Ely to Cambridge Transport Study

Preliminary Strategic Outline Business Case

January 2018

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Executive summary

The role of the Ely to Cambridge area in the Cambridgeshire economy

This report sets out the findings of a transport study into the transport network linking Ely and Fenland to Cambridge and the strategic transport network in the county of Cambridgeshire.

The A10 Primary Route and the parallel Cambridge to Kings Lynn railway line are the main transport links between Ely and Cambridge. They provide for travel between Fenland, East Cambridgeshire, West Norfolk and Cambridge, and directly serve a number of key centres of economic activity on the northern fringe of Cambridge and on the routes themselves.

The Cambridge Science Park and neighbouring innovation centres and business parks on the northern fringe of Cambridge are home to an exceptionally high-performing cluster of high-tech and knowledge-based businesses which have benefited from close associations with the University of Cambridge and generate Gross Value Added well in excess of national and county averages.

Capacity constraints threaten further growth

Because of their position linking these employment sites to residential areas in Ely and beyond, the road and rail links in the study area are already very busy, particularly at peak times, when there is extensive congestion. There is limited capacity to accommodate further travel demand on this key corridor, which will impede further economic and housing growth if not addressed.

To support the continued success and growth of the high tech and knowledge-based cluster, more employment floorspace close to the existing sites is needed, as is affordable housing for those working in these businesses. The lack of employment space and affordable housing constrain further growth of the cluster.

Employment constraints reflect the natural growth of existing businesses occupying additional space allocated in designated science and business parks. Meanwhile the housing constraint reflects both national trends towards increasing housing costs and also the relative affluence of those working in these businesses, which (in the context of limited supply) has pushed house prices in and around Cambridge to very high levels.

The need to address these constraints

Given local and national policies supporting further growth of the Cambridge area’s strongly performing economy, there is a pressing need to address these constraints.

Accordingly, local planning policy is supportive of a programme of significant development of both employment land and residential land, focused on the southern end of the Ely to Cambridge study area where the main existing economic activity is located, and extending northwards to Ely, taking advantage of the availability of relatively large tracts of brownfield and undeveloped land.

The key sites for this development are at a new town north of Waterbeach, at the Cambridge Science Park, on the Cambridge Northern Fringe East and at sites around Ely. Between them, these developments could bring up to 17,000 new homes and 14,000 new jobs.

Without further investment to manage and accommodate new travel demand, the increased volume of travel which arises from these developments will exacerbate congestion and crowding problems which are apparent today, and will displace traffic onto less suitable parallel routes.

There is therefore a need to develop and deliver a package of transport measures both to address the problems experienced today and to manage the impacts of growth.

Objectives to inform option development and assessment

A series of objectives have been agreed, distilling the key challenges and opportunities identified through this transport study. They also reflect:

- the high-level policy requirements set out in the Transport Strategy for Cambridge and South Cambridgeshire, the Third Cambridge Local Transport Plan, and the Cambridgeshire Long Term Transport Strategy, and
- the detailed policy position set out in the Cambridge and South Cambridgeshire Local Plans and the transport strategies in relation to the new town north of Waterbeach and developments on the Cambridge Northern Fringe.

The objectives seek to:

1. Maintain traffic at or below 2011 traffic levels in Cambridge
2. Minimise vehicle mileage whilst providing for increased travel demand
3. Improve reliability, capacity and speed of alternative transport modes
4. Minimise potential impact on alternative "rat-runs" to the A10
5. Intercept or substitute car trips with alternative transport modes
6. Address transport demand from the new town north of Waterbeach
7. Enable development in the Cambridge North Fringe East/Cambridge Science Park to proceed

Developing options for assessment

This study has assessed options to reduce highway travel demand and options which assist in accommodating increased travel demand as sustainably as possible. A key finding is that the level and management of parking space at the development sites will be critical, and parking standards for key employment sites will need to be reviewed.

In conjunction, this study has assessed progressively greater levels of transport investment – initially testing in isolation measures aimed at encouraging a shift from car use to public transport, walking, and cycling, and subsequently testing these in conjunction first with junction improvements along the A10, and finally with the implementation of dual carriageway standards on the South, North, and full A10 corridor between Ely and Cambridge.

The packages of transport measures that were developed for assessment are:

- **Mode-shift (DS1) – indicative cost, £150 million**
  Minimal highway network improvements providing only for direct access to the development sites, and measures to encourage mode shift to non-car modes of transport, including:
  - a relocated Waterbeach railway station serving both the village and the new town,
  - segregated public transport links between the new town at Waterbeach and Cambridge, and park and ride capacity at the new town to intercept trips into the city,

  - a comprehensive pedestrian and cycle network serving the new town and linking it to Cambridge and neighbouring villages, and
  - Parking restraints and travel planning measures at all of the major development sites.
- **Junction+ (DS2) – indicative cost, £225 million**
  Mode-shift option measures from DS1, and additionally, improvements to provide additional capacity at junctions on the A10 between Ely and Cambridge.
- **North-dual (DS3) – indicative cost, £415 million**
  Mode-shift and Junction+ measures from DS1 and DS2, and additionally, the provision of a dual carriageway route, on an alignment to be determined, between the new town north of Waterbeach and Ely
- **South-dual (DS4) – indicative cost, £310 million**
  Mode-shift and Junction+ measures from DS1 and DS2, and additionally, the provision of a dual carriageway route, on an alignment to be determined, between the new town north of Waterbeach and the A14 at the Milton Interchange.
- **Full-dual (DS5) – indicative cost, £510 million**
  Mode-shift and Junction+ measures from DS1 and DS2, and additionally, the provision of a dual carriageway route, on an alignment to be determined, between Ely and the A14 at the Milton Interchange.

A key finding is that while the mode-shift options without highway improvements provide additional travel capacity and have significant benefits, they do not substantially address the congestion and traffic displacement issues identified. Options with highway improvements are more effective in addressing these issues.

Costs and Benefits

Options involving substantial highway improvement and capacity enhancement works entail higher capital costs; fully upgrading the A10 between Ely and Cambridge to dual carriageway standard has the highest capital cost of all interventions that have been assessed.

However, those same options also deliver greater levels of benefit, and all packages assessed generate sufficient benefits to more than outweigh the estimated cost of implementation, and are assessed as providing ‘high value for money’.

The best value for money was derived from the mode shift and Junction + option (DS2), which generated a benefit to cost ratio (BCR) of 3.6 to 1. The next best value for money was the upgrading of the southern stretch of the A10 from Waterbeach to Cambridge to dual carriageway, together with mode shift measures, which delivered a BCR of 3.2 to 1. The greatest level of benefit was generated by the full upgrading of the A10 from Ely to Cambridge, which generated benefits at present value of some £760m over the lifetime of the scheme, at a BCR of 2.8 to 1.

The costs noted for the tested packages are indicative, and at this stage of the business case process, are not based on specific scheme designs. More refined scheme costs would emerge as part of further scheme development. Similarly, the assessment of benefits would also be refined, and would bring in consideration of wider economic benefits.

Commercial and Management cases

At this stage in the development of measures to support the growth in the study area, it is sufficient to note that there are a variety of routes through which the eventual scheme(s) could and would be procured, and that Cambridgeshire County Council has experience of successfully delivering substantial infrastructure schemes and has robust governance in place for such undertakings.

Conclusions

A joined-up strategy is required that seeks to introduce both demand and supply-side measures in and around the study area to cater towards all modes of transport and ensure that potential issues are mitigated. Mechanisms should be put in place to secure developer funding to deliver, or substantially contribute towards the strategy, thus ensuring that adverse transport impacts are mitigated. The recommended strategy has been divided into three stages;

1. Policy, Planning and Regulation

A demand management approach should be adopted for development and applied to planning applications for proposals in, and impacting, the corridor, whereby development should:

- Minimise external vehicular trip generation through maximising trip internalisation
- Provide significantly lower levels of car parking than has traditionally been provided, particularly at employment locations
- Promote a site-wide approach to car parking management to reduce the need for significant increases in car parking provision
- Promote the use of non-car modes through appropriate investment in supply-side measures and aggressive travel planning to encourage the required mode shift

Acceptable and stretching highway 'trip budgets' should be identified for each site and permission for continued stages of development should be made contingent on the ability of the developers to demonstrate their sites are meeting these targets through effective promotion of non-car-mode take-up and site-based demand management. Developers might be able to accelerate the phasing of their sites should they be able to demonstrate that their sites are hitting targets for car trips and are not exceeding an agreed budget. This would encourage effective promotion of non-car-mode take-up to free up "headroom" for further development.

2. Delivery of multi-modal "quick wins"

The recommended strategy requires sequential delivery of "quick wins" – comprising public transport, pedestrian and cycle enhancements and active parking restraint to promote mode shift away from the private car, and a series of prioritised on- and off-line localised highway improvements to create capacity for additional trips and manage potential re-assignment of trips onto less suitable routes.

The recommended non-private car strategy is for:

- early implementation of the cycle measures,
- a relocated railway station at Waterbeach and
- early progression of the segregated public transport corridor from Waterbeach to Cambridge's Northern Fringe, together with park and ride provision at the new town.

Implementation of the non-highway proposals alongside ambitious travel planning for new and existing communities in the corridor could create some headroom for early, moderate scale, development at Waterbeach and at Cambridge Northern Fringe East and the Cambridge Science Park.

Options for junction improvements and other localised highway capacity improvements should be developed for early implementation. Targeted improvements at junctions along the A10 itself will lead to some improvements in conditions and reduce traffic rerouting elsewhere. These improvements should be accompanied by measures to discourage use of less suitable parallel routes including the B1049 and B1047.

3. Longer-term major highway interventions

Model-based analysis shows that the above "quick wins" alone will not mitigate more significant development-related growth, nor substantially address existing or future congestion.

Beyond the investments noted above, this study indicates that there could be significant additional transport benefits from providing increased carriageway capacity in the Ely to Cambridge corridor, and that this will be required to mitigate both longer-term background growth in travel demand and more significant proposals for development, particularly at the new town north of Waterbeach.

The initial study work suggests that, subject to more detailed work including examining environmental and operational impacts further, provision of increased carriageway capacity would represent a high value for money investment. This provision might be in the corridor itself, or on an alternative corridor if such an alignment were shown to remove a significant proportion of longer distance/through-traffic from the A10, or potentially through improvements to both.

Next steps

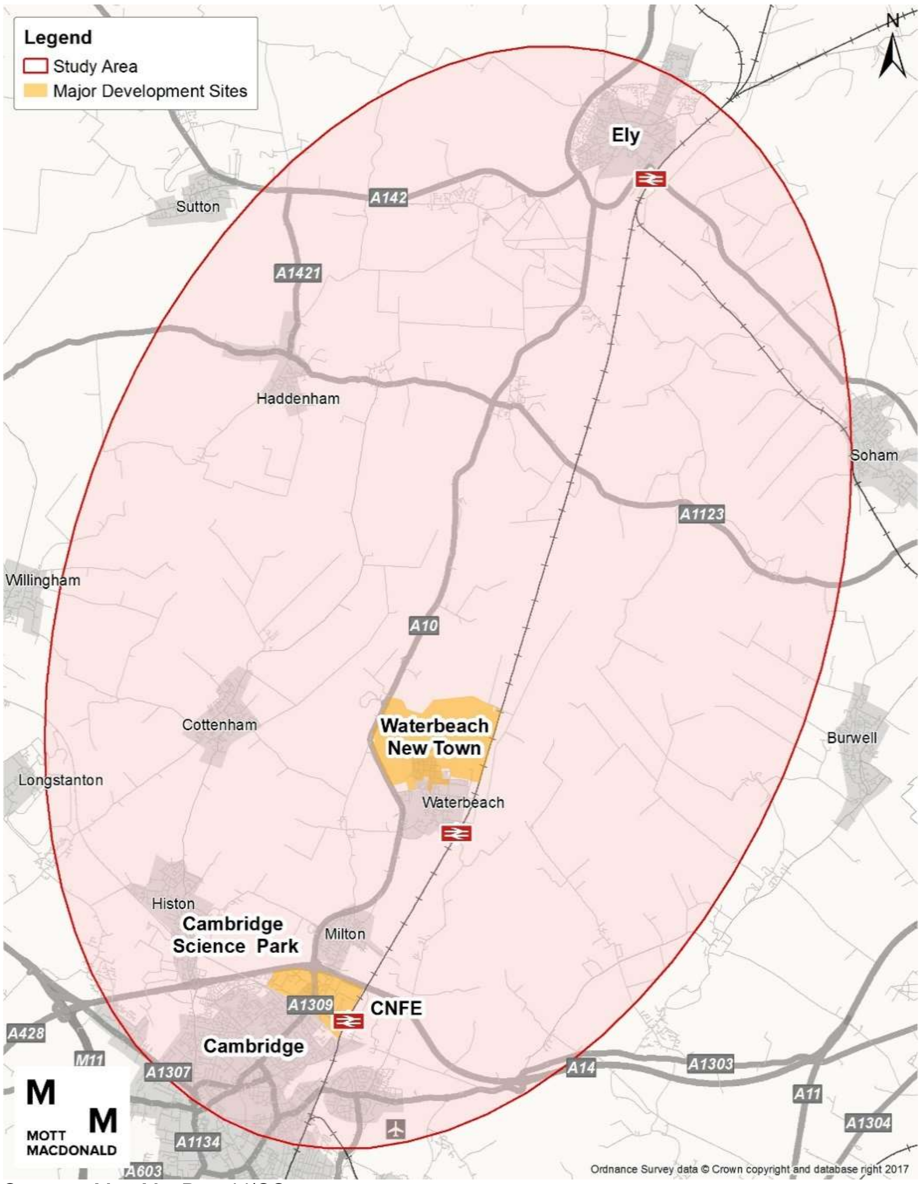
Further work will be needed to develop the case and options for intervention to support growth in the A10 corridor, and it is recommended that detailed follow-on studies are undertaken for the key elements of each package to refine the options and develop business cases for those investments. Thought will also be needed as to how to secure appropriate contributions from developers towards these strategic interventions.

1 Introduction

1.1 Headline Description

The Ely to Cambridge study area comprises the A10, a key north-south link in the Cambridgeshire highway network, and the parallel Cambridge to Kings Lynn railway line. The A10 is part of the Primary Route Network with the section in the study area being of single carriageway standard, linking the A14 Milton Interchange in the south to the A142 roundabout to the north at Ely. It passes adjacent to the villages of Milton, Landbeach, Waterbeach and Stretham. The study area is illustrated in Figure 1.

Figure 1: Indicative Ely to Cambridge Transport Study Area



Source: Mott MacDonald/OS

Currently, the route is subject to queueing and delays in peak times. These issues will be compounded in future years with further population, employment and traffic growth, and via development proposals at locations including Ely, at Waterbeach and on Cambridge's Northern Fringe.

The corridor is a focus for growth with strategic sites and other development anticipated in the study area up to 2031 and beyond. The Transport Strategy for Cambridge and South Cambridge (TSCSC) identifies a number of potential transport interventions in this corridor across the two districts which will provide for the transport demand associated with high levels of employment and population growth.

This Preliminary Strategic Outline Business Case (SOBC) sets out the case for interventions to address problems in the Ely to Cambridge study area. It represents the first stage of scheme appraisal and development, and as such will focus on establishing what the best transport strategy for the corridor will be, based on the assessment of differing levels of intervention.

1.2 Scheme Background

Mott MacDonald has been commissioned by Cambridgeshire County Council (CCC) on behalf of the Greater Cambridge Partnership to deliver the Ely to Cambridge Transport Study.

This important rail and primary route highway corridor provides one of the main links between Cambridge, its north eastern sub-region, including Ely, and beyond. It is also the focus of significant planned future development, with the Waterbeach New Settlement and the Cambridge Northern Fringe East (CNFE) and Cambridge Science Park (CSP) sites being the potential future location for significant residential and employment development. These key elements are shown in the indicative study area plan above.

As specified in the study brief, the outputs of the study are:

- An Options Study and Strategic Outline Business Case for the overall package of interventions between Ely and Cambridge, including development of principles/mechanisms for securing appropriate developer contributions.
- A Transport Study, supported by modelling, that identifies the infrastructure package and phasing of that package to provide for the transport demand of the development of a new town north of Waterbeach.
- A Transport Study, supported by modelling, which provides evidence for the level of development which could be supported in the CNFE and CSP areas and their phasing, in transport terms.

This report comprises the first output of the study listed above.

1.3 Report Structure

This report has been aligned with DfT's 'The Transport Business Cases' guidance, which sets out the 5-case structure for demonstrating the viability of transport proposals. These include:

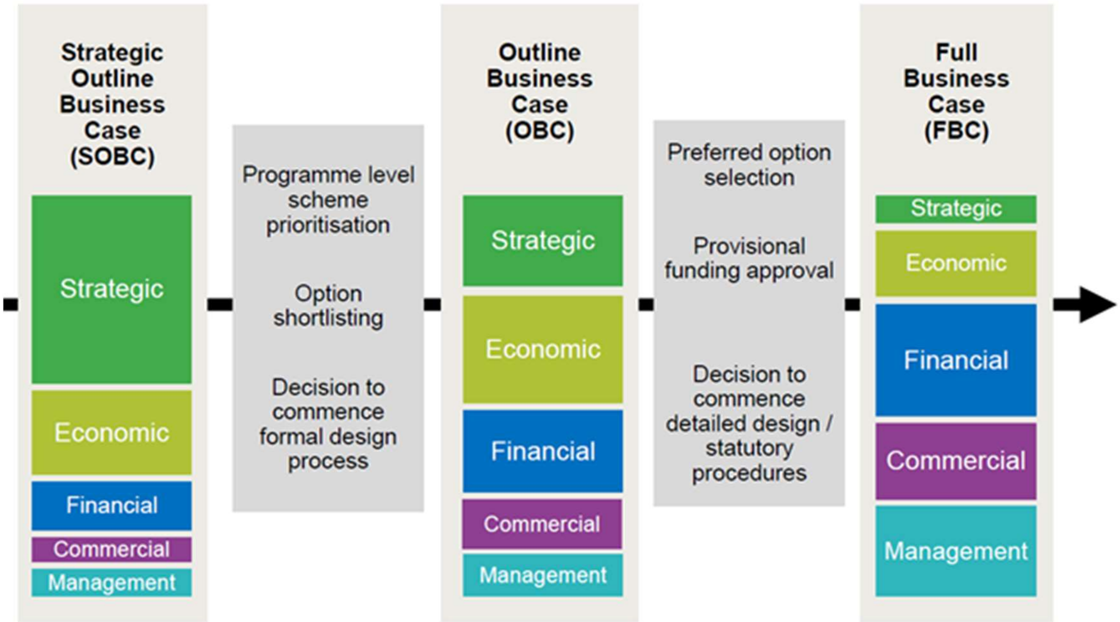
- Strategic Case
- Economic Case
- Financial Case
- Commercial Case
- Management Case

As the projects evolve, each of the cases is developed in further iterations of the Business Case documentation. These are:

- Strategic Outline Business Case (SOBC): Outlines the need for intervention in the context of established policy and current/future network issues. Undertakes a high-level appraisal of options that address locally developed objectives and a high-level strategy for delivering the interventions.
- Outline Business Case (OBC): Updates and builds upon the evidence base developed in the SOBC to incorporate a more detailed appraisal of intervention options focusing on estimating the likely performance and impact of intervention(s) in sufficient detail.
- Full Business Case (FBC): A further update of the OBC which considers the deliverability and management of the preferred intervention into the construction phases.

The relative level of input required at each phase is illustrated in Figure 2.

Figure 2: Summary of Business Case Development



This report acts as a precursor to full SOBC reports that will be required for individual schemes and measures and consequently is titled a Preliminary SOBC. The purpose of producing a report at this stage is to identify appropriate transport packages that can be implemented on the Ely to Cambridge Corridor. It is recognised that early option development forms a key part of the business case process and therefore a preliminary appraisal of five transport packages has been undertaken in this report to inform the ongoing development and delivery of a transport strategy for the Ely to Cambridge study area.

The contents of this report, alongside a summary of each part of the report is set out below in Table 1.

Table 1: SOBC Contents

Business Case Element	Report Sections	Description
Introductions	Section 1	Introduction to report structure and study area
Strategic Case	Section 2	Definition of the need for intervention and summary of option appraisal, based on evidence from policy, socio-economics and transport modelling
Financial Case	Section 3	Quantification of financial requirements for delivering the interventions
Economic Case	Section 4	Quantification of the benefits of interventions to counterbalance the cost of investment
Commercial Case	Section 5	Description of potential procurement and contractual arrangements required to deliver interventions
Management Case	Section 6	Outline of potential governance structures and project processes/interfaces required to deliver interventions.
Summary and Conclusions	Section 7	Outline of key findings and next steps

Source: Mott MacDonald

2 Strategic Case

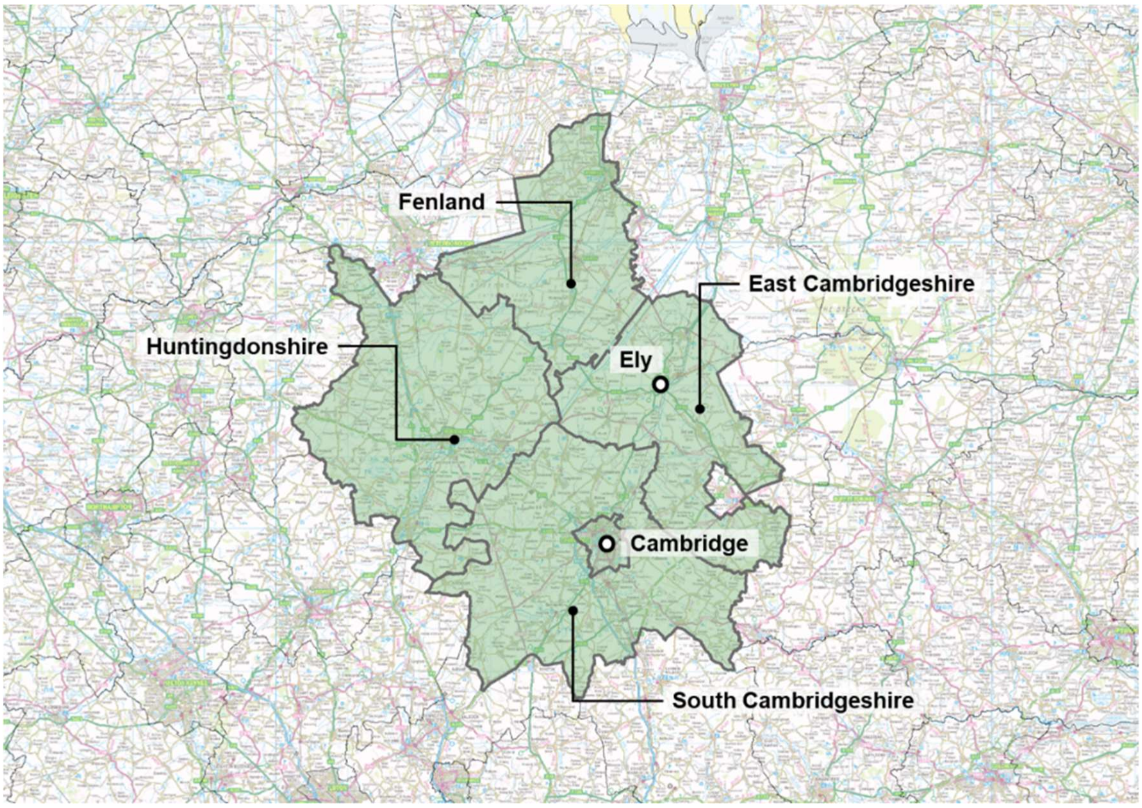
The purpose of the Strategic Case is to provide a wider narrative of the issues and opportunities in the study area that demonstrate a need for intervention. It then identifies five potential packages of interventions that could be adopted, and highlights the key findings from traffic modelling undertaken for each option. This section is based on a more detailed analysis and identification of problems and opportunities on the corridor included in an accompanying Evidence Base Report.

2.1 Economy and Population

The City of Cambridge: the engine of the Cambridgeshire economy

Together, the five districts of Cambridgeshire are home to a population of some 650,000 (647,000 in 2015). Nearly a quarter of these live in the Cambridge area in the south of the county. The boundaries of the county's districts are highlighted in Figure 3 below.

Figure 3: Cambridgeshire Authority Boundaries



Source: Ordnance Survey

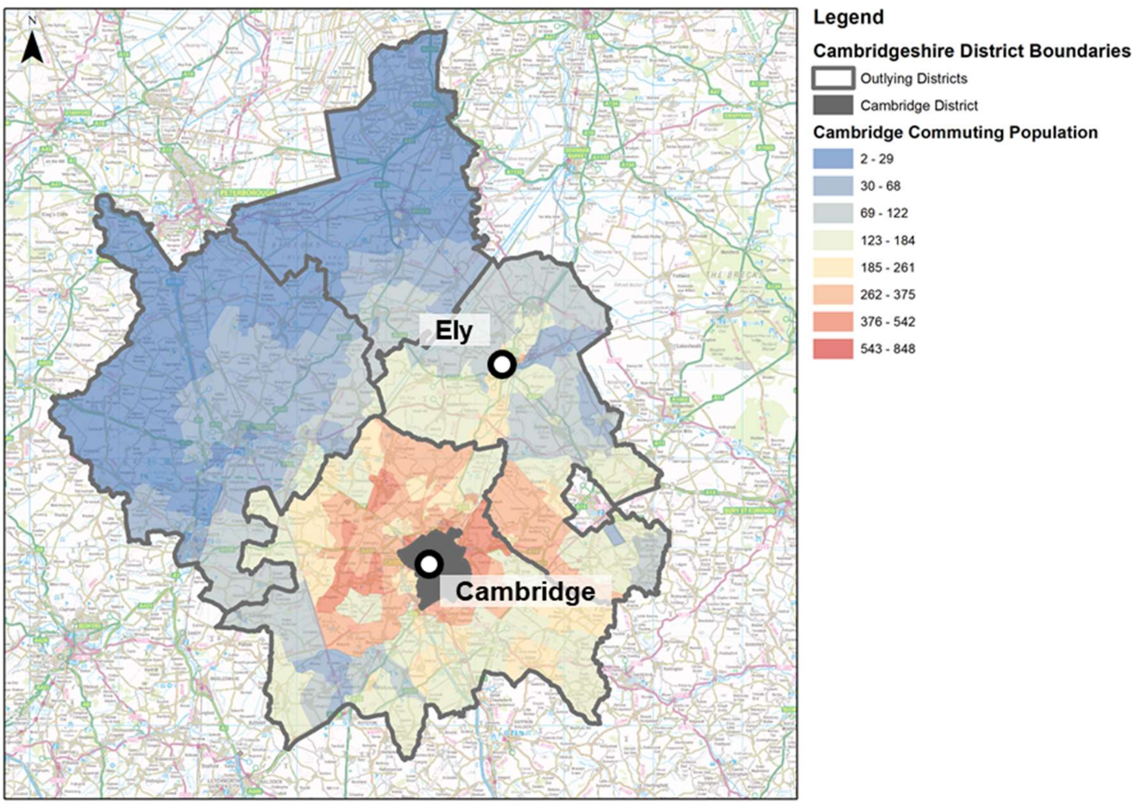
Cambridge is both the geographical and the functional heart one of the UK's most economically important areas, and also serves as the county's administrative centre. It is the site of the world-leading University of Cambridge and Anglia Ruskin University, and possesses a thriving knowledge economy. As well as being a major employer in its own right, the university sector generates associated business activity of exceptionally high value through spin-off technology enterprises located at the science and business parks located to the north of the city and in South Cambridgeshire, at the Cambridge Biomedical Campus to the south of the city, and at other locations in the sub-region.

These digital and life science businesses make Cambridge a major centre for employment in the technology sector across the UK, and indeed across Europe, with major businesses such as Acorn Computers (and the related microprocessor designer ARM), Solexa, Raspberry Pi, and Darktrace having emerged there since the late 1970s, and global tech companies such as Amazon and Apple establishing a presence in the city. Beyond science and technology, Cambridge has a strong business and management sector which has grown up around the universities and the cluster businesses.

As a result of all this activity layered on top of the many jobs traditionally associated with the day-to-day functioning of a major urban centre, Cambridge is home to by far the largest share of the jobs in Cambridgeshire, with a ratio of 1.2 jobs to every working age resident[1] (a statistic which includes the resident student population, many of whom do not in fact participate actively in the labour market). Accordingly, many of those employed in and on the fringes of Cambridge live in surrounding areas and travel some distance to their places of work.

This pattern is clearly visible in Figure 4 below, which shows how large numbers of people from across South Cambridgeshire and parts of East Cambridgeshire (notably northwards along the Ely to Cambridge corridor) commute to the Cambridge.

Figure 4: Population commuting to the Cambridge



Source: Ordnance Survey/NOMIS

[1] NOMIS data

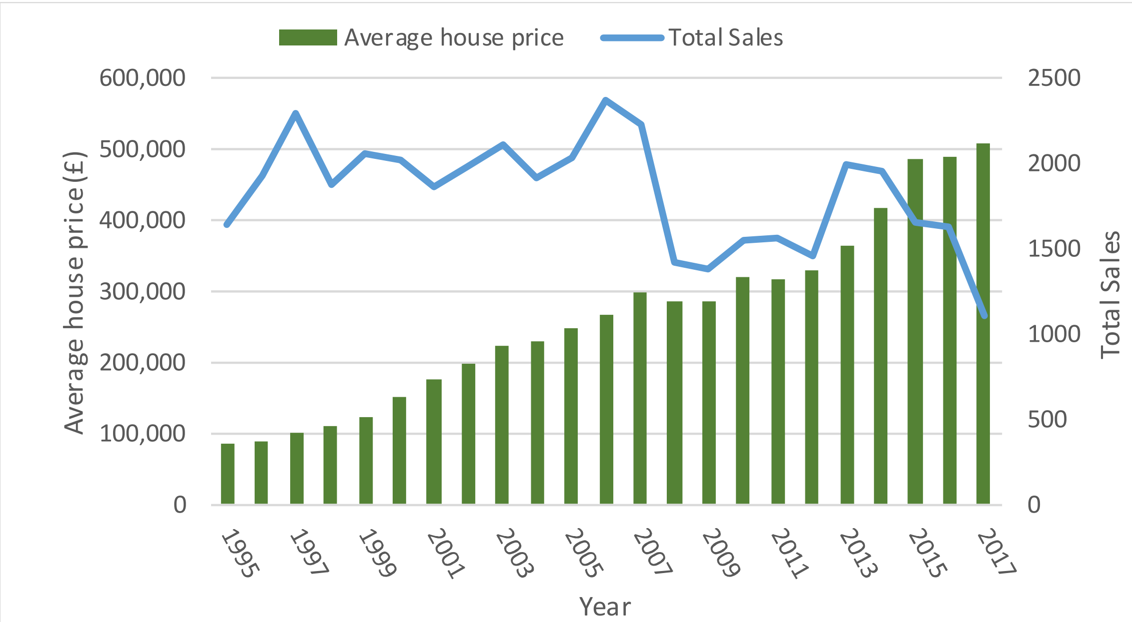
Beyond Cambridge, there is a ring of towns – St Neots, Huntingdon and St Ives in Huntingdonshire, Ely in East Cambridgeshire, Newmarket and Haverhill in Suffolk, and Royston in Hertfordshire, from which sizeable numbers of those living find employment in Cambridge. The same is true of the many smaller settlements across particularly the southern parts of Cambridgeshire.

Escalating demand for housing and the City's growing labour catchment

Over the last two decades, the strong economic performance of the Cambridge area has created many jobs of very high value (with GVA per head around £45,000 compared to between £22,000 and £28,000 across the rest of the county and around £25,000 across the UK as a whole). Consequently, it has attracted a large and affluent workforce. These successes have rightly been widely celebrated, but alongside its many positive impacts, growth has nonetheless contributed to a situation in which house prices have risen much faster than inflation over the past twenty of more years.

Figure 5 below illustrates an upward trend since 1995 which saw the average house price in Cambridge City climb from under £100,000 to some £500,000 in 2017, while the volume of sales fell over the same period. This is strong evidence of increasingly intense competition among a growing number of (increasingly affluent) would-be purchasers for what is effectively a fixed supply of housing, with those on lower income being priced out of the Cambridge housing market.

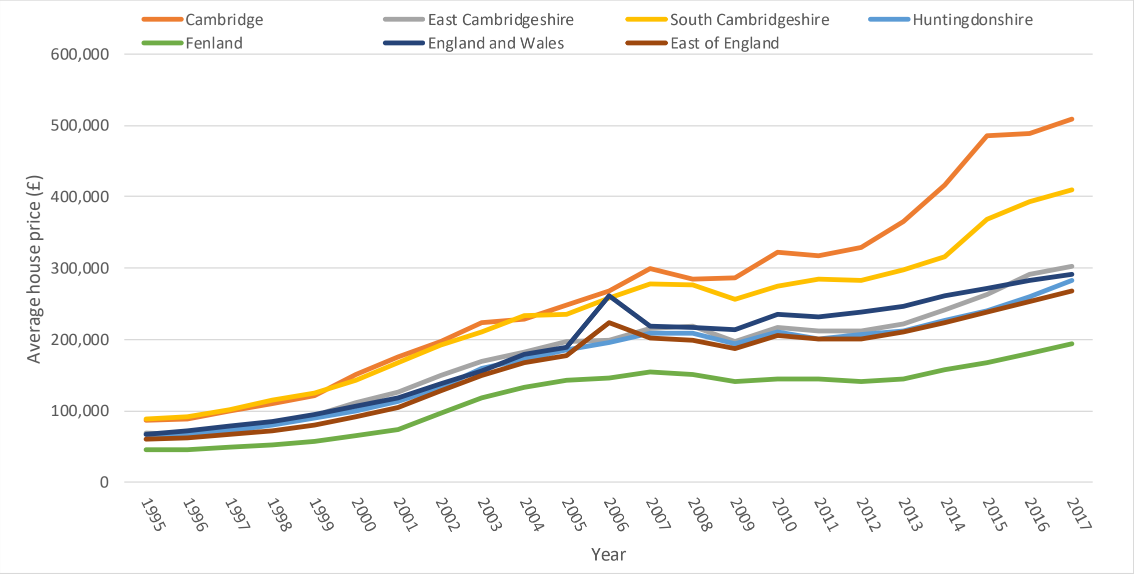
Figure 5: House prices and sales in Cambridge City, 1995-2017



Source: HM Land Registry

Figure 6 below makes clear that this is a particular problem in Cambridge and South Cambridgeshire; prices here have grown by between £300,000 and £400,000 since 1995, while prices in Fenland have risen by around £150,000.

Figure 6: House prices by district, regions and nations, 1995-2017



Source: HM Land Registry

The travel to work catchment for Cambridge has increased markedly, such that it is now not uncommon to commute to Cambridge from towns and villages around Norfolk, Suffolk, Hertfordshire, Essex, and even the north of London – while at the same time, the numbers of people commuting from the surrounding districts of Cambridgeshire which have always supplied the City with workers also continue to grow.

As the following section will make clear, the trend towards more and longer-distance commuting from within and beyond Cambridgeshire has led to increased pressure on the radial highway and public transport connections into Cambridge, leading to increases in journey times, reductions in journey time reliability, and increases in crowding.

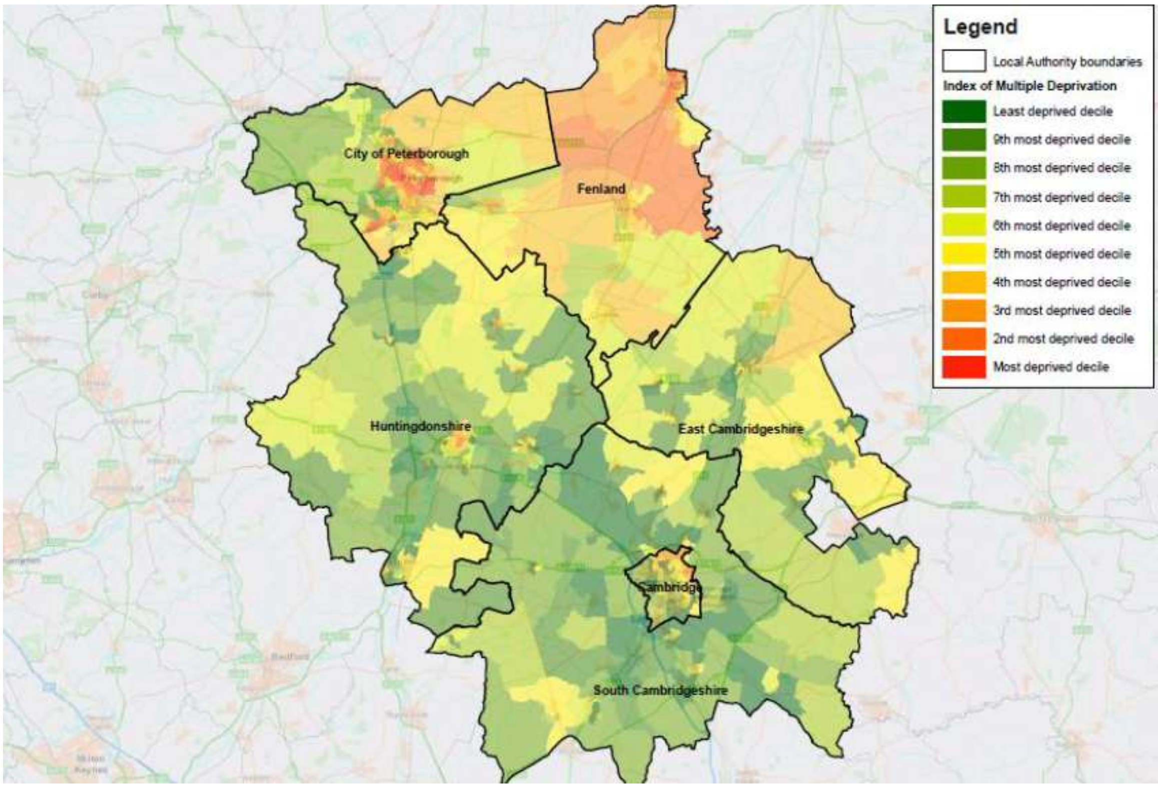
These issues not only lead to frustration and delay for those travelling in the affected areas, but at the extreme, an inability to efficiently deliver employees to their places of work may also threaten the county's otherwise strong prospects for growth.

The availability of affordable housing has caused difficulty for employers to recruit suitably qualified employees who may be required both to commute long distances, and also to locate in parts of the county which offer fewer of the conveniences such as ready access to high quality public transport, which are on offer closer to the urban core of Cambridge City.

Ultimately, if the cost of suitable accommodation in areas with sufficient transport connections and amenities becomes prohibitive within the context of the wages that businesses in Cambridge and the surrounding areas of South Cambridgeshire are able to pay, then businesses may find themselves unable to recruit appropriately qualified staff.

A further issue is the wide disparities between life outcomes which are found across different parts of Cambridgeshire. Fenland and East Cambridge, for example, lag well behind the Cambridge city average for incomes, and have rates of multiple deprivation far in excess of those in most other parts of the county, as illustrated in Figure 7 . Local policy seeks to ensure that these areas are able to share in the success of the activity clustered in and around Cambridge.

Figure 7: Indices of Multiple Deprivation across Cambridgeshire & Peterborough



For all these reasons, the identification of suitable locations for development of both residential and employment space, coupled with an effective strategy for delivery of supporting infrastructure is a key objective of the emerging Local Plans. Significant levels of development are proposed in the study area, including the proposed new settlement north of Waterbeach, where there are opportunities to focus growth along with the necessary infrastructure. The Local Plans were prepared in parallel with the Transport Strategy for Cambridge and South Cambridgeshire, which established the transport interventions that would be necessary to support growth. This includes measures to provide access to developments by walking and cycling, public transport, and to address highway impacts.

Clearly however, to ensure that growth is not simply accommodated at the expense of problematic deteriorations in travel conditions, development will need to be carefully planned, and supported by an appropriate strategy for transport.

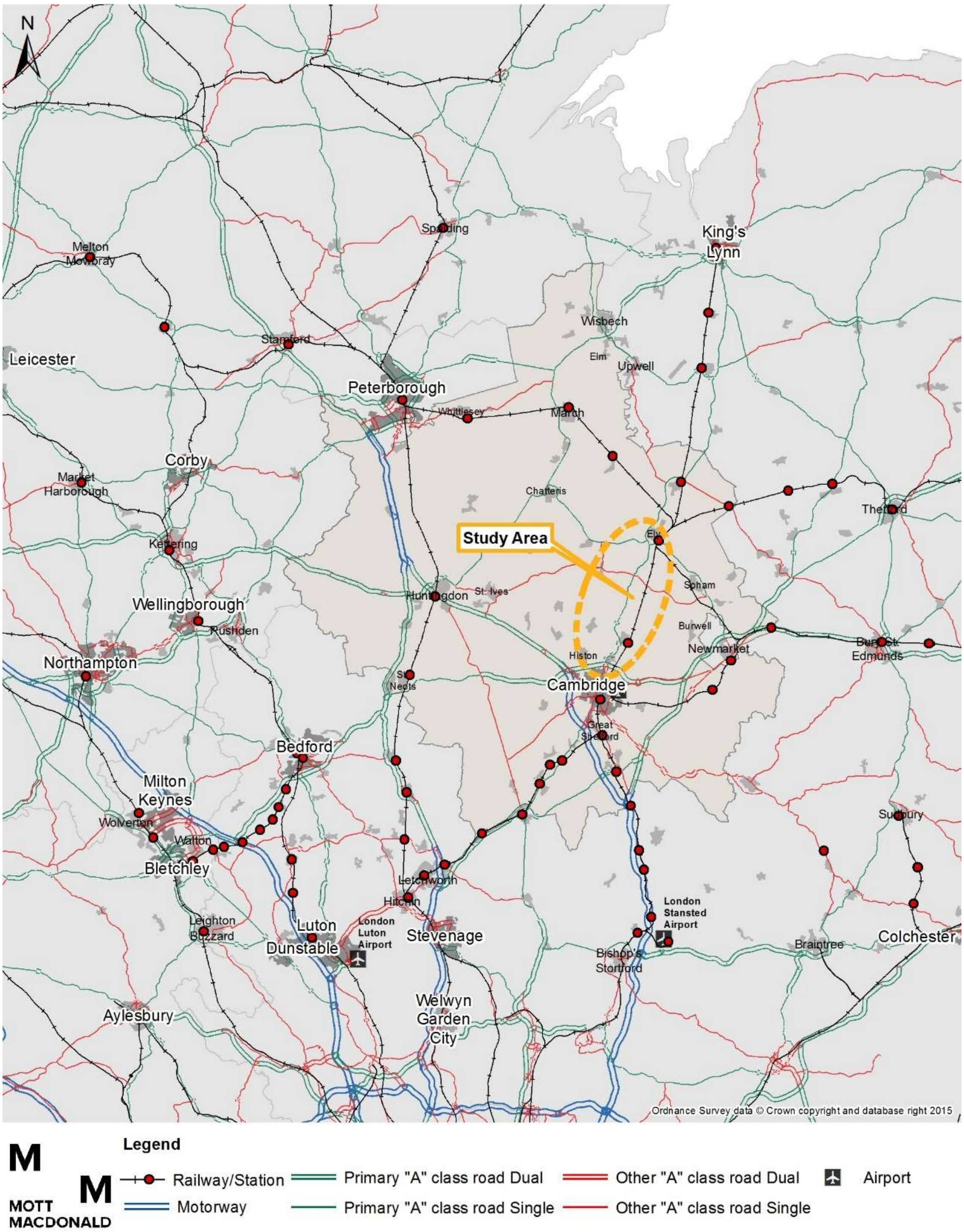
2.2 Transport

Strong transport connections link Cambridge to the county beyond

In view of its role as the county's main area of economic activity, and the trend towards commuting from outlying areas, the transport connections between Cambridge and other towns and settlements within and beyond Cambridgeshire are clearly of very significant strategic importance to the effective functioning of the entire county.

These links ensure that key employment zones can be readily reached by those living in the county at large, as well as by those living within the city and its immediate surroundings. The map below highlights the railway, busway, and main road connections in the county.

Figure 8: Cambridgeshire's strategic transport network



Source: Ordnance Survey

As is apparent from the map in Figure 8, the county is relatively well served by fixed public transport infrastructure. Several routes converge at Cambridge station, which lies just to the south east of the city centre. These provide direct regional links to Peterborough, Kings Lynn, Norwich, Ipswich, Stevenage, Newmarket, Ely, March and Stansted Airport, as well as frequent services to London Liverpool Street and London Kings Cross, and an hourly service to Birmingham. Cambridge railway station is the busiest in the East of England and was used by almost 11.5 million passengers in 2016/17.

Cambridge is further served by Cambridge North station, located approximately 3km to the north east of the city centre. This new station opened in May 2017 and serves travellers living nearby, as well as allowing access from across the county and beyond to employment opportunities at Cambridge Science Park, and the Cambridge Business Park, both of which are close at hand.

The Cambridgeshire Guided Busway (which also provides a connection to St Ives, the new town of Northstowe, and intervening villages) also calls at Cambridge North station, along with a number of local bus services. The station is well-placed for access by bike and on foot and includes parking for 1,000 cycles. The station also incorporates some 450 parking spaces, supporting park and ride journeys from across the surrounding area.

Ely Station, some 25km north of Cambridge, is a hub for trains running to destinations including Cambridge, Stansted Airport, London, Ipswich, Norwich, King's Lynn, Peterborough, Leicester, Birmingham, Nottingham, Sheffield, Manchester and Liverpool. It also provides interchange for a number of intermediate local stations.

Highway connectivity across the county is underpinned by a network of strategically important roads, many linking Cambridge City to important locations nearby – the M11 to Stansted Airport and London, the A14 to Huntingdon and Newmarket, the A10 to Ely and Royston and the A428 to St Neots.

The A10, M11 and the A14 to Newmarket all run broadly in parallel with a rail route. The A10 is single carriageway road. The M11, A14 and A428 are motorways or dual carriageway A-roads and form part of the national Strategic Road Network.

Most sizeable settlements within Cambridgeshire have at least one A-road connection to the highway network. Supporting this is a network of direct connections which link the settlements around the county to one another via lower capacity routes.

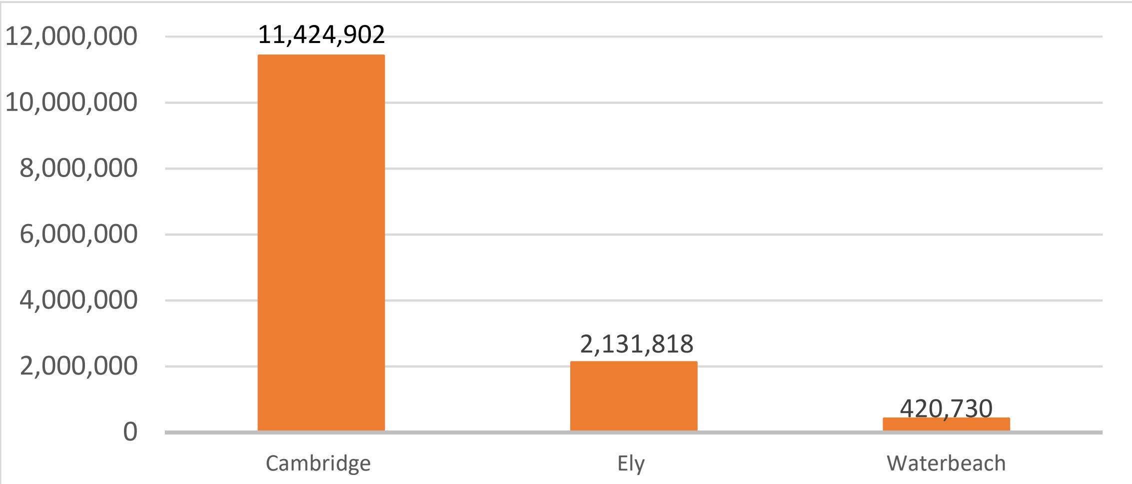
2.2.1 Rail

High and growing levels of demand, and performance issues on key corridors

Based on data from the Office of Rail and Road (ORR), the following figures compare total passenger entries/exits at Cambridge, Ely and Waterbeach in the study corridor. Cambridge North Station opened only recently in May 2017, and was used by around 2,500 people in its first week of opening. This had grown to around 5,000 people a week by September 2017.

Figure 9 shows that Cambridge station serves over five times as many passengers as Ely station, and nearly thirty times as many passengers as Waterbeach station.

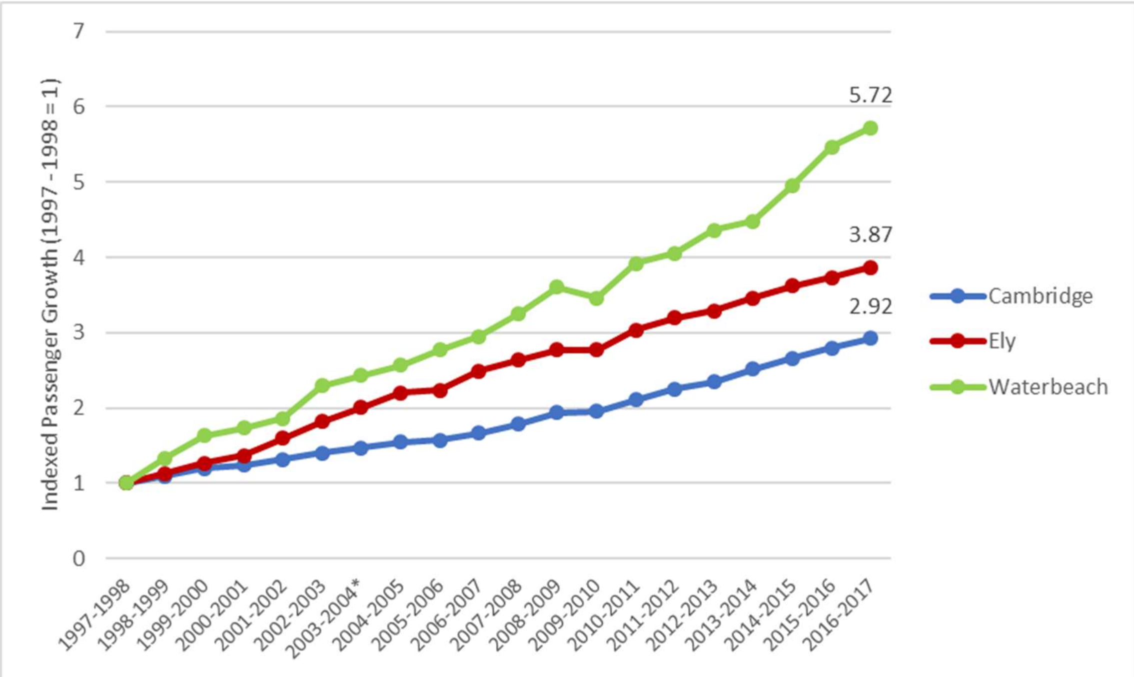
Figure 9: Total 2016/17 annual passenger entries/exits per station on study corridor



Source: ORR data

Figure 10 below shows growth of passenger numbers at each station relative to each station's 1997/98 level of passenger throughput.

Figure 10: Indexed growth in passenger throughput at each study area station



Source: ORR data (2003 - 2004 figures estimated due to ORR data excluding that year)

This shows that all stations have experienced significant growth in passenger numbers since 1997-98, exceeding the averages for the East Region and for England over the same period. Growth has been proportionately greatest at Waterbeach station, which now handles over five times as many passengers as it did in 1997/98, while Ely is approaching a fourfold increase. While Cambridge station has grown the least, in proportional terms, in absolute terms the growth it has experienced represents an increase of over seven million passenger entries/exits per year on a 1997/98 base of around four million – a very substantial increase indeed.

This growth is naturally reflected in increased loading of individual train carriages, and in peak periods there are substantial levels of crowding on key services.

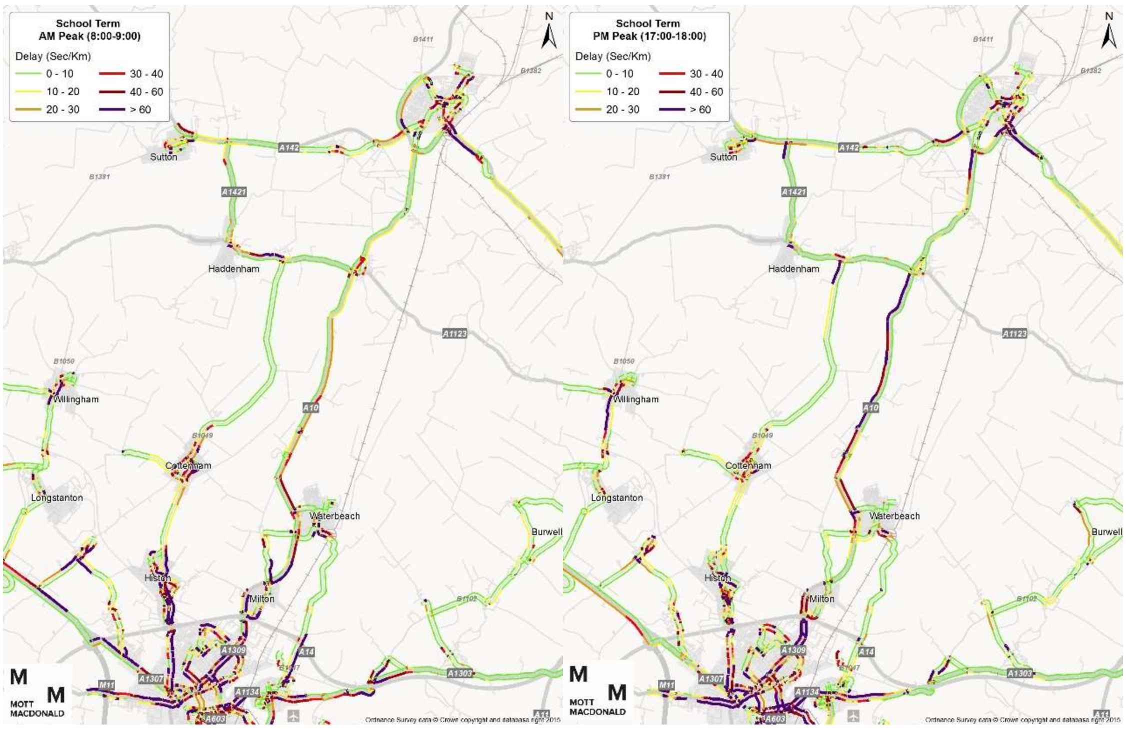
Both the Greater Anglia and Thameslink Great Northern are introducing significant additional carriage capacity over the next two years, on services from Cambridge to London Liverpool Street and Kings Cross, and on regional services across the East of England. This will provide some additional rail capacity between Ely and Cambridge.

2.2.2 Bus

In order to undertake the analysis of bus performance within the study corridor, TrafficMaster journey time data was used to calculate the delays per km along different bus routes in the study area. Figure 11 shows numerous southbound delays in the AM peak hour. Delays are notably severe along the A10 from Waterbeach to the Milton Interchange. Following the Milton Interchange, delays worsen along the Milton Road and reach over 2 minutes per kilometre near the Science Park and within Cambridge city centre. Delays are also prevalent on the B1049 from Histon into Cambridge. In the AM peak, there are also significant southbound delays on the Horningsea Road between the A14 and Newmarket Road.

In the PM peak hour, bus journey time delays are less severe. However, there are still significant delays in both directions between the Science Park and Milton Interchange, and northbound between Waterbeach and Stretham roundabout.

Figure 11: Average journey time delay on bus routes 2013/14 – AM Peak (l) PM Peak (r)



Source: Traffic Master

2.2.3 Park and Ride

The Milton Park and Ride (P&R) site is the only P&R within the study area. It offers 792 parking spaces and is located on the west side of the A10, half a mile north of the Milton Interchange and less than four miles from the city centre.

The Park and Ride service operates every 10 minutes Monday to Saturday. The first bus of the day departs at 06.21 and the last departure from Cambridge City Centre is at 20.39. On Sundays, the service operates every 15 minutes, which begin at 09.00 with the final service returning from Central Cambridge at 18:35. The journey time into the city centre is approximately 16 minutes. Current charges comprise a parking charge of £1, which will be abolished in April 2018, and a return ticket to the city centre for £3.

The Milton P&R site has the lowest capacity and is the least utilised of the five bus-served P&R sites around Cambridge. Historic trends in the usage of the Park and Ride at Milton suggest a decline in patronage since 2014 of 19%.

2.2.4 Walking and Cycling

In comparison to the national average, cycle commuting is generally high within the study corridor. The highest cycle flows are found within populated areas and the ‘necklace’ villages closet to Cambridge. Therefore, the highest levels of cycle trips are concentrated in the southern section of the corridor, with the central rural areas and Ely and its hinterland experiencing lower flows.

There are substantial cycle traffic flows on radial routes in and out of Cambridge on weekdays, suggesting that it is a key mode for commuters and students accessing employment and education sites. The shared footway/cycleway that runs alongside the guided busway is particularly well used, carrying nearly a thousand cycle trips on weekdays. National cycle route 11, which runs from north Cambridge to Waterbeach, and national cycle route 51 (east), which runs through Bottisham and Burwell, both carry between 200 and 400 weekday trips.

Beyond Waterbeach, national cycle routes 51 and 11 are predominately used by leisure cyclists whose journeys take place at the weekends. Cycle data for Ely is limited, but shows a variety of users across the week, with weekday trips being the most numerous.

The highest proportion of cycling commuting also corresponds with where high-quality cycle infrastructure is provided, as demonstrated by the large number of cyclists make use of the Busway cycle route.

A key area of weakness in the study corridor is the lack of cycle routes serving a north to south journeys, with cycling provision along the A10 being particularly poor.

Collision figures involving pedestrians and cyclists are more frequent around populated areas and where changes in the speed limit occur. These collision clusters demonstrate the need for safe and appropriate transport infrastructure where different modes of transport interact.

2.2.5 Highway

As noted above, the county’s strategic highway routes carry varying designations and have correspondingly varied levels of effective traffic capacity. The volumes of traffic using them also differ significantly by route – and indeed in many cases by time of day and direction of travel. The plots in Figure 12 below, demonstrate this significant variability based on outputs from the County Council’s Cambridge Sub-Regional Model (CSRM).

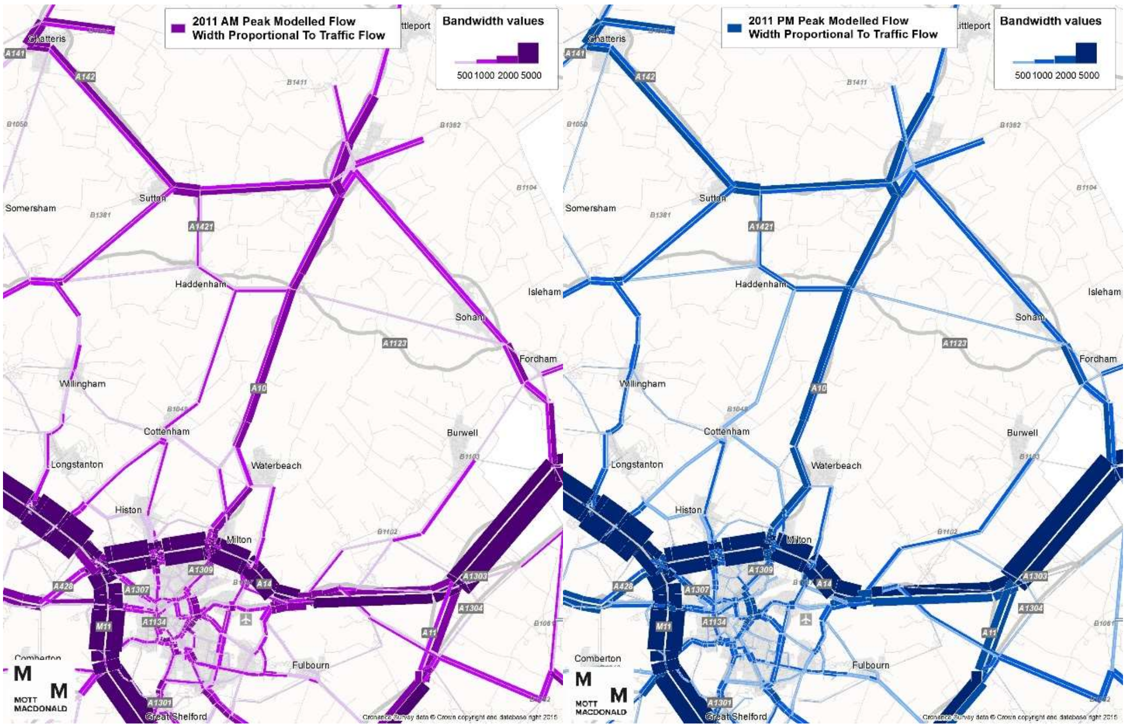
The most heavily used routes by far are the M11 between Cambridge and London (via Stansted), A14 to Huntingdon (dual carriageway), and A14 to Newmarket (dual carriageway), each of which carries upwards of 2,000 Passenger Car Units (PCUs) in each direction in both the morning and evening peak hours

The A10, the single carriageway A-road linking Cambridge and Ely, carries the highest north-south flows in the county. It carries between 1,000 and 2,000 PCUs southbound towards Cambridge in the morning peak hour, and a similar flow northbound in the evening peak/peak hour.

Meanwhile, traffic levels in the 'counterpeak' direction are in both cases much lower – around half of the peak direction flow – suggesting that demand in the corridor is very tidal.

The result of this concentration of travel demand is a very significant level of congestion which can extend almost the full length of the A10 from Ely to Cambridge in the morning peak, and from Cambridge to Ely in the evening peak hours.

Figure 12: Modelled traffic flows in study area – 2011 AM peak (l) and PM peak (r)



The plots in Figure 13, below, are based on data from TrafficMaster, which aggregates the journey times from a large fleet of vehicles equipped with GPS navigation devices.

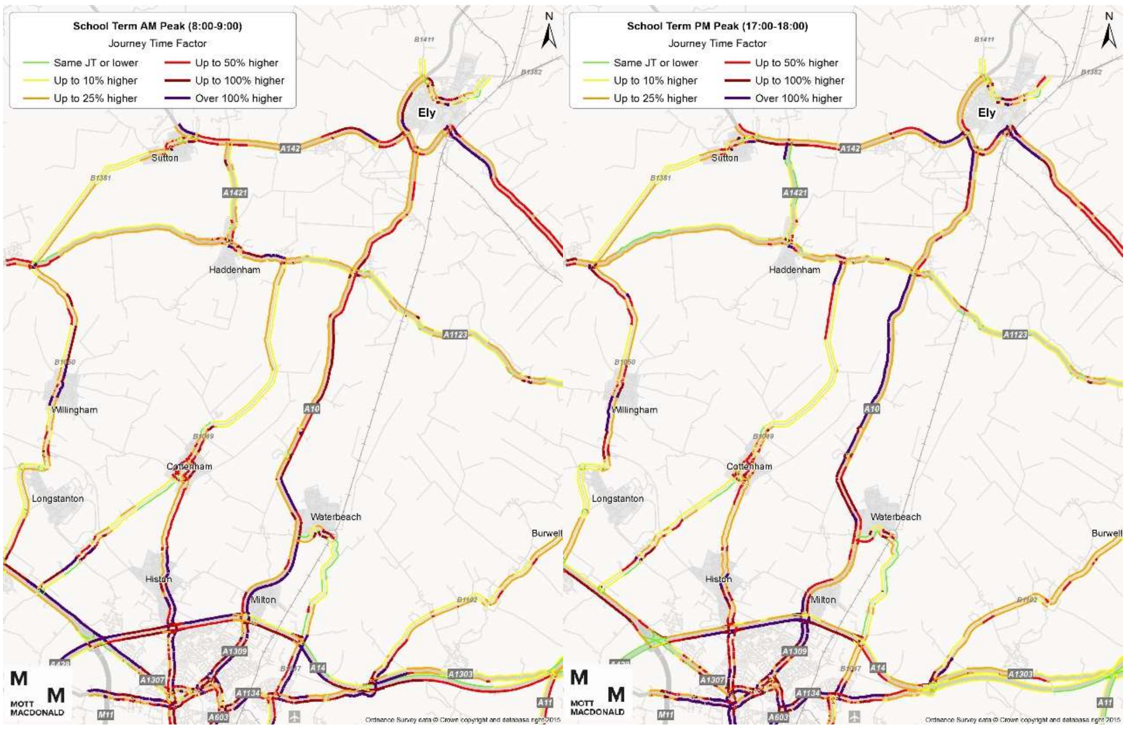
The plots show that during peak periods travel times along the A10 are frequently up to 100% longer than during free-flow periods, and are in many places more than 100% longer. Travel times in the counter-peak direction also deteriorate compared to free-flow conditions, but to a far lesser extent, reflecting the strongly tidal pattern of travel along this route across the standard working day.

It is also apparent from Figure 13 that the B1049 route (which runs parallel to the A10 and passes directly through two sizeable settlements at Cottenham and Histon) also experiences significant congestion in the peaks. Congestion is particularly apparent southbound at the approach to the A14 Histon Interchange in the morning peak and northbound at the junction with the A1123 in Wilburton in the evening peak. As well as local traffic demand, this in part reflects a displacement of traffic which would be most appropriately accommodated on the A10, bypassing major settlements, onto less suitable routes as a result of the congestion on the A-road itself. Figure 12 above, shows that traffic flow on the B1049 is around 1,000 PCUs at points southbound in the morning peak and northbound in the evening peak.

On the A14 north of Cambridge, journey times eastbound between junctions 31 (Girton) and 32 (Histon), as well as the approach to the Milton Interchange (J33) take twice as long in peak times than they do in free-flow conditions. In the PM peak, the same is true of the westbound direction.

On the east-west A142 route there are significant delays in both directions in both periods. Notably, journey times are longer for southbound travel in the AM peak, and the opposite in the PM peak. Despite this, Figure 12, shows that traffic flows on the route are less tidal than on the A10.

Figure 13: Average delay – School term-time 2013/14 – AM Peak (l) PM Peak (r)



Traffic levels on all these routes are anticipated to grow in future years, thus exacerbating issues that are already being experienced on the transport network, leading to increases in problematic transport impacts. And as the following section will demonstrate, the presence of several proposed major developments on and around the transport links connecting Ely to Cambridge will worsen these issues.

2.3 Future Issues and Opportunities

Growth will bring major opportunities, and intensify some existing challenges

The number of journeys made each day in Cambridgeshire will grow over the coming years as a result of the anticipated population and job growth and the scale of committed and proposed development within the study area.

Ely to Cambridge study area. Table 2 outlines the ONS 2011 sub-national population projections by local authority area. It forecasts significant population growth across the county between 2011 and 2031. The predicted population growth will likely correspond with an increase in commuting trips within the study area. Of particular relevance to this study is the fact that a large proportion of the development taking place in the Cambridge area will be concentrated in sites close to or impacting the Ely to Cambridge study area. Table 2: ONS 2011 Population Projections

Area	2001	Observed Change 2001-09	% Change	2009	Forecast Change 2009-31	% Change	2031
Cambridge City	109,900	9,200	8.4%	119,100	32,700	27.5%	151,800
East Cambridgeshire	70,900	9,400	13.3%	80,300	17,900	22.3%	98,200
Fenland	83,700	9,600	11.5%	93,300	19,900	21.3%	113,200
Huntingdonshire	157,200	7,400	4.7%	164,600	12,200	7.4%	176,800
South Cambridgeshire	130,600	13,000	10.0%	143,600	38,300	26.7%	181,900
Cambridgeshire	552,100	48,700	8.8%	600,800	120,600	20.1%	721,400
Cambridgeshire and Peterborough	707,400	66,200	9.4%	773,600	185,300	24.0%	958,900
East England*	5,400,000	370,100	6.9%	5,770,100	1,246,400	21.6%	7,016,500
England*	49,450,000	2,367,100	4.8%	51,817,100	8,253,600	15.9%	60,070,700

Source: ONS Mid-year population estimates (2011)

As described above, clusters of high tech employment on sites in the Cambridge Northern Fringe are supporting many jobs for the sub-region and creating significant economic value. Consequently, there is a clear incentive to facilitate further growth at these sites. Planning policy across the City of Cambridge, South Cambridgeshire, and East Cambridgeshire seeks to address this need both directly (through large scale release of land close to the existing cluster to B1, B2 and B8 development), and indirectly (by enabling further growth in housing supply, where currently constraints are acting as an impediment to business growth in and around Cambridge).

Within the study area, the three most significant of these proposed developments are those at Cambridge Northern Fringe East (CNFE) and at the Cambridge Science Park (CSP) adjacent to it, and three miles further north, north of Waterbeach village at the site of the former Waterbeach Barracks and on adjacent land.

Together with development at Ely, these developments should enable existing businesses to expand, both by offering physical floorspace for expansion and by providing residential space for new employees to live in, and by the same token should attract other businesses in related sectors who are likely to see benefits in joining a tightly agglomerated economic cluster offering a ready pool of experienced labour to take up new opportunities as they become available.

This development will help to address the pressing issue of constrained housing supply and rising prices in Cambridge, and by providing both space to expand and space for workers to live, will enable businesses in the thriving knowledge economy to grow.

However, as the following section will show, growth will lead to increased demand for north-south travel along the A10 and the road, public transport, pedestrian and cycle routes around it. Although the development of Cambridge North Station and additional services linking with the Cambridgeshire Guided Busway have significantly improved public transport connections to and from these southern sites, road and rail connections are already under significant strain. The addition of further travel demand will exacerbate these issues and make consideration of complementary transport measures essential.

2.4 Impacts of Growth

The separate Strand 1 Options Modelling Report describes in detail an analysis of the modelled performance of the A10 highway corridor showing the impacts of the proposed Waterbeach new town, CNFE and CSP developments, in the absence of any measures to mitigate transport impacts.

The modelling tool used in the analysis is Cambridgeshire County Council's Cambridge Sub-Regional Model (CSRM2). CSRM2 is a WebTAG-compliant strategic highway model which uses base data from 2015, including:

- Validation against recently collected traffic and transportation counts
- All networks (highway, PT, walk, cycle)
- Representation of parking and Park & Ride
- Base transport movement data
- Base land use data
- Matrices with up-to-date mobile phone data

Cambridgeshire County Council have agreed that they consider the model to be fit for purpose for use in the assessment of this phase of the project.

Comparing statistics from the 2031 modelled year with and without the development sites outlined above (and assuming no change in transport provision between the two scenarios), the key implications for the A10 and surrounding roads are set out below.

Travel demand on the A10 and surrounding routes would increase

The following paragraphs consider the transport impacts of planned development as they would occur without any provision infrastructure or services to cater for the new transport demand. The report then goes on to explore potential mitigation measures.

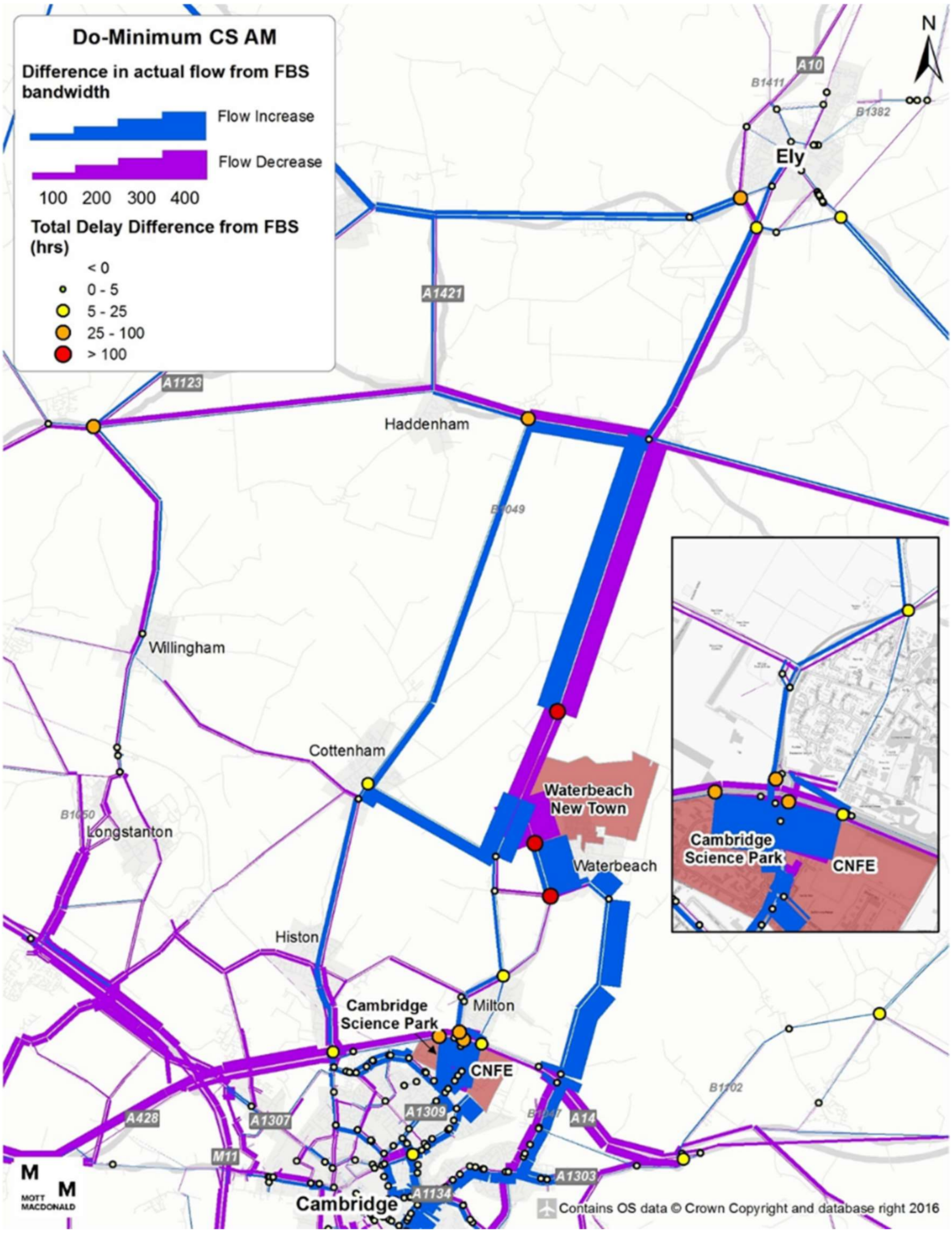
The development of these sites is likely to lead to significant change in travel demand along and around the A10, with the overall proportion of trips with both local origins and local destinations increasing, as the development adds many more such trips to the A10 at the expense of trips with both external origins and external destinations which nearly halve in proportion, reflecting the greater availability of alternative routes (and frequently leading to increases in traffic along less suitable routes or indeed increasing pressure on other strategic network links).

The overall impact of development on traffic levels and delay can be seen in Figure 14, showing a comparison of two scenarios in the 2031 modelled year, one in which the development sites adjacent to the A10 are not implemented, and a second in which the development takes place as outlined above without any mitigating transport measures.

It is notable that while there is growth at some points along the A10, the main impact is in fact an increase in traffic on nearby routes. The negligible change in traffic levels evident south of the Waterbeach development on the A10 itself essentially demonstrates that the effective capacity of the route has already been reached, even without the implementation of the development, and that new trips arising here from the development sites can therefore only be accommodated at the expense of other existing traffic which is displaced to other routes.

Some sections of the A10 are projected to experience reductions in traffic volumes as a result of development. This is principally a reflection of the impact of traffic accessing the Waterbeach development which adds delay to junctions on the route, and thereby leads to the displacement of longer distance traffic which has a route choice onto neighbouring routes – most particularly the B1047 Clayhithe Road but also the B1049 through Cottenham.

Figure 14: Change in traffic flows and junction delays resulting from development at Waterbeach, CNFE and CSP (AM peak 2031)

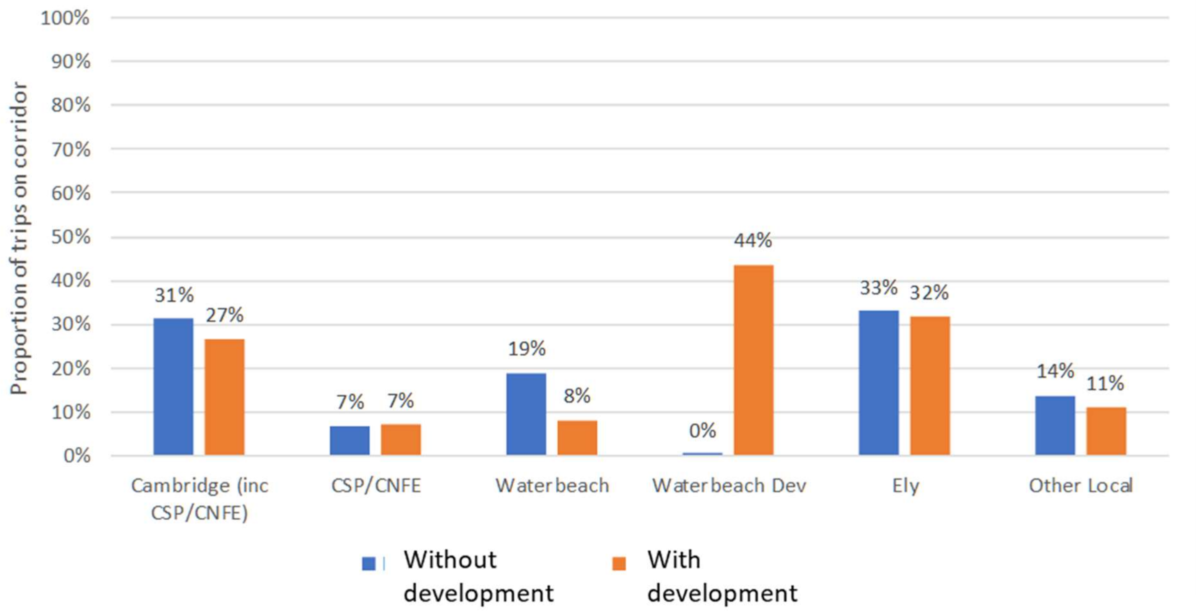


Source: Mott MacDonald/OS

Significant additional delays are evident at three junctions on the A10 – all close to the Waterbeach development, while there are also projected to be additional delays at the junctions on the A10/A14 to the north of the Science Park and Northern Fringe developments. More modest increases in delay are also visible at many junctions in inner Cambridge, along Kings Hedges Road, Milton Road, and Horningsea Road.

The chart in Figure 15 below, shows the proportion of trips on the A10 corridor which are predicted to be generated by the local locations shown both with and without development. (Note that because some trips pass through more than one location, individual values should not be added together as this would result in double-counting.)

Figure 15: Distribution of trips on A10N corridor by site of origin in 2031



Source: Mott MacDonald

The chart shows how significantly the development at Waterbeach is likely to affect the makeup of traffic on the A10 between Ely and Cambridge – once implemented in full, the modelling indicates that it would be the origin or destination for some 44% of all travel demand on the route.

It is also noticeable that the increased development at both the Science Park and Cambridge Northern Fringe East sites does not lead to an overall increase in the proportion of these trips on the corridor (notwithstanding that in absolute terms there is an increase in trips). A key reason for the relatively modest impact on the A10 from these sites is that traffic to and from the Science Park and Northern Fringe sites can use alternative routes such as the A14 and the B1049, and the A10 is slower than these routes for many of those trips without any mitigation. However, traffic to and from the new town north of Waterbeach has no choice but to use the A10 as it is the only road connecting to the site.

Overall, the modelling indicates that an average of 39% of background traffic will be displaced from the A10 as the trips generated by the new developments take up a large proportion of the constrained capacity of the route.

Traffic would increase on some routes parallel to the A10

Figure 16 sets out the level of traffic changes on each of the main parallel routes to the A10 by comparing with and without development scenarios in 2031. It is notable that with the exception of the B1047 which would see substantial increases in traffic in both the AM and PM peaks, the increases are otherwise concentrated in the AM peak.

Figure 16: Changes in traffic levels on parallel routes

AM Peak

Parallel Route	CS Do Min
B1047	52%
B1049 South	-2%
B1049 North	14%
Landbeach Rd	18%
All routes	15%

PM Peak

Parallel Route	CS Do Min
B1047	56%
B1049 South	1%
B1049 North	-10%
Landbeach Rd	-89%
All routes	-7%

Source: Mott MacDonald

Journey times would increase on key routes

Even with large amounts of traffic being displaced to other routes, the traffic generated by the development is likely to lead to significant increases in journey times along sections of the A10 between Ely and Cambridge (up to 73% in the evening peak hour at the southern section), and an overall increase of around 15% and 10% in journey times along the whole Ely to Cambridge section of the A10 in the AM and PM peak respectively, as shown in Figure 17, below (again this compares the with and without development scenarios in 2031).

Figure 17: Journey time impacts of growth

AM Peak

A10(N) Section	CS Do Min
South section	30%
Mid section	1%
North section	8%
Full route	15%

PM Peak

A10(N) Section	CS Do Min
South section	73%
Mid section	-12%
North section	-17%
Full route	9%

Source: Mott MacDonald

Given that (as outlined above) peak period journey times along some sections of the A10 are already as much as double the free-flow times, such increases would add further to an already problematic level of delay.

Car mode share would fall

The modelling indicates a likelihood of a statistically significant (5%) reduction in the share of trips along the Ely to Cambridge corridor which are undertaken by car in the AM peak hour, a slight increase in car mode share in the PM peak hour, and a slight decrease across the overall modelled network. This indicates that the concentration of development in locations close to

Cambridge with good public transport and walking and cycling access tends to facilitate more sustainable travel patterns than siting development elsewhere.

Figure 18: Change in car mode share levels

AM Peak

Area	CS Do Min
Study corridor	-5.3%
Modelled network	-1.06%

PM Peak

Area	CS Do Min
Study corridor	0.5%
Modelled network	-0.87%

Source: Mott MacDonald

The modelling results described above confirm that the major developments proposed along the A10, and in particular the Waterbeach development, would further exacerbate existing and future problems for travel on key routes in the county if implemented without some form of complementary transport measures.

Some impacts would be felt mostly by those already living and working in Cambridge, notably those close to some of the routes running parallel to the A10 who would see traffic and journey times increase as traffic is displaced from the A10 by new traffic from the developments. Other effects, such as the increase in journey times on the A10, might actually undermine the prospects of the new developments themselves by reducing the accessibility of the sites and thereby making them relatively less attractive places to expand or set up businesses.

In order to capture the many positive benefits of this development for the economy of the county and indeed the UK as a whole, without causing detriment to those already living and working in the area, it is therefore essential to develop a suitable package of complementary transport measures.

The process of identification of potential measures and sifting and prioritisation among them is described in the following sections.

2.5 Addressing the Challenges

Following a review of the emerging and policy objectives, the following Objectives have been defined in consultation with project team. The objectives are set out in the study brief and have been identified in response to the problems and opportunities highlighted in the accompanying Evidence Base Report, and refined through examination of objectives set out in key transport policy documents for the county – notably the Transport Strategy for Cambridge and South Cambridge, the Third Cambridge Local Transport Plan, and the Cambridgeshire Long Term Transport Strategy.

Table 3 summarises these agreed objectives.

Table 3: Summary of Study Objectives

ID	Scheme Objective
1	Maintain traffic at or below 2011 traffic levels in Cambridge
2	Minimise vehicle mileage whilst providing for increased travel demand
3	Improve reliability, capacity and speed of alternative transport modes
4	Minimise potential impact on alternative "rat-runs" to the A10
5	Intercept or substitute car trips with alternative transport modes
6	Address transport demand from the new town north of Waterbeach
7	Enable development in the Cambridge North Fringe East/Cambridge Science Park to proceed

Source: Mott MacDonald and Cambridgeshire County Council

These objectives will ensure that the package of interventions is fully realised and is able to address the need for intervention, as well as helping to meet local strategic priorities.

2.6 Scope of Options

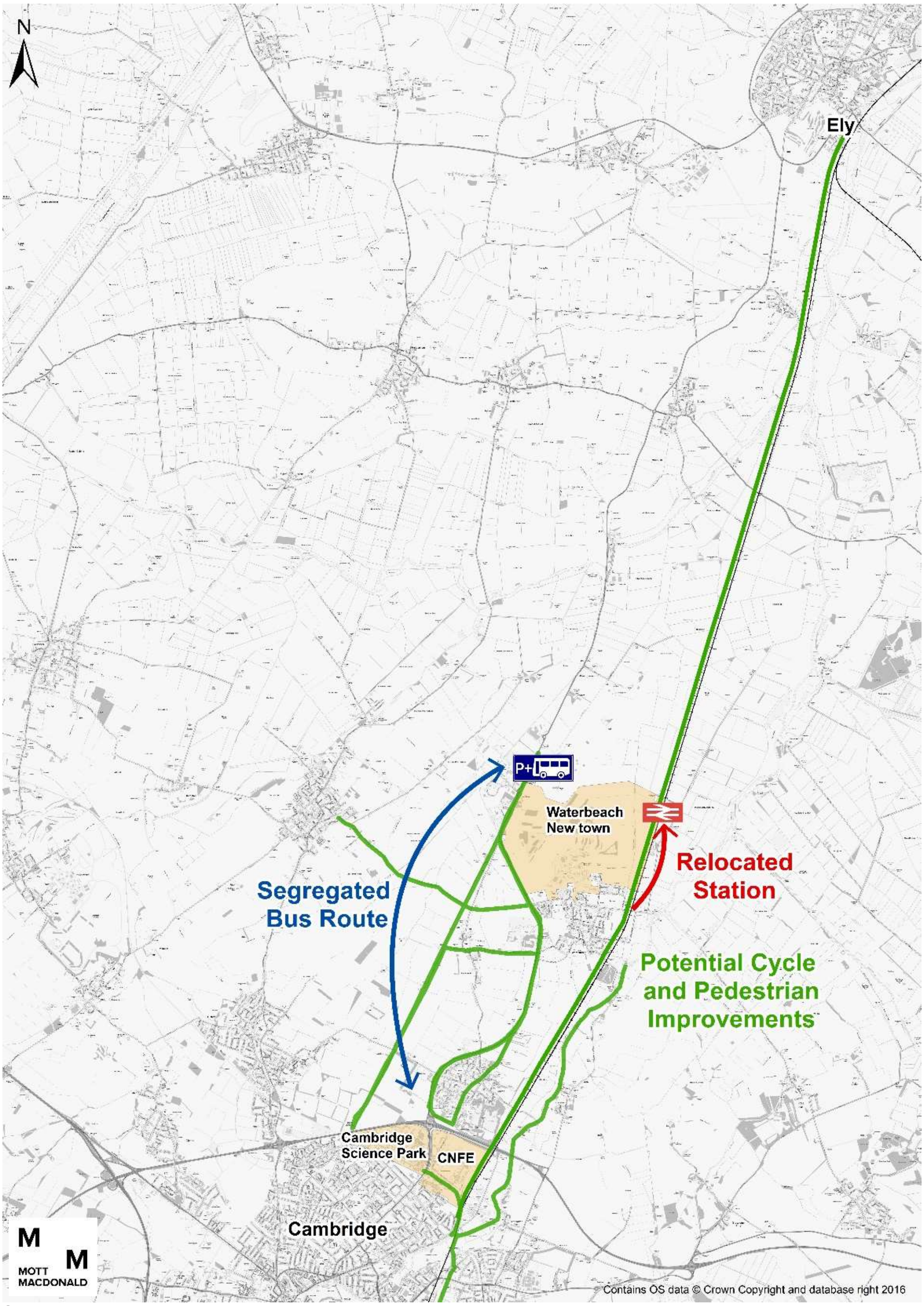
The objectives clearly highlight the role of all modes of transport in addressing the challenges in the Ely to Cambridge corridor. The options assessed will therefore include a package of multi-modal interventions as a minimum requirement, with additional options entailing increasing levels of interventions on the highway network. This approach is described further in the Strand 1 Options Modelling Report.

In light of the objectives described above, a set of potential packages has been developed. Broadly, these packages represent incrementally greater levels of intervention – ranging from packages including only measures focused on non-highway measures through to packages with an increasing level of complementary highway intervention.

This range of packages and the rationale behind them is described in the following table, and shown schematically in the five figures beneath.

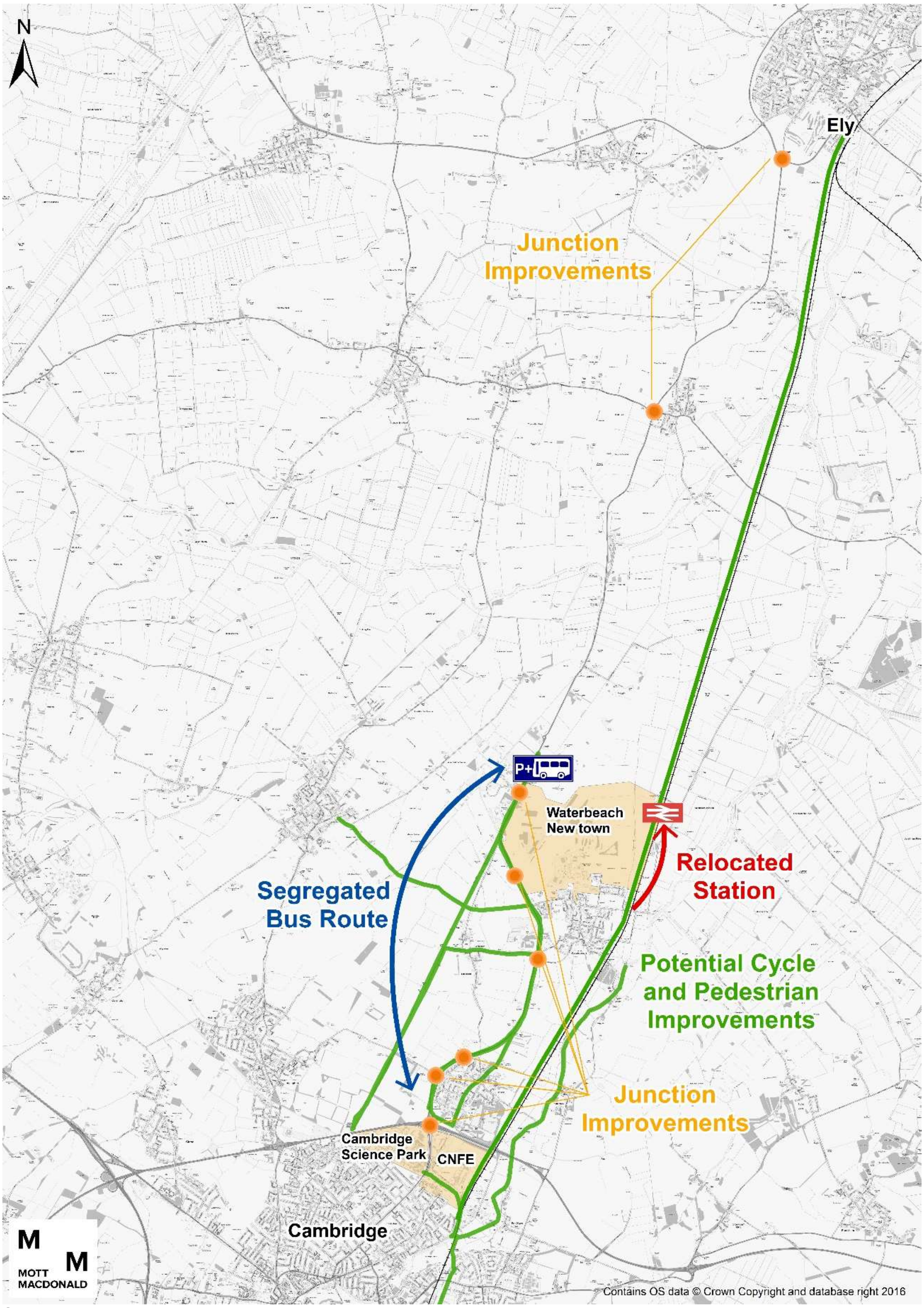
Package	Description	Rationale
Mode-shift	Measures to encourage mode shift, including: • New or improved walking/cycling routes between Ely, Waterbeach and Cambridge • New high-quality segregated public transport provision (route TBC) between Waterbeach development and Cambridge • New park and ride sites at Waterbeach development, to remove car trips from southern section of A10 • Existing Waterbeach railway station relocated closer to Waterbeach development	To test the impact of non-highway interventions only
Junction +	Mode-shift option measures, together with additional junction improvements to Ely to Cambridge corridor, including: • Improved capacity on the slip roads joining the roundabout and from Cambridge Road at Milton Interchange • Increased capacity for vehicles travelling northbound on the A10 at the Milton Park and Ride southern access, whilst keeping the left slip to access the P&R site. • Increased capacity on the southern A10 at the Butt Lane junction for flow travelling northbound, and on the Butt Lane arm, with left turns only still being implemented. • Improved capacity on Landbeach Road and Humphries Way junctions on the A10 • Increased capacity on Car Dyke Road and Waterbeach Road junctions on the A10. • Increased capacity from the site and on the southern A10 arm at the southern access to the Waterbeach Development. • Increased capacity on Green End at the junction with the A10 • Increased capacity on the site access arm at the northern access to the Waterbeach development • Increased capacity at the A10 / A1123 roundabout in Stretham. • Increased capacity at the A10 / A142 Angel Drove roundabout at Ely.	To test the impact of adding a first level of highway improvements
North-dual	As per 'Junction+' option, but with the A10 upgraded to dual carriageway from the Waterbeach development's northern access north to Ely – alignment to be determined	To test the impact of a further highway upgrade, which encourages use of Waterbeach Park and Ride to Cambridge
South-dual	As per 'Junction+' option, but with the A10 upgraded to dual carriageway from the Waterbeach development's southern access south to the A14 Histon Interchange – alignment to be determined	To test the impact of upgrading capacity on the southern half of the corridor, where it is most needed
Full-dual	As per 'Junction+' option, but with the A10 upgraded to dual carriageway along the entire length from the A14 Histon Interchange to Ely – alignment to be determined	To test the impact of a full corridor dual carriageway upgrade

Figure 19: Mode-Shift Option



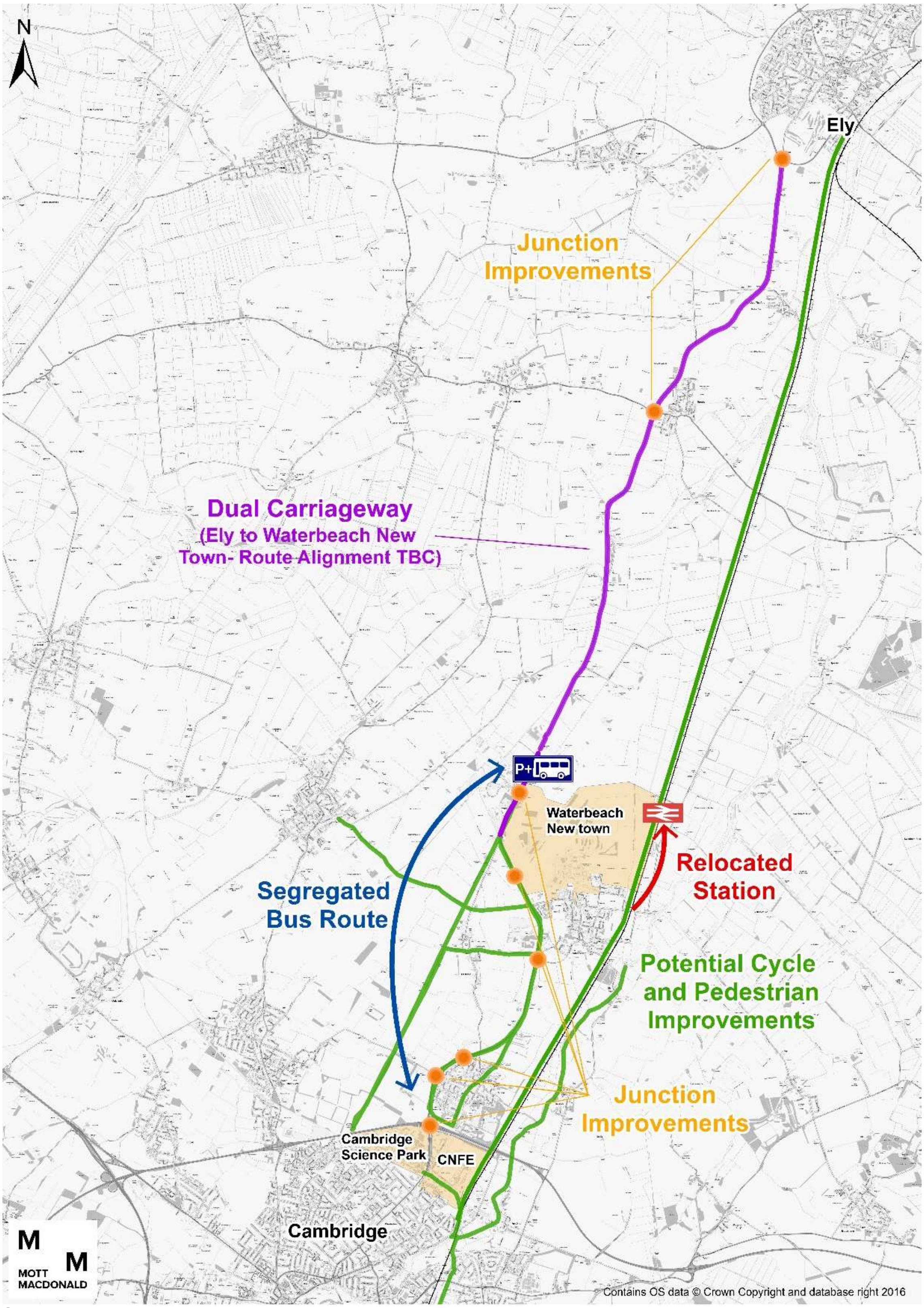
Source: Mott MacDonald

Figure 20: Junction + Option



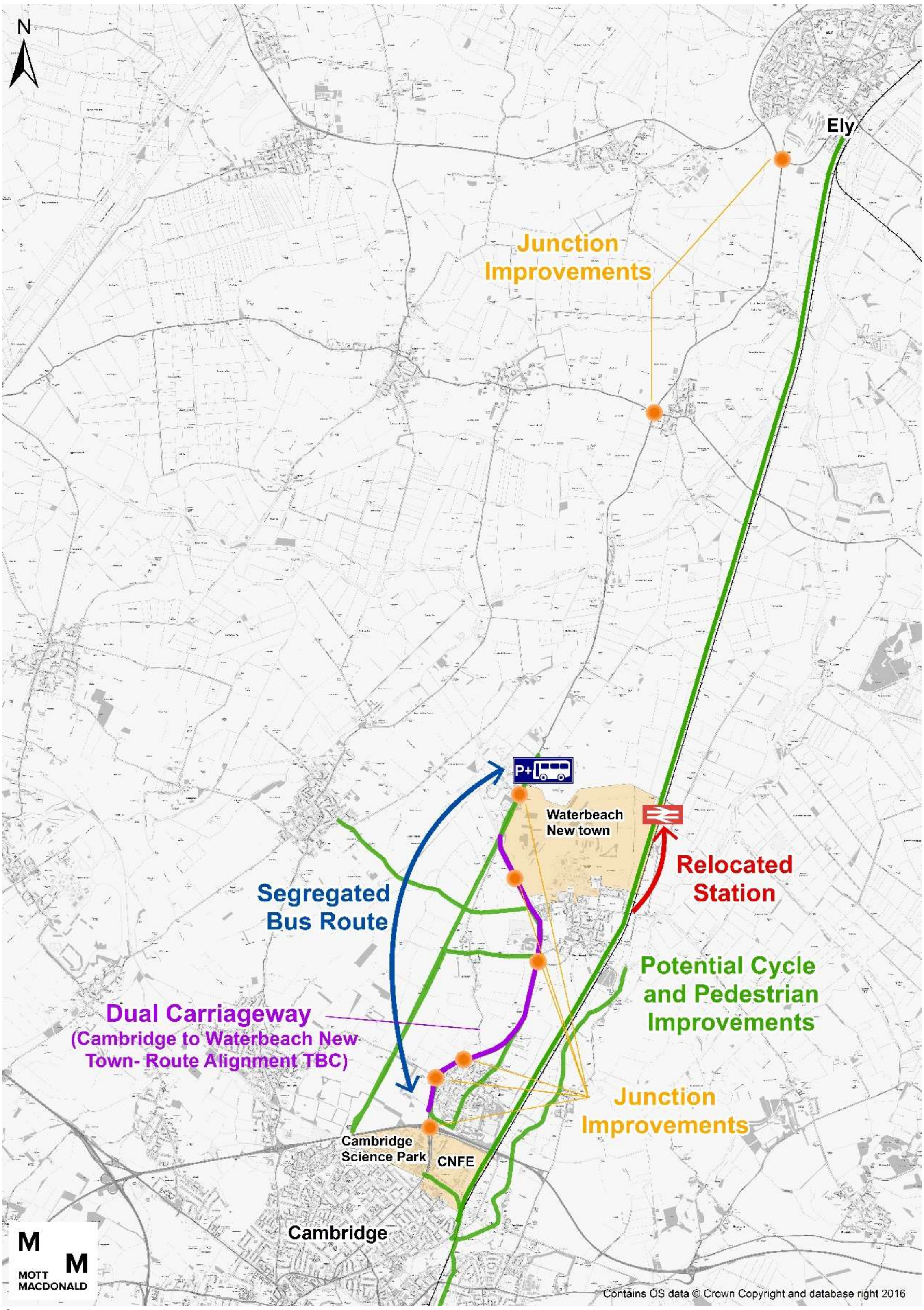
Source: Mott MacDonald

Figure 21: North Dual Option



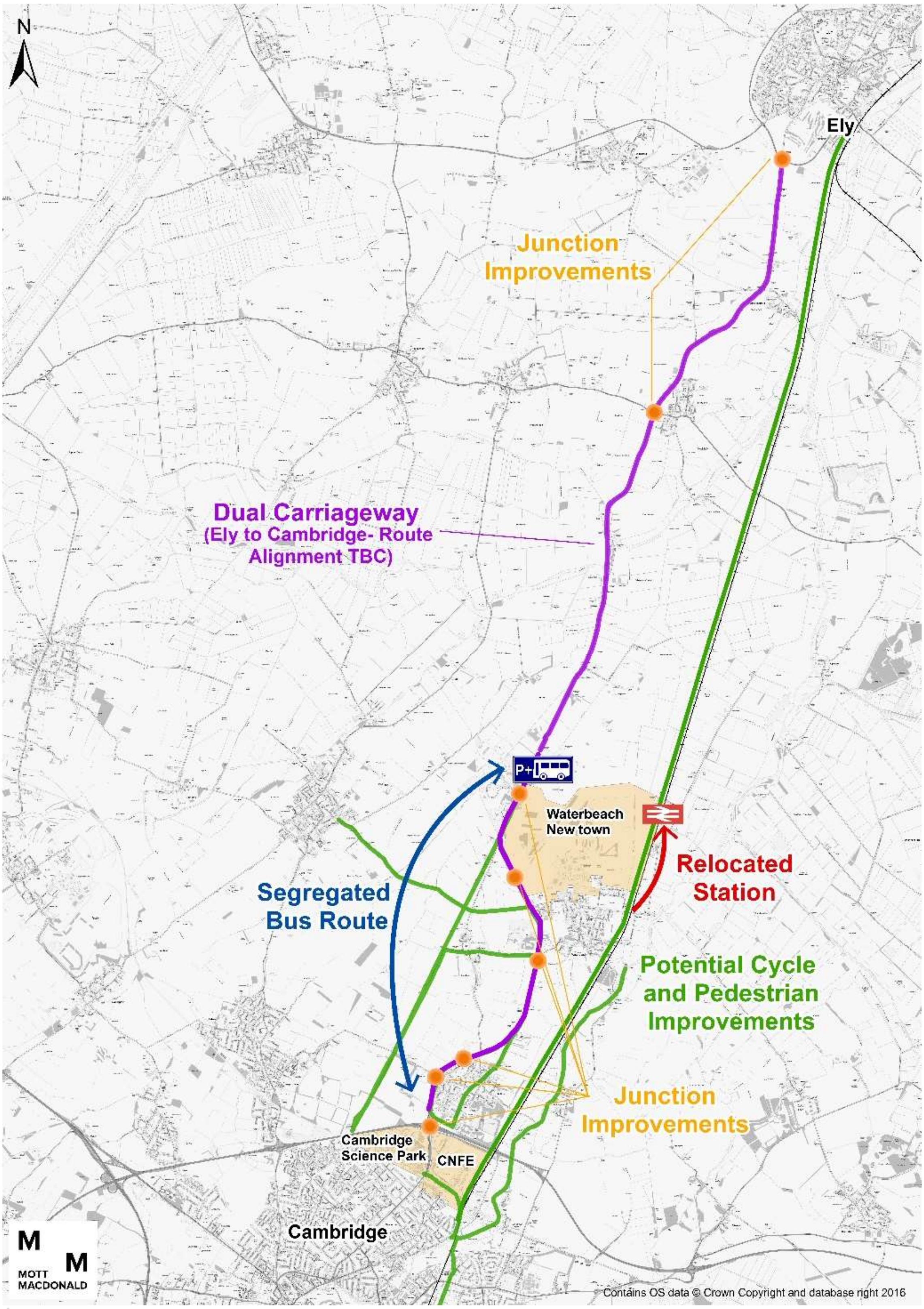
Source: Mott MacDonald

Figure 22: South Dual Option



Source: Mott MacDonald

Figure 23: Full Dual Option



Source: Mott MacDonald

2.7 Model Testing

To inform an assessment of the effectiveness and suitability of these options, the schemes in each of these packages were incorporated into scenarios within the transport model, together with the development proposals, producing forecasts of their impacts. This work is documented in full in the Strand 1 Options Modelling Report completed in parallel with this report.

The modelling work is based on two future modelling scenarios as follows:

- The 'Future Base' case – this represents the 2031 scenario where Local Plan projected levels of population and employment growth have been achieved for Cambridgeshire, but where the proposed developments at Waterbeach new town, CNFE and CSP do not take place. This therefore represents the 'without development' scenario for the A10.
- The 'Combined Scenario' case – this represents the 2031 scenario where Local Plan projected levels of population and employment growth have been achieved for Cambridgeshire and where the proposed developments at Waterbeach new town, CNFE and CSP take place. This therefore represents the 'with development' scenario, though without any additional transport investment, and is regarded as the Do-Minimum scenario.

The addition of the above mitigation package options to the Combined Scenario Do-Minimum case results in a Combined-Scenario 'Do Something' network. Each of the Combined-Scenario Do-Something network options below was then compared against both the Combined-Scenario Do-Minimum situation and the Future-Base Do-Minimum situation in order to understand the effectiveness of each mitigation package against both the unmitigated 'with development' case and the 'without development' case respectively.

It should be noted that all modelling results presented below are for the AM and PM weekday peak hours, which are:

- AM peak: 08:00-09:00
- PM peak: 17:00-18:00

In order to provide a summary of the modelled mitigation package performance, each Do Something package model run is compared against the equivalent Do Minimum run across three key model performance indicators:

- Car mode share
- Journey time
- Parallel route traffic level

The results of the scenarios in each of these respects is set out below.

2.7.1 Car Mode Share

Figure 24 shows the modelled change in car mode share levels for the Combined-Scenario Do-Minimum situation and each Combined-Scenario Do-Something mitigation package compared to the Future-Base Do-Minimum situation.

Car mode share is a primary measure of the relative sustainability of trip-making on and beyond the corridor, where a lower result is generally regarded as better. It is measured both for trips most likely to use the study corridor and for the whole modelled area, and is defined as absolute change from Future Base Do Minimum car mode share.

The results listed are taken from the above analysis and are based on all weekday AM and PM peak hour trips:

- Between sectors most likely to use the study corridor
- Across the full modelled network

Figure 24: Change in car mode share levels compared to Future-Base Do-Minimum

AM Peak

Area	CS Do Min	CS Mode Shift	CS Jn+	CS North Dual	CS South Dual	CS Full Dual
Study corridor	-5.3%	-8.8%	-8.4%	-7.9%	-6.8%	-5.9%
Modelled network	-1.06%	-1.11%	-1.08%	-1.05%	-0.98%	-0.92%

PM Peak

Area	CS Do Min	CS Mode Shift	CS Jn+	CS North Dual	CS South Dual	CS Full Dual
Study corridor	0.5%	-2.1%	-1.7%	-1.4%	-0.6%	0.0%
Modelled network	-0.87%	-0.89%	-0.82%	-0.81%	-0.75%	-0.71%

Source: Mott MacDonald

These results show that:

- Compared to the Future-Base Do-Minimum (the 'without development' case), the Combined-Scenario Do-Minimum (the unmitigated 'with development' case) results in a significant decrease in the car mode share of trips using the Ely to Cambridge corridor in the AM peak hour, and a slight increase in the PM peak hour. Across the modelled network, the scenario results in an overall car mode share decrease. This therefore indicates that the concentration of development in locations close to Cambridge, rather than being dispersed across the county, results in more sustainable travel patterns overall.
- Compared to the Combined-Scenario Do-Minimum, the five Do-Something mitigation packages all result in an improved car mode share on the Ely to Cambridge corridor, with a descending level of improvement from the Mode-Shift option to the Full-Dual option. At a modelled network level, improvement against this scenario is seen for the non-dualling mitigation options only, but all Do Something packages show a car mode share reduction against the Future-Base Do-Minimum scenario in all cases.

In summary, therefore, all the Do Something mitigation packages deliver a car mode share reduction on the Ely to Cambridge corridor when compared to the equivalent Do Minimum scenario, with the Mode-Shift package delivering the greatest reduction, and the Full-Dual package the least.

2.7.2 Parallel route traffic levels

Figure 25 shows the change in modelled traffic levels on routes parallel to the A10(N) corridor for the Combined-Scenario Do-Minimum situation and each Combined-Scenario Do-Something mitigation package compared to the Future-Base Do-Minimum situation.

Displacement of traffic onto unsuitable parallel routes through the addition of new traffic to the A10 itself is a key area of concern for any proposals in this area, and hence a lower result is regarded as better. Parallel route traffic levels are measured across the B1049 (Histon Road and Twenty Pence Road), the B1047, and on Landbeach Road, in percentage change from Future Base Do Minimum traffic levels.

Figure 25: Change in parallel route traffic levels compared to Future-Base Do-Minimum

AM Peak

Parallel Route	CS Do Min	CS Mode Shift	CS Jn+	CS North Dual	CS South Dual	CS Full Dual
B1047	52%	49%	40%	43%	-34%	-36%
B1049 South	-2%	-3%	-2%	-4%	-11%	-13%
B1049 North	14%	12%	14%	-18%	-6%	-37%
Landbeach Rd	18%	19%	8%	-10%	10%	-12%
All routes	15%	14%	11%	0%	-10%	-23%

PM Peak

Parallel Route	CS Do Min	CS Mode Shift	CS Jn+	CS North Dual	CS South Dual	CS Full Dual
B1047	56%	53%	50%	55%	26%	21%
B1049 South	1%	-1%	1%	-2%	0%	2%
B1049 North	-10%	-10%	-11%	-5%	-13%	5%
Landbeach Rd	-89%	-80%	-30%	-48%	-47%	-41%
All routes	-7%	-7%	3%	1%	-6%	-2%

Source: CSRM

These results show that:

- For the B1047 route, the Combined-Scenario Do-Minimum (the unmitigated 'with development' case) results in an increase in traffic levels compared to the Future-Base Do-Minimum (the 'without development' case). This increase is progressively addressed by each Do-Something mitigation package, with the Mode-Shift option yielding the least improvement and the Full-Dual option the greatest. In the AM peak, the South-Dual and Full-Dual options are also able to deliver improvements over the Future-Base Do-Minimum situation, though not in the PM peak.
- For the B1049 route, results are mixed. On the southern section, very little change from Future-Base Do-Minimum traffic levels are seen in any of the Combined-Scenario cases. On the northern section in the AM peak, there is a distinction between the dualling and the non-dualling options, with the former delivering improvements and the latter not while, in the PM peak, all Combined-Scenario cases apart from the Full-Dual option deliver improvements. Overall, though, the impact of the mitigation packages for this route is generally positive.
- Landbeach Road shows similar results to the B1049 in the AM peak, with the dualled mitigation options generally performing better than the non-dualled options, and with all options except Mode-Shift delivering improvements over the Combined-Scenario Do-Minimum. In the PM peak, however, all mitigation options perform progressively worse than the Combined-Scenario Do-Minimum, but still substantially better than the Future-Base Do-Minimum.

Overall, all Do Something mitigation options perform better than the Combined-Scenario Do-Minimum situation or the Future-Base Do-Minimum in both peak hours, except for the Junction+ and North-Dual options in the PM peak. However, only the South-Dual and Full-Dual options deliver an overall improvement against the Future-Base Do-Minimum scenario in both peak hours.

2.7.3 Journey time

Figure 26 shows the change in modelled two-way highway journey times on the A10(N) corridor for the Combined-Scenario Do-Minimum situation and each Combined-Scenario Do-Something mitigation package compared to the Future-Base Do-Minimum situation.

Journey time is the primary measure of corridor performance, where a lower result is regarded as better. It is measured here on the A10 between the A14 and Ely bypass, as a percentage change from Future Base Do Min journey time.

The journey times are shown by route section and for the full route, where the sections are as follows:

- South section – Milton Interchange to Cambridge Research Park
- Mid section – Cambridge Research Park to Stretham roundabout
- North section - Stretham roundabout to Ely bypass

Figure 26: Change in Ely to Cambridge Corridor journey time compared to Future-Base Do-Minimum

AM Peak

A10(N) Section	CS Do Min	CS Mode Shift	CS Jn+	CS North Dual	CS South Dual	CS Full Dual
South section	30%	26%	26%	36%	-26%	-10%
Mid section	1%	3%	4%	-40%	18%	-40%
North section	8%	8%	3%	-37%	10%	-37%
Full route	15%	14%	13%	-6%	-3%	-26%

PM Peak

A10(N) Section	CS Do Min	CS Mode Shift	CS Jn+	CS North Dual	CS South Dual	CS Full Dual
South section	73%	73%	77%	88%	6%	44%
Mid section	-12%	-10%	-13%	-54%	3%	-46%
North section	-17%	-16%	-53%	-72%	-49%	-68%
Full route	9%	10%	-5%	-22%	-19%	-31%

Source: CSRM

These results show that:

- Compared to the Future-Base Do-Minimum, the south section of the A10 shows the greatest journey time deterioration in the Combined-Scenario cases. This is because this is the section which experiences the greatest increases in demand with the proposed developments in place. This deterioration is improved the most by the South-Dual and Full-Dual options, delivering an overall improvement in the AM peak but not in the PM peak.
- On the mid and north sections in the AM peak, the situation is reversed, with only the North-Dual and Full-Dual options delivering improvements against the Future-Base Do-Minimum, as these options add link capacity to these sections. In the PM peak, however, all Combined Scenario cases improve over the Future-Base case on these sections, except the South-Dual option on the mid section.

- Overall, when measuring across the full route, all Do Something mitigation options show a journey time improvement against the equivalent Do Minimum case in both peak hours, except for the Mode-Shift option in the PM peak. However, only the three dualling options deliver an improvement against the Future-Base Do-Minimum situation in both peak hours.

2.7.4 Modelling results summary

The following table summarises, for the above three key modelling performance indicators, the level of improvement delivered by each Do Something mitigation package when compared to:

- The Future-Base Do-Minimum case (the ‘without development’ scenario)
- The Combined-Scenario Do-Minimum case (the unmitigated ‘with development’ scenario)

Table 4: Improvement over Future-Base and Combined-Scenario Do-Minimums in both peak hours

Indicator	Mode-Shift	Junction+	North-Dual	South-Dual	Full-Dual
Car Mode Share (corridor)	✓✓	✓✓	✓✓	✓✓	✓✓
Parallel Route Traffic Levels	✗✗	✗✗	✗✗	✓✗	✓✗
Journey Time	✗✗	✗✓	✓✓	✓✓	✓✓

Source: MM

This table shows a general progression in performance benefits from the mode shift package towards the full dual carriageway upgrade package as follows:

- The Mode-Shift option, which involves non-highway measures only, delivers mode share improvements, but not highway performance improvements.
- The Junction+ option, which includes the non-highway measures but also modest highway measures, shows a mode share improvement, but also some journey time improvements. It doesn’t, however, deliver overall parallel route traffic level improvements.
- The North-Dual option, which includes the non-highway measures but also more substantial highway measures, shows a mode share improvement, but also full journey time improvements. Similarly, though, it fails to deliver overall parallel route traffic level improvements.
- The South-Dual and Full-Dual options are the only ones to deliver overall improvements in all three performance indicators when compared against the Future-Base Do-Minimum option.

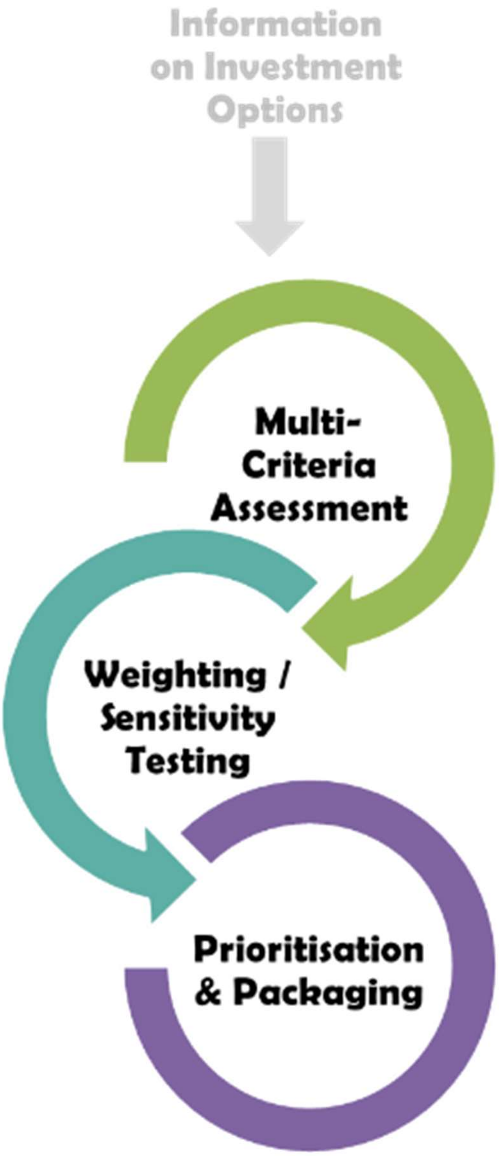
In the subsequent section, these outputs are assessed within the wider context of the full SOBC objectives defined above in order to identify a preferred option.

2.8 INSET Appraisal

In order to guide the selection of the most appropriate options, the five intervention options appraised in the traffic modelling scenarios have been subjected to a multi-criteria option appraisal using Mott MacDonald’s Investment Sifting and Evaluation Tool (INSET).

INSET is a decision support toolkit based on Green Book compliant multi-criteria decision analysis and DfT’s early assessment and sifting tool, ‘EAST’. The INSET process is illustrated in Figure 27.

Figure 27 Outline of the INSET Appraisal Process



Source: Mott MacDonald

For this project the appraisal criteria have been developed around the project objectives, enabling a tailored assessment of the performance of the options against each criterion. Individual criteria have also been weighted to reflect their relative importance.

This section first sets out the INSET appraisal process in terms of the definition of themes, criteria and sub-criteria, before moving on to an examination of the scores applied and the weightings assigned.

The weighted scores for the options are then presented at the end of the section.

2.8.1 Definition of Scoring Criteria

The INSET appraisal is organised according to a hierarchy of themes, main criteria and sub-criteria. These are outlined in detail below:

- **Themes:** Represent broad policy or strategy categories that enable the main package or scheme criteria to be classified and weighted differently, depending on local priorities
- **Main Criteria:** Correspond to specific package or scheme objectives, classified into the themes defined above
- **Sub-Criteria:** Comprises measurable metrics that can be used to appraise the degree to which each package or scheme objective/main criterion has been met

For the purposes of this appraisal, three themes have been defined; Strategic Outcomes, Transport Outcomes and Cost Implications. The first two themes cover the study objectives set out in Table 3, above and defined in the study brief, whilst the third theme is intended to enable the perceived benefits of the scheme to be balanced against the likely costs, as defined in Section 3.

The *main criteria* simply set out the seven scheme objectives. For the purposes of the INSET appraisal, Scheme Objective 7 was separated into two parts so that the benefits of the options for access to Cambridge Science Park and Cambridge Fringe North East could be appraised separately. The *themes* and *main criteria* are outlined in Table 5 below.

Table 5: Summary of INSET Themes and Study Objectives

ID	Theme	ID	Main Criteria
A	Strategic Outcomes	6	Address transport demand from the new town north of Waterbeach
		7a	Enable development in the Cambridge Science Park to proceed
		7b	Enable development in the Cambridge Northern Fringe East to proceed
B	Transport Outcomes	1	Maintain traffic at or below 2011 traffic levels in Cambridge
		2	Minimise vehicle mileage whilst providing for increased travel demand
		3	Improve reliability, capacity and speed of alternative transport modes
		4	Minimise potential impact on alternative "rat-runs" to the A10
		5	Intercept or substitute car trips with alternative transport modes
C	Cost	-	N/A

Source: Mott MacDonald

Sub-criteria were then defined against each of the main criteria to enable an appraisal of each package based on measurable data from the transport models. These are outlined in **Table 6** below.

Table 6: Summary of INSET Sub-Criteria

ID	Main Criteria	ID	Sub-Criteria
6	Address transport demand from the new town north of Waterbeach	i	Provides adequate road access to Waterbeach New Town
		ii	Provides improved rail access to Waterbeach New Town
		iii	Provides improved bus access to Waterbeach New Town
		iv	Provides improved active travel access to Waterbeach New Town
		v	Minimises car mode share to/from Waterbeach New Town
7a	Enable development in the Cambridge Science Park to proceed	i	Provides adequate road access to Cambridge Science Park
		ii	Provides improved rail access to Cambridge Science Park
		iii	Provides improved bus access to Cambridge Science Park
		iv	Provides improved active travel access to Cambridge Science Park

ID	Main Criteria	ID	Sub-Criteria
		v	Minimises car mode share to/from Cambridge Science Park
7b	Enable development in the Cambridge North Fringe East to proceed	i	Provides adequate road access to Cambridge Northern Fringe East
		ii	Provides improved rail access to Cambridge Northern Fringe East
		iii	Provides improved bus access to Cambridge Northern Fringe East
		iv	Provides improved active travel access to Cambridge Northern Fringe East
		v	Minimises car mode share to/from Cambridge Northern Fringe East
1	Maintain traffic at or below 2011 traffic levels in Cambridge	i	Cordoned Traffic Flows to/from Cambridge City
2	Minimise vehicle mileage whilst providing for increased travel demand	i	Average journey times on the A10 Corridor
		ii	Total distance travelled across the whole network
		iii	Average delay across the whole network
3	Improve reliability, capacity and speed of alternative transport modes	i	Improved Bus Journey Time reliability
		ii	Improved Bus Capacity
		iii	Improved Train Reliability
		iv	Improved Train Capacity
		v	Improved Active Travel Efficiency
		vi	Improved Active Travel Capacity
4	Minimise potential impact on alternative "rat-runs" to the A10	i	Reduced rat running on Cottenham Road
		ii	Reduced rat running on Twenty Pence Road
		iii	Reduced rat running on Horningsea Road
		iv	Reduced rat running on Green End Landbeach
5	Intercept or substitute car trips with alternative transport modes	i	Car mode share across the whole network
-	Capital Cost of Delivery	i	Capital cost of delivery

Source: Mott MacDonald

2.8.2 Scoring of Packages

The scoring was undertaken using a predefined scale to determine the relative impact of each package. These varied from simplified “Yes/No/Neutral” answers with scores of 1 to -1 respectively to more varied scores such as “Significant/Slight Benefit, Neutral, Slight/Significant Disbenefit” scored from 2 to -2 respectively. The scoring criteria for the strategic and transport themes are outlined in Table 7; scores marked as “N/A” were not used for appraising particular sub-criteria.

Table 7: INSET Appraisal Scoring Criteria

Sub-Criteria	2	1	0	-1	-2
Provides adequate road access to	Large improvement in road access to	Small improvement in road access to	No change in road access to	Small reduction in road access to	Large reduction in road access to

Sub-Criteria	2	1	0	-1	-2
Waterbeach New Town	Waterbeach New Town	Waterbeach New Town	Waterbeach New Town	Waterbeach New Town	Waterbeach New Town
Provides improved rail access to Waterbeach New Town	Large improvement in rail access to Waterbeach New Town	Small improvement in rail access to Waterbeach New Town	No change in rail access to Waterbeach New Town	Small reduction in rail access to Waterbeach New Town	Large reduction in rail access to Waterbeach New Town
Provides improved bus access to Waterbeach New Town	Large improvement in bus access to Waterbeach New Town	Small improvement in bus access to Waterbeach New Town	No change in bus access to Waterbeach New Town	Small reduction in bus access to Waterbeach New Town	Large reduction in bus access to Waterbeach New Town
Provides improved active travel access to Waterbeach New Town	Large improvement in active travel to Waterbeach New Town	Small improvement in active travel to Waterbeach New Town	No change in active travel to Waterbeach New Town	Small reduction in active travel to Waterbeach New Town	Large reduction in active travel to Waterbeach New Town
Minimises car mode share to/from Waterbeach New Town	Large improvement in mode share to Waterbeach New Town	Small improvement in mode share to Waterbeach New Town	No change in mode share to Waterbeach New Town	Small reduction in mode share to Waterbeach New Town	Large reduction in mode share to Waterbeach New Town
Provides adequate road access to Cambridge Science Park	Large improvement in road access to Cambridge Science Park	Small improvement in road access to Cambridge Science Park	No change in road access to Cambridge Science Park	Small reduction in road access to Cambridge Science Park	Large reduction in road access to Cambridge Science Park
Provides improved rail access to Cambridge Science Park	Large improvement in rail access to Cambridge Science Park	Small improvement in rail access to Cambridge Science Park	No change in rail access to Cambridge Science Park	Small reduction in rail access to Cambridge Science Park	Large reduction in rail access to Cambridge Science Park
Provides improved bus access to Cambridge Science Park	Large improvement in bus access to Cambridge Science Park	Small improvement in bus access to Cambridge Science Park	No change in bus access to Cambridge Science Park	Small reduction in bus access to Cambridge Science Park	Large reduction in bus access to Cambridge Science Park
Provides improved active travel access to Cambridge Science Park	Large improvement in active travel to Cambridge Science Park	Small improvement in active travel to Cambridge Science Park	No change in active travel to Cambridge Science Park	Small reduction in active travel to Cambridge Science Park	Large reduction in active travel to Cambridge Science Park
Minimises car mode share to/from Cambridge Science Park	Large improvement in mode share to Cambridge Science Park	Small improvement in mode share to Cambridge Science Park	No change in mode share to Cambridge Science Park	Small reduction in mode share to Cambridge Science Park	Large reduction in mode share to Cambridge Science Park
Provides adequate road access to Cambridge Northern Fringe East	Large improvement in road access to Cambridge Northern Fringe East	Small improvement in road access to Cambridge Northern Fringe East	No change in road access to Cambridge Northern Fringe East	Small reduction in road access to Cambridge Northern Fringe East	Large reduction in road access to Cambridge Northern Fringe East
Provides improved rail access to Cambridge Northern Fringe East	Large improvement in rail access to Cambridge Northern Fringe East	Small improvement in rail access to Cambridge Northern Fringe East	No change in rail access to Cambridge Northern Fringe East	Small reduction in rail access to Cambridge Northern Fringe East	Large reduction in rail access to Cambridge Northern Fringe East
Provides improved bus access to Cambridge Northern Fringe East	Large improvement in bus access to Cambridge Northern Fringe East	Small improvement in bus access to Cambridge Northern Fringe East	No change in bus access to Cambridge Northern Fringe East	Small reduction in bus access to Cambridge Northern Fringe East	Large reduction in bus access to Cambridge Northern Fringe East
Provides improved active travel access to Cambridge Northern Fringe East	Large improvement in active travel to Cambridge Northern Fringe East	Small improvement in active travel to Cambridge Northern Fringe East	No change in active travel to Cambridge Northern Fringe East	Small reduction in active travel to Cambridge Northern Fringe East	Large reduction in active travel to Cambridge Northern Fringe East

Sub-Criteria	2	1	0	-1	-2
Minimises car mode share to/from Cambridge Northern Fringe East	Large improvement in mode share to Cambridge Northern Fringe East	Small improvement in mode share to Cambridge Northern Fringe East	No change in mode share to Cambridge Northern Fringe East	Small reduction in mode share to Cambridge Northern Fringe East	Large reduction in mode share to Cambridge Northern Fringe East
Cordoned Traffic Flows to/from Cambridge City	Traffic levels are below 2011 totals	No change in traffic levels	N/A	Traffic levels increase in line with national forecasts	Traffic levels in excess of national forecasts
Average journey times on the A10 Corridor	Greater than 5-minute decrease in journey times	Up to 5-minute decrease in journey times	No change in journey times	Up to 5-minute increase in journey times	Greater than 5-minute increase in journey times
Total distance travelled across the whole network	Significant decrease in total trip distance	Slight decrease in total trip distance	No change in total trip distance	Slight increase in total trip distance	Significant increase in total trip distance
Average delay across the whole network	Significant decrease in average delay	Slight decrease in average delay	No change in average delay	Slight increase in average delay	Significant increase in average delay
Improved Bus Journey Time reliability	Bus journey times improved by more than 5 minutes	Bus journey times improved by up to 5 minutes	Bus service reliability does not change	Bus journey times decrease by up to 5 minutes	Bus journey times decrease by over 5 minutes
Improved Bus Capacity	N/A	Bus service capacity is improved	Bus service capacity does not change	Bus service capacity is compromised	N/A
Improved Train Reliability	Train journey times improved by more than 5 minutes	Train journey times improved by up to 5 minutes	Train service reliability does not change	Train journey times decrease by up to 5 minutes	Train journey times decrease by over 5 minutes
Improved Train Capacity	N/A	Train service capacity is improved	Train service capacity does not change	Train service capacity is compromised	N/A
Improved Active Travel Efficiency	Active Travel journey times improved by more than 5 minutes	Active Travel journey times improved by up to 5 minutes	Active Travel service reliability does not change	Active Travel journey times decrease by up to 5 minutes	Active Travel journey times decrease by over 5 minutes
Improved Active Travel Capacity	N/A	Active Travel capacity is improved	Active Travel capacity does not change	Active Travel capacity is compromised	N/A
Reduced rat running on Cottenham Road	Significant decrease in rat running	Slight decrease in rat running	No change in rat running	Slight increase in rat running	Significant increase in rat running
Reduced rat running on Twenty Pence Road	Significant decrease in rat running	Slight decrease in rat running	No change in rat running	Slight increase in rat running	Significant increase in rat running
Reduced rat running on Horningsea Road	Significant decrease in rat running	Slight decrease in rat running	No change in rat running	Slight increase in rat running	Significant increase in rat running
Reduced rat running on Green End Landbeach	Significant decrease in rat running	Slight decrease in rat running	No change in rat running	Slight increase in rat running	Significant increase in rat running
Car mode share across the whole network	Significant modal shift away from private car	Slight modal shift away from private car	No change in modal splits	Slight modal shift towards private car	Significant modal shift towards private car

Source: Mott MacDonald

Scoring for the cost theme was undertaken using a scale of -1 (least costly package) to -5 (most costly package) as a means to offset the benefits generated from scoring in the strategic and transport themes.

The full scores from the appraisal are summarised in Table 8.

Table 8: Summary of Sub-Criteria Scoring

ID	Sub-Criteria	Mode-Shift	Junction +	North Dual	South Dual	Full Dual	Rationale
6i	Provides adequate road access to Waterbeach New Town	0	0	1	1	1	Journey time savings to site are > 1 minute in dualling options
6ii	Provides improved rail access to Waterbeach New Town	2	2	2	2	2	All scenarios deliver significant journey time savings by train to the site
6iii	Provides improved bus access to Waterbeach New Town	1	1	1	2	2	South/Full Dual deliver >5 minute journey times savings for bus trips
6iv	Provides improved active travel access to Waterbeach New Town	0	0	0	0	0	All active travel journey time savings are < 1 minute
6v	Minimises car mode share to/from Waterbeach New Town	1	1	1	1	-1	Car mode share decreases in all but the Full Dual, where it increases
7ai	Provides adequate road access to Cambridge Science Park	0	0	0	1	1	Journey time savings are > 1 minute for south/full dual options
7aii	Provides improved train access to Cambridge Science Park	1	1	1	1	1	All scenarios generate similar train journey time savings
7aiii	Provides improved bus access to Cambridge Science Park	0	0	0	1	1	Bus journey times are only improved by south/full dual
7aiv	Provides improved active travel access to Cambridge Science Park	0	0	0	0	0	All active travel journey time savings are < 1 minute
7av	Minimises car mode share to/from Cambridge Science Park	-1	-1	-1	-1	-1	All scenarios lead to an increase in car mode share from the site
7bi	Provides adequate road access to Cambridge Northern Fringe East	0	0	0	1	1	Journey time savings are > 1 minute for south/full dual options
7bii	Provides improved rail access to Cambridge Northern Fringe East	1	1	1	1	1	All scenarios generate similar train journey time savings

ID	Sub-Criteria	Mode-Shift	Junction +	North Dual	South Dual	Full Dual	Rationale
7biii	Provides improved bus access to Cambridge Northern Fringe East	0	0	0	0	0	All bus journey time savings are < 1 minute
7biv	Provides improved active travel access to Cambridge Northern Fringe East	0	0	0	0	0	All active travel journey time savings are < 1 minute
7bv	Minimises car mode share to/from Cambridge Northern Fringe East	-1	-1	-1	-1	-1	All scenarios lead to an increase in car mode share from the site
1i	Cordoned Traffic Counts to/from Cambridge City	-2	-2	-2	-2	-2	All scenarios record traffic levels into Cambridge >20% from 2011 levels
2i	Average journey times on the A10 Corridor	1	1	2	2	2	Dualling options generate >5 minute journey time savings for all modes
2ii	Total distance travelled across the whole network	-1	-1	-1	-1	-1	All options bring about a slight increase in total trip distances
2iii	Average delay across the whole network	0	2	2	2	2	All highway interventions are able to significantly reduce the level of delay on the network
3i	Improved Bus Journey Time reliability	1	1	1	2	2	Bus journey times along corridor improved >5 minutes for south and full dual options
3ii	Improved Bus Capacity	1	1	1	1	1	Bus capacity is improved across all options
3iii	Improved Train Reliability	2	2	2	2	2	Train journey times improved by over 5 minutes in all scenarios
3iv	Improved Train Capacity	1	1	1	1	1	Train capacity is improved across all options
3v	Improved Active Travel Efficiency	2	2	2	2	2	Active travel journey times are improved > 5 minutes along the corridor

ID	Sub-Criteria	Mode-Shift	Junction +	North Dual	South Dual	Full Dual	Rationale
3vi	Improved Active Travel Capacity	1	1	1	1	1	Active travel capacity is improved across all options
4i	Reduced rat running on Cottenham Road	1	1	1	2	2	South/Full dual option reduce demand by >100 pcus
4ii	Reduced rat running on Twenty Pence Road	1	1	2	2	2	All dualling options reduce demand by >100 pcus
4iii	Reduced rat running on Horningsea Road	1	2	1	2	2	Highway options benefitting the southern end of the corridor reduce demand by >100 pcus
4iv	Reduced rat running on Green End	-1	-2	-2	-2	-2	Highway interventions all add >100 pcus to road
5i	Car mode share across the whole network	1	-1	-1	-1	-1	Highway interventions generate a slight modal shift towards private car
-i	Capital cost of delivery	-1	-2	-4	-3	-5	Schemes ranked in order of cost

Source: Mott MacDonald

2.8.3 Weighting of Criteria

Scores were then weighted according to their perceived relative importance. These have been defined as follows:

- **Themes:** Each have been weighted evenly as 1 as strategic, transport and cost outcomes are all perceived to be of equal importance
- **Main Criteria:** Access into Waterbeach has been assigned a weighting of 2 as it directly affects the Ely to Cambridge Corridor more than the Cambridge Science Park or Cambridge North Fringe East. Similarly, improving the reliability of alternative transport modes and reducing rat runs have been given weightings of 2 compared to more car-based outcomes. Minimised vehicle mileage has been given a weighting of 3 to reflect its overall strategic importance
- **Sub-Criteria:** Non-car accessibility criteria have all been given weightings of 2 to reflect the importance of modal choice on the A10 corridor. Reductions in delay have similarly been weighted as 2 as this is seen as more important as changes in trip distance. Changes to journey times have been given a weighting of 3 given their importance in determining economic benefits for the scheme. The cost scores were given a weighting of 0.2 to normalise the scoring (from -1 to -5) in line with the other outputs

2.8.4 Weighted Scores

The weighted scores are presented in and are grouped by each theme.

Table 9: Final INSET Scores

Package	Strategic Theme	Transport Theme	Cost Theme	Total Score
Modal Shift	1.00	0.93	-0.20	**0.58**
Junction Plus	1.00	1.33	-0.40	**0.64**
North Dual	1.13	1.93	-0.80	**0.76**
South Dual	1.67	2.20	-0.60	**1.09**
Full Dual	1.40	2.20	-1.00	**0.87**

Source: Mott MacDonald

These show that the South Dual option scores the highest overall, given its strong scoring in both strategic and transport outcomes and its relative cost compared to the other dualling options.

Out of the non-dualling options, both the modal shift and junction plus options deliver modest strategic and transport benefits at relatively low cost. The Junctions Plus option performs slightly better given that its highway impacts are more beneficial, despite its slightly higher cost.

Overall the dualling options all score higher than the non-dualling options as they are able to unlock significant benefits from both a strategic perspective and from a highway perspective.

This indicates that benefits could be gained by first undertaking comparatively low-cost packages which are likely to have shorter implementation programmes as well as lower costs, together with effective measures to encourage mode shift. Higher cost packages which generate significant benefits could then be adopted subsequently in line with the scale and pace of development.

2.8.5 Development-related transport planning

The model-based analysis set out above makes clear that transport conditions in the Ely to Cambridge corridor will deteriorate through time, and that this will be exacerbated with further development, unless measures are introduced both to target travel demand (and particularly private highway travel demand) and also to enhance the capacity and effectiveness of the transport networks on which people travel.

Beyond this analysis, however, there is also the case that a key responsibility for securing positive transport outcomes for the county lies with the detailed planning of individual developments and managing demand to travel, particularly by private car, at source. Moreover, it is clear that major development cannot continue to be delivered with a ‘business-as-usual’ approach to transport planning which frequently does little to discourage the frequent use of private motor vehicles.

To avoid the problematic impacts described above in this document, development must in future seek very carefully to:

- minimise external vehicle trip generation through maximising trip internalisation;
- provide significantly lower levels of car parking than has traditionally been provided, particularly at employment locations;
- promote a site-wide approach to car parking management to reduce the need for significant increases in car parking provision; and
- promote the use of non-car modes through significant investment in supply-side measures and aggressive travel planning to encourage the required mode shift.

The development of major sites at CNFE, CSP, and Waterbeach, as well as sites to the north of the corridor at Ely and beyond therefore represent an opportunity to take a more proactive approach to planning which maximises the likelihood of sustainable future travel patterns.

The planning and transport authorities should also ensure that processes for monitoring, managing, and reviewing transport outcomes are implemented and secured by and from developers through the consenting process.

Acceptable and stretching highway 'trip budgets' should be identified for each site and permission for continued stages of development should be made contingent on the ability of the developers to demonstrate their sites are meeting these targets through effective promotion of non-car-mode take-up and site-based demand management.

This is particularly relevant for the CNFE and CSP sites, given the constraints on highway capacity at, and south of, the Milton Interchange, the need for parking restraint here, and the availability of non-car travel options.

3 Financial Case

The Financial Case concentrates on the costs of each transport intervention, and how these are expected to be profiled out over time. It also discusses how allowances for risk have been accounted for in the cost estimates.

3.1 Methodology

The financial cost estimates were developed in line with national standards and guidance for individual elements of each transport intervention package.

As detailed in Section 2.6, there are five options which have been identified through the initial analysis for a more detailed appraisal:

- Mode-shift (DS1) - Do Minimum highway network, but new measures to encourage mode shift
- Junction+ (DS2) - Mode-shift option measures, but with additional junction improvements to the Ely to Cambridge Corridor
- North-dual (DS3) - Junction+ option, but with the provision of a dual carriageway, on an alignment to be determined, from the Waterbeach development north access to Ely
- South-dual (DS4) - Junction+ option, but with the provision of a dual carriageway, on an alignment to be determined, from the Waterbeach development south access to the A14 at Milton
- Full-dual (DS5) - Junction+ option, but with the provision of a dual carriageway, on an alignment to be determined, from the A14 to Ely

The cost estimates for individual scheme components have been included in this section, which are then combined to provide overall costs for each proposed option.

3.2 Assumptions

The following assumptions and exclusions have been incorporated into the cost estimates:

- **General Assumptions:**
  - The estimate is based at 4Q17 (no inflation has been allowed for beyond this time)
  - Works can be carried out under half road closure wherever possible
  - Existing ground level approximately same as finished construction levels
  - The A10 is not a Highways England maintained asset therefore no allowances have been included for roadside technology signs for NRTS
  - All signage to be unlit
  - All street lighting for the (non-rail) dedicated public transport route, ped/cycle and junction improvements is at 20m intervals
  - New Waterbeach Park and Ride site allowance for 1,000 spaces as per the Waterbeach Transport Assessment document
  - The generic layout of the relocated railway station platform uses assumptions taken from the Waterbeach Transport Assessment which is considered a reasonable basis for estimates at the early stage in the process

  - If existing lane configurations not clear then a minimum of 100m allowed on the approach to major junctions where the lane configuration changes
  - Roundabout inscribed circle diameter assumed as 30m unless existing roundabout is larger
  - Assume (non-rail) dedicated public transport route is through a greenfield site
  - Assume cycle/ped way is through a greenfield site
  - The crossing over the River Great Ouse will be widened, not demolished and rebuilt
  - Replacement of pedestrian bridge for Milton Park and Ride for the South and Full Dual Options
  - Site Compounds included in the prelims except for the Guided Busway which needs site compound for a batching plant
  - Where possible budget quotations have been used from specialist subcontractors

- **Exclusions:**
  - VAT
  - 3rd party compensation costs
  - Planning and approval charges
  - Costs associated with Statutory Fees (e.g. HMRI, Local Authority, etc.)
  - Costs associated with taxes, levies and licences
  - Costs associated with changes in legislation and any form of applicable standards
  - Christmas, Easter and Bank Holiday working
  - Environmental mitigation works
  - Archaeological digs
  - Inflation beyond the base date
  - Land deemed relatively flat - minimising the use of safety barrier in the verges allowed for 50% barrier
  - Re-location of affected businesses
  - Road diversions
  - Landscaping
  - Retaining walls
  - Footpaths for the full length of the dual carriageway
  - Any works to the existing A14
  - Tactile paving
  - Procurement of new vehicles for the (non-rail) dedicated public transport route
  - New depot for vehicles for the (non-rail) dedicated public transport route

It is common practice when schemes and measures are in the early stages of their assessment for there to be a number of exclusions such as those noted above. For the purposes of assessing the economic performance of the packages (see the Economic Case), however, factors reflecting optimism bias, risk and other elements including an assumed uplift for land costs have been applied.

3.3 Capital Costs

3.3.1 Baseline Costs

Baseline costs have been developed for individual components of each package of interventions. At this early stage of scheme development, these have been defined as follows:

- **All options**
  - New Station at Waterbeach (including car park)
  - Waterbeach Park and Ride site
  - Pedestrian and Cycle upgrades
  - Provision of dedicated (non-rail) public transport corridor
  - Localised measures on Milton Road in vicinity of CNFE and Science Park
- **Highway Intervention options (Junctions Plus, North Dual, South Dual, Full Dual)**
  - Highway Works (scaled according to level of intervention)

Costs for each component were profiled out according to the following items:

- **Construction:** Cost of building and contracting the scheme itself
- **Preliminaries (Prelim):** Cost of administering construction, assumed as 23% of construction estimate
- **Overheads & Profit (OH&P):** Business costs associated with construction, assumed to be 10% of construction + preliminary costs
- **Design:** Costs associated with the planning and design phases prior to construction, assumed to be 10% of overall Construction, Prelims and OH&P costs
- **Project Management (PM):** Costs associated with administering the design process, assumed to be 11% of overall Construction, Prelims and OH&P costs

These are presented in Table 10 alongside the scheme options and their components.

Table 10: Baseline Intervention Costs (£000s, 2017 costs & prices)

Cost Item	All Options (DS1 – DS5)					DS2	DS3	DS4	DS5
	W'beach New Station	W'beach P&R	Ped & Cycle	Public transport corridor	Milton Rd local measures	Junction Plus	North Dual	South Dual	Full Dual
Const	7,500	3,500	5,200	21,900	1,100	18,700	67,700	39,800	91,300
Prelim	1,800	800	1,200	5,000	200	4,300	15,600	9,100	21,000
OH&P	900	400	600	2,700	100	2,300	8,300	4,900	11,200
Design	1,500	700	1,100	4,500	200	3,800	13,800	8,100	18,500
PM	1,100	500	800	3,300	200	2,800	10,100	5,900	13,600
TOTAL	**12,800**	**5,900**	**8,800**	**37,400**	**1,800**	**31,900**	**115,500**	**67,800**	**155,600**

Source: Mott MacDonald

3.3.2 Risk Allowances

At this stage in the option development process, a degree of risk has been factored into the cost estimates, given the level of uncertainty associated with each package of interventions.

Several risk items have been identified as follows:

- **Risk Allocation:** Set at 10% of baseline costs – this will be updated based on a Quantified Risk Cost Allocation (QRCA) as the scope of interventions becomes more defined

- **Legal Fees:** Set at 2% of baseline costs
- **Business Case Fees (BC):** Assumed to be 3% of baseline costs
- **Land Costs:** Potential costs associated with purchasing up land for to each scheme in order to progress development, discounting any land required for construction compounds. At this stage this is assumed to be 20% of baseline costs, minus the preliminaries associated with construction compound setup but this will need to be subject to detailed review as the interventions are refined
- **Utilities Diversions (Utils):** Assumed to be 1% of baseline costs

These allocations are summarised in Table 11 alongside each option

Table 11: Risk Allocation Costs (£000s, 2017 costs & prices)

Cost Item	All Options (DS1 – DS5)					DS2	DS3	DS4	DS5
	W'beach New Station	W'beach P&R	Ped & Cycle	Public transport corridor	Milton Rd local measures	Junction Plus	North Dual	South Dual	Full Dual
Risk	3,200	1,400	2,200	9,300	400	8,000	28,900	17,000	38,900
Legal	300	100	200	800	50	600	2,300	1,400	3,100
BC	400	200	300	1,100	100	1,000	3,500	2,000	4,700
Land	800	400	500	2,300	100	1,900	7,000	4,100	9,400
Utils	100	100	100	500	50	400	1,400	800	1,900
TOTAL	**4,800**	**2,200**	**3,300**	**14,000**	**700**	**11,900**	**43,100**	**25,300**	**58,000**

Source: Mott MacDonald

Additional optimism bias uplifts have been added to these costs for the purposes of the economic appraisal, as discussed in Section 4.1.

3.3.3 Point Estimate

The total cost for each package of measures combines the baseline costs with the risk allowances for each scheme component. These are summarised in Table 12.

Table 12: Point Estimates – Scheme Components (£000s, 2017 costs & prices)

Cost Item	All Options (DS1 – DS5)					DS2	DS3	DS4	DS5
	W'beach New Station	W'beach P&R	Ped & Cycle	Public transport corridor	Milton Rd local measures	Junction Plus	North Dual	South Dual	Full Dual
Baseline Cost	12,800	5,900	8,800	37,400	1,800	31,900	115,500	67,800	155,600
Risk Allowances	4,800	2,200	3,300	14,000	700	11,900	43,100	25,300	58,000
Point Estimate	**17,500**	**8,100**	**12,100**	**51,200**	**2,500**	**43,800**	**158,500**	**93,100**	**213,700**

Source: Mott MacDonald

These individual component costs have been combined into intervention package costs for each option, as listed in Table 13.

Table 13: Point Estimates – Transport Options (£000s, 2017 costs & prices)

Cost Item	DS1 (W'beach New Station, W'beach P&R, Ped & Cycle, dedicated public transport corridor, Milton Road local measures)	DS2 (DS1 + Junction Plus)	DS3 (DS1 + North Dual)	DS4 (DS1 + South Dual)	DS5 (DS1 + Full Dual)
Baseline Cost	66,500	98,500	182,000	134,400	222,200
Risk Allowances	24,800	36,700	68,000	50,200	82,900
Point Estimate	**91,400**	**135,200**	**250,000**	**184,600**	**305,100**

Source: Mott MacDonald

3.4 Operational Costs

At this stage, operational costs have not been estimated as the scope of any changes to the maintenance regime or public transport services have not been fully defined.

3.5 Cost Profile

For the purposes of the economic assessment, it has been assumed that the total cost of each intervention package will be profiled out evenly across a four-year period leading up to an assumed package opening year of 2031. In practice, delivery of individual elements would be phased with some potentially delivered significantly earlier than others. However, for the purposes of this initial assessment, this has been used as a working assumption and to allow for a like-for-like comparison across the scenarios.

The cost profiles will therefore need be examined in additional detail once the transport interventions, and their delivery timescales, have been scoped out further.

4 Economic Case

The economic case for each package will be demonstrated by an analysis of all its impacts and their associated value for money. DfT guidance on undertaking a SOBC requires that only initial findings on the associated value for money of a scheme are provided at this stage.

4.1 Methodology

As detailed in Section 2.6, there are five do-something options which have been identified through the initial analysis for a more detailed appraisal. These all include improvements to public transport and encouraging a mode shift away from private vehicles.

In order to undertake economic assessment, a 'do minimum' case is also required for comparison purposes. The options appraised were:

- Do Minimum (DM) – the existing transport network, amended to include committed schemes as agreed with the County Council, and with increased demand reflecting planned growth in jobs and population to 2031
- Mode-shift (DS1) - Do Minimum transport network, but new measures to encourage mode shift
- Junction+ (DS2) - Mode-shift option measures, but with additional junction improvements to the Ely to Cambridge Corridor
- North-dual (DS3) - Junction+ option, but with provision of a dual carriageway, on an alignment to be determined, between the proposed Waterbeach development access and Ely
- South-dual (DS4) - Junction+ option, but with provision of a dual carriageway, on an alignment to be determined, between the proposed Waterbeach development access and the A14 at Milton
- Full-dual (DS5) - Junction+ option, but with the provision of a dual carriageway, on an alignment to be determined, between the A14 and Ely

The assessment of the transport user benefits has been undertaken using the software TUBA, with inputs provided using the County Council's CSRM2 SATURN-based strategic model.

4.2 Assumptions

This section provides a description of the assumptions used in order to undertake the economic appraisal. The approach has generally followed WebTAG criteria, but in certain cases a simplified approach has been used to reflect the early development of the interventions. The key assumptions of the economic assessment are:

- A 60-year appraisal period with a package opening year of 2031 (as noted previously, this will be refined should the packages be developed further, assuming that some elements would be delivered significantly earlier than others)
- Appraisal based on model forecast years of 2031 and 2041. Only 2031 models were available for this study and given that TUBA requires two modelled years in order to interpolate and extrapolate benefits across the 60-year appraisal period, the 2031 inputs have been repeated with a forecast year of 2041. This assumes that benefits generated by each scheme will remain fixed from 2031 to 2041. Whilst not considered unreasonable at

this early stage of the process, more detailed modelling and profiling of benefits will clearly be needed should package elements be taken forward.

- Three modelled hours including:
  - AM Peak Hour (08:00 – 09:00)
  - PM Peak Hour (17:00 – 18:00)
  - Average Inter-Peak Hour (10:00 – 16:00)
- Annualisation factors have been derived to enable modelled time periods to represent the full year. The annualisation factors used assume 253 working days in a year and also assume that the benefits generated in the AM peak hour will be repeated for each hour of the 3-hour period from 07:00 – 10:00. Similarly, the PM peak hour benefits will be repeated for each hour of the 3-hour period from 16:00 – 19:00 and the inter-peak hour will be repeated for each hour of the 6-hour period from 10:00 – 16:00.

Furthermore, the following assumptions have been used with particular consideration for scheme cost inputs:

- Optimism bias taken as 66%, taken from WebTAG A1.2, Table 8
- All costs have been assumed to be construction costs with no operation and maintenance costs included, and a general uplift factor applied for land costs, which will require detailed review should the component schemes be taken forward
- A 4-year build period of 2028 to 2031 inclusive, with costs spread 25% across each year
- All costs calculated used a 2017 price base, these are converted to a 2010 price base for TUBA calculations with all TUBA output given in a 2010 price base.

4.3 Benefits Appraisal

In this section, a description of the benefits generated from travel time improvements and operating cost reductions for each option is presented, along with a commentary on the findings. Each of the five transport interventions have been compared against the “Do Minimum” option outlined in Section 2.7.

4.3.1 Transport Economic Efficiency

The Transport Economic Efficiency (TEE) table provides a summary of the monetised journey time savings and operating cost savings generated by different user classes in each modelled scenario compared to the Do Minimum scenario. The outputs for all scenarios are summarised in Table 14.

Table 14: Transport Economic Efficiency Summary (2010 values, discounted to 2010)

Benefits Category	Benefits Sub-Category	DS1 Value (£000)	DS2 Value (£000)	DS3 Value (£000)	DS4 Value (£000)	DS5 Value (£000)
Consumer - Commuting user benefits	Travel Time	149,038	276,982	405,061	317,926	407,952
	Vehicle operating costs	20,500	19,804	21,199	7,050	6,608
	NET CONSUMER - COMMUTING BENEFITS	*169,538*	*296,786*	*426,260*	*324,976*	*414,560*
Consumer - Other user benefits	Travel Time	2,065	58,031	124,883	116,105	183,163
	Vehicle operating costs	1,473	3,866	-4,471	1,267	-9,340

Benefits Category	Benefits Sub-Category	DS1 Value (£000)	DS2 Value (£000)	DS3 Value (£000)	DS4 Value (£000)	DS5 Value (£000)
	NET CONSUMER - OTHER BENEFITS	*3,539*	*61,897*	*120,412*	*117,372*	*173,823*
Business – User benefits	Travel Time	32,776	66,940	139,684	79,762	138,986
	Vehicle operating costs	3,412	11,753	23,679	17,558	27,574
	NET BUSINESS IMPACT	*36,188*	*78,693*	*163,363*	*97,320*	*166,560*
TOTAL		**209,265**	**437,376**	**710,035**	**539,668**	**754,943**

Source: Mott MacDonald

The DS1 scenario offers significant travel time and VOC benefits to all trips. The net overall impact of the mode shift scenario generates approximately £210m benefits over the entire appraisal period when compared to the do-minimum.

DS2 consists of both mode shift package measures along with junction upgrades on the Ely to Cambridge corridor. These improvements result in an uplift in benefits when compared to the mode shift measures alone (DS1). This scenario also offers benefits to all trip purposes with the largest portion coming from commuter trips.

Providing a dual carriageway between Waterbeach and Ely (ie the northern section of the Ely to Cambridge corridor – alignment to be determined (DS3)) increases benefits further due to the increased capacity and speeds likely to be experienced as a result of the upgraded infrastructure.

Providing a dual carriageway between Waterbeach and the A14 (ie the southern section of the Ely to Cambridge corridor – alignment to be determined (DS4)) generates more modest benefits compared to the northern dualling, in part due to the shorter distance covered by the improvements.

Provision of a full dual carriageway from the A14 to Ely (the alignment would need to be determined through further detailed assessment work) offers the largest benefits.

4.3.2 Analysis of Monetised Costs and Benefits (AMCB)

The AMCB table summarises the outcomes of the TEE calculations from Section 4.3.1, alongside an outline of greenhouse gas benefits and indirect taxes for each of the options. It also includes the cost components derived in Section 3, discounted to 2010 at 2010 prices. These are included in Table 15

Table 15: Analysis of Monetised Costs and Benefits Summary (2010 prices discounted to 2010)

Benefits/Costs Category	DS1 Value (£000)	DS2 Value (£000)	DS3 Value (£000)	DS4 Value (£000)	DS5 Value (£000)
Greenhouse Gases	976	2,473	155	329	-4,284
Economic Efficiency: Consumer Users (Commuting)	169,538	296,786	426,260	324,976	414,560

Benefits/Costs Category	DS1 Value (£000)	DS2 Value (£000)	DS3 Value (£000)	DS4 Value (£000)	DS5 Value (£000)
Economic Efficiency: Consumer Users (Other)	3,539	61,897	120,412	117,372	173,823
Economic Efficiency: Business Users and Providers	36,188	78,693	163,363	97,320	166,560
Wider Public Finances (Indirect Taxation Revenues)	-1,870	-4,435	229	-132	8,828
Present Value of Benefits (PVB)	**208,371**	**435,414**	**710,419**	**539,865**	**759,487**
Present Value of Costs (PVC)	**82,856**	**122,376**	**222,947**	**166,856**	**267,482**

As described in Section 4.3.1, the full dualling option offers an increase in benefits from both the north and south dualling options in isolation but at greater present value cost.

4.3.3 Safety Benefits

Due to the strategic nature of the options under consideration, the safety benefits have not been examined at this stage.

4.3.4 Environmental Benefits

Environmental benefits have been calculated based on the AMCB outputs above. These calculate the approximate monetised value of changes in greenhouse gas emissions between the Do Minimum scenario and each of the options.

The Junction + (DS2) option appears to generate the greatest greenhouse gas benefits, as it does little to change the speed and classification of the Ely to Cambridge corridor, but alleviates key areas of congestion which would have adversely affected emissions.

There are also modest greenhouse gas benefits for both the north (DS3) and south (DS4) dualling options, as the impact of congestion alleviation counter-balances the impact of increased speeds on the dualled parts of the route.

There are greenhouse gases disbenefits associated with the full dual option (DS5), which could be attributed to higher levels of traffic using the fully dualled route and travelling at higher speeds along the corridor, which outweighs the environmental benefits of any congestion alleviation.

4.3.5 Wider Economic Benefits

Wider Economic benefits have not been investigated at this stage due to the strategic nature of the interventions under consideration. Once the preferred options are refined, the impacts of the proposals on business, the economy and regeneration can be assessed as part of business case development for the recommended schemes

4.3.6 Reliability Benefits

The reliability benefits have not been quantified at this stage, although consideration was given to potential reliability impacts as part of the wider INSET appraisal outlined in Section 2.8.

4.3.7 Summary of Benefits

Each of the packages bring about monetised benefits in terms of journey time savings and reduced vehicle operating costs, particularly for commuting traffic on the Ely to Cambridge Corridor.

The level of benefit calculated for each intervention package at this stage suggests that the package including all of the public transport measures and provision of a full dual carriageway will generate the most benefits, followed by the package including the north dual proposal, then the package with the south dual proposal. The non-dualling options also generate benefits, with the junction improvement option providing more benefits than the mode shift option.

However, these benefits are counterbalanced by the relative costs of each scheme, with the packages that include the full dual and the north dual also being the costliest options, followed by the south dual, junction improvements and mode shift. The relationship between these costs and benefits are outlined further in the next section.

4.4 Value for Money

This section draws together the benefits calculations from the above section alongside the cost calculations from Section 3 to understand the net present value and benefit to cost ratios for each intervention package. These illustrate the value for money can be offered through each set of interventions.

4.4.1 Package Costs

The estimates in Table 16 have been calculated for each scenario, which incorporate the estimated costs of design, construction and risk allowances, but do not allow for the purchase of land or the ongoing operation and maintenance costs.

Table 16: Package Cost Summary (£000, 2017 prices)

Cost Item	DS1 (Mode Shift)	DS2 (Junction Plus)	DS3 (North Dual)	DS4 (South Dual)	DS5 (Full Dual)
Baseline Cost	66,500	98,500	182,000	134,400	222,200
Risk Allowances	24,800	36,700	68,000	50,200	82,900
Point Estimate	**91,400**	**135,200**	**250,000**	**184,600**	**305,100**

4.4.2 Risk and Optimism Bias

Risk allowances have been included in the prices outlined above, as detailed in Section 3.3.2. For the purposes of the economic appraisal, an additional 66% optimism bias has been added to the estimates to account for the level of uncertainty associated with the scope of the packages and the cost estimates themselves at this early stage of scheme development.

This is consistent with WebTAG Unit A1-2 on Scheme Costs, which states that early scheme development involving public transport components should apply a 66% uplift.

Table 17: Package Cost Summary (£000, 2017 prices)

Cost Item	DS1 (Mode Shift)	DS2 (Junction Plus)	DS3 (North Dual)	DS4 (South Dual)	DS5 (Full Dual)
Point Estimate	91,400	135,200	250,000	184,600	305,100
Optimism Bias (66%)	60,300	89,300	164,900	121,800	201,500
Total Scheme Estimate	**151,700**	**224,500**	**414,900**	**306,400**	**506,600**

4.4.3 Present Value of Costs

As described in Section 3, assumptions have been made regarding the years in which the schemes will be built and therefore the years in which costs will be incurred. It is assumed that all schemes will be built and operational in the year 2031 and, for the purposes of this high-level initial appraisal, that each package will be built in the three years prior to 2031 then finished and opened that year.

TUBA uses a 2010 price base and therefore the costs given in Section 3 are converted to a 2010 price base using the GDP deflator and then discounted to the assumed build year at 3.5% per year until 2031 and 3.0% after. This results in the present value of costs (PVC) given in Table 18.

Table 18: Application of package cost discounts (£000s)

Cost Item	DS1 (Mode Shift)	DS2 (Junction Plus)	DS3 (North Dual)	DS4 (South Dual)	DS5 (Full Dual)
Package Estimate (2017 Prices)	151,700	224,500	414,900	306,400	506,600
Package Estimate (2010 Prices)	82,856	122,376	222,947	166,856	267,482

Source: Mott MacDonald

4.4.4 Present Value of Benefits

Table 19 summarises the benefits described in Section 4.3. The table currently only displays the benefits generated through transport system efficiency improvements and currently does not take into account any safety, reliability or wider economic benefits that are likely to be generated by the packages.

This demonstrates that the full dual package (DS5) generates the highest level of benefits of around £760 million over the 60-year appraisal period, followed by the south dual package.

Table 19: Present Value Benefits (£000s, 2010 prices discounted to 2010)

Benefits/Costs Category	DS1 Value (£000)	DS2 Value (£000)	DS3 Value (£000)	DS4 Value (£000)	DS5 Value (£000)
Present Value of Benefits (PVB)	**208,371**	**435,414**	**710,419**	**539,865**	**759,487**

Source: Mott MacDonald

4.4.5 Benefit to Cost Ratios

Following on from the processes outlined above, the present value of benefits (PVB) are offset against the present value of costs (PVC) for each of the intervention options. The absolute difference between both values is referred to as the net present value (NPV), whilst the ratio between the two is referred to as the benefit to cost ratio (BCR). The BCR is then used to determine the value for money offered by each intervention package. These figures are given in Table 48 below.

Table 20: Benefit to Cost Ratios (£000s, 2010 prices discounted to 2010)

Benefits/Costs Category	DS1 Value (£000)	DS2 Value (£000)	DS3 Value (£000)	DS4 Value (£000)	DS5 Value (£000)
Present Value of Benefits (PVB)	208,371	435,414	710,419	539,865	759,487
Present Value of Costs (PVC)	82,856	122,376	222,947	166,856	267,482
Net Present Value (NPV)	125,515	313,038	487,472	373,009	492,005
Benefit to Cost Ratio (BCR)	**2.515**	**3.558**	**3.186**	**3.236**	**2.839**

4.4.6 Value for Money Statement

All intervention packages generate sufficient levels of benefits to offset the estimated cost of implementation.

The DfT's Value for Money Framework outlines different categorisations for schemes achieving BCR values within defined ranges. This classifies any schemes that score a BCR above 2 as demonstrating "High Value for Money". All packages tested here generate a BCR greater than this and, at this stage in the development process, are considered to demonstrate high value for money.

Based on the BCR scores, the package containing the southern dual scored highest out of the dualling options, followed by the packages including the north dual and then the full dual. The package including junction improvements and the mode shift proposals scores the highest BCR overall, whilst the mode shift package alone scores the lowest BCR overall. All packages have BCRs significantly in excess of 2 and therefore represent high value for money

This demonstrates that both lower-cost modal shift packages and higher cost highways packages have the potential to deliver significant benefits, although the greatest benefits have been derived from the packages which entail the provision of dual carriageway capacity to part or all of the A10 between Ely and Cambridge.

5 Commercial Case

The Commercial Case considers whether a transport investment is commercially viable and the potential procurement strategies that will be used to engage the market. It presents evidence on risk allocations and transfer, contract timescales and implementation timescales

5.1 Introduction

The main purpose of the Strategic Outline Business Case is to set out the need for intervention and define a preferred way forward. At SOBC stage, the Commercial Case is therefore typically presented as a high-level outline, which will be further developed as the scheme becomes more defined and the decision-making process reaches the Outline Business Case Stage.

5.2 Outline of Procurement Options

Different elements of the packages will likely be implemented using different routes depending on the type of scheme to be delivered and the lead authority be this the Combined Authority, the Greater Cambridge Partnership, or the County Council (possibly on behalf of the CA and / or the GCP). Some measures might also be implemented by third parties such as developers (potentially via Section 278 highways works), Network Rail, and others.

Further work by the authorities on the preferred procurement route for the different elements of the emerging preferred package will therefore be required but this could include:

- For large scale schemes (up to £20M), the Eastern Highways Alliance Framework
- For smaller scale schemes, the use of the County Council's Highway Services Contract
- Potential open invitation to tender (OJEU procurement) to select a contractor for the works from the open market
- Network Rail procurement mechanisms for rail-related works
- Developer-led works on the public highway via S278 Highways Act agreements
- Developer implementation of on-site works secured via planning condition

The advantages and disadvantages of these procurement routes, and their relevance to the different elements of the emerging preferred package will be considered in more detail as the different component schemes move through the Business Case process.

5.3 Programme Implications and Risk

An indicative timeline for delivery of a typical major scheme has been provided in the management case section to this report. However, more detailed programmes for each element of the emerging preferred package will need to be developed as these are progressed. This will need to include consideration of the following matters:

- Risk identification, allocation/transfer between commissioning authorities and contractor
- Timescales for procurement
- Contractor management strategy
- Payment mechanisms and arrangements should there be cost overruns

These issues will all be refined as the schemes move through the Business Case process, with full details being required at the Full Business Case stage.

6 Management Case

The management case demonstrates that the proposed packages are deliverable. It covers issues of the project planning and governance structure, risk management, communications and stakeholder management, benefits realisation and assurance.

6.1 Introduction

The Ely to Cambridge Transport Study has assessed a number of schemes, all of which require significant further development work and each with their own delivery mechanisms. At this early stage in the Business Case cycle, the management case is therefore high-level only. It is, however, considered important that programme-level oversight across the development and delivery of the whole package is retained and the recommended governance and management structures proposed in this section provide a start point for doing this.

6.2 Evidence of Similar Projects

Cambridgeshire County Council has successfully delivered a number of large-scale transport projects across the County in recent years. These include:

- **The Addenbrooke's Access Road** is a single carriageway route with several junctions and structures that connect Hauxton Road in Trumpington on the south side of the city, to Addenbrooke's Hospital. The route provides access to the expanding hospital and Bio Medical Campus, together with development on the Cambridge Southern Fringe, and reduces traffic in the Trumpington area, and on Long Road. The scheme was funded through a combination of Growth Area Fund and developer contributions, and was completed in October 2010
- **The Ely Southern Bypass** is a single carriageway highway, currently under construction, connecting the A142 at Angel Drove to Stuntney Causeway. The scheme include bridges over the railway line and the River Great Ouse and its floodplains and, when open to traffic will relieve heavy traffic around Ely station, remove the need for heavy goods vehicles to use the railway level crossing, and avoid an accident-prone low-bridge. The route will open to traffic in late summer 2018
- **The Cambridgeshire Guided Busway** provides a high quality public transport connection between Huntingdon and St Ives, to the north west of Cambridge, and Addenbrooke's Hospital and Trumpington Park and Ride to the south of Cambridge. Access to Cambridge City Centre is provided via on-street running. The overall route is 42km long with 25km of that being guided busway and 17km of on-street provision including bus priority measures. Construction began in March 2007 with the busway opened in August 2011. Although there were challenges during the delivery of the scheme, learning from this can benefit the delivery of future significant transport measures in the County.

6.3 Governance Arrangements

6.3.1 Existing Governance and Management Arrangements

To date, the development of the proposed package of measures for the Ely to Cambridge corridor has been overseen by a two-tier structure as set out in Table 21 below.

Table 21 Existing Project Management

Body	Role	Composition
Project Board	Strategic oversight and direction	Cambridgeshire County Council (Chair) Cambridge City and South Cambridgeshire District Councils East Cambridgeshire District Council Cambridgeshire and Peterborough Combined Authority Greater Cambridge Partnership Greater Cambridge Greater Peterborough Local Enterprise Partnership Highways England University of Cambridge
Project Team	Day-to-day project management	Cambridgeshire County Council (Chair) Cambridge City and South Cambridgeshire District Councils Greater Cambridge Partnership

Source: CCC

Given the work to date has largely been technical in nature, engagement with decision-makers has largely been on a 'for-information' basis via briefing sessions with members of all of the directly impacted local authorities, GCP and CA members, and the local Member of Parliament.

6.3.2 Potential Future Governance and Management Arrangements

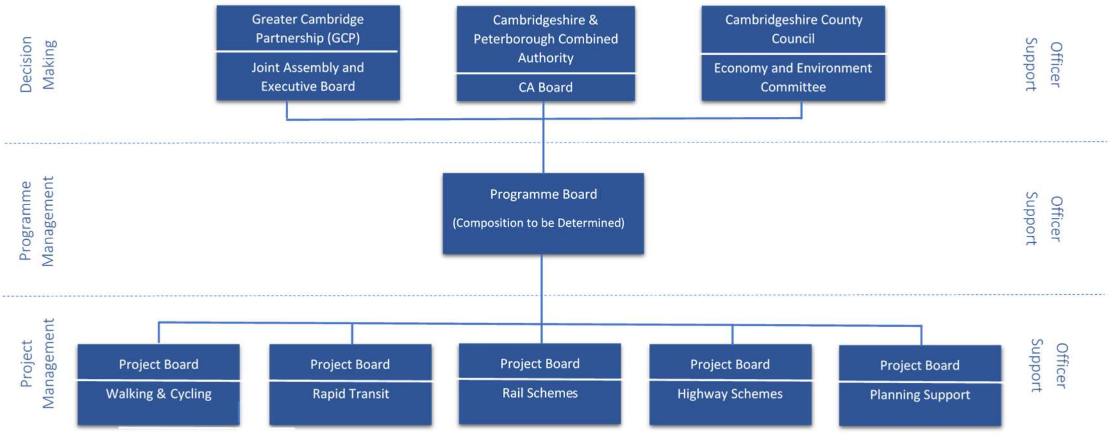
This initial phase of technical work has recommended a package of measures from walking and cycling improvements, through to larger-scale highway and dedicated public transport works.

The detailed governance and management arrangements for this package, should it be taken forward, will need to be developed in detail following approvals to proceed from the various decision-making bodies. However, the scale of the measures will invariably require strong project-level governance, with Project Boards and technical/administrative officer support for each element of the package, together with over-arching Programme Board oversight to manage the programme overall.

Given the complex transport funding and decision-making landscape in Cambridgeshire, and the variety of measures in the recommended package, strategic direction and approvals will likely need to be sought from all of the Combined Authority, the Greater Cambridge Partnership, and the County Council (depending on the element of the package being considered). The three bodies already work together on transport delivery so this could effectively be an extension to existing arrangements.

Figure 28 shows the potential governance arrangements. Clearly this may need to evolve as greater certainty emerges on the schemes, their funding, and the roles and responsibilities of the different bodies but this is considered to represent a sound initial basis for further development and agreement.

Figure 28: Potential Future Governance Structure



Source: CCC

6.4 Programme and Preliminary Indications of Delivery Timeline

The packages tested have a number of sub-elements. The programme for delivery of each of these, and their integration into a package-level programme, will need to be developed in detail as part of the next phase of the work depending on the recommendations and approvals from the various decision-making bodies.

The packages include a number of larger scale interventions including for dedicated public transport and increased highway capacity. Such interventions can have significant lead-times but an indicative traditional programme for their delivery, assuming approval to move towards major scheme business case development is given by September 2018, is shown in Figure 29.

This indicative programme will need significant development and refinement when agreement has been reached on the phasing of individual scheme delivery and as part of the development of scheme-level Business Cases when the scope to compress delivery timescales can be examined in detail.

Figure 29: Indicative potential delivery programme for an individual major scheme in Ely to Cambridge Corridor based on traditional timelines and DfT guidelines

6.5 Assurance, approvals and reporting

As shown in the indicative programme above, there are a number of key decision-making points at which a major scheme needs to be formally reviewed before it can proceed further.

These decision-making points include:

- Approval of the Outline Business Case;
- Approval of the Major Scheme Business Case; and
- Approval of the planning application (or other statutory processes depending on the nature of the scheme).

The exact assurance and approvals process to be followed will depend on the scheme itself (e.g. highways, rapid transit, other) and the type and source of funding that is used to deliver the scheme.

If a scheme is funded locally (i.e. the final decision to invest is taken by either the Combined Authority, and/or the Greater Cambridge Partnership), a detailed assurance and approvals plan for the scheme will need to be developed using the existing CA and GCP Assurance Frameworks. These describe the two bodies' processes for ensuring that investments provide value for money, based on best practice guidelines and require transport schemes to be appraised in line with the Department for Transport's (DfT) WebTAG guidance.

Given the devolved transport funding regime within Cambridgeshire, local funding is considered to be the most likely route. However, if funding from central Government were to be sought then any subsequent Outline Business Cases and Major Scheme Business Cases would need to be submitted directly to DfT, with scrutiny of the business case provided by DfT officials and the final investment decision taken by a Minister.

In addition to these formal decision-making points, the identified scheme sponsor will also undertake regular operational reviews. The operational reviews will form part of project monitoring meetings conducted every month by the relevant Project Manager and Senior Responsible Owner and will sit within the overall governance and management regime proposed in Figure 28 above.

The outcomes from the operational reviews will need to be reported to the relevant Project Board, potentially using a BRAG (Black, Red, Amber, Green) process with processes for remedy and escalation worked up in detail as overall governance arrangements for the projects are firmed up.

6.6 Communications and Stakeholder Engagement

At present, the package for the Ely to Cambridge corridor scheme is still in the early stages of development. The stakeholders to be involved and the communication methods used to engage with them will therefore evolve as the package, and its constituent schemes, progress.

At Outline Business Case stage, a 'stakeholder mapping' exercise will be developed to understand the potential levels of interest in, and influence over, the package that various stakeholders have.

This will be used to develop a full Stakeholder Management and Communications Plan, which will include full details of who will be consulted, for what purpose, when, how and how often.

6.7 Risk Management Strategy

The lead authorities will adopt a robust risk management strategy to ensure effective management of risk for the proposed programme of works. The partners (CPCA, GCP, and CCC) already have well established, proactive processes to managing of risk, therefore risk management plans will be implemented in accordance with those principles and with best practice. All risk registers will be reviewed regularly throughout the detailed design, procurement, construction and post-construction phase.

This well-established process has enabled the successful development and delivery of many transport projects within the County from smaller scale cycling and traffic management projects through to the larger scale projects set out in Section 6.2.

6.8 Monitoring and Evaluation

Scheme monitoring and evaluation for those measures taken forward from the emerging preferred package will follow established best practice procedures as set out by DfT and/or the local bodies. The delivery partners will agree clear objectives which will be documented within each scheme level (and potentially at programme level) monitoring and evaluation plan.

A logic map linking project inputs to outputs, outcomes and impacts will establish data requirements. The required baseline data, and the proposed methodology for monitoring impact/ outcomes will all be established prior to formal project commencement. It is proposed that the level of reporting of the monitoring and evaluation plan will be at appropriate intervals, and will provide data to assess the success of each project in meeting the agreed objectives.

7 Summary and Conclusions

Following a review of the transport options and their cost and delivery implications, this section proposes a recommended approach for implementing a transport strategy on the Ely to Cambridge Corridor and the next steps for progressing the business case.

7.1 Recommended Strategy

The findings of this report have demonstrated that:

- The Ely to Cambridge Corridor is currently affected by congestion and connectivity issues
- Model analysis shows that travel demand will increase further on the Ely to Cambridge Corridor
- Significant additional developments are also planned around the Ely to Cambridge Corridor
- This will exacerbate issues on the corridor, leading to deterioration of economic opportunities, the environment and the wider transport offer

A joined-up strategy is therefore required that seeks to introduce both demand and supply-side measures along the corridor that cater to all modes and ensure that potential issues are mitigated. The strategy has been divided into 3 stages;

1. Policy, Planning and Regulation
2. Delivery of multi-modal “quick wins”
3. Longer term major highway interventions

These are described further in the sections below.

7.1.1 Policy, Planning and Regulation

Securing funding for the transport strategy on the Ely to Cambridge corridor will form a core element of the delivery process.

Model-based analysis suggests that transport conditions in the Ely to Cambridge corridor will deteriorate through time, and that this will be exacerbated with further development, unless both demand and supply-side measures are introduced.

Therefore, mechanisms should be put in place to secure developer funding to deliver, or substantially contribute towards demand management and non-car infrastructure to ensure that adverse transport impacts are mitigated.

A demand management approach should be adopted for development and applied to planning applications for proposals in, and impacting, the corridor, whereby development should:

- Minimise external vehicular trip generation through maximising trip internalisation
- Provide significantly lower levels of car parking than has traditionally been provided, particularly at employment locations
- Promote a site-wide approach to car parking management to reduce the need for significant increases in car parking provision
- Promote the use of non-car modes through appropriate investment in supply-side measures and aggressive travel planning to encourage the required mode shift

The planning and transport authorities should also ensure that processes for monitoring, managing, and reviewing transport outcomes are implemented and secured by and from developers through the consenting process.

Acceptable and stretching highway 'trip budgets' should be identified for each site and permission for continued stages of development should be made contingent on the ability of the developers to demonstrate their sites are meeting these targets through effective promotion of non-car-mode take-up and site-based demand management.

Developers might be able to accelerate the phasing of their sites should they be able to demonstrate that their sites are hitting targets for car trips and are not exceeding an agreed budget. This would encourage effective promotion of non-car-mode take-up to free up more "headroom" for further development.

Developers should propose an approach to this for agreement with the planning and transport authorities.

Residual development-related highway impacts will need to be addressed through either direct delivery of schemes by developers, or through appropriate developer contributions based on proportionate impact to the proposed strategic highway and non-highway interventions.

7.1.2 Delivery of Multi-Modal "Quick Wins"

The recommended strategy requires sequential delivery of "quick wins" – comprising both non-car based service/infrastructure enhancements and active parking restraint to promote mode shift and a sequence of prioritised on and off line localised carriageway improvements to create capacity for additional trips and manage potential re-assignment of trips onto less suitable routes.

The recommended non-private car strategy is for early implementation of the cycle measures, a relocated railway station at Waterbeach and early progression of the segregated public transport corridor from Waterbeach to Cambridge's Northern Fringe, together with park and ride provision at the New Town. Implementation of the non-highway proposals alongside ambitious travel planning for new and existing communities in the corridor could create some headroom for early, moderate scale, development at Waterbeach and at CNFE/CSP. The details of this will need to be explored through detailed transport assessments accompanying any planning applications.

7.1.3 Wider Highways Interventions

Model-based analysis shows that the above "quick wins" alone will not mitigate more significant development-related growth or substantially address existing or future congestion. Predicted uplifts in travel demand is forecast to lead to greater displacement of traffic onto less suitable parallel routes including the B1049 and the B1047 unless it can be managed effectively.

Therefore, following on from the multi-modal improvements, a series of localised carriageway improvements should be pursued in the short to medium-term to reduce the likelihood of any additional trips rerouting via less suitable routes.

Options for junction improvements and other localised highway capacity improvements should therefore be developed for early implementation. Targeted improvements at junctions along the A10 itself lead to some improvements in conditions and reduces traffic rerouting elsewhere. These improvements should be accompanied by measures to discourage use of less suitable parallel routes including the B1049 and B1047. The traffic modelling demonstrates that such improvements would also be high value for money in transport appraisal terms. However, the details of these measures will need to be developed through further study work. It is expected that development will make a substantial contribution to funding / delivering these measures.

Beyond these investments, this study indicates that there could be significant additional transport benefits from providing increased carriageway capacity in the Ely to Cambridge corridor, and that this will be required to mitigate both longer-term background growth in travel demand and more significant proposals for development, particularly at Waterbeach.

The initial study work suggests that, subject to more detailed work including examining environmental and operational impacts further, provision of increased carriageway capacity would represent a high value for money investment. This might be in the corridor itself, or on an alternative corridor if such an alignment were shown to remove a significant proportion of longer distance/through-traffic from the A10, or potentially through improvements to both.

7.2 Next Steps

Key stages following on from the publication of this report are set out below, with a view to delivering the transport strategy as set out in the recommendations above:

1. Undertake a consultation exercise to seek the views of decision-makers, members of the public, and other stakeholders, on:
   a. the proposed sequencing of transport measures proposed
   b. the content of each package and responsibilities for delivery
   c. the implications for phased growth along the corridor arising from the measures proposed and opportunities to increase the impact of such measures
   d. progression of a strategic option assessment for dealing with longer distance/through-traffic on the network, and the interaction this has with local traffic demand, via the ongoing M11-A47 study.
2. Along with this consultation exercise, it is recommended that detailed options are developed for all of the key elements of each package, including examination of their impacts, and developing business cases for those investments. Detailed assessments of environmental, operational, wider economic impacts will form part of this stage of the appraisal, along with consultation with local people and other stakeholders
3. Additional feasibility work for the cycling schemes, and the public transport components, should be considered an early priority. Similarly, it is recommended that early, detailed, exploration of the highway proposals is also undertaken.
4. The Highway Authority and Local Planning Authorities should develop funding/delivery options for the delivery of transport and related infrastructure to be explored with developers and key stakeholders to provide certainty to a package of transport investments required to facilitate planned future growth in the corridor. The model-based analysis shows that, although existing transport demand and that associated with wider growth, creates pressures on the network, this is exacerbated by development. Development will therefore be required to deliver, or substantially fund, key non-highway elements of the recommended strategy. Residual development-related highway impacts will need to be addressed through either direct delivery of schemes by developers, or through appropriate developer contributions based on proportionate impact to the proposed strategic highway interventions.

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