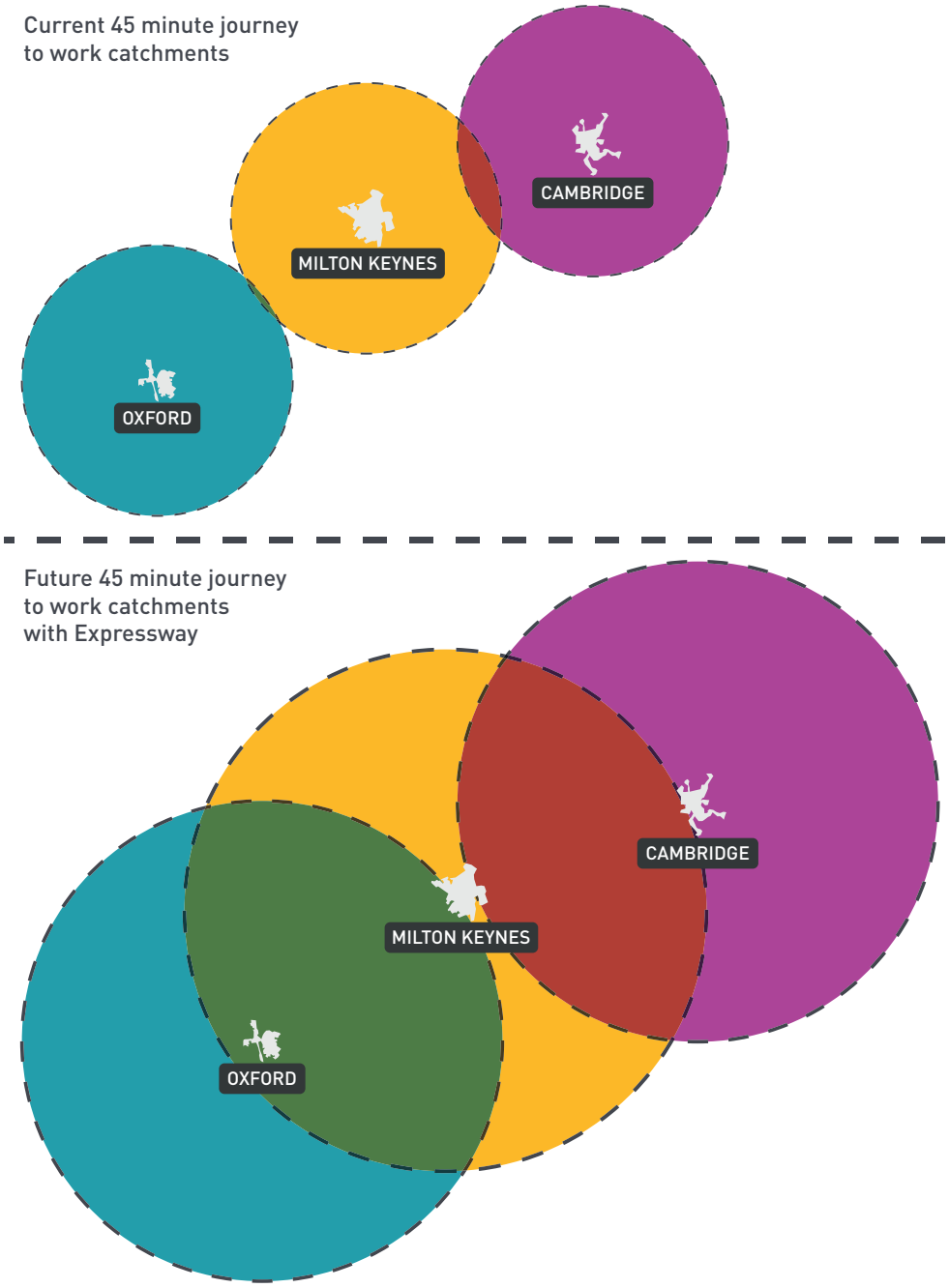


Figure 6-3: Summary of the Oxford, Milton Keynes and Cambridge 45 Drive-Time Catchments

Wider Economic Benefits

6.4.12 The shortlisted Expressway options have the potential to deliver wider economic benefits. The next stage of this study will use a Land-Use and Transport Interaction model to assess the likely impacts of transport investment in the Oxford to Cambridge corridor on local economic activity. In the interim, key wider economic benefit growth metrics include working age population, dwellings, knowledge economy jobs and total jobs directly served by the Expressway options have been analysed. To establish the potential for wider economic benefits to be accrued these metrics have been forecast to 2041 for direct catchments areas along each of the main Expressway route options (Table 6-4).

Option	Working Age Population	Dwellings	Knowledge Economy Jobs	Total Jobs
A	936,000	583,000	108,000	736,000
B	871,000	541,000	101,000	683,000
C	879,000	545,000	101,000	689,000

Table 6-4: Summary of the 2041 Socio-economic impacts of the Shortlisted Expressway Options

6.4.13 Table 6-4 shows that an Expressway is forecast to provide direct transport benefits (including journey time savings and increase journey time reliability) for up to 936,000 people of working age by 2041. An Expressway could provide direct transport access and travel benefits for people employed in 108,000 Knowledge Economy jobs and 736,000 jobs in total by 2041. These metrics have been calculated for route catchments areas directly served by each of the short listed Expressway routes and therefore do not include the wider study area. Further analysis of the potential wider economic benefits of an Expressway intervention will be undertaken in the next stage of the study.

6.4.14 The results in Table 6-4 show that Option A (via Aylesbury) performs strongest in these socio-economic metrics with Option B (EWR corridor) and Option C (A441 corridor) resulting in similar levels of socio-economic benefits. All three options have the potential to serve a substantial number of people and jobs and key employment sites.

7. Summary

7.1.1 The study area is one of the most innovative, productive and significant growth corridors in the country. The corridor also contains three of the UK's fastest growing and most successful urban areas, Oxford, Milton Keynes and Cambridge. The economic success of the region presents a massive challenge for the delivery of housing, jobs and the efficient movement of goods and people. Despite strong economic growth across the region, there is no direct strategic road or rail network connection linking Oxford, Milton Keynes and Cambridge.

7.1.2 The corridor from Oxford through Milton Keynes to Cambridge has the potential to sustain its strong economic growth and contribution to the UK economy. But poor connectivity and a shortage of affordable housing means the corridor is unable to fulfil its full potential, and that could reduce the ability for jobs and growth both locally and nationwide. The corridor is already one of the UK's most productive and innovative regions, and strategic transport interventions need to make sure that a lack of transport connectivity does not prevent it competing and being prosperous in an international market place. Transport improvements could achieve this by bringing jobs, homes, businesses and world leading universities closer together, maximising the integration benefits of a high skilled, high employment, high innovation cluster, contributing to the national economy by leading the world in innovative technology and jobs.

7.1.3 However, there are significant challenges. Transport connectivity is poor with towns and cities across the corridor being often better connected to London than each other, and congestion along the corridor is predicted to get much worse, as travel demand is forecast to increase by around 40% by 2035.

7.2 Need for intervention

7.2.1 The study has identified that there is currently a lack of east-west transport connectivity across this part of the UK, to the north of London and south of the Midlands. The evidence demonstrates the potential for improving strategic connectivity by addressing this missing link in the national infrastructure.

7.2.2 Failure to address the challenges identified in these studies, and invest accordingly in east-west transport links within the study area, is likely to constrain economic growth along the Oxford to Cambridge corridor, and adversely impact on the significant development opportunities. In the absence of transport interventions, congestion along the existing road and rail networks is expected to worsen, leading to increased journey times for commuters and businesses. This could constrain economic development in key growth areas including the Oxford, Milton Keynes and Cambridge city regions and wider functional economic areas.

7.2.3 Within the study area there are substantial levels of population and job growth planned. In particular, substantial housing and job growth in the Cambridge, Oxford and Milton Keynes city-regions is required to support their expanding, strong, dynamic, innovative and successful knowledge based economies, which contribute disproportionately more towards the national economic output.

7.2.4 The local authorities in the area have identified that congestion, unreliable journey times and poor east-west connectivity are barriers to delivering future housing development and economic growth within the corridor. If strategic east-west transport improvements are not delivered, the networks will be operating over-capacity, further increasing journey time variability and delays. Delays as a result of increased congestion will be a cost borne by businesses, restricting business efficiency, investment and access to local, regional and global markets.

7.2.5 In order to flourish, knowledge-based sectors depend upon high quality support from 'enabling' sectors such as financial and professional services and other business services which are predominantly, but not exclusively, located in London. Existing high-quality radial transport links into London already allow firms located along the Oxford to Cambridge route to access world-class support in London, but improved east-west connectivity along the corridor, such as journey times of around 45 minutes between Oxford and Milton Keynes could enable such support in the corridor, further boosting economic growth. Improved east-west transport interventions could therefore;

- Improve commuting/interaction between Oxford, Milton Keynes and Cambridge (each has zone of influence) and the urban and rural areas in between;
- Improve matching between skills and employment opportunities, widening the labour pool; and
- Increase economic interaction (with associated impacts on trade, specialisation, productivity) between the local areas.

7.3 Next Steps

7.3.1 The initial option sifting resulted in the three main Expressway options scoring highest together with EWR. The initial assessment of the three short listed Expressway options showed that the benefits were promising enough to take them forward to the next stage of assessment.

7.3.2 The next stage of this assessment will undertake a more detailed qualitative and quantitative assessment of the short listed Expressway schemes. This stage of the study will assess the value for money, environmental, transport, and economic impacts of the Expressway interventions and will be reported in a Strategic Outline Business Case.

7.3.3 The next stage of this study will also include further analysis of the potential interaction between the short listed Expressway schemes and EWR to better understand the complementary benefits both schemes could provide.

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