

Cambourne to Cambridge Better Bus Journeys

End of Stage Report
Greater Cambridge Partnership

September 2017



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Executive Summary

This report identifies and provides commentary on the work undertaken since October 2016 for the proposed Cambourne to Cambridge Better Bus Journeys Project. This report presents a 'snapshot' of information that supports the scheme and emerging options with a view to informing all interested parties of the potential benefits and dis-benefits of the scheme at its present project stage. It is envisaged that further ongoing work will enhance the scheme options moving forward to the next phase of project work.

From the decision to undertake further assessment work on Option 3a made by the Greater Cambridge Partnership Board in October 2016, a further Option 6 as proposed by the Local Liaison Forum (LLF) and has been included within the process. The three options therefore being assessed are:

- Option 1: A low cost comparator that runs on a bus lane on Madingley Road into and out of Cambridge City Centre;
- Option 3a: A segregated bus route that proceeds South of Madingley Road and North of Coton village interacting with West Cambridge and proceeding into Cambridge City Centre; and
- Option 6: A low cost comparator that runs on a bus lane or a tidal flow system on Madingley Road into and out of Cambridge City Centre.

The project aims to deliver High Quality Public Transport (HQPT) through Bus Rapid Transit (BRT) as the main ways to provide fast, frequent and reliable services between Cambourne and Cambridge whilst serving populations in St Neots and further afield. In support of which on street bus priority measures would also be promoted.

This report presents findings from a number of assessments of the options including considerations of any variations of the alignments within the options.

Option 3A catchment area for the section of the route identified as the Future Investment Programme (Phase 2), between Bourn Roundabout and the A1303 St Neots Road/Long Road junction. This assessment has determined that bus rapid transit within the 3A catchment area is feasible, therefore in line with the GCP Board decision of October 2016 the Option 3 Catchment area has not been considered at this stage pending further consideration. As such this engineering assessment forms, only a part of the wider business case development process which is currently underway to identify the overall case for investment in both the Future Investment Programme of the Greater Cambridge Partnership and Phase 1 element of the scheme (from Madingley Mulch to Grange Road)

Park and Ride Location

Mott MacDonald have undertaken a Park and Ride location study along the A428/A1303 corridor and reviewed eight potential sites within their first stage of assessment which were reduced to five locations for further assessment:

- Scotland Farm;
- Madingley Mulch and Waterworks site;
- The existing Madingley Road Park and Ride; and
- Bourn Airfield.

Through a thorough review against a set of criteria related to transport, environmental impacts and public consultation, the five locations have been reduced further to two locations which are being recommended for a new Park and Ride site; Scotland Farm and the Waterworks Site.

Transport Modelling

The strategic modelling (CSRM2) used to model Options 1, 3a and 6 has indicated that, together with a City Access Scheme in place, mode shift from motor car to bus and park and ride is likely to be achieved. Option 3a is predicted to achieve 1.8 million busway users annually, with Option 1 and Option 6 achieving 1.1 million busway users annually building on a predicted Foundation Case (local plan implementation at 2031) of 1 million bus users annually (The foundation case is A 2031 modelled period which includes housing and employment growth as allocated within the Local Plan preferred strategies for South Cambridgeshire and

Cambridge City). The mode share is predicted to increase for bus and Park and Ride use from the existing situation of 19% to 43% for Option 3a and 40% for Option 1 and 41% for Option 6.

VISSIM microsimulation modelling has shown how the proposed options can achieve improved journey times by public transport over that of the motor car between Maddingley Mulch Roundabout to Northampton Street. Option 3a provides the greatest reduction in journey time over that section of the route versus Option 1 and Option 6 of 10 to 12 minutes.

Journey time analysis shows that Option 3a is predicted to lead to the quickest journey times with Option 1 and Option 6 journey times predicted to be comparable. Option 3a is most likely to achieve the predicted journey times due to the segregated route allowing improved reliability. In terms of patronage, Option 3a is likely to attract the most people.

Design and Alignments

This assessment has investigated the design of the proposed alignments for all three Options. For Option 3a a potential alignment running adjacent to St Neots Road has been produced which shows how the proposed busway and cycle/maintenance track could be sited alongside the existing carriageway. This work has also investigated how the busway alignment would potentially interact with the local junctions and the highway and would be subject to further assessment within the next stage of work.

A proposed Option 3a busway alignment between Maddingley Mulch and Grange Road have gone through a series of assessments to determine the best alignment and tie ins with existing roads. This work is ongoing and is part of the material to be presented at the public consultation later this year. These sections of busway would entail a new 'green bridge' crossing of the M11 and a bus hub on the West Cambridge site with an alignment through to Grange Road across the Westfields.

Option 1 and Option 6 have been developed and designed on-road to show how they may fit within the constraints along Maddingley Road. These indicative designs have demonstrated how the proposals may potentially be introduced along Maddingley Road and how they would interact with existing constraints; private property, junctions and highway features (such as the M11 Junction 13 bridge), trees and vegetation.

Journey times for each option have been calculated to assess the overall journey time between Cambourne High Street and Grange Road using spreadsheet models deriving data from observed bus speeds and operations (Vix data and Cambridgeshire Guided Busway data). Option 3a is predicted to be the fastest taking 20 minutes in the AM peak period inbound to travel between Cambourne and Grange Road assuming a Park and Ride site at Scotland Farm. Option 6 is predicted to take 28 minutes and Option 1 predicted to take 30 minutes both assuming Scotland Farm as a Park and Ride site. Should a potential Maddingley mulch site be taken forward, Option 3a would take 19 minutes, Option 6 would take 27 and Option 1 would take 29 minutes to complete the AM peak inbound journey.

Landscape and Visual

Landscape and visual impacts have been as important aspects the developing scheme, the continuing assessments of the proposed options has considered how each section of route may affect the surrounding area set within the green belt e.g. the Westfields, and how these impacts could be mitigated.

The landscape and visual assessment has sought to provide innovative designs such as cut and fill, which amongst others, could be utilised to mitigate the introduction of any of the options within the existing setting. The scheme would seek to enhance biodiversity through the introduction of habitat creation, for instance through the planting of native species hedges and trees. An off-road busway would apply a 'green lane' design treatment along its length providing extensive habitat creation whereas on-road options due to the existing constraints are less capable of such mitigation and general biodiversity enhancement.

Further Environmental Aspects

This report initially assesses a variety of further environmental aspects which could be affected by the proposed scheme. The individual environmental assessment reports show that the potential impacts can be mitigated by the measures stated. A full environmental impact assessment (EIA) would need to take place for the proposed scheme, however it is concluded at this stage that there are no overwhelming environmental constraints that would prevent delivery of the scheme.

Next Steps

Following this report immediate work includes continuing liaison with the LLF specifically concerning the ongoing development of Option 6. The project team will continue to further develop Options for the public consultation events in November which allows for further understanding of public opinion on the Options and associated considerations. This will inform the preparation of a Full Outline Business Case in Summer 2018 for a recommended Option to be presented to the GCP board for a Transport and Works Order or the appropriate consent.

Glossary

Term	Definition
Alignment	A specific route width and dimension that could accommodate bus infrastructure between two points to the required design for on-road or off-road
Bus Lane	Part of the road that is indicated on the carriageway by a thick white line. They are reserved for certain vehicles shown, including buses, on the sign
Bus Priority	Measures installed within the existing highway that provide buses with benefits in terms of access, journey times, and distance over other road users, particularly other motorised vehicles
Bus Rapid Transit	A term used to describe a wide range of bus based transport solutions. BRT is “ <i>flexible and adaptable</i> ” and bridges the gap between an ordinary bus and a light rail transit system
Busway	A road or section of road segregated exclusively for buses, typically for guided buses e.g. kerb guided. Integral cycle and pedestrian facilities alongside.
Catchment Area	The area that users of the scheme would travel to / from to use it
Conflict	Where interaction between travel modes has the potential to lead to delays and safety concerns e.g. at side roads, junctions, cycle lanes.
Congestion	When general traffic prevents the sufficient progress of a motor vehicle along a route leading to delay and unreliability.
Connectivity	Links between travel modes to provide improved accessibility and network capability.
Constructability	Complexity of delivery – extent of disruption caused by construction including through traffic management measures
CSRM	Cambridge Sub Regional Model
Do Minimum Scenario (CSRM)	Future year scenario (2031) is the Foundation Case plus a City Access Assumption
Flexibility	Having the capability to adapt and develop to meet future rapid transit public transport needs.
FOBC	Full Outline Business Case
Foundation Case (CSRM)	A 2031 modelled period which includes housing and employment growth as allocated within the Local Plan preferred strategies for South Cambridgeshire and Cambridge City
Future Investment Programme	The second phase of funding for the scheme (formerly Tranche 2). Future Investment Programme funding covers Cambourne to Maddingley Mulch Roundabout
High Quality Public Transport (HQPT)	Provides the highest levels of speed, reliability and capacity to and from key destinations
Mode Shift	Change in the proportion of people using cars in favour buses and park and ride services
Off-Road	Bus services on dedicated off-road bus infrastructure e.g. BRT
On-Road	Bus services on or extending the public highway e.g. Bus Priority
Option	General Characteristics of the route being considered

Term	Definition
Option 1	An on-road option which includes the introduction of bus lanes on Maddingley Road between Maddingley Mulch Roundabout and Lady Margaret Road
Option 3/3a	An off-road busway running between Cambourne and Grange Road, Cambridge
Option 6	An on-road tidal lane on Maddingley Road running between Maddingley Mulch Roundabout and High Cross as proposed by the LLF
Park and Ride Occupancy	The total number of vehicles within the Park and Ride site at any given time taking into account both arrivals and departures
Patronage	The number of people using a service at some point during the journey.
Phase 1	The first phase of funding for the scheme (formerly Tranche 1). Phase 1 funding covers Maddingley Mulch Roundabout to Cambridge City Centre
Project	The Busway elements as well as any additional bus priority measures that would benefit all buses, not just those associated with the project
Punctuality	Punctuality is the relationship between the time, at which the bus service arrives in real life, compared to the time at which the bus service is supposed to arrive according to the timetable
Reliability	How dependable the continuous operation of the bus service is within the context of demand and conflict e.g. roadworks, congestion
Route	General alignments being considered within an Option
Scheme	The Busway elements and the works and operations associated with them (including Park and Ride site)
SOBC	Strategic Outline Business Case
Stakeholders: Non-Statutory	Where there are policy requirements to engage other consultees who – not designated in law – are likely to have an interest in a proposed development
Stakeholders: Statutory	Where there is a policy requirement, set out in law, to consult a specific body, who are then under a duty to respond providing advice on the proposal in question
Trafficmaster Data	Data of road traffic from the Department for Transport taken from GPS sources
Vix Data	This is data on bus related operations that is collected and managed by a company called Vix Technologies
Working Plans	Current scheme plans which show potential route alignments in line with the catchment area for the scheme identified within the SOBC

1. Introduction

1.1. The Proposed Scheme

The proposed scheme aims to deliver High Quality Public Transport (HQPT) between Cambourne and Cambridge through a combination of Bus Rapid Transit (BRT) and bus priority. The scheme is split into two distinct parts, these have been referred to throughout this project as Tranche 1 and Tranche 2 and are now being re-named to 'Phase 1' and 'Future Investment Programme' respectively, as described below:

- Phase 1 (formerly Tranche 1) – between Maddingley Mulch Roundabout and Cambridge City Centre;
- Future Investment Programme (formerly Tranche 2) – between Cambourne Town Centre and Maddingley Mulch roundabout.

This report provides information relating to both the Phase 1 and the Future Investment Programme parts of the scheme

1.2. Purpose

The purpose of this report is to summarise the work undertaken since October 2016 as part of the Cambourne to Cambridge Better Bus Journeys Project, specifically with regards to developing the current Options as instructed by Greater Cambridge Partnership (GCP). The report will be presented to the Greater Cambridge Partnership Executive Board prior to the public consultation event planned for November 2017.

This report details analysis of preferred options both in terms of transport and environmental considerations. The purpose of this report is to provide information for the scheme and recommendations for public consultation. The report also presents the technical work that has been undertaken to support the upcoming public consultation, however this work is ongoing in the form of analysis including user surveys and Automatic Number Plate Recognition (ANPR) surveys among other tasks and will ultimately inform the Full Outline Business Case (FOBC) for the scheme.

Throughout this report there are information boxes like this one which provide questions addressed by the report and summaries for each section they relate to for ease of reference.

1.3. Background

What are the objectives of the scheme?

A key objective of the Cambourne to Cambridge Better Bus Journeys Project is to provide a HQPT scheme which is proposed to be funded by the GCP, formerly known as the Greater Cambridge City Deal (GCCD). The potential options are focussed on linking the centre of Cambridge with growing residential settlements to the West of Cambridge; they are also intended to provide a HQPT option to access the City from the West from existing settlements such as St Neots and Papworth. The scheme would allow for increased connectivity between major employment and housing sites, providing a sustainable alternative to travelling by private car along the A428 / A1303 corridor.

Options being considered for provision of HQPT through BRT and bus priority between Cambourne and Cambridge consist of two on-road options, Option 6 and Option 1, as well as two off-road options, Option 3 and Option 3a. Options are described in detail in Section 3.1. Options for a new Park and Ride location have also been considered further as part of an independent assessment conducted by Mott MacDonald which is summarised in Chapter 5.

The recommendations made in this report have been informed by previous work and published documents that will be referred to throughout. All material that has been referenced within this report is available on the GCP website or appended to this report where specified.

1.3.1. Location Description

The project covers the area within the A428 corridor between Cambourne and Cambridge City Centre.

The A428 / A1303 corridor and study area for the Cambourne to Cambridge Better Bus Journeys is located between West Cambridge and Cambourne. The scheme aims to service settlements within the study area including the following:

- Cambourne;
- Hardwick;
- Highfields Caldecote;
- Maddingley; and
- Bourn Airfield (Future Development).

However, the SOBC captures patronage from a wider area in order to serve growing populations within the corridor including St Neots and further afield with fast, frequent and reliable bus services along the entire corridor.

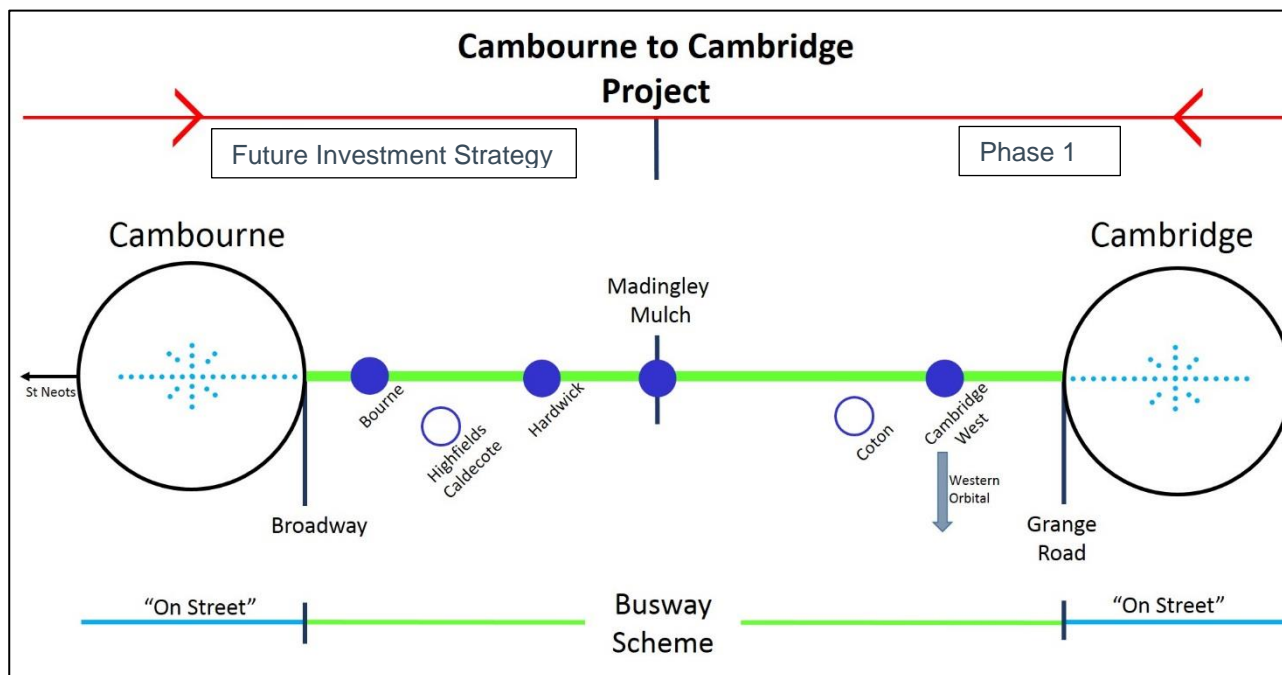
The settlements stated above are all within a 1.5km radius of the proposed route, whilst there are currently bus services that operate within the villages, the Cambourne to Cambridge Better Bus Journeys Project is intended to offer a HQPT service into West Cambridge, Cambridge City Centre connecting to other employment areas. Figure 1-1 shows the Cambourne to Cambridge Better Bus Journeys Project study area which is based on the most direct route from Cambourne to Cambridge subject to constraints. From this line a buffer area of 2km has been established which forms the basis of the assessment.

Figure 1-1 Cambourne to Cambridge Better Bus Journeys Study Area



The project study area includes the A428/ A1303 corridor from the Caxton Gibbet roundabout to Cambridge City Centre. It is envisaged that Cambourne High Street will serve as a bus hub for future bus services. The following figure shows the various elements of the project and scheme:

Figure 1-2 Diagram Showing Elements of Project and Scheme



1.4. The Strategic Outline Business Case

The Strategic Outline Business Case (SOBC) is the first part of business case development and seeks to establish the need for development and how investment will meet aims and objectives of the project. In 2016, Atkins were commissioned by the City Deal Partners to develop a SOBC for the Cambourne to Cambridge Better Bus Journeys Project in support of a GCP funding request. The SOBC is available on the GCP website. The SOBC assessed five options including an on-road option (Option1) as a low-cost comparator and concluded that Option 3 performed best in terms of strategic fit, with a fully off-road route providing the highest level of connectivity. The indicative route of Option 3 as presented in the SOBC is shown in Figure 1-3 below.

Figure 1-3 Option 3 Indicative Route location (from SOBC)



Conclusion from the SOBC for Option 3:

“Option 3 is fully offline between Cambourne and Grange Road. This Option performs best in terms of strategic fit, mainly because the fully offline route provides the highest level of connectivity, capacity and journey efficiency. This is assumed to make bus travel much more attractive and to deliver wider economic benefits as a result of the potential to accommodate intensification of development. This Option does not add to congestion on Maddingley road as it is not online which indicates a good strategic

fit in this area, in that it addresses HQPT objectives whilst also addressing congestion issues in this part of the corridor.”¹

The further development of Option 3 is discussed in this end of Stage report with respect to the GCP Board decision in October 2016 to review an alternative Option 3a which is a variant of Option 3:

“Possible specific route alignments within catchment area 3a, with catchment area 3 as an alternative if Option 3a proves unviable”²

Option 3a would provide a predominantly segregated route between Cambourne and Cambridge running south of the existing A428/ A1303 corridor. The route would travel on-road with bus priority measures through Cambourne between High Street and Stirling Way where it would join a proposed bus-only link to Broadway. The route would then join a segregated busway through the proposed Bourn Airfield development and connect with an off-road busway running adjacent and to the north of St Neots Road east of the development to the Madingley Mulch roundabout.

Option 3a then continues off-road between Coton and Madingley Road/ Madingley Rise, with a connection to the West Cambridge site over the M11 via a new ‘green’ bridge. The route would connect to the existing highway and Grange Road and continue on-road into the City. Option 3a provides the opportunity of significantly improving walking and cycling facilities by providing a shared track adjacent to the entire off-road route.

1.5. Structure

The remainder of this report is as follows:

- Chapter 2 provides a contextual basis for the End of Stage Report;
- Chapter 3 sets out both on-road and off-road options being considered;
- Chapter 4 assesses Option 3a in terms of transport considerations;
- Chapter 5 provides a summary on the independent Park and Ride assessment; and
- Chapter 6 provides a summary and conclusion of this stage of reporting and identifies routes and Options to be taken forward to further stages of work and consultation.

¹ <http://scambs.moderngov.co.uk/ieDecisionDetails.aspx?AllId=67351>

² <http://scambs.moderngov.co.uk/ieDecisionDetails.aspx?AllId=67351>

2. Context

Why is the scheme needed? This Chapter provides context to this report, providing background information on the Cambourne to Cambridge Better Bus Journeys Project, including a review of the local and regional policy considerations.

2.1. Greater Cambridge Partnership

The GCP is an agreement between local organisations and central government which aims to improve economic growth and quality of life in the Cambridge area. Central government will provide up to £1 billion worth of investment over the next 15 years which seeks to facilitate the development of employment areas and homes. The GCP further aims to enhance transport infrastructure to make it easier for people to travel to work, education and home using sustainable modes of transport which will result in a reduction in congestion and carbon emissions. The GCP transport vision is as follows:

“The City Deal (GCP) will make it easier to travel in, out and around Cambridge and South Cambridgeshire by public transport, cycle or on foot, and reduce and maintain lower traffic levels to ease congestion.”³

A number of schemes are proposed to be funded through the GCP. Phase 1 schemes, of which the Cambourne to Cambridge Better Bus Journeys Project is one, have funding available between 2015 and 2020. Future Investment Programme schemes have funding available between 2020 and 2025.

It is considered that the proposed Cambourne to Cambridge Better Bus Journeys Project will meet GCP objectives as it will form links between existing and future developments employment zones such as the West Cambridge Site and the City Centre. Moreover, the scheme promotes sustainable infrastructure aimed at reducing congestion and contributing to meeting air quality and carbon reduction targets.

2.2. Local Plans

The Greater Cambridge area (comprising the districts of Cambridge and South Cambridgeshire) is one of the fastest growing parts of the UK and this high rate of growth is expecting to continue. The draft Cambridge City Council (CaCC) and South Cambridgeshire District Council (SCDC) Local Plans envisage further growth up to 2031 of 33,500 new homes (equating to a 25% rise in population) and 44,000 new jobs.

The Local Plans for South Cambridgeshire and Cambridge set out a vision, objectives and detailed proposals for spatial development which will both deliver housing and jobs and the transport measures required to support these. The Local Plan was prepared in parallel with the Transport Plan for Cambridge and South Cambridge. Both local plans have been subject to public examination with hearings completing in July 2017.

It is considered that the Cambourne to Cambridge Better Bus Journeys Project meets Local Plan objectives as summarised in Appendix A.

2.3. High Quality Public Transport, Bus Rapid Transit and Bus Priority

How can the scheme meet current policy? The Local Plan and the Transport Strategy for Cambridge and south Cambridgeshire discusses how HQPT is needed to support local growth in housing and jobs. This section discusses HQPT and its relationship with Bus Rapid Transit and Bus Priority.

The Cambourne to Cambridge Better Bus Journeys project aims to provide a HQPT service that offers a higher level of service than existing transport options. The following section defines HQPT and how it can be

³ <http://www.gccitydeal.co.uk/citydeal/transport>

achieved. Given the lack of a rail connection into Cambridge from the west, the project seeks to achieve HQPT by implementing a BRT system or ensuring on-road bus priority throughout the A428/ A1303 corridor. The project assumes the Highways England project of dualling the A428 between St Neots and Caxton Gibbet Roundabout will provide improved bus priority.

2.3.1. High Quality Public Transport

HQPT can be defined as a system that provides the highest levels of speed, reliability and capacity – resulting in ‘fast frequent and reliable’ journeys’ as described in the Options Assessment Report for Cambourne to Cambridge Better Bus Journeys⁴. It is considered that the Cambourne to Cambridge Better Bus Journeys Project could achieve this by implementing the following attributes:

- **Fast:**
 - Busway route is closely aligned to the desired route of demand;
 - Segregated from general traffic along A428 corridor;
 - Bus priority given through urban areas.
- **Frequent:**
 - Service provision at bus stops such as off-board ticketing and step-free boarding;
 - Ease of access to facilities; and
 - ‘Turn up and Go’ availability.
- **Reliable:**
 - Operated well to a high standard;
 - Traffic free on segregated route;
 - Maximises separation from general traffic and other potential delays to ensure punctuality; and
 - Flexible and adaptable to both on-road and off-road HQPT and future requirements.

2.3.2. Bus Rapid Transit and Bus Priority

BRT can be defined as follows:

“a wide range of bus based transport solutions which are flexible and adaptable and bridge the gap between an ordinary bus and a light rail transit system”

Bus Priority is defined as follows:

“Measures installed within the existing highway that provide buses with benefits in terms of access, journey times, and distance over other road users, particularly other motorised vehicles”.

In order to achieve the highest level of HQPT the target standard for the scheme is BRT and the lesser standard of Bus Priority. These target standards and minimum standards have been developed by producing a Technical Specification for the project, as shown in Table 2-1. It should be noted that the target standard may not always be achieved to the aspiration of the project. The development of this Technical Specification is ongoing and will be subject to further refinements as the assessment progresses.

The targets of this Technical Specification have been developed throughout the current stage of assessment and should be borne in mind when reading this report. The Technical Specification is work that has been derived from a variety of sources such as the BRT Handbook and has been progressed with the project team in order to achieve HQPT by BRT or Bus Priority.

⁴ Greater Cambridge City Deal: Selection of a Catchment Area for Detailed Scheme Development, Appendix 1 OAR Report – Ashley Heller (CCC) – 13/10/2016.

Table 2-1 Cambourne to Cambridge Technical Specification

FACTORS	<i>Target standard – required for HQPT with BRT</i>	<i>Minimum standard – required for HQPT with BUS PRIORITY</i>
	TARGET STANDARD	MINIMUM STANDARD
Operation		
Punctuality	95% - achieve headway of less than 10 minutes for high frequency services; 95% for off-peak services between 1 minute early and 5 minutes late	Achieve greater punctuality than existing services (e.g., Citi 4)
Reliability	Achieve 99% reliability	Achieve greater reliability than existing services (e.g., Citi 4)
Flexibility	Services able to utilise the Busway as part of a longer journey	All services able to utilise bus priority measures
Vehicles		
Identity	Distinguishable from on-road services to promote the BRT as a HQPT which offers the best service between Cambourne and Cambridge	Distinguishable from other services promoting HQPT which offers the best service between Cambourne and Cambridge
Features	Free Wi-Fi, on board CCTV, on board real time information, and next stop audio-visual announcements, USB charging points	Free Wi-Fi, on board CCTV, on board real time information, and next stop announcements
Accessibility	Access for all	Access for all
Operational Control	Agile route in case of road closure or congestion	Information given to driver regarding traffic on route
Real Time Passenger Information (RTPI)	Real time information to be integrated with Cambridgeshire Highways to ensure full notice is given in an event of road congestion or closure	Real Time information given to passengers
Stops		
Stop location	Greatest catchment with respect to route	Greatest catchment with respect to route
On Route Shelters	High quality shelters, real-time information, CCTV, wayfinding and clearly marked walking routes	High quality shelters, real-time information, CCTV, wayfinding and clearly marked walking routes
Interchanges	Park and Ride and Kiss and Ride on route	Park and Ride on route
Level Boarding	Level boarding at all Busway stops with Equality Act compliance elsewhere	Equality Act compliance at all stops
Cycle Facilities	Storage provided at interchanges and major bus stops	Wayfinding to cycle facilities provided
Fares and Ticketing		
Fares	Cashless payments that are no more expensive than local bus fares and full ticket inter-availability between service providers	Cashless payments that are aligned with local bus fares and full ticket inter-availability between service providers
Ticketing	Ticket medium to reduce dwell times at stop which may include ticket vending machines, Smart and contactless payments	Ticket medium to reduce dwell times at stop which may include ticket vending machines, Smart and contactless payments
Highways and Priority		

Carriageway separation	Busway for majority of route, bus lanes where achievable	Bus lanes/bus priority where achievable
Design Speeds	56mph for Busway where achievable	Within road speed limits where achievable
Signalling	Full signal priority at junctions	Full signal priority at junctions
Stop approaches	Clear approach to facilitate docking, easy barding and marked boarding positions	Clear approach to facilitate docking, easy barding and marked boarding positions
Local bus interaction	Joint bus stops with priority given to busway service	Joint bus stops
Journey times	More punctual journey times than car	Equal to more punctual journey times than car
Enforcement	Priority measures reinforced with CCTV cameras and car traps enforced by Cambridgeshire County Council	Priority measures self-enforcing
Segregated		
Traffic free (Cambourne to Cambridge)	Route substantially segregated	Route integrated on-road
Guided	Route to be largely guided between Cambridge and Cambourne	Route facilitated with bus priority on-road
Intelligent Transport System		
Systems	Vehicles with automatic vehicle location for signal controlled junctions and real-time information	Vehicles with automatic vehicle location for signal controlled junctions and real-time information
Flexibility	Scope of infrastructure and bus operators open to alternative technological systems	Scope of infrastructure and bus operators open to alternative technological systems
Environmental Considerations		
Emissions	Better than Euro VI technology – hybrid or electric (0 tailpipe emissions)	Euro VI technology
Siting	Location and minimal visual intrusion	Location and minimal visual intrusion
Branding and Marketing		
Brand	Distinct brand to be used in all marketing	Distinct brand to be used in all marketing
Customer Engagement	Regular customer satisfaction surveys, continuous specialised training programmes, sustained customer engagement.	Regular customer satisfaction surveys, continuous specialised training programmes

2.4. Public Consultation and Stakeholder Engagement

Workshops and liaison with statutory and non-statutory stakeholders has been ongoing since the start of the project including a public consultation exercise in 2015 (see GCP website for outcomes). Furthermore, a Local Liaison Forum (LLF) has been set up to engage with local residents. Stakeholder engagement is ongoing throughout the progression of the project.

The purpose of stakeholder workshops is to develop more understanding of specific concerns relating to the scheme option development. A workshop was held in relation to P&R locations which is detailed in Appendix M. A further workshop to address potential bus priority measures east of the M11 was also held. This workshop identified a number of key issues and concerns regarding bus infrastructure measures in this section of the corridor - these included:

- The importance of retaining the character of the area and the role of special role of the green belt in this context;
- The importance of Madingley Road and its character;

- The need to ensure that the West Cambridge site is well serviced by buses; and
- The overall importance of environmental issues including landscaping, heritage and ecology.

The need to ensure effective integration of city centre proposals into corridor schemes and for future consideration of a Western Orbital scheme to be part of the assessment process. The workshop supported interventions on the existing highway rather than new alignments to the south.

2.4.1. Local Liaison Forum

A Local Liaison Forum (LLF) for the Cambourne to Cambridge Better Bus Journeys and Western Orbital scheme was formed in 2016 upon instruction from the GCCD Board. The forum provides regular dialogue between the project team and members of the local community, ensuring that interested parties are kept informed and can continue to contribute to the scheme development.

The LLF has developed an Option, which for assessment purposes has been termed 'Option 6'. It consists of a route between Cambourne and the A1303/A428 junction, with bus priority measures, a Park and Ride near Scotland Farm and an on-road single tidal or double bus lane from the A1303/A428 junction into the West Cambridge site.

Stakeholder engagement by means of meetings and workshops with the LLF with discussions focussing around the development of specific route alignments for Option 3a as well as work to date on Option 1/6.

2.4.2. Stakeholder Workshops

A number of stakeholder workshops have been held to address specific elements of the scheme including a planning and landscape workshop and a Cambourne Routes workshop. See Appendix B for further details and output of stakeholder workshops.

2.4.3. Other Data Sources

Cambridgeshire Guided Busway 'The Busway' User Surveys 2017

Surveys of existing users of Cambridgeshire Guided Bus were undertaken in July 2017 as a follow up to the 2012 post-opening surveys ('Cambridgeshire Guided Busway Post-Opening User Research, Cambridgeshire County Council, September 12th 2012) and to inform ongoing work on the Cambourne to Cambridge Project.

The surveys aimed to understand existing users views on 'The Busway' service only and how they use it and has been conducted at a number of bus stops and Park and Ride sites along the route. The survey aimed to identify the origin and end destination of busway users, as well as how they access the busway, why they use it and any ways that the Busway could be improved.

High level results have been received with the majority of detailed results to follow. The following summarises the overall headline survey results:

- 1057 survey responses were obtained at 12 Busway stops along the route;
- 51.9% of respondents accessed the bus stop by foot;
- 72.6% of respondents made their onward journeys by foot;
- 22% of respondent's main journey purpose was commuting, 20.3% was shopping;
- 23% of respondents make the same journey five or more times a week;
- If the busway was not used, 36.8% of respondents would have made their journey by car;
- The main reasons for using the busway were speed of the journey, reliability of the journey and frequency of the service;
- 40.5% of respondents have used the track alongside the busway for walking and cycling;
- The three most favoured improvements to the busway were faster journey times, more reliable journey times and more buses per hour;
- 90.4% of busway users were either very satisfied or satisfied with the service; and
- 94.9% of busway users considered the busway a success.

Detailed results will be received and presented in September 2017. These Busway Users Survey Report included in Appendix C.

Computer Assisted Telephone Interviewing

Computer Assisted Telephone Interviewing (CATI) questionnaires were undertaken with 1000 respondents residing in St Neots (Love's Farm), Cambourne, Hardwick, Caldecote, Dry Drayton, Coton and Madingley to gauge opinion on the busway proposals as well as decipher existing travel patterns along the A428 corridor. The report will be available prior to the public consultation. The following draft headlines summarises the overall survey results:

- 25% of respondents travel in either direction between St Neots and Cambridge 5 or more times a week;
- 25% of trips along the corridor are for commuting purposes;
- 40% of trips along the corridor are for leisure purposes;
- 28% of trips along the corridor are in the AM and PM peak periods;
- 35% of respondents said they would be likely to use a new bus service along the corridor;
- Speed, reliability and frequency of services were the factors most likely to encourage respondents to use a service along the corridor.

The draft CATI results will be received and presented in September 2017.

These Busway Users Survey Report and the CATI report included in Appendix C.

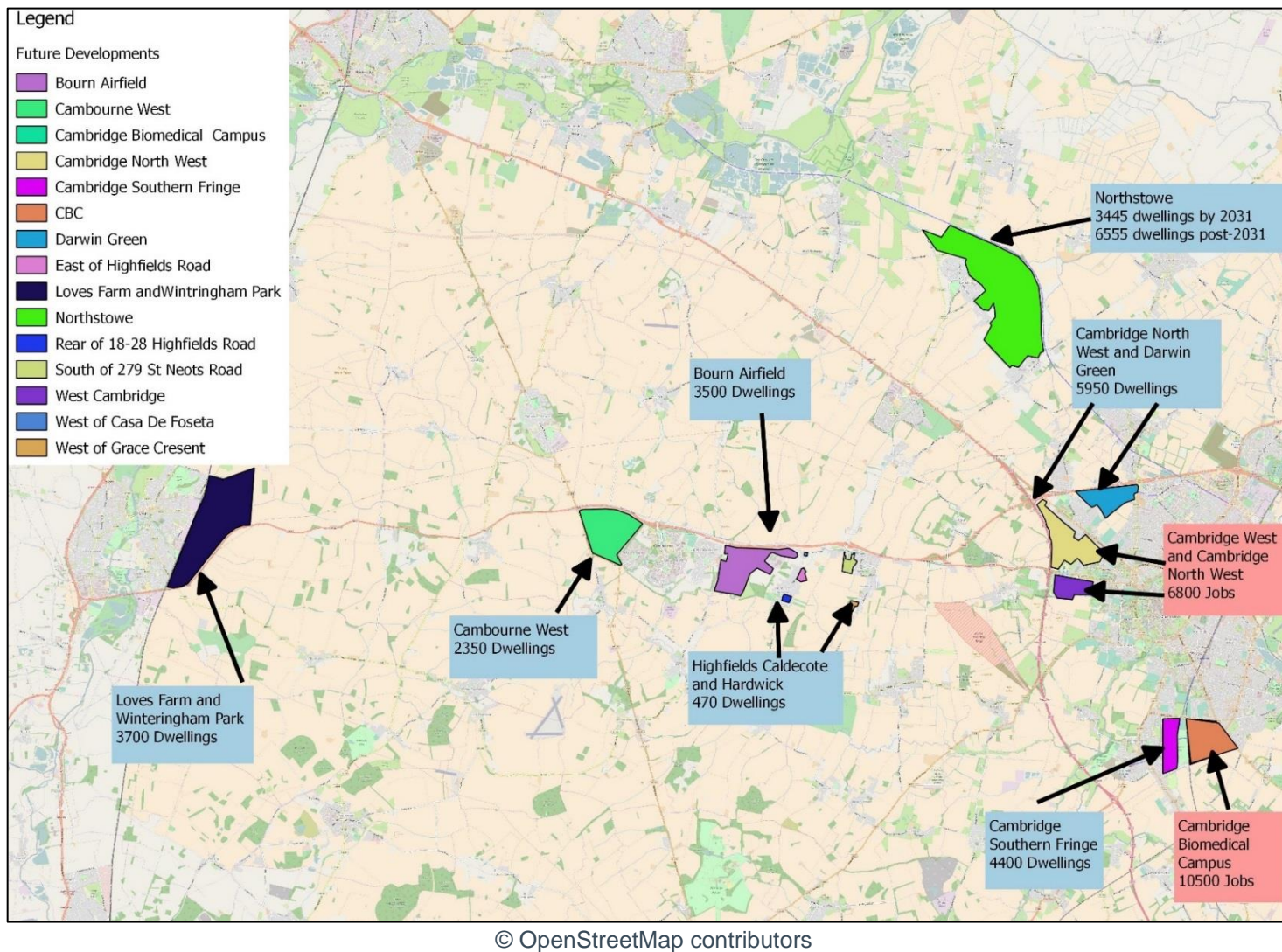
2.5. Growth in the Cambridge Region

The GCP has a mandate to maintain and enhance the Cambridge region economically, socially and environmentally. Core to their mandate is an aim to accelerate the delivery of 33,500 new homes and 44,000 new jobs⁵. In order to deliver more jobs and economic growth, the Greater Cambridge City region must be able to accommodate new and growing businesses and research centres, house the people who work in them, whilst also ensuring ease of movement. Figure 2-1 shows the main proposed development areas within the A428 corridor. By providing new travel choices, and as an alternative to the car, the Cambourne to Cambridge scheme will help manage growing congestion on the A428 and ensure people have good access to opportunities in the Cambridge area.

The Transport Strategy for Cambridge and South Cambridgeshire (TSCSC), prepared in parallel with the Submitted Local Plans, was adopted by Cambridgeshire County Council in March 2014. The strategy provides a plan to manage the rising population and increase in demand on the travel network by shifting people from cars to other means of travel including cycling, walking and public transport. It envisages a range of infrastructure interventions on the St. Neots and Cambourne to Cambridge corridor as a key part of the integrated land use and transport strategy, responding to the levels of planned growth.

⁵ <https://www.greatercambridge.org.uk/about-city-deal/>

Figure 2-1 Potential Future Developments within the West Cambridge Region



The growth areas identified above are directly adjacent to the A428 corridor however it is considered that the overall catchment area for the project has the potential to reach St Neots and further afield, as with the existing CGB. This project therefore has the potential to serve wider growth areas to the west towards Bedford and Milton Keynes. Travel to work data from these areas to Cambridge has been derived from 2011 Census and it presented in Table 2-2

Table 2-2 Travel to Work Figures into Cambridge City Centre (Census 2011)

Usual Residence	Place of Work
Milton Keynes	88 people
Central Bedfordshire	536 people

A summary of the potential major developments and proposals within the wider corridor which encompasses Bedford is summarised as follows:

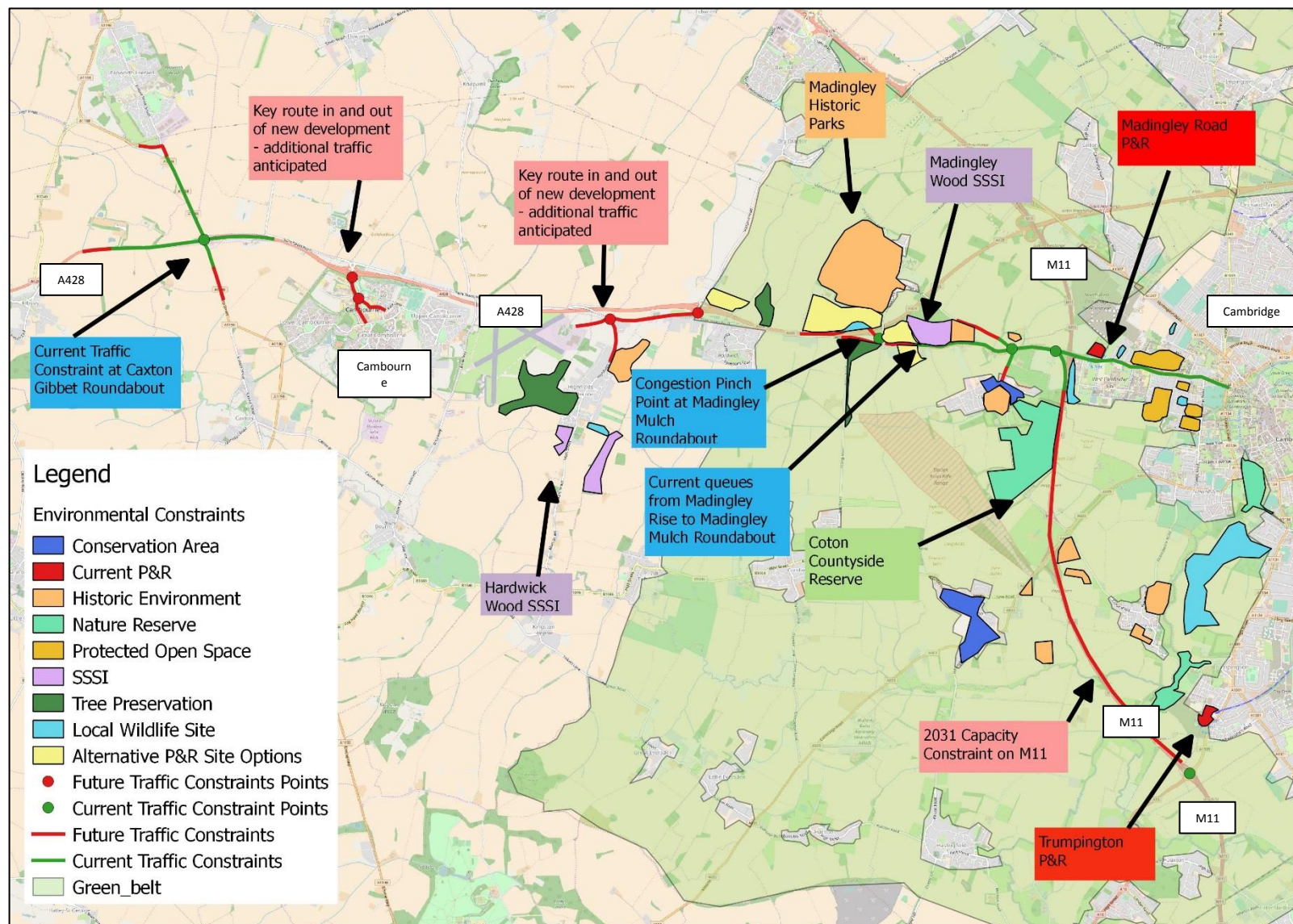
- **A428 Dualling** – The A428 between the A1 junction near St Neots and the A1198 Caxton Gibbet is single carriageway with a series of roundabouts and give-way junctions. Highways England are currently working on duelling proposals to reduce congestion through the corridor until it reaches the Cambourne to Cambridge Study Area;
- **Bedford** – There are a number allocated developments within Bedfordshire could contribute and use the Cambourne to Cambridge Better Bus Journeys Project service. It is recognised that the western corridor could provide large amounts of users for the project due to increased employment opportunities being created in the city; and
- **East West Rail** - East West Rail is a major project aimed at establishing a strategic railway corridor connecting East Anglia with Central, Southern and Western England. The preferred central section of the route is proposed to connect Bedford, Sandy and Cambridge and therefore provide connections to the Midland Mainline, East Coast Mainline, and West Anglia Mainline.

2.5.1. Existing Constraints

What are the existing local issues and high level constraints?

The local environmental and transport constraints are shown on the figure overleaf. The project seeks to provide a fast, frequent and reliable service without having a significant adverse impact on the environment.

Figure 2-2 Existing and Future Constraints within the A428 Corridor



Environmental constraints have been summarised further in Chapter 4 and in the individual discipline assessment reports contained within the appendices of this report.

Traffic Volume, Congestion and Delays

Current conditions on the highway network are known to be variable along the length of the corridor. Previous analysis of Trafficmaster speed data showed congestion issues at either end of the corridor, with the A428 between Caxton Gibbet and St Neots shown to have high variability and congestion, with delays up to 10 minutes eastbound in the morning peak and 3 minutes in the evening peak period. The A1303 approach to Cambridge is shown to have greater levels of variability and congestion, with delays up to 18 minutes travelling into Cambridge in the morning peak, and 4 minutes travelling westbound in the evening peak. The problem can be seen to propagate from the combination of two significant traffic streams at the A1303/M11 junction as well as downstream junctions entering Cambridge itself when travelling eastbound, with up to 80% of the route experiencing congestion in the morning peak.

Trafficmaster data was obtained for Madingley Road from the 2016 data set, which is the most recent data available. Trafficmaster data is sourced from the Department for Transport which obtains the data from GPS sourced data. The Trafficmaster data for Madingley Road is shown in the figures below. The data shows average road speeds for all vehicles during the respective peak periods. The dark red shows where the congestion is highlighted during that peak period.

Figure 2-3 Average Vehicular Speeds during the AM Peak Period (2016 Trafficmaster data)

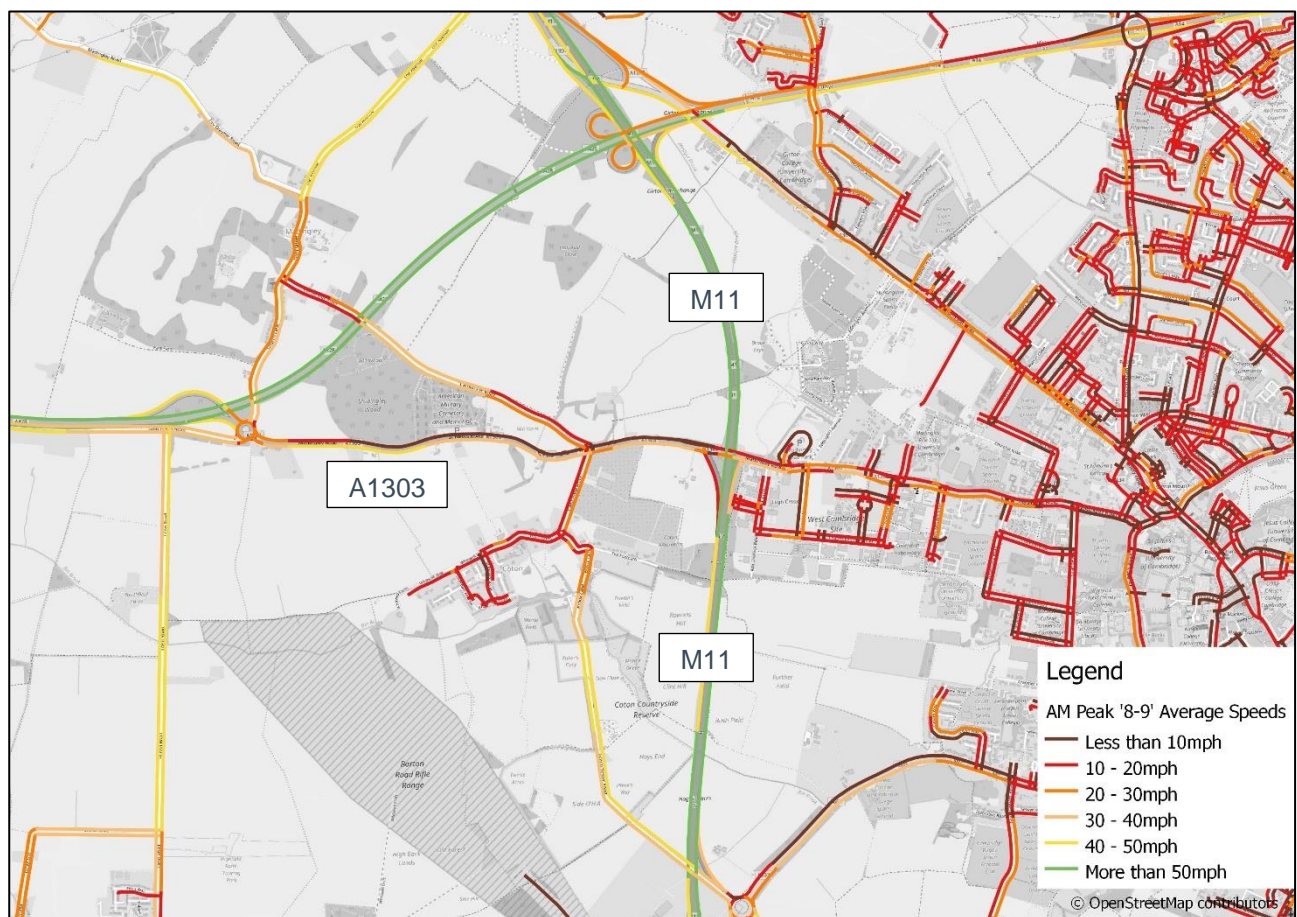
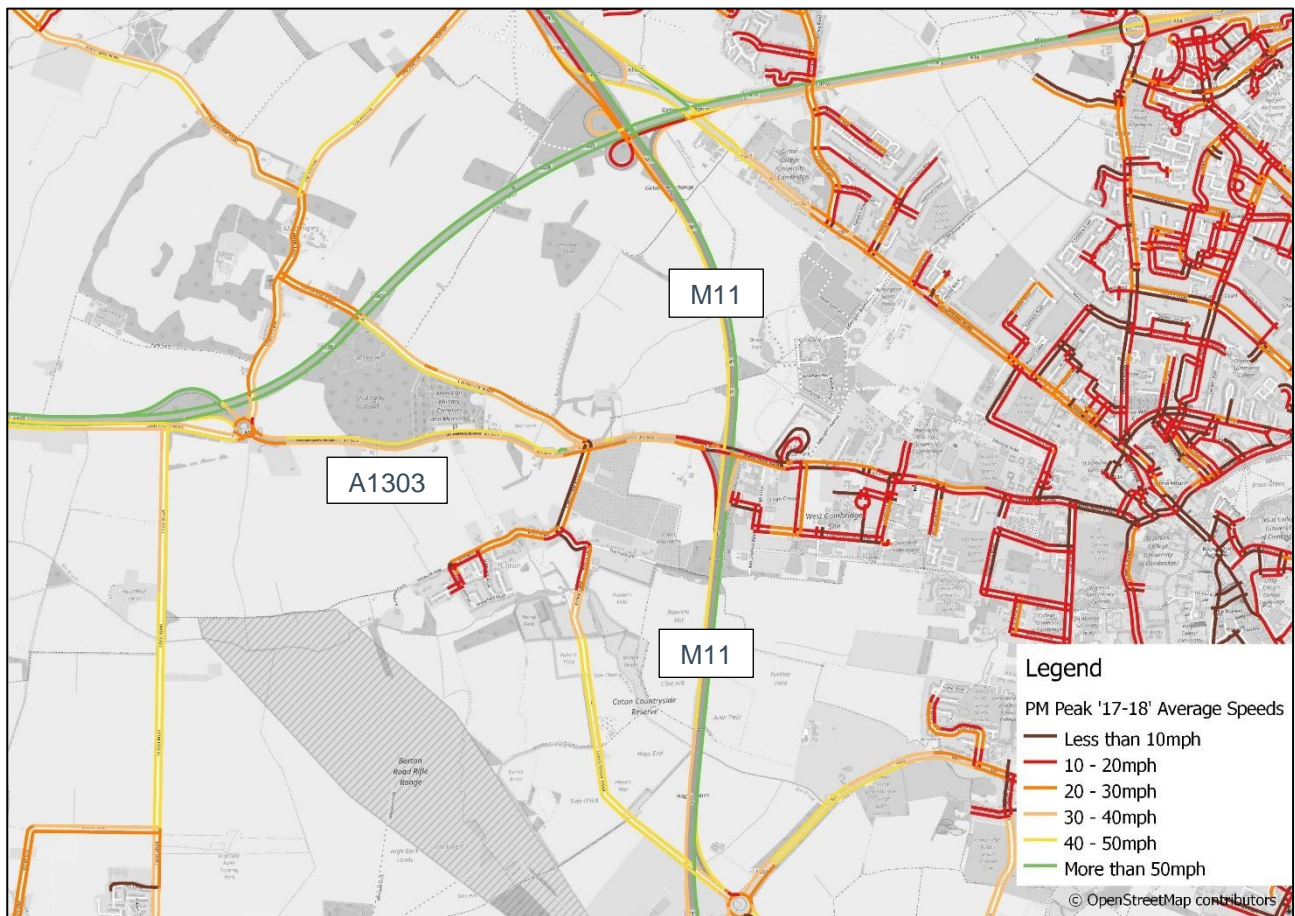


Figure 2-4 Average Vehicular Speeds during the PM Peak Period (2016 Trafficmaster data)

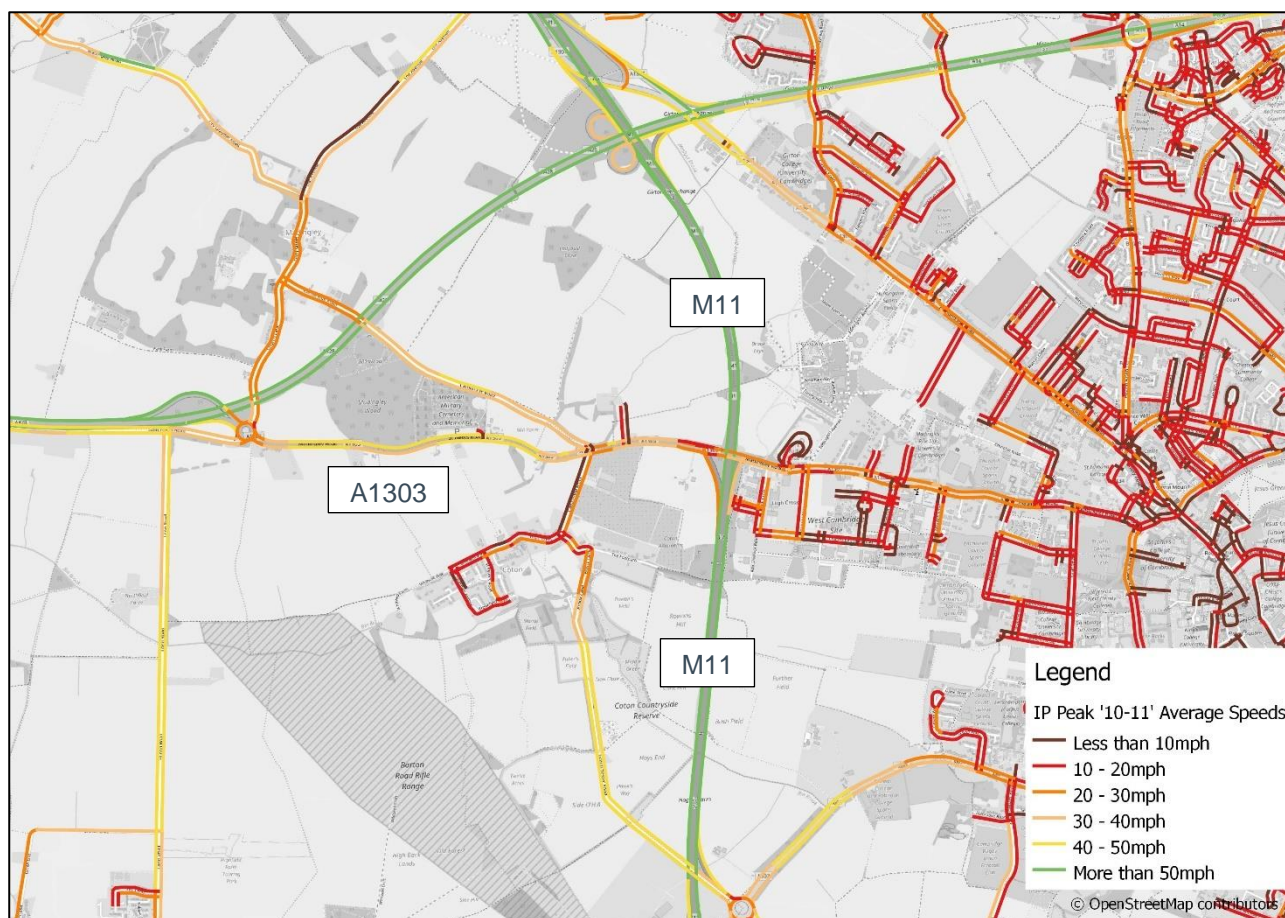


The Trafficmaster data shows the average speeds of general traffic for the given peak periods from the 2016 data. The delays on the road network are evident from the low traffic speeds experienced on the roads shown in the diagrams.

From assessment work undertaken within the SOBC it is expected that the delays experienced currently within the peak periods along Madingley Road are likely to get worse over time without interventions.

As a comparison, the Inter-Peak periods are shown below which indicate the present state of the network during the less busy periods.

Figure 2-5 Average Vehicular Speeds during the Inter-Peak (Off Peak) period (2016 Trafficmaster data)



For further details about the performance of the existing highway network, this is provided in the 'Maddingley Road / A428 Corridor Study Options Appraisal Report (20 June 2014)' which is available on the GCP website.

2.6. Corridor Accessibility

It is important to promote sustainable forms of transport aside from public transport to decrease current levels of congestion experienced within the A428/ A1303 corridor. The following sections summarise current access arrangements into the study area.

2.6.1. Walking, Cycling and Bridleways

The Cambourne to Cambridge Better Bus Journeys Project aims to promote sustainable travel into Cambridge from surrounding settlements, and aims to promote cycling and walking where possible. Cambridge has a thriving cycling culture therefore it is considered that the Cambourne to Cambridge Better Bus Journeys Project serves as an opportunity to provide enhancements for cyclists within the study area'.

There is a comprehensive footpath network within the A428/ A1303 corridor that can facilitate walking to potential busway stops.

CCC's Public Right of Way (PROW) map⁶, which is summarised in in the figure overleaf, suggests there are four key routes that will interact with the proposed scheme and surrounding area however overall the routes within the corridor are disconnected and disjointed and therefore do not lend themselves to fast, safe and easy journeys by foot and cycle along the corridor.

⁶http://www4.cambridgeshire.gov.uk/info/20012/arts_green_spaces_and_activities/199/definitive_map_and_statement

Figure 2-6 Public Right of Ways



Current cycle access to West Cambridge is possible via a footbridge from the west from Coton village. From the West Cambridge site, there is a signed primary off-road cycle route to Adams Road terminating at Grange Road. Cyclists can also use a cycle lane from the roundabout north of Hardwick to the Madingley Road/Northampton Street junction. The constraints of any potential on-road option would entail lesser scope for significant improvements to cycling and walking.

Cycling times from Cambourne to Cambridge will vary depending on the cyclist. The average cyclist according to the Design Manual for Roads and Bridges (v.11.8.3) cycles at 20kph (12.4mph). Table 2-3 details approximate journey times between potential busway stops.

Table 2-3 Cycling Route Attributes

Stops	Distance (Miles)	Approximate Time (Minutes) (12.75mph)
Cambourne High Street to Bourn	0.47	2:20
Bourn to Hardwick	1.8	8:45
Hardwick to Crome Lea	1.9	9:20
Crome Lea to West Cambridge	1.6	7:45
West Cambridge to Grange Road	1.4	6:50

According to the 2011 census 29 individuals cycle to Cambridge from Cambourne for work. There are likely to be many shorter journeys between destinations in addition to this. This suggests that there is an existing cycle demand to and from work which can be further supported by a direct cycle route adjacent to the busway.

Comberton Greenway Scheme

Greenways are a GCP scheme to provide a high-quality network of 12 separate routes into Cambridge from surrounding towns and villages utilising existing bridleways or quieter roads. They will predominantly provide commuter cycle paths but with additional benefits for pedestrians, horse riders and leisure users. The Comberton Greenway Route is proposed to connect Comberton with Coton, West Cambridge and Cambridge City Centre with the majority of the route running along existing bridleways⁷. There is potential for the scheme to link with the Cambourne to Cambridge Project which also proposed to provide high quality cycle routes into Cambridge accompanying Option 3a. The two projects have an interdependency which needs to be assessed in order to avoid potential conflict and optimise interface benefits.

2.6.2. Existing Bus Services

In order to provide a service which is likely to be attractive to people who have access to a private car, a frequent and fast HQPT service is required. Where demand is greatest, HQPT services seek to provide services frequencies that allow a passenger to “turn up and go” – which means a minimum of a bus every 10 minutes in the peak. In order to be attractive, journey times (including walking elements at either end and the

⁷ <https://citydeal-live.storage.googleapis.com/upload/www.greatercambridge.org.uk/transport/transport-projects/Appendix%2012%20Comberton.pdf>

wait at the bus stop) need to be comparable with those of the private car. Most importantly, services need to provide reliable and consistent journey times – day in and day out.

Table 2-6 sets out the frequencies of buses which use the A428 corridor.

Table 2-6 Highest bus service frequencies for A428 corridor

Number	Operator	Routing (<i>Non A428 / A1303 Corridor Sections in Italics</i>)	Highest Corridor Frequency	
			Monday-Friday	Saturday
1	Whippet	<i>St Ives – Papworth Everard</i> – Cambourne – Hardwick – Coton – Cambridge	1 per day	0
2	Whippet	Boxworth – Highfields - Hardwick – Maddingley – Coton – Cambridge	1 per day	0
3	Whippet	<i>Huntingdon – Papworth Everard</i> – Cambourne – Hardwick – Coton – Cambridge	2 per day	1 per day
X3	Whippet	<i>Huntingdon – Papworth Everard</i> – Cambourne – Hardwick – Coton – Cambridge	1 per hour	6 per day
Citi 4	Stagecoach	Cambourne – Hardwick – Coton – Cambridge	3 per hour	3 per hour
18	Whippet	Cambourne – Bourn – Comberton - Cambridge	1 per hour	1 per hour
X5	Stagecoach	<i>Oxford – Milton Keynes – Bedford - St Neots – Maddingley Road Park and Ride</i> – Cambridge	2 per hour	2 per hour
U	Whippet (Subsidised by Cambridge University)	Maddingley Park and Ride – <i>Cambridge Railway Station</i> – Addenbrooke's Hospital	4 per hour	3 per hour
Red	Stagecoach	Maddingley Road Park and Ride – Cambridge City Centre – Newmarket Road Park and Ride	6 per hour	6 per hour

Source: CCC

With the exception of routes 4, X5, U and the Maddingley Road Park and Ride, bus services are low frequency - one per hour or significantly less in some cases. Only the Park and Ride attains a “turn up and go” frequency of one bus every 10 minutes.

In the absence of substantial bus priority along the A428/A1303 corridor, the congestion and delays experienced by existing bus services mean that buses offer no competitive advantage over private cars in terms of journey times and reliability. Table 2-7 shows that scheduled peak hour journey times from Cambourne in particular are very slow – taking over an hour for a journey of around 10 miles. This is partly due to the length of time that the bus takes to traverse the roads within Cambourne. However, the impact of peak hour congestion into Cambridge City Centre is the major reason in the variation between the peak and off peak periods. Interestingly, the X5 limited-stop service from St Neots has a much lower journey time than the Cambourne services. There is no variation in the peak and off peak times for the Park and Ride service.

Table 2-7 Monday to Friday Peak and Off Peak bus journey times (most frequent routes)

Number	From / To	Peak (Minutes)	Off Peak (Minutes)	Variation (Minutes)
3 / X3	Cambourne to Cambridge	77	52	25
4	Cambourne to Cambridge	73	53	20
X5	St Neots to Cambridge	55	43	12
Red	Maddingley Road Park and Ride to City Centre	12	12	0

In July 2017 Whippet Coaches announced plans to cease a number of services operating in Cambridgeshire including the 1 service which runs along the A428 corridor. Negotiations are currently ongoing and the exact nature of the changes to services is yet to be finalised.

3. Considered Options

What solutions are currently being considered?

There are four options being considered within this report:

- **Option 1:** An on-road option which includes the introduction of bus lanes on Madingley Road between Madingley Mulch Roundabout and Lady Margaret Road;
- **Option 3/3a:** An off-road busway running between Cambourne and Grange Road, Cambridge;
- **Option 6:** An on-road tidal lane on Madingley Road running between Madingley Mulch Roundabout and High Cross as proposed by the LLF.

This Chapter summarises the assessment undertaken on the four options which are proposed for stakeholder and public consultation during the next phase of the study.

As per the CGP Board's decision October 2016, assessment of Option 3a has been undertaken. Option 1 is the low-cost comparator to Option 3a and was included within the SOBC in 2016. Option 1 has gone through further assessment since the SOBC and is discussed in this report. Option 6 is an alternative on-road proposal which has been proposed by the LLF and instructed by the GCP board to undergo further assessment.

The four options that have been assessed include the off-road Options 3 and 3a and the on-road Options of 1 and 6, descriptions of these options are provided below:

3.1. On-Road Options

On-road options would use bus priority to enhance journey times and reliability of the service between Cambourne to Cambridge. It should be noted that existing bus services as detailed in Section 2.6.2 and taxi's will be able to use the bus lane as it would not be solely limited to scheme services. On-road options would have the potential to route via the Cambridge West development however this will ultimately be down to the bus operators who would serve the route. Generally, on-road routes along the existing corridor have greater constraints than off-road.

3.1.1. Option 1

This option requires no infrastructure improvements west of Madingley Mulch roundabout and comprises of an inbound bus lane running between Madingley Mulch Roundabout and Lady Margaret Road to the east of the M11. This bus lane terminates before the M11 Junction 13 Bridge, where buses would join general traffic for approximately 1200m and then re-joins the bus lane at JJ Thompson Avenue continuing to the Madingley Road/Lady Margaret Road signalised junction.

Walking and cycling facilities would remain largely unaltered from the current provision (shared cycle and footway along Madingley Road), as there is insufficient width to improve them. Option 1 is shown coloured green in Figure 3-1 and Figure 3-2 below. Where the green line is solid, bus services would be in a bus lane, where the line is dashed, services would be on-road.

Figure 3-1 Option 1 (West of the M11)



Figure 3-2 Option 1 (East of the M11)



3.1.2. Option 6

This option is a community based option that was developed with close engagement with the LLF. Option 6 begins on the A428 eastbound off-slip where a bus lane is provided for buses to bypass general traffic and reach the give-way line at the Madingley Mulch Roundabout quicker. Option 6 then comprises of a central tidal bus lane which runs between Madingley Mulch Roundabout and High Cross to the east of the M11. Option 6 would require the installation of approximately 19 gantries along the A1303 in order to manage traffic through the tidal system.

The Tidal System

The tidal system proposed by the LLF is used by both inbound and outbound services within the respective peak periods. Option 6 proposes a central tidal lane on Madingley Road which would facilitate bus movement inbound to Cambridge within the AM peak period, 7am to 10am; and outbound in the PM peak period, 4pm to 7pm. Outbound services in the AM peak period would therefore be travelling in general traffic westbound along Madingley Road and inbound services within the PM peak period would be travelling westbound in general traffic along Madingley Road. The tidal bus lane terminates adjacent to the Madingley Road/High Cross junction at West Cambridge, where services would join general traffic on-road towards the City Centre.

Walking and cycling facilities will remain largely unaltered from current provision (shared cycle and footway along Madingley Road), as there is insufficient width to improve them. Further work is to continue for this option until it is to the same level of assessment as other options as instructed by the GCP board. Option 6 is shown coloured orange in Figure 3-3 and Figure 3-4. Where the orange line is solid, bus services would be in a bus lane, where the line is dashed, services would be on-road.

Figure 3-3 Option 6 (West of the M11)



Figure 3-4 Option 6 (East of the M11)



3.2. Off-Road Options

3.2.1. Option 3

Option 3 provides an off-road BRT route from Cambourne to Cambridge running south of the existing A428. Within Cambourne, the nature of the development (relatively narrow, curved roads) will not allow for a segregated route, which can only be provided upon exit from the settlement and through a potential new development at Bourn Airfield. After passing through the Bourn Airfield, the route would continue off-road to Madingley Mulch roundabout connecting with a potential Park and Ride site within the vicinity of the roundabout. Option 3 then runs off-road between Coton and Madingley Road/ Madingley Rise, with a connection to the West Cambridge site over the M11 via a new bridge. The route would connect to the existing highway at Grange Road and continue onwards into the City Centre.

3.2.1.1. Further Assessment on Option 3

In October 2016 GCP Board members instructed officers to look at:

“Possible specific route alignments within catchment area 3a, with catchment area 3 as an alternative if Option 3a proves unviable,”

Further assessment of Option 3 has been undertaken since the SOBC, including assessment of the on-road portions of the project in Cambourne and has concluded that earlier alignments presented for Option 3 were not viable. Subsequent analysis of costs and alignments which has been part of the reporting to the GCP board through the process of this assessment has deemed Option 3a feasible and less costly than Option 3, therefore, Option 3 has not been included in further assessment.

It is considered that Option 3 or 3a cannot be fully assessed until various other aspects of the scheme and wider impacts have been decided including the Park and Ride location, Bourn Airfield Development, the dualling of the A428 from St Neots and the design of the Broadway busway. For this reason, it is considered that Option 3 is still feasible to achieve the aims of the scheme however, in line with the CGP Boards decision, assessment work since October 2017 has focussed on Option 3a which will be referred to throughout the remainder of this report.

3.2.2. Option 3a

Option 3a would provide a predominantly segregated BRT route between Cambourne and Cambridge running south of the existing A428/ A1303 corridor. The BRT route would travel on-road with bus priority measures through Cambourne between High Street and Stirling Way where it would join the proposed bus only link to the Broadway. The route would then join a segregated busway through the proposed Bourn Airfield development and connect with an off-road busway running adjacent and to the north of St Neots Road east of the development to the Madingley Mulch roundabout.

Option 3a then runs off-road between Coton and Madingley Road/ Madingley Rise, with a connection to the West Cambridge site over the M11 via a proposed new ‘green’ bridge. The route would connect to the

existing highway and Grange Road and continue on-road into the City Centre. This option provides the opportunity of significantly improving walking and cycling facilities by providing a shared track adjacent to the entire off-road route.

3.2.2.1. Option 3a Alignments

Figure 3-5, Figure 3-6 and Figure 3-7 below show the proposed working alignments for Option 3a. The coloured lines blue, light green, red and pink all show a variation on the working alignments that could be provided through the sections shown within the figures. The current lines being shown are the most up to date alignments. Previously considered working alignments can be found within Skanska's 'Future Development Phase' Report.⁸

The working alignments shown across Bourn Airfield has been discussed with Countryside Properties who are looking to develop Bourn Airfield however this alignment is subject to Masterplanning and consent.

Figure 3-5 Section 1: Cambourne to Long Road

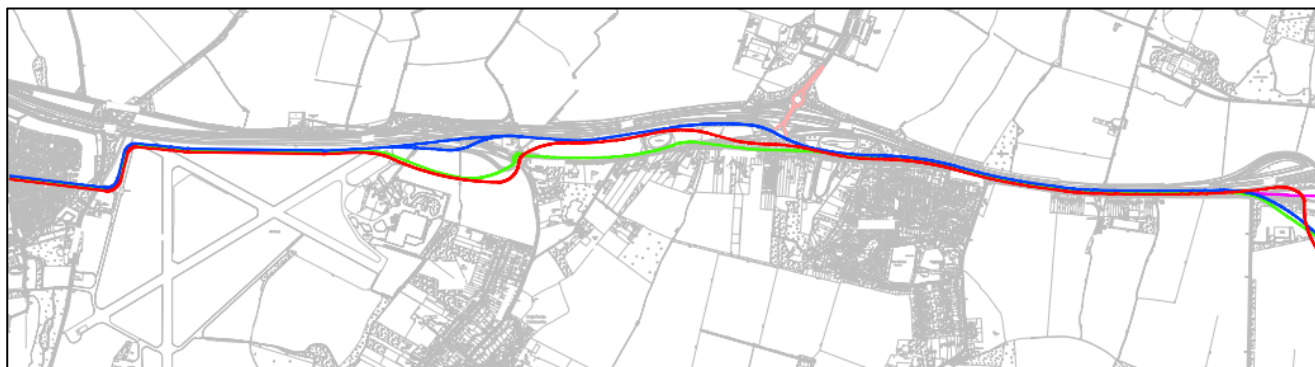
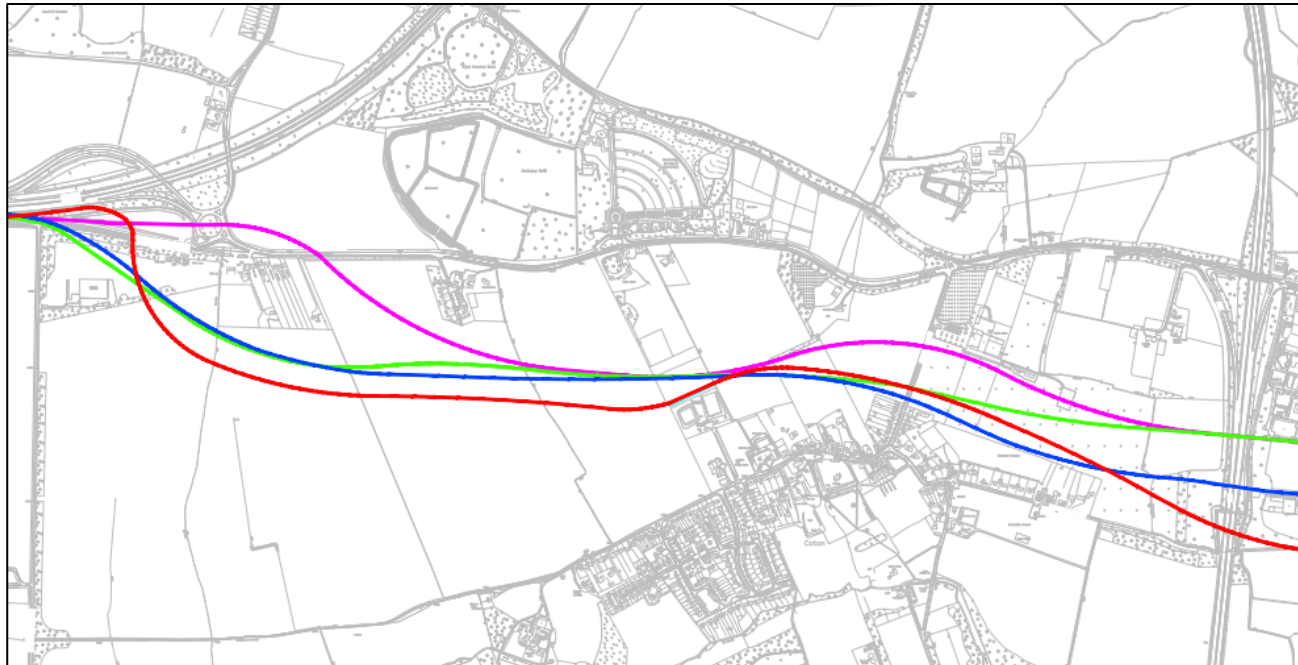
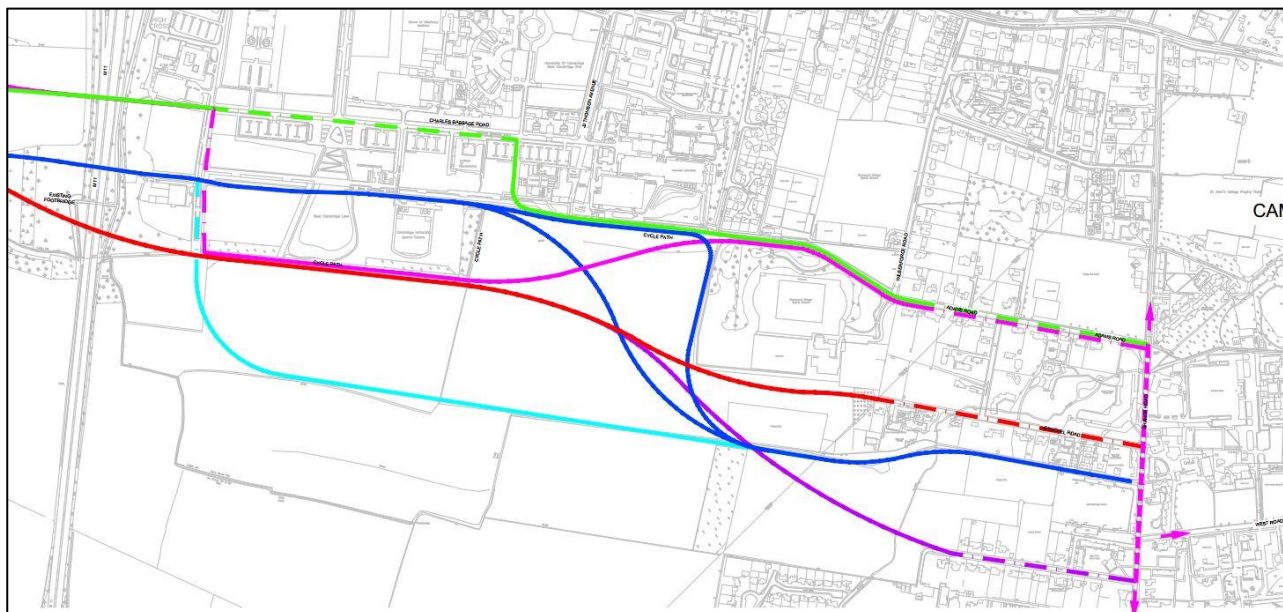


Figure 3-6 Section 2: Long Road to Junction 13 of the M11



⁸ GCP Website.

Figure 3-7 Section 3: Junction 13 of the M11 to Grange Road



The potential connections to Grange Road for Option 3a has been considered via four routes, Adams Road, Herschel Road, Rugby Club Access and Cranmer Road depending on the preferred alignments. Figure 3-7 shows potential working alignments which are subject to on-site survey and design.

3.3. Option Progression

Further transport assessment has been undertaken on the options in accordance with the Full Outline Business Case (FOBC) approach.

Since the Board's decision in October 2016, Options 1, 3a and 6 have undergone further transport and environmental assessment in accordance with FOBC approach and this includes further consideration of the design priorities as follows:

- *“Location of infrastructure – respecting the urban and rural context for example through assessing proximity to and the relationship with the existing built up areas;*
- *A specific route alignment assessment to test accessibility from the start to the end of the journeys through the centres of employment (e.g. Cambridge West) and housing (e.g. Bourn) and the environmental effects with a view to integrating with existing infrastructure and minimising impacts;*
- *Siting – positioning of infrastructure to minimise visual intrusion on the existing landscape through considering issues such as ground levels, slopes and other natural features and also minimising impact on important features such as ecological and heritage assets; and*
- *Design – the materials, features and introduced landscaping that will form the new infrastructure and achieve high quality design, minimising environmental impacts consistent with delivering the scheme's objectives, and integration with existing infrastructure and the ends of the route and along it.”⁹*

These options have been regularly updated on Working Plans derived from the Catchment Areas as set out by the GCP board. The criteria set out above has shaped the assessment going forward.

⁹ <http://scambs.moderngov.co.uk/documents/s97880/A428%20covering%20report.pdf>

What assessment has been done on these options since October 2016?

- Alignment and engineering design work (Working Plans);
- Multi-Criteria Assessment Framework (MCAF);
- CSRM2 Strategic modelling;
- VISSIM Microsimulation modelling;
- Landscape and Visual Assessment;
- Stakeholder Workshops; and
- High Level Costing.

The assessment undertaken on Options 1, 3a and 6 focusses on aspects highlighted in the existing constraints plan which have the potential to have a significant impact i.e. environmental impacts (landscape and planning), traffic impacts and specific alignment issues.

The development of the considered options has included the following assessments:

- Alignment design work (Working Plans) to understand the feasibility of each potential alignment. Detailed design work will be further provided during further stages;
- Multi Criteria Assessment framework (MCAF) of the options using specific WebTAG based criteria to assess each option;
- CSRM2 Modelling to calculate patronage and journey times of specific options and occupancy at a Park and Ride dependant on option alignments;
- VISSIM modelling to produce journey time data, model delay and to visually show congestion levels and journey times in the Phase 1 area;
- Landscape and visual assessment;
- Workshops held with statutory and non-statutory stakeholders who have provided comment on the scheme including engineering aspects and environmental aspects; and
- High Level construction costing of the options based on the design and alignment work excluding land costs.

Option 6 has been proposed by the LLF and has been developed as an alternative on-road comparator to Option 1. The GCP board instructed officers to develop Option 6 to the same level as Option 3a and Option 1 as an alternative on-road comparator and this report updates the ongoing work.

The following sections summarise the assessments undertaken as outlined above.

3.3.1. Working Alignment and Indicative Engineering Feasibility Design Work

Working alignment and illustrative engineering design work has been undertaken for all options and has investigated how each option may be introduced along the corridor with minimal impact on the local constraints and sensitive sites.

An assessment of potential off-road busway alignments has been carried out within the Option 3a catchment area. This assessment has determined that BRT within the 3a catchment area is feasible, therefore the Option 3 Catchment area has not been considered.

The assessment reviews and summarises different busway alignments and junction options based on the working assumption of a kerb guided busway arrangement, highlighting the engineering potential for BRT provision. The assessment also considers, buildability, walking and cycling, traffic management for bus priority and the safety of each option, identifying and comparing additional land requirements.

Topographical surveys have been undertaken on the A1303 Madingley Road to further develop the on-road option, Option 1. Layout plans have been produced to determine the land take requirements and assess any further constraints. Option 6 has been developed up to the same level of engineering feasibility as Option 1, including an appraisal of the potential safety and buildability constraints.

3.3.2. Multi-Criteria Assessment Framework

Multi-Criteria Assessment Framework (MCAF) is a WebTAG based assessment which uses a set number of criteria to assess the options considered. These criteria are based on a combination of the various attributes derived from the GCCD Assurance Framework and WebTAG guidance.

A MCAF was included within the SOBC and was applied to Option 1 and Option 3 only. Since then further MCAF analysis has been carried out using collected and modelled information to provide a high-level assessment of Option 1, Option 3a and Option 6. The MCAF analysis has been through two stages of assessment as follows:

- MCAF Assessment of Option 6 in accordance with agreement with LLF; and
- Further High Level MCAF Assessment of all options.

These two assessments are discussed below.

3.3.2.1. MCAF Assessment of Option 6

A Multi Criteria Assessment Framework was undertaken for the proposed Cambourne to Cambridge Better Bus Journeys Option 1, Option 6 and Option 3a. The criteria were set out and agreed with the LLF in a series of meetings with a view to broadly assessing each option against each other with respect to performance, service, cost, risk and impact. Meetings were held with the LLF Technical Group on three separate occasions, 26th May 2017, 2nd and 9th June 2017 to discuss and agree elements used to measure some of the criteria such as routes, bus stops, journey times and reliability data agreed within the MCAF assessment.

Following the series of meetings with the LLF Technical Group each option was scored by Skanska and Atkins with respect to the criteria being assessed, some criteria scoring was based on modelled outputs and some on professional judgement. The outcomes of the scoring system indicate that Option 3a performs best followed by Option 1 and then Option 6. It should be noted that the criteria used are considered a subset of the wider MCAF analysis that should be undertaken with respect to these options and that the simple scoring provides only an indicative result which should be treated as such. The scoring was recorded as follows:

- Option 1 – 51
- Option 3a – 52
- Option 6 - 45

The LLF undertook a review of the MCAF analysis and provided comments and the scores were revised based on their views of some of the criteria assessed.

- Option 1 – 44.5
- Option 3a – 35
- Option 6 - 46

MCAF Clarifications

Atkins reviewed the LLF comments on the MCAF scoring and provided revised scores based on a thorough review of the scoring undertaken previously. It was noted that the scoring for the journey time data was doubled counted and so it was adjusted resulting in the following total scores:

- Option 1 – 42
- Option 3a – 36
- Option 6 - 35

The Option 6 report including the MCAF analysis can be viewed on the GCP website. The clarifications to the MCAF are included in Appendix F.

3.3.2.2. Further High Level MCAF Assessment

As discussed in Section 3.3.2.1, the criteria used within the MCAF analysis agreed with the LLF is considered only a subset of a wider MCAF analysis that should have been undertaken with respect to these options and that the simple scoring provides only an indicative result which should be treated as such. Therefore, further MCAF analysis has been undertaken using a broader range of criteria which incorporated and expanded certain elements of the previous MCAF, while adding new attributes for assessment. The new attributes considered included the following:

- HQPT;
- Journey Ambience;
- Punctuality;
- Reliability (included within initial LLF MCAF assessment but lacked the data at that point in time);
- Resilience/versatility;
- Future proofing against employment and housing growth;
- Vehicles per Kilometre reduction;
- Volume over capacity (a measure of congestion);
- Improvements in walking and cycling infrastructure;
- Accident Impact and impact on performance of road network;
- Disruption during construction;
- Maintenance and renewal costs; and
- Accessibility.

The further high level MCAF assessment is appended to this report in Appendix F.

The outcome of the further high level MCAF indicates that, out of the three proposed options, Option 3a results in the highest score and can be considered the best performing option with respect to the criteria used. The results are as follows:

- Option 1 – 77
- Option 3a – 91
- Option 6 - 76

Option 3a received high scores for its HQPT attributes and journey ambience. This implies that Option 3a will provide passengers with a safe and pleasant experience while travelling on a busway. Furthermore, through high scores in punctuality, reliability, mode shift and future proofing, Option 3a exhibits potential in being a highly efficient mode of transport, that will appropriately address the challenges facing the area, surrounding Cambridge, in the future.

The limitation of Option 3a set against the on-road options is the higher cost of delivery and subsequent maintenance/renewal. Option 3a proposes a large amount of new infrastructure, that goes above and beyond the proposals of the other two options, thus increasing the associated costs.

Option 1 and Option 6 propose smaller scale interventions targeted at congestion reduction, which will have a lesser impact on the environment around them. However, Option 1 and Option 6 lack the reliability, versatility and mode shift of Option 3a, as well as many other technical attributes. This makes them less future proof.

Option 6 does require more investigation so that a reasonable comparison can be carried out across all three options. Therefore Option 6 should be further developed at an appropriate level for its comparison with Option 1 and Option 3a.

3.3.2.3. LLF Comments on Further High Level MCAF Assessment

As part of the MCAF exercise undertaken with the LLF, the project team has committed to provide space within this report for the LLF to provide their comments in relation to the MCAF exercise. The comments provided by the LLF do not form part of the technical work but are the opinions of the LFF Technical Group on the MCAF assessment to date. The LLF's comments on the High Level MCAF assessment are included in Appendix F.

3.3.3. Transport Modelling

Transport Modelling has been used to inform the options considered with respect to the targets set for achieving HQPT.

Transport Modelling has been undertaken using the following:

1. Area-wide Strategic modelling (CSRM2);
2. Micro-simulation modelling (VISSIM); and
3. Journey Time Analysis;

The modelling has been undertaken for all options tested to provide data on how each option may perform in a given future scenario.

Transport modelling is used to assist with the development of transport schemes by helping to understand future trips and mode shift within a certain area. This assessment has used a number of modelling tools including the following:

- CSRM2, which is a strategic transport model;
- VISSIM microsimulation model which was used to visually show the effects of the scheme on the local highway network and to derive travel time and queuing implication of the options; and
- Spreadsheet modelling to derive potential journey time for each option.

The transport modelling has sought to assess each option with respect to the fast, frequent and reliable aspects of the scheme and these aspects are considered within the modelling results reported below.

3.3.3.1. Cambridge Sub-Regional Model 2 (CSRM2)

The Cambridge Sub-Regional Model (CSRM2) is a strategic model that covers the majority of Cambridgeshire including Cambridge City and South Cambridgeshire. It is a transport model that has been used on various schemes within Cambridgeshire to assist in the process of providing evidence to support transport schemes and investigate likely impacts of these schemes in future scenarios. The application of the model for all City Deal Schemes was agreed with CCC.

For the current work, the refreshed model with a 2015 Base Year has been used, and is denoted CSRM2 to distinguish from the 2006-based model previously used for A428 scheme analysis (CSRM1).

Most transport models have a series of assumptions that underlie their application and use and CSRM2 is no exception, the assumptions that underpin the operation of the model are included in Appendix G. One of the agreed assumptions that has been applied to CSRM2 which is pertinent to this study is an assumption that a City Access GCP scheme would be in place in the future year scenario of 2031 (the future modelled year of CSRM2).

The assumption for the impact of a City Access scheme has been applied to general traffic travelling to and from Cambridge. This assumption is built into the option scenarios tested within this assessment.

What scenarios does the CSRM2 assess?

CSRM2 has modelled the following scenarios:

- **2015 Base** – the model Base Year, validated against locally collected data (detailed further within the Model Data Validation Report);
- **Foundation Case** – this is a 2031 modelled period which includes housing and employment growth as allocated within the Local Plan preferred strategies for South Cambridgeshire and Cambridge City;
- **Do minimum** – this is a 2031 modelled period which includes the Foundation Case and the proxy assumptions for a City Access Scheme (See Appendix G for details on how this scheme has been included); and
- **Option 1, 3/3a, 6** – 2031 model tests which include the Do Minimum assumptions, altered to incorporate each of the scheme options in turn.

The following sections provide some summary results from CSRM2. It should be noted that the results are only indicative as the process of assessing the considered options is ongoing. It is considered that further option assessment work, including analysis as part of the FOBC, will further tease out the benefits and impacts of these options and would look to report further on the modelling.

Patronage

A key objective of the GCP is to reduce congestion in Cambridge City Centre which means that individuals will need alternative means of accessing the City Centre. CSRM2 provided annual estimates of bus patronage along the A428 corridor between Cambourne and Cambridge inclusive of a new park and ride site and associated park and ride bus services. CSRM also considers patronage from St Neots and further afield making trips along the A428/A1303 corridor.

The annual patronage data as derived from CSRM2 for the three options is presented in the table below which shows two scenarios:

- Total Annual Bus Patronage along the corridor; and
- Total Annual Bus Patronage using the proposed scheme.

The numbers presented are based on the number of users on the services that are proposed to use the Cambourne to Cambridge scheme: the existing, Citi 4, X5 and X3. Patronage has been extracted from one point on the network (taken as the M11 bridge) as this is considered to be the key location likely to hold the most passengers as it is between the key origins (places of residence) and destinations (places of employment). Given this there may be some trips that are not captured i.e. trips from Cambourne to Bourn Airfield or from West Cambridge to Cambridge City Centre.

The modelled outputs give annual patronage figures for all options for all bus services along the corridor as shown below:

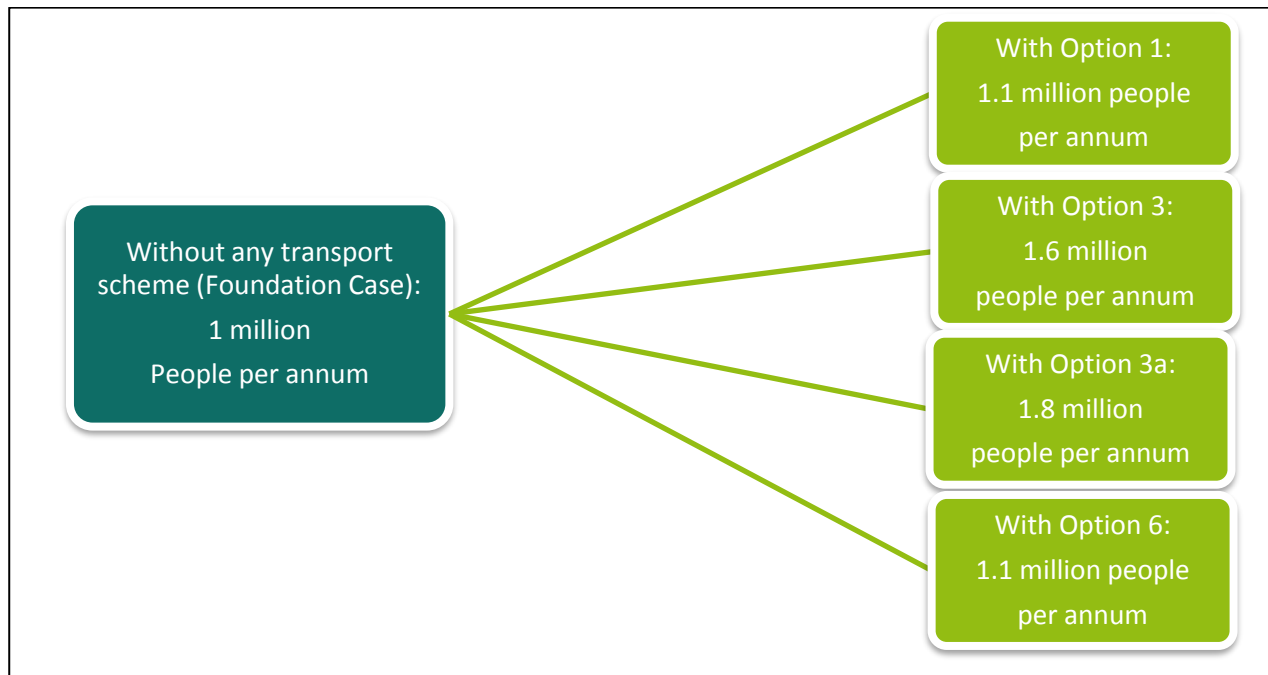
Table 3-1 Annual Patronage Figures from CSRM for Options

	Foundation Case	Option 1	Option 3	Option 3a	Option 6
Total Annual Bus Patronage for ALL bus services including Park and Ride	1.5m	3.8m	3.6m	3.8m	2.7m
Annual Bus Patronage for Buses using the scheme only	1m (no scheme)	1.1m	1.6m	1.8m	1.1m

The modelled outputs suggest that demand for bus services including park and ride is likely to grow along the corridor for a 2031 scenario with the respective options. The total demand for park and ride and bus services shows that there is little difference between the options as the demand for all services will grow irrespective of a new scheme or not and therefore without a new scheme there would be pressures on existing services to grow and put on more services. This would be expected in a scenario where a bus operator would grow with the growing demand where no alternatives are provided. The upshot of this unanswered growth would be more bus services travelling in peak periods in congested conditions and therefore providing little benefit to customers and potentially causing people to seek employment elsewhere or make their trips to other destinations to avoid the delays and poor experience on public transport.

With the proposed scheme in place the modelled data is showing that Option 3a would encourage more people to use busway services than the other options showing it is more attractive and delivers more benefits for the users. The figure below shows the predicted patronage on the buses that would use the scheme.

Figure 3-8 Annual Patronage for 'Modelled Scheme Services Only' for all Options 2031 per annum



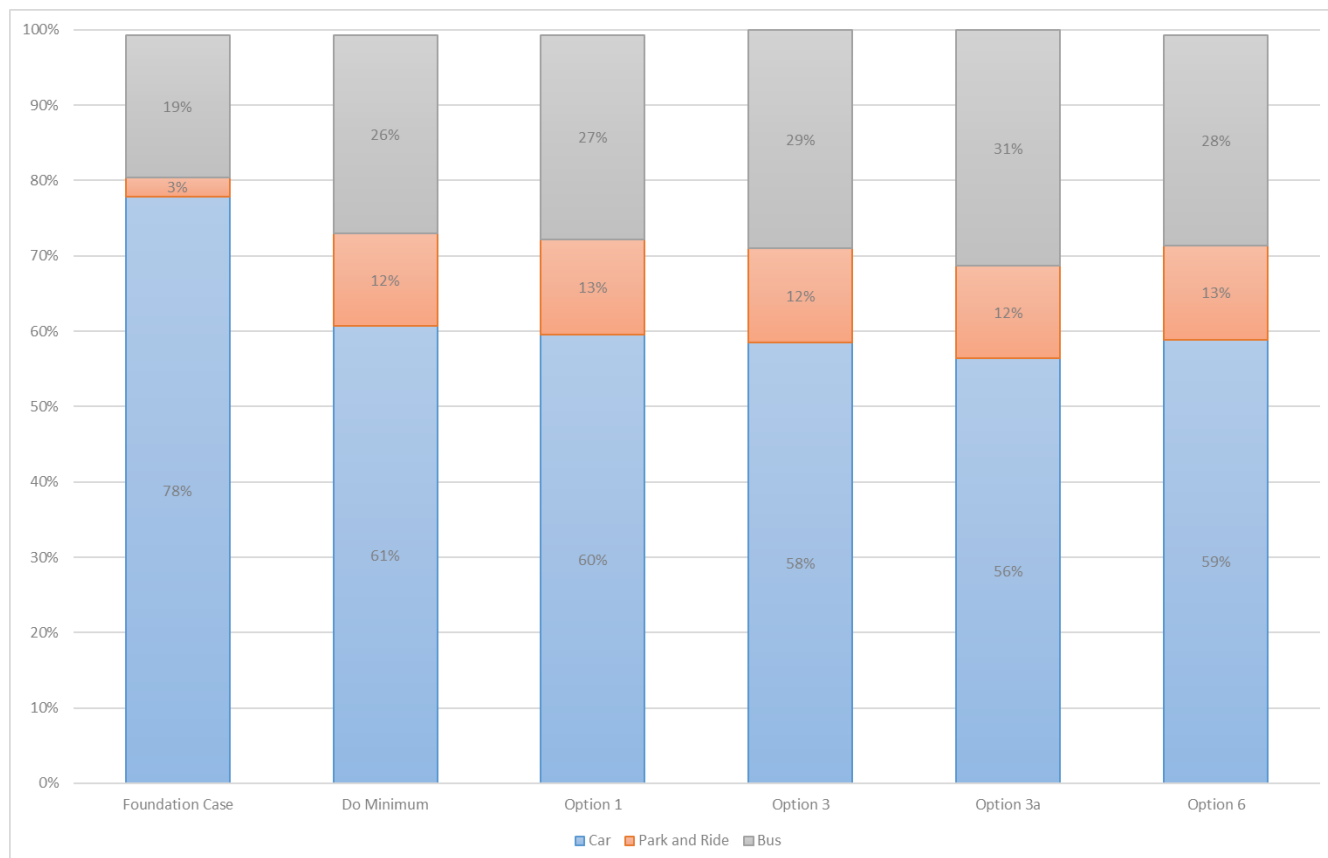
Option 3a shows the greatest patronage for the proposed busway services of over 800,000 upon the Foundation Case, Option 1 and Option 6 show an increase on the Foundation Case of 100,000 passengers.

It is expected that further assessment using CSRM2 will be undertaken as the scheme is developed towards the FOBC and further reporting will be made on predicted patronage levels.

Mode Shift

To facilitate the reduction in congestion of cars in the City Centre a scheme should seek to shift as many users to public transport as much as possible. CSRM2 predicts that Option 3a will attract the largest number of users and therefore shift the most amount of people to public transport travel. This can be seen in the bar chart below.

Figure 3-9 Mode Share for each scenario (2031)



The mode shift as shown in the graph above takes effect within the Do Minimum scenario which shows the effect of introducing a City Access Scheme on people driving into and out of Cambridge and Cambourne. The introduction of the City Access scheme creates a mode shift of 22% from private car to public transport and Park and Ride. As mentioned previously this is a hypothetical situation and the Do Minimum scenario demonstrates the forecast demand but does not provide a supply for the demand.

There is no scheme to cater for the demand within the Do Minimum scenario so the mode shift to public transport effectively would overload the existing bus services which would travel with general traffic as the existing services currently do.

CSRM2 is predicting that with the City Access Scheme and the proposed options in place the following mode shifts to bus and Park and Ride are likely:

- Option 1 = shift of 18%;
- Option 3a = shift of 22%; and
- Option 6 = shift of 19%.

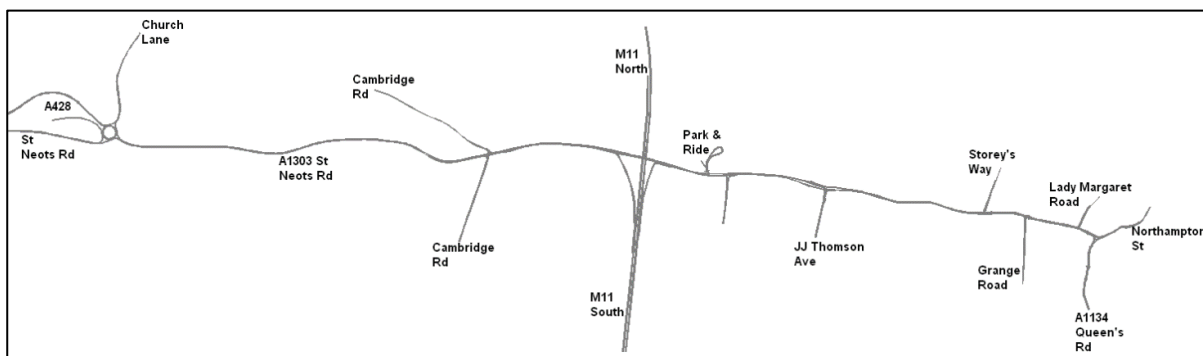
The implementation of a City Access scheme is therefore likely to affect change in travel patterns for people accessing destinations in Cambridge and Cambourne and result in a mode shift of people driving to alternative modes of transport as reflected in these mode shifts presented above. This includes shifts to public transport, Park and Ride usage and other modes such as cycling. With this predicted mode shift the options provide bus services and a new park and ride site to accommodate those people likely to change modes where the options capture them to varying degrees.

3.3.3.2. VISSIM

VISSIM is a micro-simulation model that visually represents the impacts of a system down a stretch of road, in this case Madingley Road. VISSIM identifies congestion levels through different points within a system such as junctions along a route. VISSIM is used to provide congestion levels, average speeds of potential services and journey times. This analysis is included in Appendix H.

The VISSIM model takes into account side arms in addition to the main route which has been illustrated in in Figure 3-10.

Figure 3-10 The Extent of the VISSIM Model



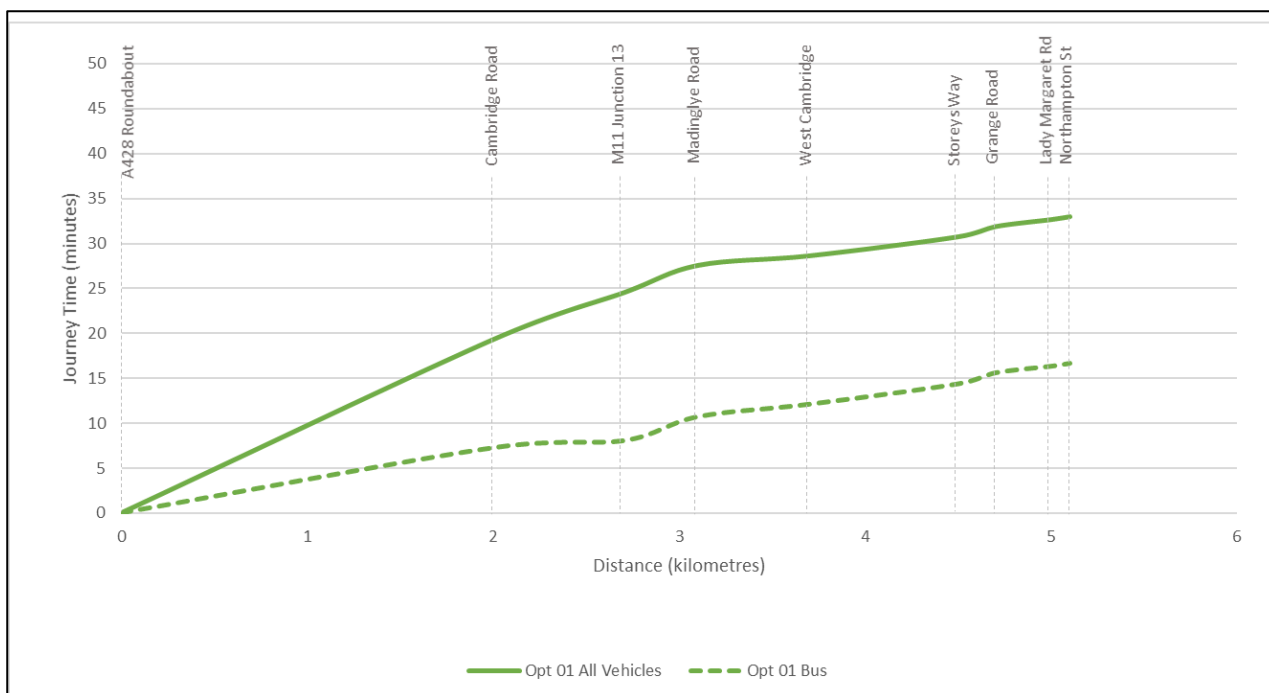
VISSIM - Journey Times

The journey time graphs in Figure 3-12 and Figure 3-11 present cumulative journey times for the AM peak hour 08:00 to 09:00 in the critical inbound (eastbound) direction. Journey times are averages for all vehicles on the A1303 corridor between the A428 roundabout in the west and Northampton Street in Cambridge.

The 2014 Base model reported average AM peak hour journey times along the corridor of 15 minutes. With the significant increase in highway demand and no associated mitigation in the Foundation Case this increases to 142 minutes. The introduction of the Cambridge Access Study proxy in the Do Minimum scenario reduces journey time down to 46 mins.

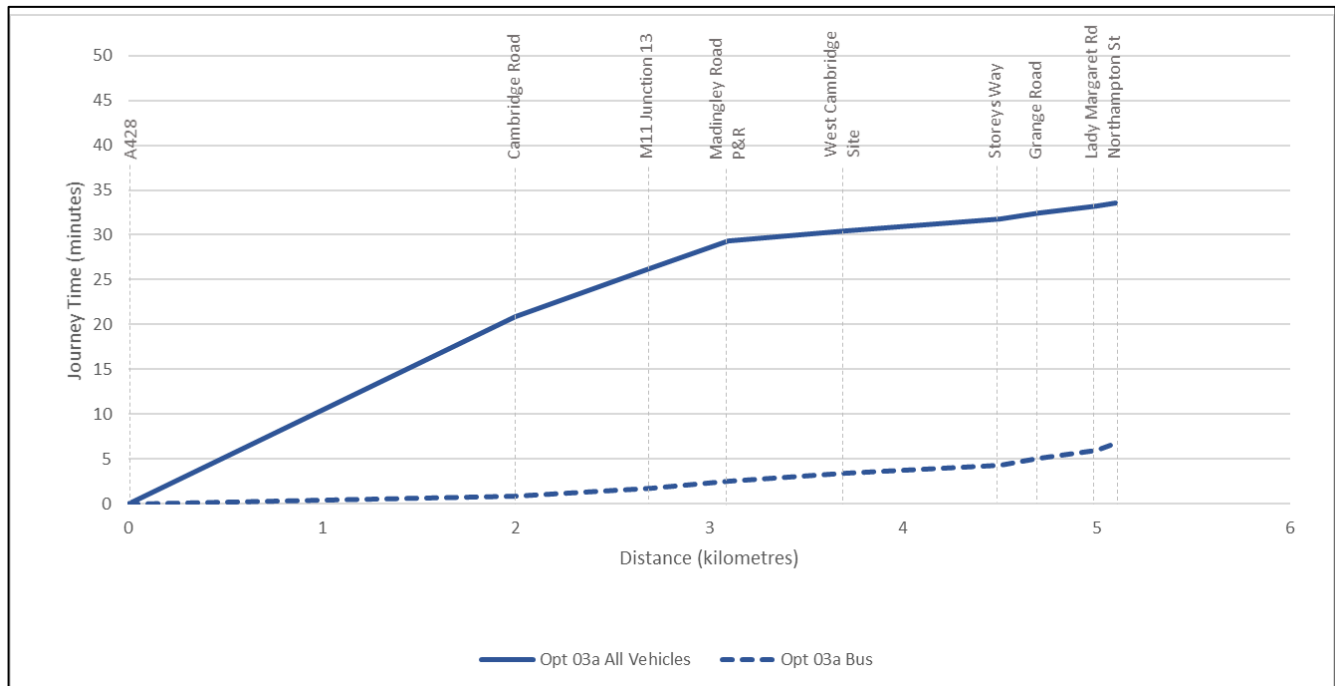
The figures shown below compare the all-vehicle (including buses) average journey time against the average bus journey time modelled within VISSIM for each of the three proposed options.

Figure 3-11 Predicted Journey Times for Option 1 (Bus vs All Vehicles) AM Peak (08:00 – 09:00)



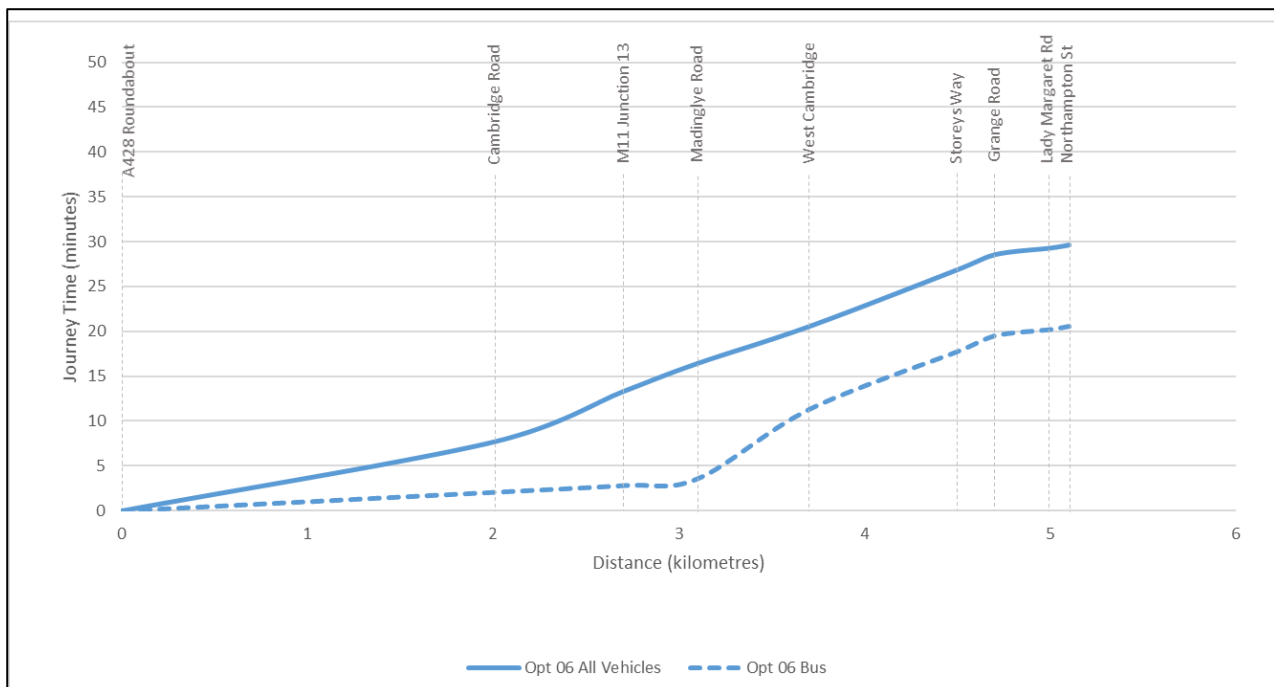
Bus journey times in Option 1 between the A428 roundabout and M11 Junction 13 are predicted to be 8 minutes, with the scheme providing a saving of 16 minutes over the all vehicle average of 33 minutes. Beyond the M11 and the end of the proposed scheme buses join the other traffic and have no priority therefore journey times are consistent with the all vehicle average.

Figure 3-12 Predicted Journey Times for Option 3a (Bus vs All Vehicles) AM Peak (08:00 – 09:00)



Bus journey times in Option 3a between the A428 roundabout and M11 Junction 13 are predicted to be 2.5 minutes, with a time saving of 25 minutes between Madingley Mulch Roundabout and Grange Road over the all vehicle average of 33 minutes. This predicted time saving is due to the off-road nature of the busway providing faster bus journey times through to Grange Road.

Figure 3-13 Predicted Journey Times for Option 6 (Bus vs All Vehicles) AM Peak (08:00 – 09:00)



Bus journey times in Option 6 between the A428 roundabout and M11 Junction 13 are predicted to be 3 minutes, with the scheme providing a saving of 10 minutes over the all vehicle average. Beyond the M11 and the end of the proposed scheme buses join the other traffic and have no priority therefore journey times are consistent with the all vehicle average.

The model predicts that Option 6 will provide marginally quicker journey times between the A428 roundabout and Cambridge Road, however journey times for the remainder of the route to Northampton Street are slower than Options 1 and 3a. All the proposed options are predicted to have inbound AM peak journey times of between 30 to 34 minutes.

Network Delay

For the AM peak the average total junction delay per vehicle in the 2014 Base is approximately 450 seconds across the modelled area. With the significant increase in highway demand and no associated mitigation in the Foundation Case, the delay increases to over 2,200 seconds. The VISSIM model predicts that with the introduction of the Cambridge Access Study proxy in the A428 Do Minimum scenario, the average delay is reduced to approximately 1,200 seconds. Each of the proposed options reduces the average vehicle delay further when compared against the Future Case. Option 6 provides the greatest reduction in delay with a total average delay of approximately 800 seconds.

For the PM peak the average total junction delay per vehicle in the 2014 Base is just over 300 seconds. With the significant increase in highway demand and no associated mitigation in the Foundation Case, the delay increases to approximately 750 seconds. With the introduction of the Cambridge Access Study proxy in the A428 Do Minimum scenario, the average delay is reduced to approximately 600 seconds. Comparing against the Foundation Case Option 1 offers a slight reduction in average delay, but Option 3a causes a slight increase in average delay. Option 6 on the other hand significantly reduces average delay to a total of less than 400 seconds.

Visual Outputs

The visual outputs from the VISSIM modelling can be viewed on the GCP Website.

3.3.3.3. Journey Times

Journey time analysis has been undertaken using a spreadsheet model and has derived likely journey times for each considered option. The journey time analysis has used locally derived bus speeds from sources such as Vix data for the existing Citi 4 and Newmarket Park and Ride service, and bus speeds data from the existing Cambridge Guided Busway buses. These data sources have been used to inform likely achievable average bus speeds on sections of road/busway for each option. The resulting total journey times have then been revised to include dwell times at bus stops, derived from observed dwell times (Vix data), to give a total journey time expected from bus stop to bus stop.

Bus journeys times from Broadway, Cambourne to Grange Road, Cambridge are shown in **Figure 3-14** and **Figure 3-15**. It should be noted that the data labels have been rounded to the nearest minute. The figures only show AM Peak inbound journey times (Inter-Peak and PM Peak have been provided in Appendix I).

Figure 3-14 AM Peak Inbound Journey Times between Cambourne High Street and Grange Road (via a potential Scotland Farm Park and Ride)

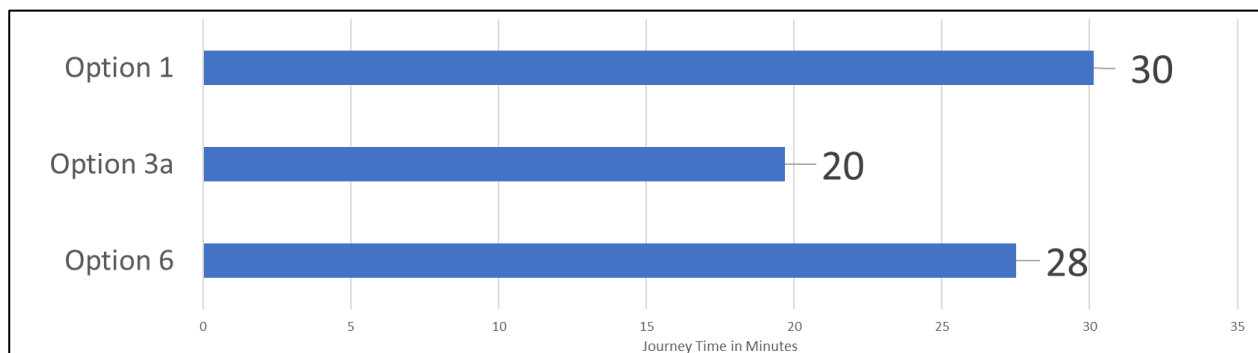
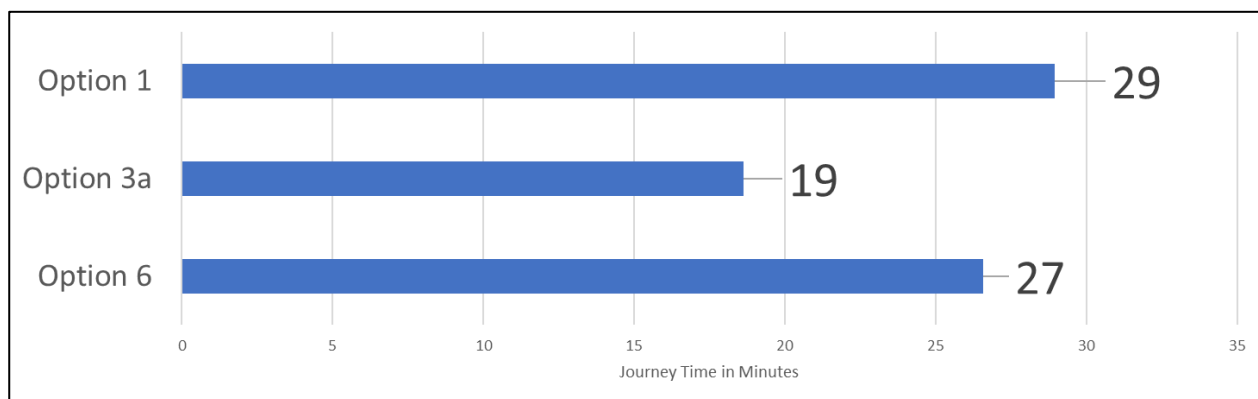


Figure 3-15 AM Peak Inbound Journey Times between Cambourne and Grange Road (via a potential Maddingley Mulch Park and Ride)



The results show that Option 3a would provide the quickest service from High Street to Grange Road. The Interpeak and PM Peak show similar results to one another in the table below. Option 1 and Option 6 offer similar journey times, as expected given the schemes are similar in nature.

Journey times for Option 3a are also more likely to be achieved due to the segregated nature of the route. Journey times will vary on the on-road portion of the scheme (Cambourne and Cambridge City Centre) due to fewer bus priority measures being present. Bus lanes are likely to lead to more variable journey times than a busway due to interactions with junctions and the interaction with other road users.

Table 3-2 Journey Times in minutes for Peak Periods between Cambourne High Street and Grange Road

	With Scotland Farm Park and Ride			With Maddingley Mulch Park and Ride		
	Option 1	Option 3a	Option 6	Option 1	Option 3a	Option 6
AM Peak (7am to 10am) INBOUND	32	20	29	29	19	27
Interpeak (10am to 4pm) INBOUND	30	19	27	29	19	26
Interpeak (10am to 4pm) OUTBOUND	31	24	27	30	22	26
PM Peak (4pm to 7pm) OUTBOUND	32	24	28	31	22	28

Phase 1 Journey Times

The table presented below shows the likely journey times for the Phase 1 study area, between Madingley Mulch Roundabout and Grange Road:

Table 3-3 Journey Times in minutes for Peak Periods between Madingley Mulch Roundabout and Grange Road (Phase 1 area)

	With Scotland Farm Park and Ride			With Madingley Mulch Park and Ride		
	Option 1	Option 3a	Option 6	Option 1	Option 3a	Option 6
AM Peak (7am to 10am) INBOUND	12	4	10	12	4	9
Interpeak (10am to 4pm) INBOUND	12	4	9	11	4	9
Interpeak (10am to 4pm) OUTBOUND	11	4	8	11	4	7
PM Peak (4pm to 7pm) OUTBOUND	12	4	9	12	4	8

The journey times presented for the Phase 1 area indicate that Option 3a is likely to deliver a consistent journey time between Madingley Mulch Roundabout and Grange Road of 4 minutes in all peak periods, inbound and outbound. Options 1 and 6 are likely to deliver variable journey times in different peak periods with option 6 delivering reasonable outbound journey times.

3.3.4. Landscape and Visual Appraisal of Options

Potential landscape and visual impacts have been identified for Options 1, 3a and 6 along with possible opportunities to mitigate the impacts. This assessment has been undertaken as a response to the CGP Boards instruction to assess *“the environmental effects with a view to integrating with existing infrastructure and minimising impacts”*.

The potential landscape and visual effects and opportunities for mitigation for each option are set out below. They have been grouped under the headings of Option 1 and Option 6 (on-road Options) and Option 3a (off-road option). The Green Lane Concept Report is contained within Appendix J.

On-road Options - Option 1 and Option 6

Option 1 and Option 6 would result in landscape and visual effects to receptors along Madingley Road, particularly the Madingley Wood Ancient and Semi Natural Woodland and the Cambridge American Cemetery & Memorial Grade I Registered Park and Garden. Options should be explored to avoid or reduce the potential impact on those landscape features. The extent of potential landscape and visual effects would generally be limited to the area within and around the existing road corridor, thereby avoiding landscape and visual effects within the wider area. However, the corridor does form a predominantly green transport corridor to the city and that overall character should be retained if possible through detailed design consideration. The gantries proposed as part of Option 6 would create an urbanising feature within the corridor which would result in a slightly greater landscape and visual effect than Option 1. There are limited opportunities to mitigate the potential landscape and visual effects of Option 1 and Option 6 due to the space available within the corridor and the location of sensitive designated features.

Off-road Options - Option 3a

The varying alignments of Option 3a have been reviewed with respect to Landscape and Visual impact and these are discussed in further detail in Chapter 4. With respect to the three options considered, the extent of potential landscape and visual effects for Option 3a will be wider than for the on-road Options due to the availability of views towards the corridors and variety of features that may be affected. However, as the area around the Option 3a route is less physically constrained there is accordingly a greater opportunity to avoid, reduce and mitigate those potential effects to varying degrees.

3.3.5. LLF Meetings and Workshops

To compliment option assessment, regular workshops with statutory and non-statutory stakeholders have been undertaken to create options that will benefit the wider community. The LLF review and comment on work done to date which can be found on the GCP website. Workshops were held with the LLF on 21st August on options east of the M11 and a workshop was held on the 23rd August 2017 on Park and Ride locations. Members of the LLF assessed the options on transport and environmental criteria. The outcomes of the workshop are presented in Appendix B.

3.3.6. High Level Costs

A high-level cost estimate update has been undertaken by Faithful + Gould for Option 1, Option 3a and Option 6. Figure 3-3 presents the overall costs for each route option and alignment.

Table 3-4 Option Costs – Standard 2010 prices (excluding VAT)

Route / Alignment	Future Investment Programme	Phase 1	Totals
Option 1	n/a	£12,406,000	£12,406,000
Option 3a*	£29,700,00 to £36,140,000	£41,500,000 to £58,260,000	£85,510,000 to £93,260,000
Option 6	n/a	£17,741,000	£17,741,000

**Option 3a includes a range for costs due to the different considered alignments for each section. The breakdown of the costs of alignments is included in Chapter 4.*

The costs contained with Table 3-4 are based on a number of assumptions and exclusions, which are detailed within the high-level cost estimate update in Appendix K, and include the exclusion of land costs. It is evident from these costs that there some differences to the costs that were presented in the SOBC, there are multiple reasons for this which include the following:

- Level of detail of schemes – the options have been developed further enabling the costs to be further refined;
- Option alignment work for Option 3a which has implications on costs;
- New emerging Option 6 which has not been previously costed;
- Information and data – further information on utilities, land take has been obtained; and
- Further indicative design work specifically related to Option 1.

3.4. Cambourne – Potential Bus Priority

A study was conducted to assess the proposed bus priority measures that may need to be implemented through Cambourne in order to introduce the proposed Cambourne to Cambridge Scheme through the town (Appendix D). The report concluded that with a series of bus priority measures and interventions for consideration to provide BRT through Cambourne. Ultimately, measures in Cambourne will be subject to future planning and consideration through the Section 106 process for Cambourne West. This report has considered potential measures that could be put forward as follows:

- **Cambourne West:**
 - Bus priority and a bus-only access from the A1198 between the Caxton Gibbet roundabout and the realigned roundabout to the south via a new junction;
 - A segregated route between the A1198 and the Primary Road through the development to the north east of the central lakes; and
 - Bus-only link from Cambourne West to Cambourne Business Park.
- **Western Gateway:**
 - Installation of a new access road extending west from the Cambourne Business Park to provide connectivity to Cambourne West including a bus priority measure in the form of an access control to only permit access by buses; and
 - Reconstruction of the existing raised tables to provide a more relaxed gradient on approaches in order to improve passenger ride comfort.
- **Internal Gateway:**

- The installation of a bus priority measure in the form of access control at a point on High Street to allow access by buses only.
- **Eastern Gateway:**
 - The installation of a bus priority measure in the form of access control at the junction with Sterling Way;
 - A new highway corridor comprising of a bus-only access road and adjacent shared surface for pedestrians between Sterling Way and Broadway; and
 - The installation of a bus priority measure in the form of access control at the junction with Broadway to prioritise access of buses.

It is recommended that for the HQPT service through Cambourne to be provided with bus priority in order to achieve quick journey times through the existing streets. The interventions highlighted within the report best serve to facilitate the bus route through Cambourne connecting with the segregated infrastructure to the eastern edge of Cambourne.

The Eastern Gateway provides the best alignment for a bus priority connection between Cambourne and Bourn in terms of journey time, cost and impact on existing built environment of Cambourne.

The interventions discussed within the report would serve to provide an important bus priority element of the overall Cambourne to Cambridge scheme in accordance with the development of the outline business case and GCP Policy and aims. The bus priority measures noted within the report are currently being assessed by the local planning authority within the context of present allocated sites.

3.5. Cambridge City – Potential Bus Priority

A study into Cambridge City bus priority has been produced to consider the potential measures that could be considered as part of the overall City Access and Cambourne to Cambridge programme. The 'Grange Road to City Centre Report' is included within Appendix E.

The outputs of the report are deliberately high-level at this stage and intended to assist in the overall process of integrating City Deal proposals across different projects. The report does not conclude or make recommendations for decision but forms part of the overall development process for public transport improvements within the historic built environment of Cambridge. The concepts within it may not form any part of Cambourne to Cambridge TWA application.

Further combined project work will include analysis of potential interventions along with stakeholder engagement, journey time analysis, patronage calculations and accessibility assessments. Furthermore, any options taken forward at a later date will be within the strategic fit of the city access project.

3.6. Recommendation Summary

This Chapter has summarised the assessment conducted to date on Options 1, 6 and 3a following the GCCD Boards recommendation to look at *"possible specific route alignments within Catchment area 3a, with catchment area 3 as an alternative if Option 3a proves unviable"*.

The MCAF analysis has shown that using a MCAF can be subjective and relies on the appropriate criteria to assess each option in turn over a broad spectrum of transport related aspects. The high level MCAF assessment has demonstrated that Option 3a reports the highest score over the two on-road comparators. It is considered however that the analysis would benefit from further additional information and that all three options should be taken forward to the public consultation whilst further data is collected.

The CSRM2 has been run for scenarios including Option 3a, Option 6 and Option 1. Journey time analysis shows that Option 3a is predicted to lead to the quickest journey times with Option 1 and Option 6 journey times predicted to be comparable to each other. Option 3a is most likely to achieve the predicted journey times due to the segregated route allowing improved reliability. In terms of patronage, Option 3a is likely to attract the most people. CSRM2 has also been used to predict the likely number of Park and Ride users. It is suggested that a site of 2000 spaces is required to accommodate Park and Ride demand from the corridor.

VISSIM microsimulation modelling for Madingley Road shows that for all options there are positive effects on Madingley Road for all traffic and for buses gaining access to Cambridge quicker than existing services within the peak periods. The VISSIM output video files show the potential options and how they interact with general traffic along Madingley Road. The VISSIM analysis demonstrates the differences between options

within the Madingley Road corridor section and it is recommended that through further assessments the VISSIM models are revised to suit emerging options.

Options to be taken to Public Consultation

Given the analysis above, it is considered that Option 1, Option 3a and Option 6 should be considered further as part of public consultation in Autumn 2017. Transport, environmental and MCAF analysis has shown that Option 1 and Option 6 are comparable and therefore both will be taken forward to public consultation as on-road alternatives to Option 3a. It is considered that Option 6 provides a feasible alternative to Option 1 in that it:

- Allows for two-way bus priority along Madingley Road (AM inbound and PM outbound);
- Potentially has a reduced impact on residents of Madingley Road (east of the M11); and
- Allows for bus priority across the M11 to JJ Thomson Avenue.

Chapter 4 further appraises the alignments associated with Option 3a in order to present those to be taken forward to consultation.

4. Assessing Potential Alignments within Option 3a

This Chapter assesses Option 3a as per the GCP decision in order to understand the feasibility of the option and further appraise the strategic route alignments to be taken to public consultation in November 2017.

4.1. Introduction

Remind me what Option 3a is?

Option 3 provides an off-road route from Cambourne to Cambridge running south of the existing A428. Within Cambourne, the nature of the development (relatively narrow, curved roads) will not allow for a segregated route, which can only be provided upon exit from the settlement and through a potential new development at Bourn Airfield. After passing through the Bourn Airfield, the route would continue off-road to Madingley Mulch roundabout connecting with a potential park and ride site in a location on the corridor. Option 3 then runs off-road between Coton and Madingley Road/ Madingley Rise, with a connection to the West Cambridge site over the M11 via a new bridge. The route would connect to the existing highway at Grange Road and continue onwards into the City.

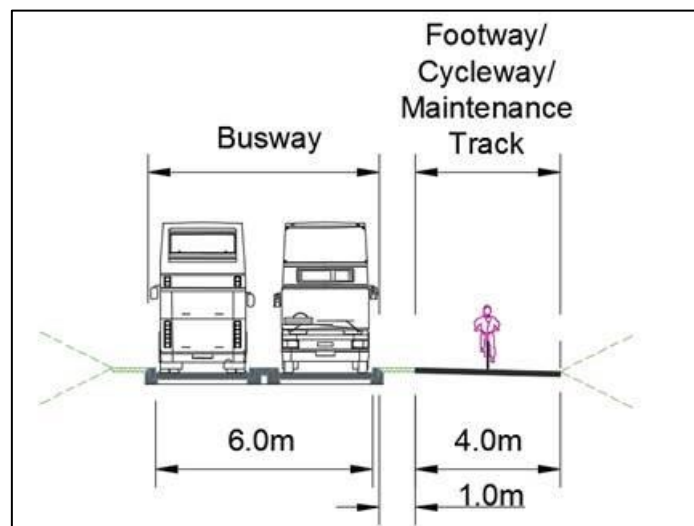
In working up options and feasibility for a high quality segregated public transport bus scheme a guided busway provides an adequate model for development of proposed scheme. In order to provide for the consent and powers necessary to deliver a high quality, major public transport system, along a segregated alignment a Transport and Works Act (TWA) Order 1992 is a recognised way of authorising the construction and operation of new public transport schemes including railways, light and BRT (see Transport and Works Act orders, A brief guide, Department of Transport, July 2013). A TWA Order is a special form of statutory authority which a public or private developer can apply in order to deliver major transport infrastructure. The scope of TWA Orders is wide incorporating such powers as the compulsory acquisition of land and deemed planning permission amongst others. Typically, a public enquiry in accordance with the application process is held to determine whether the grant of a TWA is in the public interest. A TWA Order, once made, provides a high degree of reliability and resilience for the segregated transport route as the authority holds specific safeguards conferred upon it as a statutory undertaker. This for instance prevents utilities companies from simply digging up the surface of the busway in the same way as within the public highway.

The design of the route would provide for the optimum possible alignment for rapid transit system while avoiding and mitigating against environmental constraints as necessary and in accordance within the provisions of and Environmental Statement and conditions put in place as part of any TWA Order consent. The alignment would be designed to seek to achieve a maximum design speed of 100 kph. The maximum speeds of vehicles on the guided sections has been assumed to be the fastest current type of rapid transit vehicles, a bus, to a maximum operational speed 90 kph (56mph). The design parameters applied are therefore compatible with other types of contemporary rapid transit systems such as trams and light railways.

What would Option 3a look like?

A working assumption for the development of option 3a is a kerb guided busway which would consist of a two-way running surface of concrete with a maximum width of 6.4 metres. The carriageways would be separated by a central reserve of a minimum width of 400mm. Breaks or “burst throughs” in the busway, where for example a bridleway crossing is located can be up to 9 metres wide. A typical cross section of a guided busway is shown in the Figure 4-1.

Figure 4-1 Typical Guided Busway Cross Section



Adjacent to the busway a 3 to 4m wide maintenance track would be provided. The maintenance track would be available to use by emergency vehicles and would be made available as public rights of way in the form of a bridleway for use by pedestrians, equestrians and cyclists. The scheme would be designed to accommodate exiting public rights of way that either cross or run adjacent to it.

In order to reduce the prospect of light pollution in both rural and residential areas, lighting will not be included along the busway or cycle track between junctions. The Park and Ride and stops will be lit. At traffic signalled controlled junctions with the public highway, street lighting will be provided in accordance with the Design Manual for Roads and Bridges. This will provide the safest means of negotiating the junction (for example at Cambridge Road, Coton). Light pollution will be reduced by design including the use of cut off screens.

With the exception of safety fencing where necessary (bridges and culverts) the busway will not be fenced. Where appropriate boundary treatments would be of a native species hedging. The development of scheme landscape mitigation will incorporate planting measures undertaken as part of the Environmental Impact Assessment for the proposed scheme. See Green Lane report in Appendix J.

How is Option 3a being assessed?

This section summarises the work done to date for Option 3a in terms of transport considerations. It is assumed that as Option 1 and Option 6 are both on-road that the alignments will not deviate from the local highway network. Option 3a on the other hand is an off-road option that has several specific route alignments being considered. This section aims to assess each alignment in terms of transport to identify routes to take forward for further work. In doing so this Chapter sets out the methodology viability the assessment including a high-level comparison between options.

For the purposes of the assessment it has been assumed that the off-road sections of Option 3a are in the form of a Guided Busway. If this assumption were to change at a later date, for example for non-guided roadway, the assessment would need to be revisited. The capability for future proofing and potential for Light Rapid Transit has been considered to some extent and as outlined under the flexibility criteria in Table 4.1 overleaf.

Option 3a has been assessed using predominantly transport and environmental related criteria; the following sections discuss the criteria used within the assessment.

4.2. Transport Criteria

The Cambourne to Cambridge Better Bus Journeys project aims to provide a transport scheme that can deliver HQPT services. It is therefore considered that the proposed Option 3a alignments be assessed using

transport related criteria. Table 4-1 below defines the transport criteria that has been applied in order to assess Option 3a following on from the SOBC undertaken in 2016.

Table 4-1 Assessment Criteria: Transport

Criteria	Rational and Definition
Journey Times (Quantitative)	<p>The time taken (in minutes) the service takes to get from Cambourne to Cambridge. The journey times also consider dwell time as part of the calculations. Journey times have been calculated by using a variety of sources including CSRM2 outputs and Vix RTPI data compared to the existing services timetable.</p> <p>This attribute can be measured in minutes from the bus departing a stop and arriving at the next stop.</p>
Catchment Area (including location of stops) (Quantitative)	<p>The area that users would be likely to travel to and from the bus stop. Walking and cycling accessibility is also a key consideration in assessing the scheme catchment area. The desirable walking distance for a bus stop from a residence is 400m which is in accordance with IHT guidelines. However, according to research undertaken on the Cambridgeshire Guided Busway there is evidence that people will walk in excess of 800m to reach the service, with some people walking up to a mile.¹⁰</p> <p>This attribute can be measured by the total residential and commercial properties within 800m of the bus stop.</p>
Connectivity (Qualitative)	<p>The interaction between the scheme and the local highway network which also includes other bus lanes, cycle lanes and road users and footways.</p> <p>Connectivity also takes into account the link between Cambourne to Cambridge Better Bus Journeys Project and the potential Western Orbital scheme and City access project.</p>
Conflict with other modes (Qualitative)	<p>Where interaction between travel modes has the potential to increase delay and lead to poor reliability e.g. at side roads, junctions, cycle lanes.</p>
Constructability (Qualitative)	<p>Constructability can be defined as the complexity of delivery.</p> <p>This attribute can be measured by a qualitative assessment based on Skanska's assessment of the routes. No full assessment of construction disruption has been undertaken, however the construction impact on Madingley Hill (Option 6) is likely to be similar to that caused on the M11 due to the construction of a new bridge (Option 3a).</p>
Safety (Quantitative)	<p>Safety is imperative to any public transport system. Improving road safety should be a priority when constructing a transport system. This attribute is defined by the amount of road accidents that would occur over a period of time.</p>
Flexibility (Qualitative)	<p>The GCP seeks to further promote economic development within the City for future years so it is important to make transport scheme future proof so it can be used going forward e.g. from Bus to Light Rail.</p> <p>This attribute can be measured by the use of the route and scheme in future years.</p>

¹⁰ Cambridgeshire Guided Busway Post-Opening User Research – CCC – 12/09/2016

4.3. Option 3a Alignments

What are the routes and alignments?

Table 4-2 below summarises the differences between the four routes. All Working Plans shown within this Section are indicative.

Table 4-2 Option 3a Alignment Summary

Alignment	Description
Blue	This route would proceed north of Bourn Roundabout running adjacent to the A428 until it crosses through Hardwick Roundabout before running adjacent to the A428 and St Neots Road. Once the route hits Long Road it starts to go south east past the covered reservoir then East, North of Coton Village. The route runs close to existing properties and the southern side of Coton Orchard. The Green Bridge would be located North of the existing footbridge and would land on Ada Lovelace following the existing footway past West Cambridge and converging with Coton footpath. Depending on preferred routes into Grange Road the Blue Route can continue on Coton footpath into Adams Road or proceed adjacent to/ through the Westfields to the Cambridge Rugby Club access, Hershel Road or Cranmer Road.
Green	This route would proceed around Bourn Roundabout running adjacent to St Neots Road. Once the route hits Long Road it starts to go south east past the covered reservoir then East, North of Coton Village. The route runs close to existing properties and through the centre of Coton Orchard. The Green Bridge would be located North of the existing footbridge and would land on Ada Lovelace following Charles Babbage Road through West Cambridge and turning south to converge with Coton footpath. Depending on preferred routes into Grange Road the Green Route can continue on Coton footpath into Adams Road or proceed adjacent to/ through the Westfields to the Cambridge Rugby Club access, Hershel Road or Cranmer Road.
Red	This route would proceed through Bourn Roundabout running adjacent to the A428 until it goes south above the existing balancing pond. The route proceeds south of Hardwick Roundabout abutting St Neots Road. Once the route passes Long Road it starts to go south east over the road then East, North of Coton Village. The route runs close to existing properties and through the centre of Coton Orchard. The Green Bridge would be located south of the existing footbridge and would land on Ada Lovelace following Coton footpath past West Cambridge and turning south across the Westfields. Depending on preferred routes into Grange Road the Red Route can continue north onto Coton footpath and into Adams Road or proceed through the Westfields to the Cambridge Rugby Club access, Hershel Road or Cranmer Road.
Pink	The Pink Route starts on the A428 slip road north of the Madingley Mulch Roundabout on Church Lane the South of Madingley Road proceeding south east over Cambridge Road onto the Northern side of Coton Orchard. The Green Bridge would be located North of the existing footbridge and would land on Ada Lovelace turning south then east along Coton footpath passing West Cambridge. Depending on preferred routes into Grange Road the Pink Route can continue north onto Coton footpath and into Adams Road or proceed through the Westfields to the Cambridge Rugby Club access, Hershel Road or Cranmer Road.
Cyan	The Cyan route starts to the east of the M11 but can be fed by any of the above routes from the West of the M11. The Cyan alignment would route from the Cambridge West Development south across the Westfields and connect with the Blue alignment to the south. Depending on preferred routes into Grange Road the Cyan Route can continue on Coton footpath into Adams Road or proceed adjacent to/ through the Westfields to the Cambridge Rugby Club access, Hershel Road or Cranmer Road.
Purple	The Purple route starts to the east of the M11 but can be fed by any of the above routes from the West of the M11. The Purple alignment provides an alternative alignment to the red route into Cranmer Road.

Figure 4-2 Section 1: Cambourne to Long Road

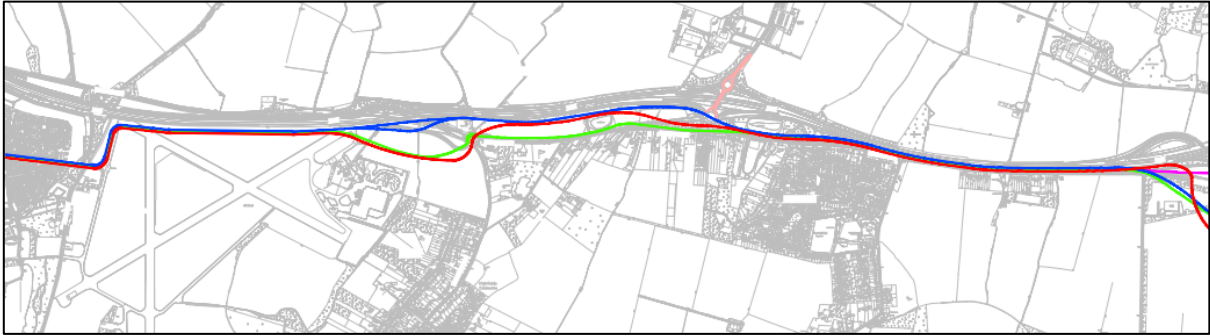


Figure 4-3 Section 2: Long Road to Junction 13 of the M11

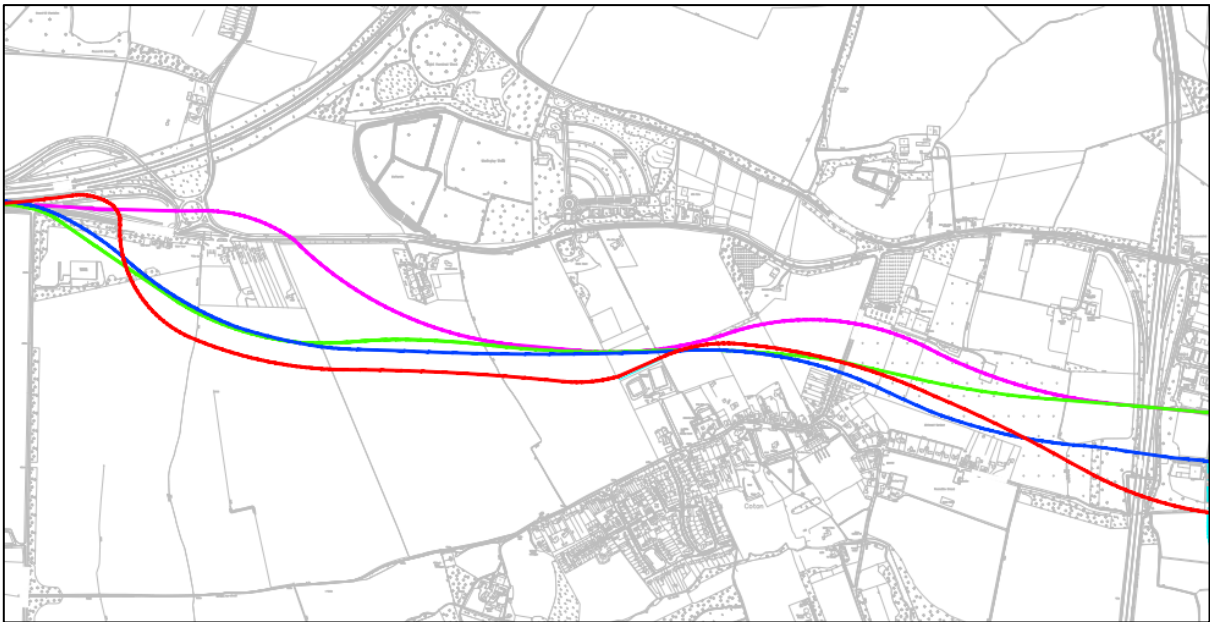
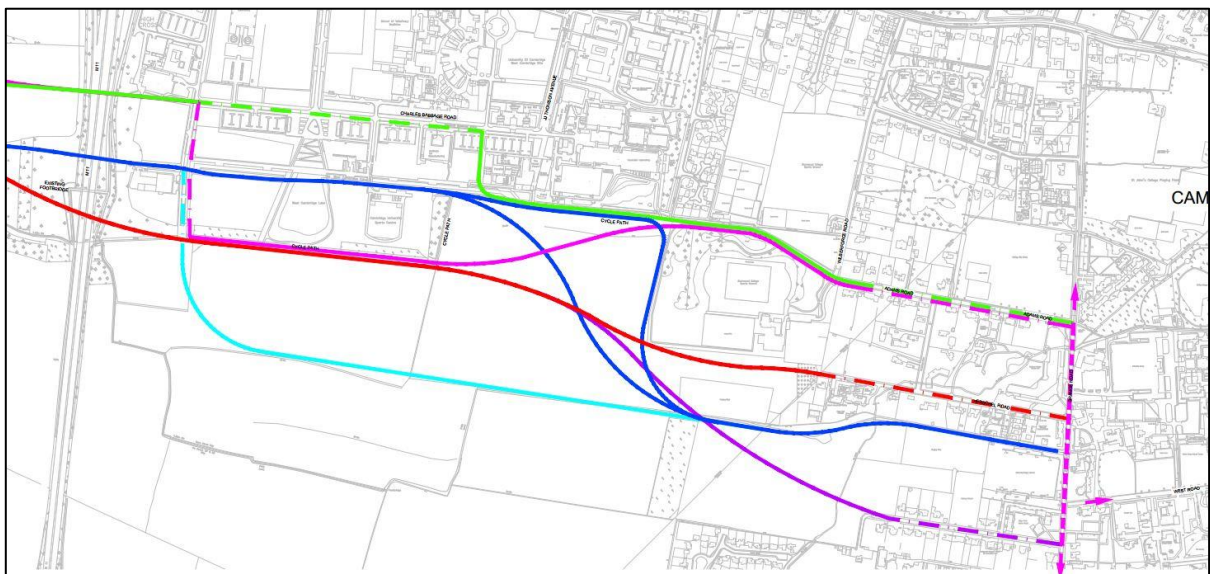


Figure 4-4 Section 3: Junction 13 of the M11 to Grange Road



4.4. Specific Routes Alignment Assessment

The following tables assess each potential route using the criteria identified in Table 4-1. To identify opportunities and constraints that are tailored to certain areas, the route has been divided into three sections for ease of assessment which been identified as follows:

- **Section 1:** Cambourne to Long Road;
- **Section 2:** Long Road to Junction 13 of the M11; and
- **Section 3:** Junction 13 of the M11 to Grange Road.

Table 4-3 Section 1 Transport Considerations (Future investment programme)

Transport Assessment Criteria	Blue	Green	Red
Journey Time	12 minutes		
Catchment Area (including location of stops)	<p>Cambourne – proposed bus hub on High Street</p> <p>Bourn – stop at new village centre to the west of the development and employment site to the north east (subject to Masterplanning)</p>		
Connectivity	<p>Bus hub in Cambourne would allow for connectivity from other bus services, walking and cycling</p> <p>Stops within Bourn Airfield would allow for connection from walking and cycling</p>		
Conflict with other modes	<p>Interaction with vehicles at Hardwick Roundabout</p> <p>Crossing of St Neots Road north of Long Road</p>	<p>Bourn Roundabout and crossing of St Neots Road north of Hardwick</p> <p>Crossing of St Neots Road north of Long Road</p>	Bourn Roundabout and crossing of St Neots Road north of Hardwick
Constructability	<p>Disruption to traffic during construction of new junctions or structures. Impact on existing buried services adjacent to the highway.</p> <p>Noise mitigation may be required when working adjacent to residential/commercial properties</p>		
Safety	<p>Off-road alignment means less conflict with other modes therefore less chance of collisions</p> <p>Provision of off-road segregated cycle lanes providing an alternative route to St Neots Road.</p>		
Future Proofing	<p>Increase in services is possible to meet future demand</p> <p>Corridor is designated as a public transport route allowing for easier adaptation due to improvements in technology or conversion to light rail technology</p>		

Table 4-4 Section 2 Transport Considerations (Long Road to M11)

Transport Assessment Criteria	Blue	Green	Red	Pink
Journey Time	2.5 minutes			
Catchment Area (including location of stops)	No bus stop provided in this section unless Park and Ride site is to be located in this section.			

Transport Assessment Criteria	Blue	Green	Red	Pink
Connectivity	No bus stop provided in this section unless Park and Ride site is to be located in this section.			
Conflict with other modes	Crossing of Cambridge Road via new signalised junction PROW crossing near Coton Reservoir	Crossing of Cambridge Road via new signalised junction PROW crossing near Coton Reservoir	Crossing of St Neots Road and crossing of Cambridge Road via new signalised Junction PROW crossing near Coton Reservoir	Crossing of Church Lane and Madingley Road. Crossing of Cambridge Road via new signalised crossing. PROW crossing near Coton Reservoir
Interaction with West Cambridge	West Cambridge is located within Section 3 (M11 to Grange Road)			
Constructability	Low risk. Disruption to the orchard operation. New structure (bridge) required over M11			
Safety	Off-road alignment means less conflict with other modes therefore less chance of collisions Provision of off-road segregated cycle lanes providing an alternative route to St Neots Road / Madingley Road			
Future Proofing	Increase in services is possible to meet future demand Corridor is designated as a public transport route allowing for easier adaptation due to improvements in technology or conversion to light rail technology			

Table 4-5 Section 3 Transport Considerations (M11 to Grange Road)

Transport Assessment Criteria	Blue	Green	Red	Pink	Cyan	Purple
Journey Time	2 minutes	3 minutes	2 minutes	3 minutes	2 minutes	3 minutes
Catchment Area (including location of stops)	Stop would be located in Cambridge West Development. Potential for stop to be located more centrally in the	Stop would be located at the south west corner of Cambridge West Development on Ada Lovelace. Could be located further north than stops on	Stop would be located at the south west corner of Cambridge West Development on Ada Lovelace	Stop would be located at the south west corner of Cambridge West Development on Ada Lovelace. Could be located further north than stops on	As combined with another coloured route, this alignment would have a bus stop in the location associated with its corresponding route.	As combined with another coloured route, this alignment would have a bus stop in the location associated with its corresponding route.

Transport Assessment Criteria	Blue	Green	Red	Pink	Cyan	Purple
	development than on other alignments.	red and blue alignments therefore having the potential to increase patronage		red and blue alignments therefore having the potential to increase patronage		
Connectivity	Connectivity with cyclists and pedestrians within the Cambridge West Development	Opportunity to connect with existing bus services within Cambridge West Connectivity with cyclists and pedestrians within the Cambridge West Development	Connectivity with cyclists and pedestrians within the Cambridge West Development	Opportunity to connect with existing bus services within Cambridge West Connectivity with cyclists and pedestrians within the Cambridge West Development	Route starts south of West Cambridge and bypasses the site.	Route starts south of West Cambridge and bypasses the site.
Conflict with other modes	Conflict with cyclists on Coton Footpath Crossing of Ada Lovelace would be required	Service would run on-road through the development and would therefore be limited by the speed of the internal roads and would come into conflict with vehicles, cycles and pedestrians.	Off-road nature of the route would minimise risk of conflict with other modes	Requires on-road running along Ada Lovelace. After this, the off-road nature of the route would minimise risk of conflict with other modes	Off-road nature of the route would minimise risk of conflict with other modes	Off-road nature of the route would minimise risk of conflict with other modes
Interaction with West Cambridge	Opportunity to located bus stop on the south west edge of the development	Opportunity to locate bus stop within Cambridge West to maximise on patronage	Opportunity to located bus stop on the south west edge of the development. Could lead to lower patronage due to distance from the main development	Opportunity to located bus stop on the western edge of the development	Route starts south of West Cambridge and bypasses the site.	Route starts south of West Cambridge and bypasses the site.
Constructability	Utilises existing private roads and assumes bus priority through development;	Utilises existing private roads and assumes bus priority	Disruption to Coton footpath. Liaison with West Cambridge	Low risk. Liaison with West Cambridge	Low risk. Liaison with West Cambridge	Low risk. Liaison with West Cambridge

Transport Assessment Criteria	Blue	Green	Red	Pink	Cyan	Purple
	will be achieved through close engagement with West Cambridge developers.	through campus. Liaison with West Cambridge development on bridge landing.	development on bridge landing.	development on bridge landing.	development on bridge landing.	development on bridge landing.
Constructability (Connection to Grange Road):						
Via Adams Road		Impact on residential access and parking on Adams Road during construction. Disruption to the cycle route.		Impact on residential access and parking on Adams Road during construction. Disruption to the cycle route.		
Via Herschel Road			Impact of residential street and private land to the west of Herschel Road.			
Via Rugby Club Access	Impact on access to the playing fields near Cambridge University Rugby Club.		Impact on access to the playing fields near Cambridge University Rugby Club.	Impact on access to the playing fields near Cambridge University Rugby Club.	Impact on access to the playing fields near Cambridge University Rugby Club.	Impact on access to the playing fields near Cambridge University Rugby Club.
Via Cranmer Road						Impact on residential street and parking during construction.
Safety	Interaction with vehicles when crossing Ada Lovelace. Potential interaction with cyclists and vehicles if routed along Adams Road.	Interaction with vehicles, cycles and pedestrians through the Cambridge West Development and along Adams Road	Interaction with vehicles on Adams Road / Herschel Road.	Interaction with vehicles, cycles and pedestrians through the Cambridge West Development and along Adams Road	Interaction with vehicles on Adams Road / Herschel Road.	Interaction with vehicles on Adams Road / Herschel Road.

Transport Assessment Criteria	Blue	Green	Red	Pink	Cyan	Purple
Future Proofing	<p>Increase in services possible to meet demand</p> <p>Corridor is designated as a PT route allowing for easier adaptation due to improvements in technology or conversion to light rail technology</p>	<p>Increase in services possible to meet demand</p>	<p>Increase in services possible to meet demand</p> <p>Corridor is designated as a PT route allowing for easier adaptation due to improvements in technology or conversion to light rail technology</p>	<p>Increase in services possible to meet demand</p>	<p>Increase in services possible to meet demand</p>	<p>Increase in services possible to meet demand</p>

Grange Road Access

Skanska have produced a report related to the potential specific route alignments that connect with Grange Road. The report is included in Appendix N.

Interconnectivity

There are various locations on the potential alignments where the routes could interconnect as shown in Figure 4-5, Figure 4-6 and Figure 4-7. For example, at these points, the red alignments could connect with the pink alignment or the green alignment could connect with the blue alignment, therefore making the number of possible alignments associated with Option 3a extensive.

Figure 4-5 Potential Interconnectivity of Option 3a alignments - north of Coton



Figure 4-6 Potential Interconnectivity of Option 3a alignments - across M11

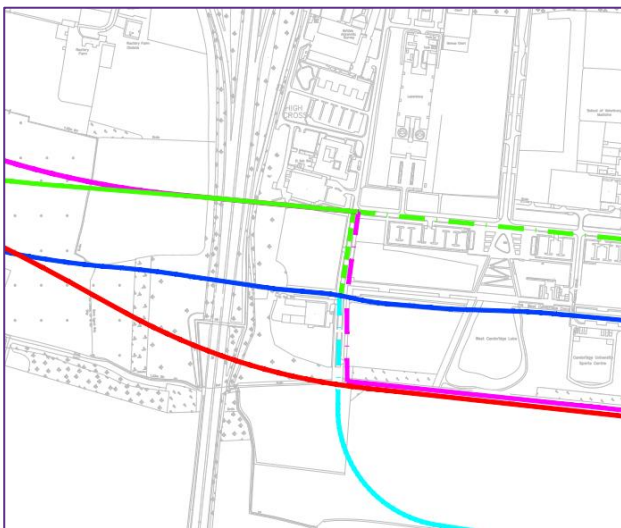
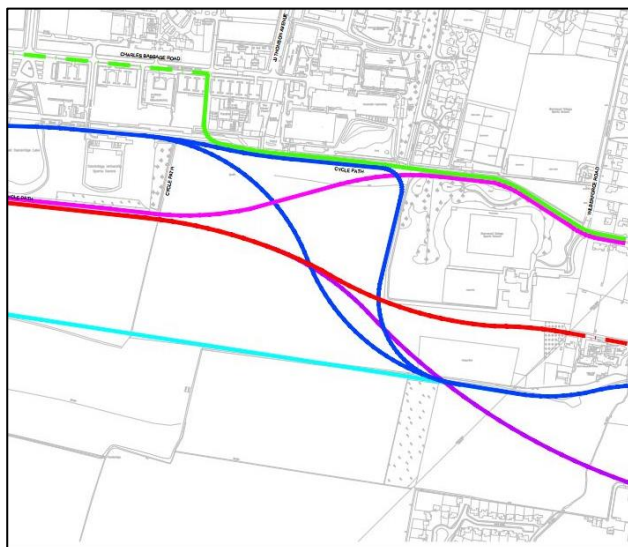


Figure 4-7 Potential Interconnectivity of Option 3a alignments - east of Cambridge West



Costs

The currently estimated approximate cost of each alignment when comparing. Table 4-6 below breaks down the costs for each alignment for Option 3a.

Table 4-6 Option 3a Costs (Base 2010 prices)

Alignment	Future Investment Programme	Phase 1	Totals
Blue	£36,140,000	£57,120,000	£93,260,000
Red	£35,470,000	£50,040,000	£85,510,000
Green	£29,700,000	£40,620,000	£70,320,000
Pink	N/A	£43,770,000	£43,770,000
Purple	N/A	£15,080,000	£15,080,000
Cyan	N/A	£19,520,000	£19,520,000

Costs associated with the Red, Blue and Green alignments in Section 1 and 2 can be applied also to the Purple and Cyan alignment depending on which alignment would feed the end of the route as they effectively become the same alignments through that section. These costs may differ to the costs presented in the SOBC for the reasons outlined in paragraph 3.5.6.

4.5. Summary and Recommendations on Transport Considerations

Following the analysis of the route 3a alignments presented in this Chapter, it is considered that a number of the strategic route alignments should be taken forward on transport grounds:

- Section 1: Blue and Pink;
- Section 2: No identifiable differences between routes; and
- Section 3: Green, Blue and Pink.

Within Section 1, it is considered that the blue and the pink route provide alternative alignments, with the blue being the most direct route and the pink route providing an alternative to the north of Madingley Road. Within Section 2, the transport analysis has highlighted no noticeable differences between the alignments. Within Section 3, it is considered that the green alignment provides the greatest connectivity to Cambridge West and would allow for a bus stop or hub in the centre of the development.

With respect to the connections to Grange Road which have been assessed within the Skanska report contained within Appendix N, the report in summary considers the following:

- Herschel Road is too narrow with private housing the route could potentially be costly for the scheme;
- Cranmer Road is too far south to provide the transport benefits needed;

Therefore, the Blue and Pink routes are considered to provide the fastest alignments via Adams Road or the Rugby Club Access.

4.6. Statutory Planning

Strutt & Parker, with input from Atkins undertook a Planning Appraisal (August 2017), which provides a detailed overview of the key planning policy considerations related to the principle of the Cambourne to Cambridge Better Bus Journeys Project. In particular, the planning process for the off-road BRT scheme. The Planning Appraisal relates specifically to Option 3a/3 and was informed by the LDA Green Belt Issues Report (2017) included within the Planning Report in Appendix L.

The social and economic benefits of the project and the transport objectives of it are considered to be strongly supported by both local and national planning policy. This needs to be weighed against the impact in environmental terms, particularly accounting for the location of large parts of the proposed busway project route being situated within the Cambridge Green Belt. In accordance with the requirements of paragraph 90 of the National Planning Policy Framework (NPPF), the busway has a required need for a Green Belt location in order to deliver the key transport objective of providing a fast, frequent and reliable route from Cambourne to Cambridge.

In addition, parts of the busway proposal are defined as 'not inappropriate' development within the Green Belt on the basis that they will preserve the openness of the Green Belt and that the busway route will not conflict with the purposes for including land within the Green Belt.

As set out within the Considerations of Green Belt Impacts Report, prepared by LDA, the busway can be delivered without compromising the openness of the Green Belt. This is with the exception of the green bridge ramp, which may conflict with the openness of the Green Belt, dependent upon the option chosen. It is the view of LDA that parts of the route immediately to the west of Cambridge and to the north of Coton have a degree of conflict with the purposes for including land within the Green Belt.

The LDA Report concludes that whilst parts of the route could be delivered as not inappropriate development within the Green Belt, very special circumstances would be required within the area of the Green Belt to the west of Cambridge City and to the north of Coton. The level of harm to the Green Belt will be dependent upon the final alignment chosen, which in itself will need to be considered against other material planning factors, such as the transport objectives of the project and assessed accordingly.

Even accounting for the worst case and conservative approach taken by LDA, it is considered in planning terms that a strong case can be made for very special circumstances for the busway project. This accounts for the substantial transport benefits associated with the proposals and that the land will remain in the Green Belt following the completion of the development. The proposals will facilitate access to the Green Belt. This planning balance will be assessed in further detail dependent upon the final route chosen.

Overall it is therefore concluded that the principle of the busway from Cambourne to Cambridge is supported in planning terms when assessed against the Development Plan as a whole. It is consistent with the objectives of the NPPF, the adopted Cambridge City Council Local Plan (2006) and the South Cambridgeshire Core Strategy and Development Control Policies (2007).

In working to a TWA order approval an Environmental Impact Assessment (EIA) would be required including the provision of an Environmental Statement to establish the detail of planning considerations related to the project. This will require a further assessment of the strategic route alignments within Option 3a, the park and ride site and options 1 and 6 as required.

4.7. Environmental Assessment

What are the environmental impacts of the working alignments and can they be overcome?

This section provides a general overview of each environmental consideration in relation to the proposed option 3a alignments and provides comments if there are any specific environmental issues relevant to individual alignments. It should be noted that the working alignments are subject to ongoing assessment and it is considered further environmental work will be undertaken to further assess them.

The following sections describe the further work conducted to date in terms of environmental considerations for the Cambourne to Cambridge Better Bus Journeys Project, as well as the recommendations going forward. The SOBC reported the environmental considerations in accordance with the WebTAG guidance, this assessment has explored the environmental aspects further and reports the findings below. All environmental reports referenced within this Section are included within Appendix L.

Identification of the specific route alignment would require further environmental assessment in the form of an Environmental Impact Assessment (EIA) by which the anticipated or potential effects on the environment of the selected Option would be assessed and measured. The appraisal towards the FOBC requires further detailed assessment including site surveys to identify the potential scope of impacts in order to understand the likely environmental effects and to inform the design development and mitigation measures.

The Local Planning Authority and relevant bodies such as Natural England play an important role in attaining formal consent for a major transport scheme. This is likely to require an Environmental Impact Assessment to be undertaken and Environmental Statement submitted. And as such a full EIA scoping exercise as part of the development towards the submission of a TWA or pertinent Planning Consent process.

4.7.1. Ecology

'Cambridge Ecology' have conducted a desk-based ecology data search and Protected species scoping (walkover) survey, in January 2017, on land associated with the catchment area for Option 3a between Cambourne and Cambridge. Including further specific site inspections along within the catchment area.

Existing Environment

The report has collated baseline data, provided a record of the ecological features present within the survey area and determined the actual or likely presence of protected species, highlighting potential ecological constraints that might require species specific surveys and opportunities to enhance the ecological value of the site.

The report summarises findings in four areas as follows:

- Statutory and Non-statutory sites – 30 sites were identified within 2km of the study area, 6 of which are located within the study area:
 - **Madingley Wood Site of Special Scientific Interest (SSSI);**
 - Knapwell Roadside Verge – County Wildlife Site;
 - Madingley Slip Road Verge – County Wildlife Site;
 - Scrub east of M11 Verge – County Wildlife Site;
 - Coton Path Hedgerow – County Wildlife Site; and
 - Bin Brook – City Wildlife Site.
- Protected Habitats – the study identified the presence of Deciduous Woodland, Traditional Orchard, Hedgerows, Waterbodies and Floodplain Grazing Marsh within the Study Area;
- Protected Species within 2km of the study area in the last 10 years including the following species of specific note:
 - **Great Crested Newt;**
 - **64 species of birds listed on various conservation designations;**
 - **26 records of Water Vole;**
 - **5 records of European Otter;**
 - **6 species of Bat; and**
 - **86 records of Badger.**
- Signs of Badger activity found in Coton Orchard Garden Centre;

- Main Habitat within the Study area is arable land; and
- The presence of an invasive species (Himalayan Balsam) in Bin Brook.

Recommendations for Further Work

The report presented a wide range of recommendations to inform scheme design, the planning process and mitigation measures, including but not limited to the following:

- Further species specific surveys on the Great Crested Newt, Reptiles, Badger, Bat, Water Vole, Otter, Breeding Birds, Wintering birds, Botany and Invertebrate surveys to identify their presence and activities within the study area; and
- The study identifies a number of ways in which ecology could be enhanced through the scheme design including an extensive green bridge over the M11, new hedgerows, commitment to develop and long term site management plan for existing designated sites such as the County Wildlife Sites that are within and adjacent to the proposed route and commitment to develop long term site management plans for new habitats.

4.7.2. Flood Risk and Water Environment

A Flood Risk Desktop Study was undertaken by Atkins in January 2017. This study presents a summary of findings from a high-level desktop study and site walkover which was carried out to observe the watercourses and potential associated flood risk issues.

Existing Environment

A flood risk assessment desktop study has been undertaken to determine further actions that are required to make an informed decision about mitigating or avoiding flooding that could negatively impact the scheme. The study sets out the existing environment and the potential impacts of the scheme.

Bin Brook is the key constraint within the study area and is designated as a Main River. It is located at the eastern edge of the scheme and would be impacted by Option 3a. This watercourse would need to be accommodated as part of the scheme and at a high-level assessment stage it is considered that a box culvert would be suitable.

Option 3a, where the route passes to the north of Hardwick, will be on new tracks adjacent to St Neots Road. Although drainage requirement for the new track is minimal, the proposed location may interfere with current **drainage channels**. It is considered that adequate drainage mitigation could be provided to accommodate any offset from existing drainage channels.

Recommendations for Future Work

Without mitigation, there would be a potential for increases in flood risk, particularly in relation to Bin Brook. Therefore, a detailed assessment with proposed mitigation measures is required.

The further assessment north of Hardwick, adjacent to St Neots Road, will need to determine location and catchment of current drainage channels, and the design must ensure there is no negative impact on the existing system.

At all other locations where the route will cross drainage channels or watercourses it is anticipated that a suitable further assessment would be required to determine flows within the channels to inform culvert sizes.

4.7.3. Historic Environment

A Pre-Assessment Report on Heritage Assets was undertaken by Atkins in August 2017. The report provides a brief overview of the known archaeological assets and likely for potential buried remains within the scheme area.

Existing Environment

An assessment of known designated heritage assets was conducted as part of a WebTAG assessment included within the SOBC. This identified a number of designated heritage assets within the study area.

Further to this SOBC assessment, the area within a 250m buffer on either side of the alignments has been desk-based reviewed and **extensive buried archaeological remains** dating from the Palaeolithic to modern periods have been identified. Intrusive studies would confirm the presence of these sites. Furthermore, it is expected that the area closer to the City of Cambridge is more likely to contain preserved remains of Roman and medieval periods whereas prehistoric archaeology is better preserved in the less developed Green Belt areas to the west of the study area, and on the sand and gravel terraces of modern and prehistoric rivers.

Recommendations for Future Work

Previous investigations within the study area have taken place over the last 20 years which have resulted in known archaeological remains. Given this knowledge, it is anticipated that more remains are likely to be present in the area. It is therefore recommended that fieldwork evaluation is undertaken to confirm the presence of archaeological sites during the next stage of the study, to allow for mitigation by design.

4.7.4. Landscape and Visual

A Landscape and Planning Appraisal was undertaken by Atkins in November 2016, with further studies undertaken as part of the Green Lane Concept report which is contained in Appendix J. In terms of landscape and visual, the Appraisal examines the existing baseline conditions of the landscape and its character and visual amenity for people within the landscape.

Existing Environment

The appraisal highlight landscape designations and notable landscape features / buildings Including but not limited to:

- Registered Parks and Gardens;
- Ancient Woodland;
- Conservation Areas;
- Tree Preservation Orders;
- Traditional Orchards;
- Local landscape character areas;
- Public rights of way (PRoW); and
- Potential visual receptors.

Preliminary Impact Assessment

The Green Lane Concept report assesses Option 3a alignments further in terms of landscape and visual impact. Route Option 3a (Cyan) is the southernmost route and is predominantly located away from the urban edge. The potential landscape and visual effects as a result of this include loss of mature trees west of Grange Road, change to the character of part of the Bin Brook corridor and views from surrounding residential properties and users of the PRoW in the area.

The alignment and mitigation measures of Route Option 3a (Cyan) can be developed to avoid and reduce potential impacts to some degree (such as avoiding existing hedgerows, following the existing landscape pattern and planting to screen sensitive views) however the presence of a new piece of infrastructure within a greenfield location would still be a notable change to the landscape. Route Option 3a (Red, Blue and Pink) (east of the M11) is the only Option within this section of the corridor that would run diagonally across a field parcel. This would result in views, from the footpath and cycleway south of the University Campus, of buses in the fore to middle ground crossing the open landscape. A section of mature vegetation at the end of Herschel Road would be lost as a result of Route Option 3a (Red). Route Option 3a (Green) (east of the M11) would result in less landscape and visual effects than Route Option 3a (Cyan) and Route Option 3a (Red) as a large section of the route would consist of a bus utilising existing infrastructure through the University Campus and along Adams Road. Therefore, the potential landscape and visual effects would be focused within a small section of this Option. Route Option 3a (Cyan), Route Option 3a (Green) and Route Option 3a (Red) all require a bridge across the M11. Some woodland would need to be lost to accommodate the bridge but this could be mitigated to some degree through the provision of a green bridge which would connect the wooded habitats on either side of the motorway and provide an improvement in visual amenity for people crossing the M11.

Route Option 3a (Green) would have a greater potential effect on Coton Traditional Orchard as its position further north would result in a greater severance effect. As Route Option 3a (Cyan) and Route Option 3a

(Red) are positioned further south they are located closer to the edge of Coton Traditional Orchard and, whilst the quantity of loss of orchard features would be similar to Route Option 3a (Green), the effect on landscape pattern would be less. For all route options, the presence of trees and vegetation within Coton Traditional Orchard, and along the southern boundary, would help to screen or filter views towards this section of the corridor, fully or partially, from properties and rights of way within the surrounding area.

Between Coton Traditional Orchard and Long Road, the potential landscape and visual effects of Route Option 3a (Cyan), Route Option 3a (Green) and Route Option 3a (Red) are broadly similar. The potentially significant visual effects of these route options would be limited to a small number of visual receptors such as residential properties in close proximity to the route options and public rights of way and they would be noticeable from Red Meadow Hill. The sight lines demonstrate that a kerb guided busway could be positioned out of sight within key views from Whitwell Way, however the transient movement of buses along the corridor would be visible from some locations. The extent of potential landscape and visual effects for these Options would be wider than for the on-road Options due to the availability of views towards the corridors and variety of features that may be affected. However, as the area around the Route Options is less physically constrained there is accordingly a greater opportunity to avoid, reduce and mitigate those potential effects to varying degrees.

Recommendations and Further Work

The report has presented a wide range of recommendations to ensure that the scheme follows guidance and mitigates potential landscaping and visual impacts:

- **Landscape:**
 - Undertake a tree survey of the proposed corridor to allow potential impacts to be avoided during design development and subsequent Arboricultural Impact Assessment and Tree Protection Plan;
 - Focus design development on minimising visual impact on properties in the wider landscape – particularly where the route may need to pass along higher ground;
 - Develop an approach to integrating the proposal with the Whitwell Way, Harcamlow Way and Wimpole Way whilst minimising visual intrusion and providing opportunities to enhance the journey experience;
 - Prepare a Landscape Concept Plan in advance of consultation to the specification detailed in the South Cambridgeshire District Council Landscape in New Developments Supplementary Planning Document (March, 2010), considering also potential for off-site landscape treatment; and
 - Prepare an outline Landscape and Environmental Management Plan to achieve stakeholder buy-in, confirm landscape and environmental objectives and approach to delivery, maintenance, management and monitoring.
- **Design:**
 - Undertake a study into potential surfacing, kerb and fencing treatments considering their appropriateness in relation to appearance, engineering function, sustainability, resilience and adaptability; and
 - Develop understanding of drainage requirements how run-off would need to be treated within a Sustainable Drainage system to remove any contaminants.

4.7.5. Noise

A Noise Assessment was undertaken by Acoustic Associates in March 2017. The report highlights the potential noise impacts as a result of the scheme on local residents. It includes attended noise monitoring, predictive noise modelling, assessment of the results and consideration of mitigation measures.

Existing Environment

The noise assessment determined the potential impact a scheme could have on an area according to DMRB criteria. To determine the noise impact at identified receptors, the existing ambient noise levels were measured and the likely noise level at the receptors following opening of the bus route was established.

The receptors chosen were nine residential locations deemed sensitive to noise and located close to the scheme. These included:

- **Bourn Airfield;**
- **Highfields North;**
- Highfields South;
- Highfields South – Hall Drive;
- South Hardwick;
- Jagaards Road;
- Madingley Road – Southeast;
- **North-east Coton;** and
- **Stacey Lane.**

The ambient noise at seven measurement locations was estimated by using two methods: noise measurements and predictive modelling using traffic noise data. Results showed average noise levels at the measurement locations ranging between 48.8 and 59.5 dB(A) (LAeq, 18 hours). Results also showed that there is significant variation in the levels measured at different times of the day and night and between the measured levels and those predicted by computer modelling using traffic data.

Preliminary Impact Assessment

The noise assessment concludes that the impact is “negligible” as most of the dwellings affected are on Hall Road at the south of Highfield. Option 3 routes impact is estimated to be “moderate”. This option is not to be taken forward however.

4.7.6. Air Quality

An air quality appraisal was undertaken by Atkins in April 2017. This study sets out the existing air quality levels, potential impacts on air quality and greenhouse gases for each option and actions required to make an informed decision with regards to mitigating air quality impacts within the study area (defined as the area within 200m of the proposed route). The high-level appraisal was undertaken to inform the SOBC for the scheme options.

Existing Environment

Cambridge has two Air Quality Management Areas (AQMA's): The inner ring road and the A14 bypassing Cambridge. The scheme would not enter these areas until it proceeds past Grange Road into the City Centre. The CCC Local Plan Policy 4/14 states that any new development should have no adverse effect on air quality in the AQMA. It is therefore essential to fully understand the impact, both negative and positive, of the scheme on local air quality within the AQMA.

Air quality in the study area outside of the Cambridge City Centre AQMA is relatively good, with monitoring data showing exceedances of the annual mean NO₂ UK AQS objectives only at locations not representative of sensitive receptors within the study area, i.e. a kerbside site.

Preliminary Impact Assessment

The high level SOBC appraisal indicates that changes in local air quality are likely to be negligible outside central Cambridge; a green risk category has been assigned to local air quality impacts outside of the Cambridge City AQMA and an amber risk category assigned within the AQMA.

Recommendations and Further Work

Further assessment should be undertaken using a verified air quality dispersion model, assessing in detail the change in concentrations of NO₂ and PM₁₀ at discrete receptor locations. Should further assessment indicate adverse impacts in Cambridge City Centre these may be mitigated by encouraging bus companies

to use vehicles with more stringent emissions standards or by incentivising specific routes and bus stops to minimise the impact on the most sensitive locations within the City Centre. Should the scheme lead to a renewal of the current bus fleet, then this could have a beneficial impact on air quality in the Cambridge City AQMA.

4.7.7. Land and Property

Land and property would be acquired or used for the project in a number of different ways, including:

- Temporary use of land and property;
- Permanent acquisition of land and property;
- The safeguarding and survey of land and property; and
- Permanent acquisition of rights over land and property.

Temporary use of land and property is required where it is needed for construction purposes, but not for the future operation of the Project. Permanent acquisition of land and property is required for both the siting of the permanent structures, equipment and its operation and maintenance, it is also required for landscaping and mitigation measures, including those of drainage, environment and severance.

The Scheme and Project will underpin the sustainable transport requirements for the various proposed development sites securing their development in accordance with national, regional and local policies and will therefore have a positive impact on bringing sustainable development to Cambridgeshire and property values.

The land required the accommodate option 3a is proposed to be the following:

- Land that is required for the construction of the Project, for the construction and safeguarding of works to be carried out, together with all construction work sites and working areas; and
- Land which will need to be acquired for the permanent structures and equipment associated with the Project, or land over which rights will be required to maintain, operate and safeguard its operation.

The project team would seek to minimise land take, whilst ensuring that the extent is sufficient for the purposes of the construction and operation of the Project, including working areas and worksites. As the project progresses the amount of land required will further be defined and further assessment work will be required to inform the land and property requirement for the scheme.

All property interests will be identified as the scheme is developed and any further land interest identified will be incorporated within the existing stakeholder engagement.

4.7.8. Environmental Summary

Tables 4-7, 4-8 and 4-9 summarise the key findings of the environmental studies in relation to the Option 3a Section.

Table 4-7 Section 1 Environment Considerations (Future investment programme)

Environment Assessment Criteria	Blue	Green	Red
Statutory Planning	Green Belt location to the east of Hardwick		
Ecology	No specific comments relating to the area surrounding Option 3a in this section		
Flood Risk and Water Environment	Runs adjacent to the balancing pond near Hardwick roundabout which needs to be maintained as it is awarded to the District Council.	Watercourse by Wellington Way. Ordinary watercourse with no known fluvial flood mapping. Runs adjacent to the balancing pond near	Watercourse by Wellington Way. Ordinary watercourse with no known fluvial flood mapping. Runs adjacent to the balancing pond near

Environment Assessment Criteria	Blue	Green	Red
		Hardwick roundabout which needs to be maintained as it is awarded to the District Council.	Hardwick roundabout which needs to be maintained as it is awarded to the District Council.
Historic Environment	Prehistoric archaeology is better preserved in the less developed areas to the west of the study area.		
Landscape and Visual	Bypasses Hardwick SSSI. Potential severance of openness of Green Belt.	Bypasses Hardwick SSSI. Potential severance of openness of Green Belt.	Bypasses Hardwick SSSI. Potential severance of openness of Green Belt.
Noise	Bourn Airfield has been identified as a sensitive noise area.		
Air Quality	No specific comments relating to the area surrounding Option 3a in this section		

Table 4-8 Section 2 Environment Considerations (Long Road to M11)

Environment Assessment Criteria	Blue	Green	Red	Pink
Statutory Planning	Green Belt Location from Long Road to M11			
Ecology	Bats – Coton Orchard Traditional Orchard Conservation area to the north of Whitwell Way	Bats – Coton Orchard Traditional Orchard Conservation area to the north of Whitwell Way	Bats – Coton Orchard Scrubland to the East of the M11 Conservation area to the north of Whitwell Way is most ecologically valuable.	Bats – Coton Orchard Traditional Orchard Conservation area to the north of Whitwell Way
Flood Risk and Water Environment	All routes will cross an existing drainage channel south of Madingley Wood. No known fluvial flood mapping			
Historic Environment	Prehistoric archaeology is better preserved in the less developed areas to the west of the study area.			
Landscape and Visual	Bypasses Madingley Wood SSSI. Potential severance of openness of Green Belt.	Bypasses Madingley Wood SSSI. Potential severance of openness of Green Belt.	Bypasses Madingley Wood SSSI. Potential severance of openness of Green Belt.	Bypasses Madingley Wood SSSI. Potential severance of openness of Green Belt.
Noise	Highfield North and North-East Coton have been identified as sensitive noise areas.			
Air Quality	No specific comments relating to the area surrounding Option 3a in this section			

Table 4-9 Section 3 Environment Considerations (M11 to Grange Road)

Environment Assessment Criteria	Blue	Green	Red	Pink	Cyan	Purple
Statutory Planning	Green Belt Location					
Ecology	Great Crested Newts Badgers / Water Vole / European Otter- Bin Brook	Great Crested Newts Badgers / Water Vole / European Otter- Bin Brook	Badgers / Water Vole / European Otter- Bin Brook	Great Crested Newts	Badgers / Water Vole / European Otter- Bin Brook	Badgers / Water Vole / European Otter- Bin Brook
Flood Risk and Water Environment	Route Crosses Bin Brook	No flood risk issues associated with this section of the route.	Route crosses Bin Brook.	No flood risk issues associated with this section of the route.	Route crosses Bin Brook.	Route crosses Bin Brook.
Historic Environment	In general, the area closer to the City of Cambridge is more likely to contain preserved remains of Roman and medieval periods.					
Landscape and Visual	Potential severance of openness of Green Belt and Westfields.					
Noise	Stacey Road has been identified as a noise sensitive area.	Stacey Road has been identified as a noise sensitive area.		Stacey Road has been identified as a noise sensitive area.		
Air Quality	No specific comments relating to the area surrounding Option 3a in this section.					

4.8. Summary and Recommendations on Environmental Considerations

Environmental studies have highlighted and confirmed a number of constraints within the Cambourne to Cambridge study area. It is considered that the impact of the Cyan route on the Green Belt would be significant therefore at this stage it should be excluded from further assessment. In Section 2 of this report, ecological analysis has identified the alignment of the red route over the M11 as ecologically valuable, therefore the red route in this section is to be excluded from further assessment. No other 'show-stoppers' to scheme progression have been identified at this stage. For this reason, it is considered that all other alignments associated with Option 3a should be taken forward on environment grounds.

The majority of Environmental studies have recommended a full EIA scoping exercise be carried out therefore it is considered that this will be conducted following the consultation period.

4.9. Recommended 3a Specific Route Alignments to be taken forward to Consultation

What are the recommended specific route alignments for Option 3a?

Transport and Environmental Assessment has been undertaken to decipher which Option 3a alignments should be progressed to public consultation. When combining the two sets of recommendations it is considered that the following 3a alignments should be taken forward to public consultation in Autumn:

- Section 1: Pink and Blue;
- Section 2: Pink and Blue; and
- Section 3: Pink, Blue and Green.

Once in the built-up area of Cambridge it is suggested that Adams Road and the Cambridge University Rugby Club accesses to Grange Road are taken forward. Assessments has shown that these are the most viable alignments for the blue and pink to access Cambridge from the West. It is considered that all alignments presented within Section 3 can connect with either Adams Road or the Rugby Club Access. For alignments into the City Centre from Grange Road, see the 'Grange Road to City Centre Access Report' in Appendix E.

5. Park and Ride Assessment

What assessment has been done on the Park and Ride location?

A Park and Ride assessment has been carried out by Mott MacDonald.

5.1. Introduction

The GCP requires a review of Park and Ride sites along the Cambourne to Cambridge Corridor. This study is in two stages – Stage 1 shortlisting, and Stage 2 specific site evaluation. Stage 1 has been completed and more detail can be found in the Mott MacDonald Report ‘Cambourne to Cambridge Better Bus Journeys Park and Ride Study’ (Ref: 377897/001/A) which can be found on the GCP website. Stage 2 is ongoing but initial conclusions are provided below.

5.2. Stage 1 Findings

Building upon previous studies, workshops, and stakeholder engagement, the Stage 1 study assessed nine indicative site locations against a range of criteria (covering social, economic, environmental and transport) that were agreed with CCC.

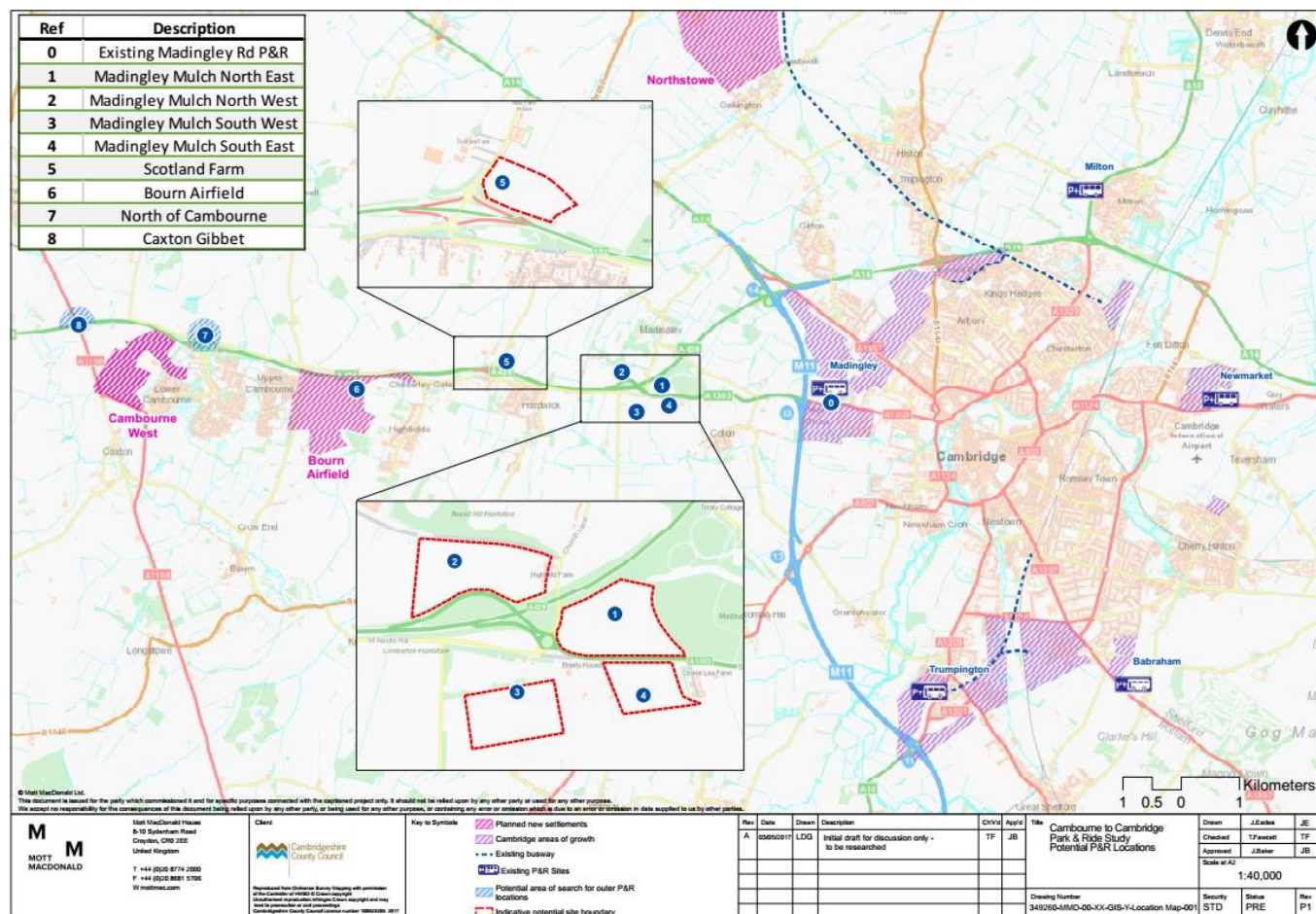
At the Stage 1 assessment, options have generally been appraised using a qualitative methodology. The appraisal has been carried out by qualified and experienced professionals, using objective comparisons and, where possible, recognised methodologies.

As the bus route options were still being developed, no definitive assessment has been made on the impact on traffic issues of the combination of the Park and Ride and bus route, or the resultant economic benefits.

Generally, the corridor can be considered as offering three broad areas of search for a proposed new site, for which the transport characteristics and suitability for a Park and Ride site have been considered. These are:

- A western, outer, area with potential sites including 6, 7 and 8 (all close to Cambourne);
- A central area, which includes site 5 (Scotland Farm); and
- An eastern, inner, area around Madingley Mulch (sites 1, 2, 3 and 4).

Figure 5-1 Considered Sites – Stage 1



Stage 1 assessment was undertaken through a multi-criteria assessment using Mott MacDonald's INSET (Investment Sifting and Evaluation Tool) – based on key criteria agreed with stakeholders. No weighting of criteria (i.e. making a judgement that any given criterion should carry more weight than another) has been carried out to date.

Criteria were organised into three key themes:

- High Level Theme – Policy Alignment;
- Intermediate Theme – Benefits; and
- Operational Theme – Deliverability.

Having undertaken this initial review, the findings for Stage 1 were as follows:

- The options to the west, (sites 6,7,8) which are less environmentally constrained perform better. Of these sites 6 and 7 perform best and are similar. Site 6 at Bourn Airfield is preferable to site 7 because of the potential interaction with future adjacent development which cannot yet be assessed as no development master plan is in place;
- Site 5 enjoys direct A428 access via a grade separated roundabout, although access to any future bus route is less clear. It is less environmentally constrained than some of the sites further to the east; and
- Sites 1 to 4 are closer to a SSSI, the American Cemetery, and are in a prominent location, likely to be visible from part of the City of Cambridge, and other sensitive areas. As such these sites, which in transport operational terms may prove preferable once modelling work is completed, score less well on environmental issues. The sites to the south, further from the SSSI, particularly site 3, which is on an existing waterworks, and site 4 at Crome Lea Farm score most strongly.

The recommendation from Stage 1 was to proceed with 5 options. These are Sites 3 (waterworks site), 4 (Crome Lea Farm), 5 (Scotland Farm) and 6 (Bourn Airfield), for reasons outlined above, together with Site 0 (expansion of Madingley Road Park and Ride). Although Site 0 scores poorly because it adds no new connectivity, does not relieve the A1303, and would not provide as much capacity as the other sites, it would provide significant value to the M11 corridor and, as such, should still be considered.

Site layouts for each of the sites to be taken forward were developed and traffic modelling data received. These will be used in Stage 2 of the Assessment which will look at the remaining sites and re-evaluate the INSET scoring based on the new information, and give consideration to potential environmental mitigation measures as well as the implications of the busway proposals.

5.3. Stage 2 Initial Findings

Based on the previous stages of the work, Mott Macdonald selected 5 sites to go forward with.

- Site 0 Madingley Road
- Site 3 Waterworks
- Site 4 Crome Lea
- Site 5 Scotland Farm
- Site 6 Bourn Airfield

Having undertaken further research and development and using some data, such as CSRM data, supplied by Atkins, the following initial conclusions have been drawn.

Madingley Road is in the Green Belt and space constrained. Some expansion of the site to add additional spaces (Site 0) could be undertaken but would not address the anticipated level of demand. As the site is in the Green Belt, the loss of planting needed to add these spaces would be undesirable and double-decking is unlikely to be acceptable. The issue of ownership and a limited lease is also a risk. Moreover, this site does not enable incoming traffic to divert onto Buses west of the M11. Madingley Road will remain in the assessment as a low-cost comparator for scheme appraisal purposes but does not fulfil the requirements of a do-something scheme.

Crome Lea (Site 4) is felt to be less desirable than the Waterworks site (Site 3) on both environmental and traffic grounds. Specifically, it is virtually adjacent to the Madingley Wood SSSI, and all access and egress traffic would need to transit Madingley Mulch roundabout.

Similarly, having reviewed access and egress issues, Bourn Airfield (Site 6) is considered less desirable than Scotland Farm (Site 5) given the likely pressure which would be put on the St Neots Road and the roundabouts connecting to the A428 by the proposed residential development. Modest parking provision for cyclists and disabled drivers adjacent to bus stops within the development itself, and potentially additional parking to meet local needs, would be desirable to maximise the use of the busway by residents, and to reduce external trip-making, but the additional pressure of traffic generated by the Park and Ride would not be helpful when considered cumulatively against the impact of the development itself.

Therefore, the two sites which merit further consideration are Scotland Farm and the Waterworks. Of these, both have strengths and weaknesses. Scotland Farm has less visual impact on the wider countryside but is in much closer proximity to existing housing whereas the Waterworks is already developed in places and there is existing development activity with associated visual impact associated with a radio mast and nearby street-lighting. Scotland Farm is also less well connected to Option 3a alignment. Both sites lie in the Green Belt but Scotland Farm is located to the edge of the Green Belt. The Waterworks site is predicted to be more heavily used than Scotland Farm so offers greater potential transport benefits and opportunities for Park and Cycle to the City Centre.

Mitigation measures for any outstanding issues will be developed in advance of public consultation.

5.4. Park and Ride Occupancy

A Park and Ride site is considered to be a key facilitator in providing an additional public transport system that moves users between outlying towns and villages and Cambridge. An assumption of the CSRM2 modelling is that Maddingley Road Park and Ride would close in favour of a new Park and Ride opening somewhere along the A428 corridor. The Maddingley Road Park and Ride site is owned by the University of Cambridge. When the lease for the site expires, there is a possibility that the Park and Ride would close leaving a larger strain on the other Park and Ride sites, namely Trumpington Park and Ride and the proposed site west of the city due to their proximity to Maddingley Road Park and Ride

At the time the CSRM2 modelling was undertaken a Park and Ride site at Maddingley Mulch was being considered and so the data shown in the figures below shows the likely occupancy levels at a Park and Ride site at Maddingley Mulch for options 1 and 3a. As a sensitivity test CSRM2 predicts the total Park and Ride occupancy (Total cars in the site) through a typical 24-hour period. The times of the graphs show peak periods throughout the day. The inter-peak period shows the largest occupancy as this period is when individuals are typically working and/or visiting the city. The results show that should the existing Maddingley Road Park and Ride site close, the proposed Maddingley Mulch Park and Ride occupancy levels could reach 1928 during the inter-peak period.

Figure 5-2 Vehicle Occupancy Levels for a New Park and Ride Site for the Scheme (Existing Park and Ride Closed) - Option 1

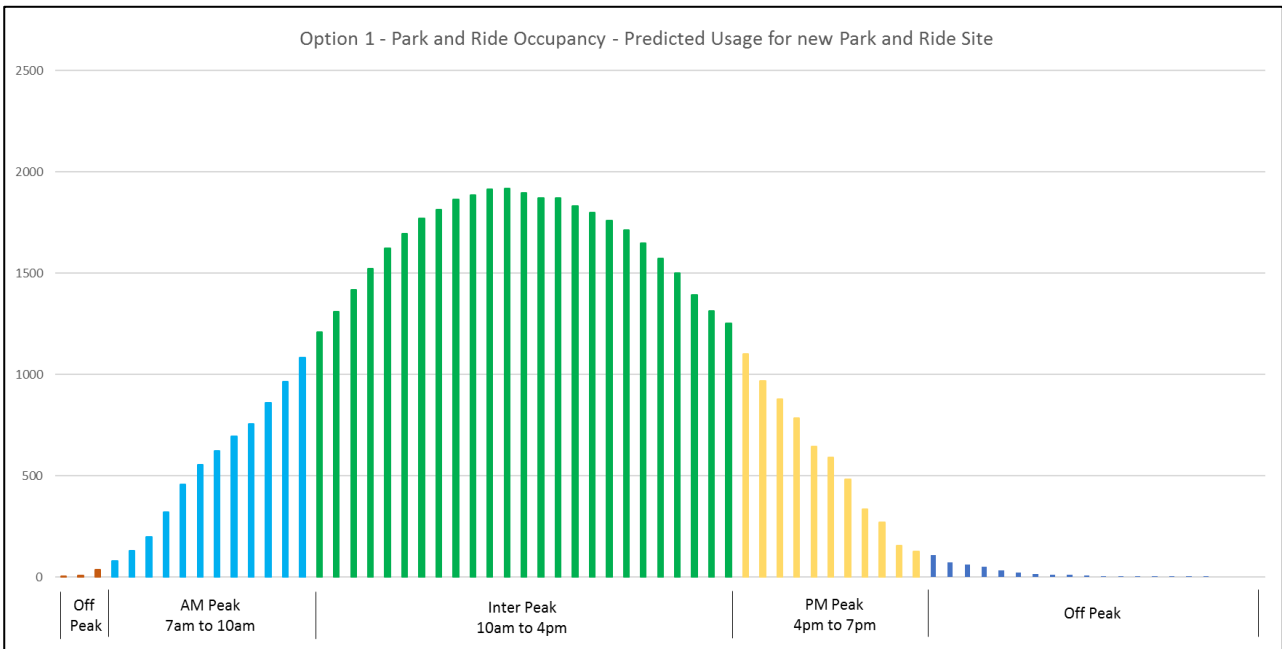


Figure 5-3 Vehicle Occupancy with Madingley Road Park and Ride site remaining open - Option 1

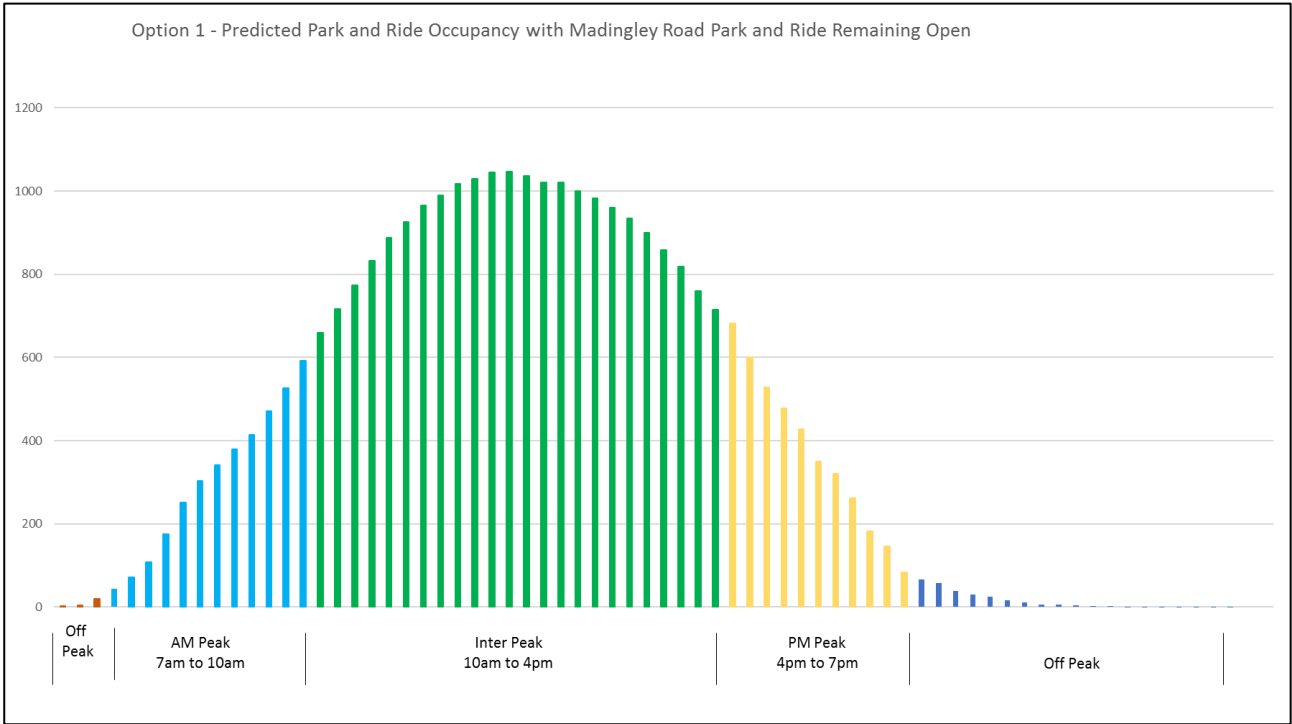


Figure 5-4 Vehicle Occupancy Levels for a New Park and Ride Site for the Scheme – Option 3a

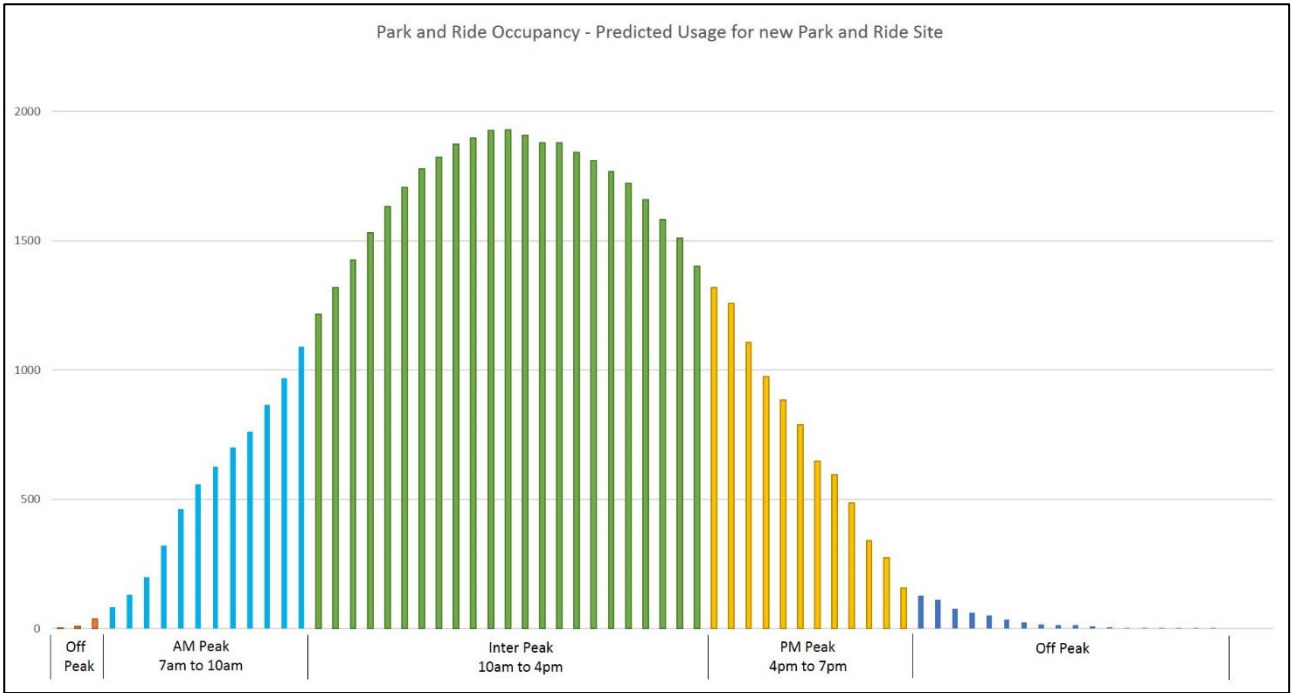


Figure 5-5 Park and Ride Occupancy with Madingley Park and Ride Remaining Open – Option 3a

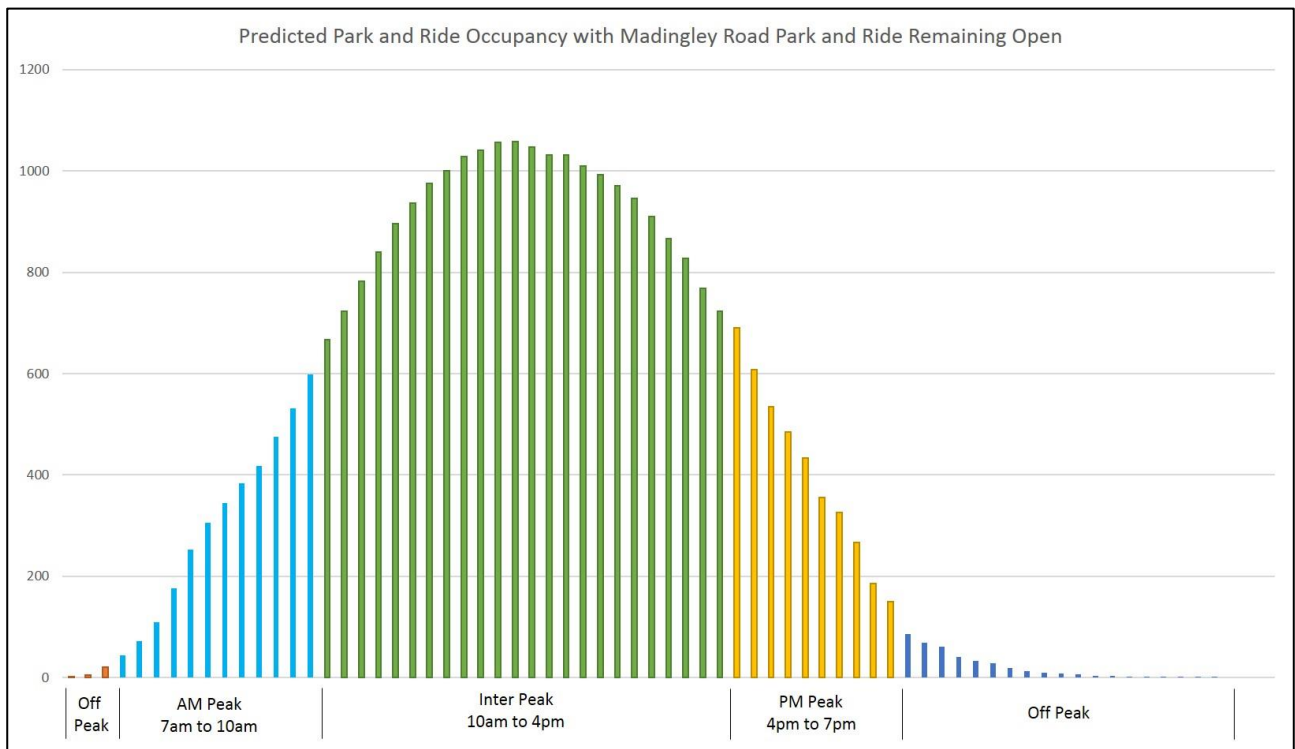
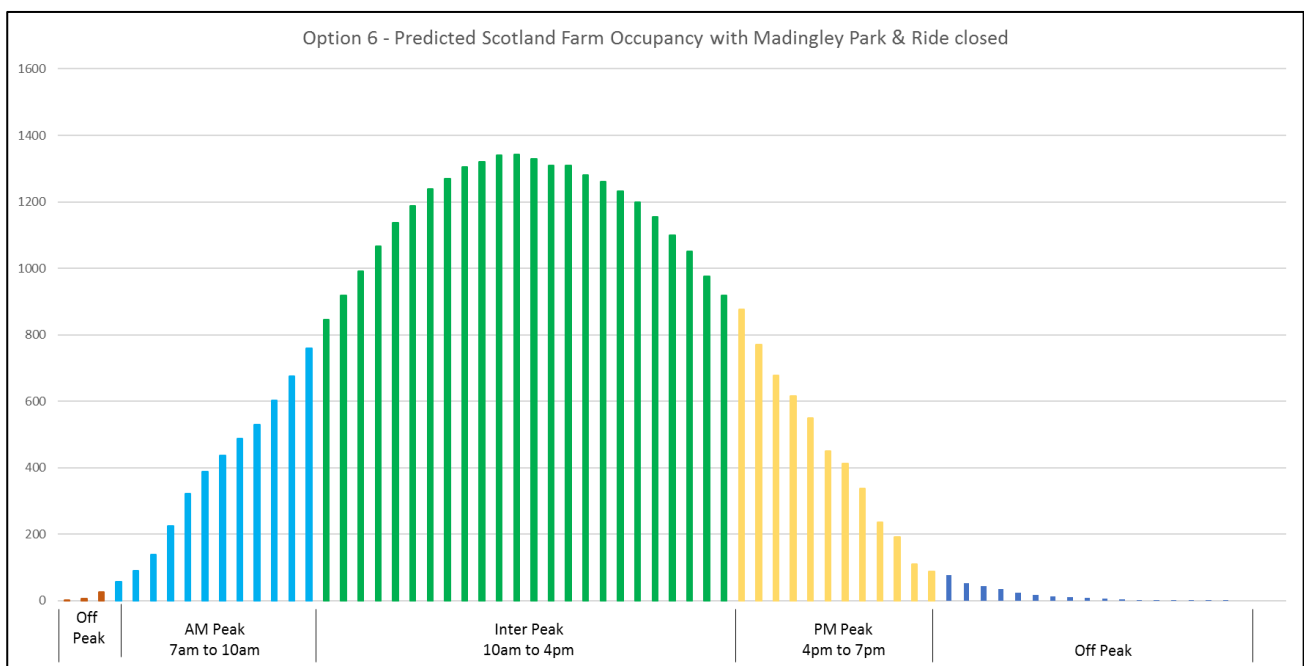


Figure 5-6 Park and Ride Occupancy without Madingley Park and Ride – Option 6



The figures above show a sharp increase in occupancy within the AM Peak Period and a sharp decline in the PM Peak Period as these are the two periods that the majority of people work. The figures highlight that if Madingley Road Park and Ride was to stay open the total occupancy levels would potentially reach a maximum of 1058 which highlights the dependency and usage of the existing site.

The additional Park and Ride occupancy figures for Option 1 and Option 6 with and without Madingley Road Park and Ride are included in Appendix M.

Park and Ride Workshops

Detailed outcomes of workshop held in relation to P&R locations and the associated assessment criteria are provided in the P&R Appendix M. In summary 2 workshops were held (1 for each stage of the study). The Stage 1 workshop identified the key local community stakeholder assessment criteria and to cross reference those to the study assessment process. As would be expected the range of community criteria were reflected in the formal assessment process although the workshops did help to clarify and prioritise community concerns specifically around the environmental and social impact of new P&R sites. The stage 2 workshop presented the 5 short listed sites for further consideration and the emerging assessment outcomes. The workshop was important in testing the evaluation. Neither workshop was intended to 'select' sites, however a number of local stakeholders did set out their support for a P&R site at Scotland Farm which was perceived to be the least environmentally impactful site and the one which will best intercept traffic on the A428.

5.5. Stage 2 Summary

What are the shortlisted Park and Ride locations?

Having undertaken further research and development, the following initial conclusions have been drawn and the two sites which merit further consideration and greater understanding of wider opinion through public consultation are Scotland Farm and the Waterworks. Of these, both have strengths and weaknesses. Scotland Farm has less visual impact on the wider countryside but is in much closer proximity to existing housing whereas the Waterworks is already developed in places and there is existing development activity with existing associated visual impact relating to a radio mast and nearby street-lighting. Scotland Farm is less well connected to the proposed off-line busway. Both sites lie in the Green Belt but with Scotland Farm being located to the edge of the Green Belt and being partly bounded by existing built development. The Waterworks site is predicted to be more heavily used than Scotland Farm so offers greater potential transport benefits and opportunities for park and cycle to the city centre.

Whilst the sites have not been assessed alongside the potential bus routes in the area, it is felt that either of these sites provides flexibility on the choice of alignment, although this will need to be considered as part of the ongoing scheme development.

Bourn Airfield is considered less desirable than Scotland Farm given the likely pressure which would be put on the St Neots Road and the roundabouts connecting to the A428 by the proposed residential development. Modest parking provision for cyclists and disabled drivers adjacent to bus stops within the development itself, and potentially additional parking to meet local needs, would be desirable to maximise the use of the busway by residents, and to reduce external trip-making, but the additional pressure of traffic generated by the Park and Ride would not be helpful when considered cumulatively against the impact of the development itself.

With regard to Bourn Airfield the matter of compliance with the current Transport Strategy and Emerging Local Plan may result in the potential inclusion of a park and ride facility as part of the Bourn Airfield new settlement being removed from the proposed allocation. As such, it is proposed that land at Bourn Airfield is excluded from further assessment subject to the Local Plan Examination process.

Crome Lea scores less well than the Waterworks site and has been rejected on that basis. Specifically, it has a larger effect on the landscape and visual impact of the two sites and is located in closer proximity to the SSSI. It is also located to the east of the Madingley Mulch roundabout and provides less relief to the A1303."

6. Summary

What are the summaries of this report?

Atkins has been commissioned by GCP to report on the progress of the Cambourne to Cambridge Better Bus Journeys Project since October 2016. The project has been further developed by tailoring Options and routes to fit the 'fast, frequent and reliable' attributes of a HQPT system. The project seeks to reduce the congestion within Cambridge City Centre in future years and provide a public transport connection for settlements to the west of the city, namely, Cambourne, Bourn Airfield and Hardwick into the City Centre. The project team has also been engaging with key stakeholders such as the LLF to develop a community based option referred to as Option 6.

It is intended that three project options are presented for public consultation:

- Option 1 – a low cost comparator that would provide a bus lane on the inbound and outbound journeys with on-road sections either end in Cambridge City Centre and Cambourne;
- Option 3a – an offline route that would provide a segregates busway to bypass traffic on Maddingley Road; and
- Option 6 – The LLF proposal would provide a central bus lane in a tidal flow system with inbound buses in the AM peak period using the lane and outbound buses in the PM peak using the lane.

6.1. Recommendations

This report comments on the attributes of Option 3a in terms of transport and environmental considerations. Four variations of the option are explored due to the of-road nature of the options.

It is recommended that the following alignments are taken forward for further work:

- Future investment programme: Blue, Green and Red Routes;
- Long Road to M11: Blue, Green, Red and Pink Alignments; and
- M11 to Grange Road: Blue, Green, Red, Pink and Cyan Alignments.

Adams Road and the Cambridge University Rugby Club Access should be consulted upon to provide connections to Grange Road.

It is recommended that the following Park and Ride site locations taken forward for ongoing work:

- Scotland Farm: and
- Waterworks Site.

6.2. Further Work

What's next?

Ongoing work will continue within this stage of work (defined in Step 3 in the project documentation). Step 3 is the compiling of a Full Outline Business Case for a single option. This FOBC necessarily offers the investment board (in this case the GCP Executive Board) the opportunity to compare and contrast alternative approaches. As such the FOBC will continue to assess Option1, 3/3a and for the entire corridor. This assessment will include the following work streams:

- Continued communication with the LLF in the ongoing development of Option 6;
- A public consultation on the basis set out in this End of Stage report; and
- Further refinement and assessment of options and Specific Route Alignment including more detailed environmental and transport assessment.

Together these work streams will be presented to the Executive Board in July 2018 in the form of the Transport Assessment Guidance compliant Full Outline Business Case. This FOBC will provide a '5 case' evaluation of options and the overall public cost/benefit of them. On this basis, the Executive Board may at that point wish to proceed with seeking statutory consent with a Phase 1 scheme and single P&R site or may alternatively wish to consult further on a Phase 2 scheme with a view to promoting a single consent process for interventions along the entire corridor. In the latter case a final decision on the whether to submit applications for statutory consent will take place in early 2019 following the outcome of the this further consultation.

Appendices



Appendix A. Local Plan Objectives

Appendix B. Atkins Report - Stakeholder Workshop (East of M11 Bus Priority)

B.1. Facilitators Report (East of the M11 Workshop)

B.2. Facilitators Report (Park and Ride Workshop)

Appendix C. Bus User Surveys

- C.1. Bus User Survey - Cambridgeshire Guided Busway User Research**
- C.2. Draft Bus User Research – Potential Cambourne to Cambridge Bus Users (Draft)**

Appendix D. Cambourne – Potential Bus Priority

Appendix E. City Centre – Potential Bus Priority

Appendix F. MCAF Report – Second high Level Assessment

F.1. Mini-MCAF Assessing LLF's Response TN

Appendix G. CSRM Assumptions

Appendix H. VISSIM Report

Appendix I. Journey Time Data

Appendix J. Green Lane Report

Appendix K. High Level Costs

K.1. High Level Costs - Busway

K.2. High Level Costs - Option 1

K.3. High Level Costs - Option 6

Appendix L. Planning and Environmental Reports

L.1. Planning

L.2. Ecology

L.3. Flood and Water

L.4. Historic Environment

L.5. Noise

L.6. Air Quality

Appendix M. Park and Ride Study

Appendix N. Specific Route Alignment Reports

N.1. Future Investment Programme – Engineering Assessment


N.2. Phase 1 Engineering Assessments

N.3. Grange Road Access Options Engineering Assessment

N.4. Specific Route Alignments (Busway)

N.4.1. Option 1

N.4.2. Option 6



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