MOTT MACDONALD

Cambourne - Cambridge Better Public Transport Project

Options Appraisal Report (Part 2)
392438-MMD-BCA-XX-RP-BC-0004

December 2018

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Glossary of key terms

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

Committed Schemes: Schemes that are outside the control and scope of the proposed project being put forward and are due to be delivered during the forecast period.

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

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

Countryside: The rural environment and its associated communities.

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

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

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

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

Enhancement: Landscape improvement through restoration, reconstruction or creation.

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

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

Full Business Case (FBC): The culmination of the final phase is the Full Business Case. An investment committee will consider the Full Business Case then make a recommendation to ministers. Ministers will decide whether a proposal should proceed to implementation.

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

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

HQPT: A system that provides high levels of speed, reliability and capacity, enabling fast, frequent and reliable journeys.

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

Illustrative Comparator: An option including both Phase 1 and 2 which has been presented at this stage of the business case for comparative purposes.

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

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

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

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

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

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

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

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

LLF: Local Liaison Forum, provide a link between a project team and the local community.

Multi Criteria Assessment Framework (MCAF): Multi-Criteria Assessment Framework used in the optioneering assessment process.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Townscape: Physical and social characteristics of the built and unbuilt urban environment and the way in which those characteristics are perceived. The physical characteristics are expressed by the development form of buildings, structures and space, whilst the social characteristics are determined by how the physical characteristics are used and managed.

TUBA: Transport User Benefit Appraisal, is an assessment of a transport schemes economic appraisal in accordance with the DfT's guidance.

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

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

Executive summary

Scheme Background

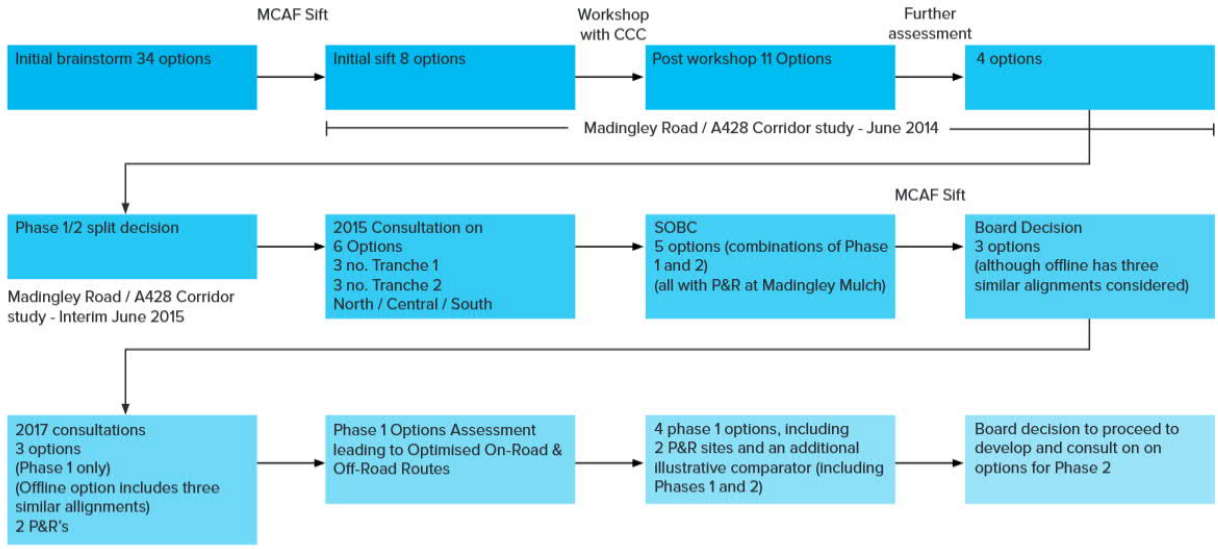
In 2015 the proposed Cambourne to Cambridge Better Bus Journeys (C2C) project was prioritised for funding by the Greater Cambridge Partnership (GCP) from the City Deal. This was in response to existing issues of congestion and poor journey time reliability along the A428/A1303 corridor during peak periods, as well as the need to improve the levels of connectivity between the growing settlements to the west of Cambridge and key employment centres within Cambridge to ensure continued economic growth.

Since the scheme's inception, it has progressed through a series of optioneering steps to identify and assess options that address these issues. The option development and assessment process undertaken as part of the production of the scheme's Outline Business Case (OBC) has been carried out and presented in two parts. This Options Appraisal Report (OAR) forms Part 2 of the assessment process.

Position at the end of OAR Part 1

OAR Part 1 provides a summary of all options development and assessment work that has been carried out since the scheme's inception, up to the formal consultation period on the initial shortlisted options that ran between November 2017 and January 2018. OAR Part 1 also included further assessment of the shortlisted options to develop and refine them and arrive at an optimised list of options that include a single recommended on-road option and a single recommended off-road option. The assessment of the refined shortlisted options forms the basis for OAR Part 2 which sets out the assessment of these options using Mott MacDonald's Investment Sifting and Evaluation Tool (INSET) against a series of assessment criteria, and traffic modelling to provide initial Benefit Cost Ratios (BCRs) for each option. This assessment also incorporates the findings and feedback from the consultation phase to arrive at a recommended option.

Figure 1: Options Appraisal Methodology



Source: Mott MacDonald

Development post OAR part 1

Following further traffic modelling of the optimised route and the consultation responses, it was decided that the public transport lane from High Cross Junction and Lady Margaret Road would not be included and instead improved cycling facilities would be implemented. This will be undertaken outside of this business case and as such, will be assumed to be a committed scheme and will form part of the Do Minimum option.

The traffic modelling also showed significant improvements from implementing changes to the M11 off and on slips and the junction with Madingley Road. It was therefore decided that this would be included in the off-road options presented in OAR part 1.

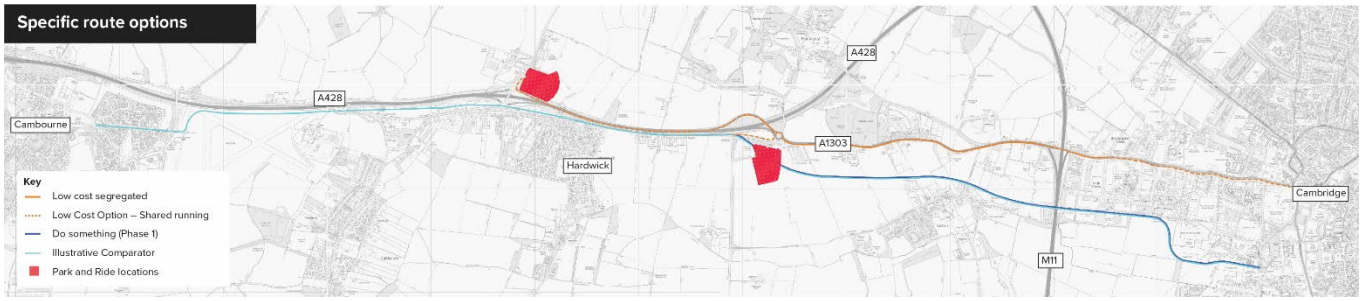
With the changes to the options presented at the conclusion of OAR Part 1, this OAR (Part 2) has assessed the following shortlisted options:

- **Do Minimum** – Delivery of committed schemes between Madingley Mulch Roundabout and Cambridge City Centre (this includes improved cycle infrastructure between the University West development and Storeys Way)
- **Low Cost a and b** – Completion of recommended on-road option between Madingley Mulch Roundabout and Cambridge City Centre, with incorporation of a Park and Ride site either at Water Works (a) or Scotland Farm (b)
- **Do Something 1a and 1b** – Recommended off-road option running between Madingley Mulch Roundabout and Cambridge City Centre, incorporating a Park and Ride site either at Waterworks (a) or Scotland Farm (b) and improvement to the off and on slips of the M11 junction 13 and the junction with Madingley Road.
- **Illustrative Comparator** – All above options tested against an illustrative comparator from Camborne to Cambridge. This comparator comprises an off-road scheme between Camborne and Grange Road with a Park and Ride at the Waterworks site, near to Madingley Mulch roundabout.

The illustrative comparator is used as a means to assess a strategic option and is not intended to preclude any options for Phase 2 including a Park and Ride at Scotland Farm.

A summary of the route options is illustrated in **Figure 2**.

Figure 2 – OAR Part 2 route options



Source: Mott MacDonald

OAR Part 2 Assessment Methodology

To arrive at a recommend route option, and Park and Ride location, each option was appraised using Mott MacDonald's in-house Investment Sifting and Evaluation Tool (INSET). This assessed the route options against a series of assessment criteria that were grouped by the following themes; Policy fit, Contribution to economic Growth, Contribution to improved transport network, Contribution to quality of life, Scheme deliverability and Stakeholder support. As well as the INSET assessment, detailed traffic modelling for each option is being carried out, along with an outline cost estimation for each option. This will enable the generation of initial Benefit Cost Ratios (BCR) for each option, to further inform the recommendation of a route option and Park and Ride location.

OAR Part 2 Assessment Results

The initial BCR values showed that the emerging recommended option was **Do Something 1a.**

The initial BCR results are below the required 2:1 ratio as recommended by DfT. Therefore, an adjusted BCR was developed based on a percentage uplift detailed in the strategic outline business case (SOBC). As the uplift was applied to all the BCRs the emerging recommended option was still **Do Something 1a.**

The INSET assessment results showed that the emerging strategic option was the **Illustrative Comparator.**

To support the INSET results a Value for Money assessment (VfM) was undertaken using a Wider Economic benefit (WEB) report published in 2016[1]. This work will need to be revisited to reflect the adopted Local Plans and latest options but the initial WEB appraisal of the Illustrative Comparator confirms that there is a high level of growth associated with provision of a full off-road public transport route to unlock development opportunity on the corridor.

The Value for Money assessment takes into account the monetised impacts vs the scheme costs presented as a Benefit to Cost Ratio, as well as the findings from any qualitative and non-monetised assessments.

The approach to the assessment of Value for Money (VfM) of City Deal schemes, as set out in the City Deal Assurance Framework, reflects this by stating that schemes scoring a BCR less than 2:1 will still be considered for funding if they can demonstrate a compelling case for investment based on meeting the objectives of the City Deal. For example, unlocking barriers to growth, delivering wider economic benefits, environmental and social benefits. As long as the

[1] Strategic Economic Appraisal of A428-A1303 Bus Scheme – Wider Economic Benefits, August 2016

scheme provides a robust evidence base with a proportionate level of quantitative and qualitative analysis to demonstrate that the scheme represents good value for money and can meet the policy objectives of the City Deal, these do not need to be included in the central benefit-cost analysis.[2]

Emerging Conclusions and Next Steps

Following the results of the INSET scoring, BCR calculation and consideration of the WEB appraisal, the emerging strategic option is the Illustrative Comparator.

This is due to the indication from both the INSET scoring and the supporting value for money report that providing some infrastructure between Cambourne and Madingley Mulch Roundabout will deliver additional benefits over and above the Phase 1 options.

For the purposes of the assessment in this report, the Illustrative Comparator is based on the Waterworks Park and Ride site, but the Scotland Farm site would be likely to generate similar benefits and the two should be seen as interchangeable at this stage.

The option will be considered during Phase 2 of the scheme and a final recommended scheme will only be decided post Phase 2 consultation.

Phase 2

It should be noted that the value for money report only considered an off-road route from Cambourne to Cambridge, and did not consider any other options. Also, the Phase 2 section between Cambourne and Madingley Mulch Roundabout has yet to be consulted on to date and as such consideration and assessment of all options should be undertaken to the same extent as Phase 1. These options could include:

- Off Road Only
- On Road with junction improvements only
- On Road Public Transport Priority

In addition, each option should be considered in combination with the alternative Park and Ride locations as Scotland Farm and Waterworks.

Once the phase 2 route option has been consulted on and confirmed, and further consultation and analysis undertaken to allow a Park and Ride to be selected, updated assessments will be undertaken to arrive at a single recommended option as part of the final OBC.

[2] City Deal Assurance Framework

1 Introduction

1.1 Purpose of this report

In 2015 the proposed Cambourne to Cambridge Better Bus Journeys (C2C) project was prioritised for funding by the Greater Cambridge Partnership (GCP) from the City Deal. This was in response to existing issues of congestion and poor journey time reliability along the A428/A1303 corridor during peak periods, as well as the need to improve the levels of connectivity between the growing settlements to the west of Cambridge and key employment centres within Cambridge to ensure continued economic growth.

Following the approval of the Strategic Outline Business Case (SOBC) for the Cambourne to Cambridge Better Public Transport (C2C) project in October 2016, by the Executive Board of the Greater Cambridge Partnership (GCP), and completion of an End of Stage Report in September 2017 which informed subsequent public consultation, the GCP commissioned Mott MacDonald to develop an Outline Business Case (OBC) as part of the next phase of the scheme's development. An integral component of the business case process and that of producing an OBC is the development of options and their assessment, which is reported in an Options Appraisal Report (OAR).

This OAR is produced in line with the Department for Transport's (DfT) Transport Appraisal Guidance (TAG) and, follows the Transport Appraisal Process and methodology. The OAR summarises all work previously undertaken to identify the need for the intervention, to identify options for addressing the identified issues and opportunities, and how those options have been assessed and refined to arrive at a recommended option.

The OAR for the C2C project is formed in two parts:

- **OAR Part 1** – outlines all work done to date to identify the need for the intervention, and the options development process and assessment process carried out in order to arrive at a short list of options. OAR Part 1 also includes the assessment of the shortlisted options in order to refine and optimise them and arrive at on and off-road options to be taken forward for further assessment.
- **OAR Part 2** – outlines the assessment of the shortlisted options as presented at the conclusion of OAR Part 1, and takes the reader through the assessment of the on-road and off-road options defined in OAR Part 1 using the INSET tool and BCRs based on user benefits and scheme costings to present a final recommend option.

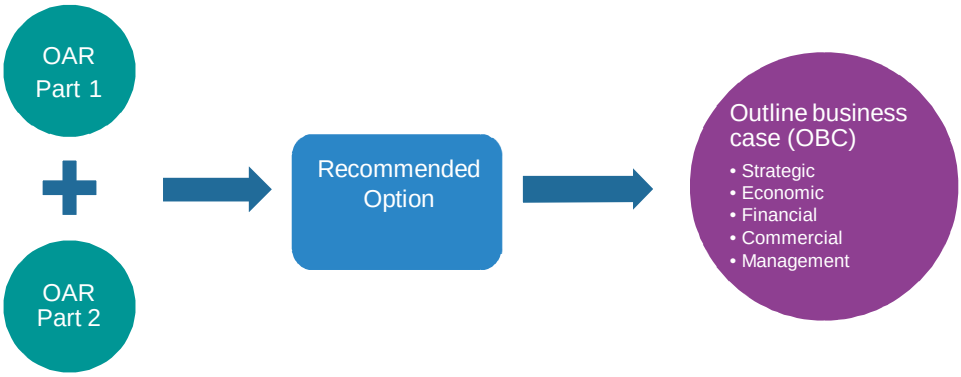
This document is **OAR Part 2**. To fully understand this document, it is advised that **OAR Part 1**[4] is read prior to reading **OAR Part 2**.

The results of OAR Part 2, an emerging strategic option, and subsequent consultation and option assessment on Phase 2 will directly inform the OBC that presents the optioneering process alongside the wider strategic context for investment and information on the transport economic benefits of the recommended option. The OBC also sets out each of the five cases for

[4] Cambourne – Cambridge Better Bus Journey Options Appraisal Report (Part 1), 392438-MMD-BCA-XX-RP-BC-0002, Mott MacDonald, March 2018

the recommended option in line with DfT's 'five cases' model[5], covering the Strategic, Economic, Financial, Commercial and Management cases for the C2C scheme.

Figure 3: Process following the completion of OAR Part 2



Source: Mott MacDonald

1.2 Structure of this report

OAR Part 2 for the C2C project is to be read in conjunction with OAR Part 1, with both parts structured to align with the DfT's Transport Appraisal Process. Table 1 sets out how OAR (Parts 1 and 2) align with this process. Both OAR Part 1 and 2 will be appended to the scheme's OBC along with an additional OAR which addresses Phase 2 of the C2C project and the selection of a Park and Ride site.

Table 1: OAR Part 1 and Part 2 Report Structure

Report and Section	Contents	Description	Alignment with WebTAG option appraisal development stages and steps
OAR (Part 1) – 2	Strategic and Local context	Review the strategic and local context of the A428/A1303 transport corridor to help identify the need for intervention.	Stage 1 Steps 1, 2 and 3
OAR (Part 1) – 3	Scheme Background	Provides an overview of the C2C scheme's background and description of the scheme.	N/A
OAR (Part 1) – 4	Options Assessment Methodology	Reviews the steps in the DfT's transport appraisal process and outlines the proportionate including and options assessment methodology for the C2C scheme.	N/A
OAR (Part 1) – 5	Current and Future Issues and Opportunities	Reviews the evidence base for the C2C scheme based on the following: Rationale for Scheme – Policy review; Strategic Socio-Economic Review; Economic and Business; Highways Network and Traffic; Wider Transport Network Provision; How People Travel; Land Use and Development; Housing;	Stage 1 Steps 1, 2 and 3

[5] This is based on HM Treasury's Green Book appraisal guidance.

Report and Section	Contents	Description	Alignment with WebTAG option appraisal development stages and steps
		Environmental Issues; and Underlying Drivers or Causes. Establishes the need for intervention.	
OAR (Part 1) – 6	Scheme Objectives and Scope	Defines 3 strategic scheme aims and objectives for the C2C scheme, including outputs and outcomes of the C2C scheme through a Logic Map.	Stage 1 Step 4
OAR (Part 1) – 7	Stage 1 - Options Generation and Assessment	Reports on the option development process undertaken to generate and assess the initial Long List and the option assessment carried out to arrive at an initial Short List, including the three core options (1, 3a, 6) progressed to Stage 2.	Stage 1 Steps 5, 6 and 7
OAR (Part 1) – 8	Stage 2 – Further Options Assessment	This section reviews the process to refine the options to arrive at a recommended on-road and recommended off-road solution.	Stage 2 Step 10
OAR (Part 2) – 2	Methodology	Reviews the steps in the DfT's transport appraisal process and outlines the proportionate including and options assessment methodology for the C2C scheme.	N/A
OAR (Part 2) – 3	Summary of Consultation	Review the results from the public consultations and stakeholder meetings, and the changes that have been undertaken in the design due to the comments and responses.	Stage 2 Step 11
OAR (Part 2) – 4	Final Option Assessment	This section sets out the changes to the options from OAR (Part 1), and the methodology used to assess the shortlisted options and arrive at a single recommended option.	Stage 2 Step 10
OAR (Part 2) – 5	Options Assessment Results	This section assessed the recommended on-road and off-road options using the Mott MacDonald in-house Investment Sifting and Evaluation Tool (INSET)	Stage 2 Step 10
OAR (Part 2) – 6	Initial Benefit Cost Ratios	Assess the benefits gained from the scheme against the cost of the scheme.	Stage 2 Step 10

Source: Mott MacDonald

1.3 Position of options at conclusion of OAR Part 1

OAR Part 1 set out to review the aims and objectives of the scheme and the need for change, summarising the option development work that had been carried out to date. OAR Part 1 also set out the assessment of the shortlisted options to select both a recommended on-road and off-

road option that would be taken forward for further assessment that is summarised in OAR Part 2.

The review of the scheme aims and objectives confirmed that the issues and opportunities that previously fed into the development of the project's aims and objectives had not altered, therefore providing a re-confirmation for the need for intervention.

A summary of all previous options development and assessment work was also included to show what work had been carried out leading up to the production of OAR Part 1, as well as how the options that were assessed as part of OAR Part 1 were originally arrived at.

Using the Mott MacDonald in-house Investment Sifting and Evaluation Tool (INSET), the assessment of the shortlisted options resulted in an 'optimised' Option A being selected as the recommended on-road option and Option C 'blue route' with the Rifle Range connection to Grange Road being selected as the recommended off-road option (detail of these options can be found in OAR Part 1).

Note that OAR Part 1 did not include the assessment of the two shortlisted options for the Park and Ride sites. Therefore, both sites were carried forward into the further assessment of the options as summarised in OAR Part 2.

At the conclusion of OAR Part 1 the refined shortlisted options were:

Table 2: Shortlisted Options from OAR Part 2

OAR Part 1 Shortlisted Options	Park and Ride location	Option Route Description
Do Minimum	N/A	No change
Recommended on-road Phase 1	Water Works	• Madingley Mulch Roundabout becomes signalised and a new public transport lane is added to the A428. • East bound public transport lane and sections of westbound public transport lanes along Madingley Road (A1303). • New pedestrian bridge over M11 and additional traffic lane on existing bridge. Alterations to the slip to allow two lanes of traffic. • Public Transport priority at High Cross junction. • Changes to access to existing Park and Ride.
Recommended on-road Phase 1	Scotland Farm	
Recommended off-road Phase 1	Water Works	• Changes to Madingley Mulch Roundabout to accommodate off-road route • Junction with Cambridge Road • New bridge over M11 • Junction with Ada Lovelace road • Junction with Grange Road
Recommended off-road Phase 1	Scotland Farm	
Illustrative Comparator	Water Works	• Junction with Broadway • Off-road route through Bourn development • Junction with St. Neots Road • Junction with Scotland Rd roundabouts • Changes to Madingley Mulch Roundabout to accommodate off-road route • Junction with Cambridge Road • New bridge over M11 • Junction with Ada Lovelace road • Junction with Grange Road

Source: Mott MacDonald

2 Options Assessment Methodology

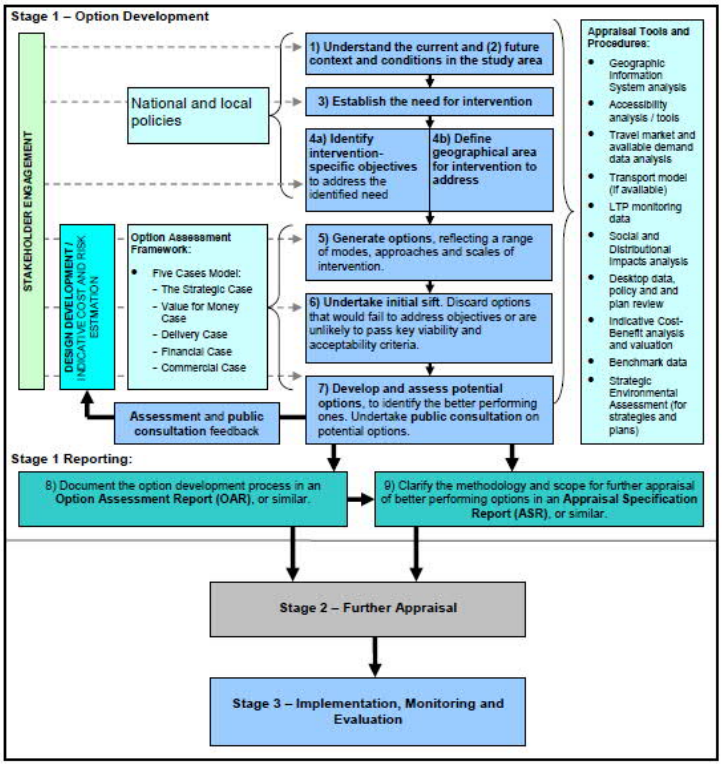
2.1 WebTAG guidance on the Transport Appraisal Process

OAR Parts 1 and 2 follow the Department for Transport's (DfT) guidance 'The Transport Appraisal Process' which provides detailed guidance on appraisal and the requirements needed for transport intervention. A structured approach sets out the necessary steps from initial intervention through to the detailed appraisal that supports preparation of business or investment cases to subsequent approval stages and post implementation evaluation (see **Figure 4** and **3** which illustrate the DfT process).

The three stages in the DfT's transport appraisal process are shown below:

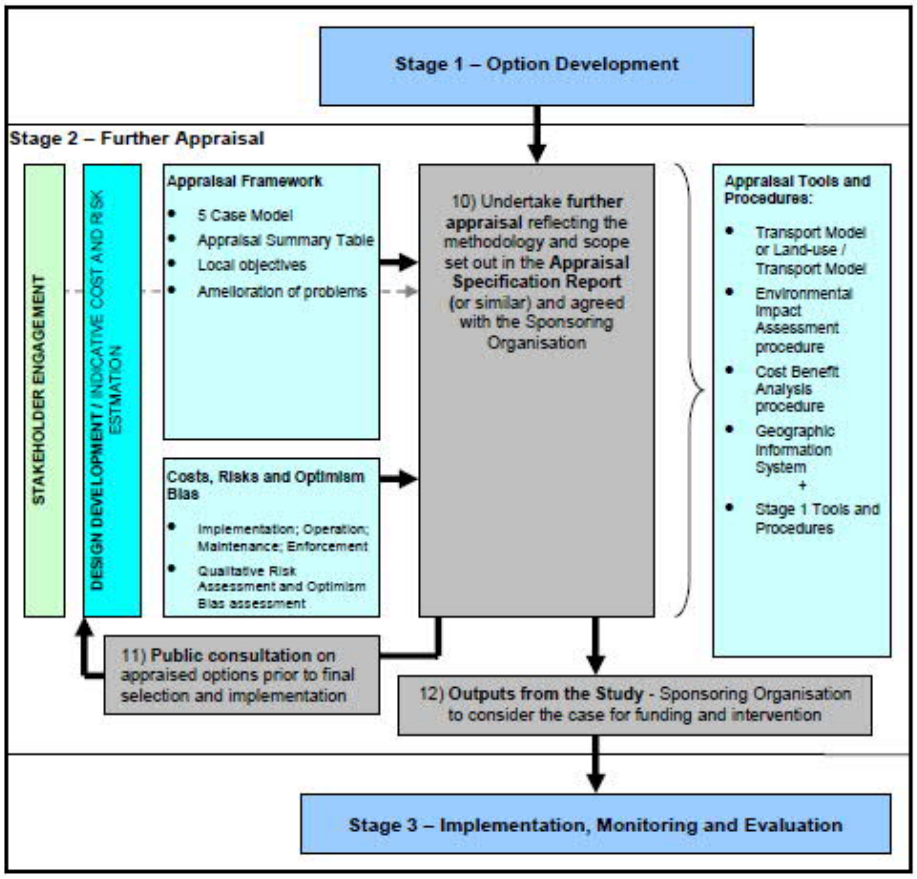
- **Stage 1** – Option Development. This involves identifying the need for intervention and developing options to address a clear set of locally developed objectives which express desired outcomes. These are then sifted for the better performing options to be taken on to further detailed appraisal in Stage 2.
- **Stage 2** – Further Appraisal of a small number of better performing options in order to obtain sufficient information to enable decision-makers to make a rational and auditable decision about whether or not to proceed with intervention. The focus of analysis is on estimating the likely performance and impact of intervention(s) in sufficient detail.
- **Stage 3** – Implementation, Monitoring and Evaluation.

Figure 4: Stage 1 of the Transport Appraisal Process ('Option Development')



Source: Department for Transport (2014), Transport Analysis Guidance: The Transport Appraisal Process

Figure 5: Stage 2 of the Transport Appraisal Process ('Further Appraisal')



Source: Department for Transport (2014), Transport Analysis Guidance: The Transport Appraisal Process

2.2 Methodology summary

The options appraisal process and this report for the C2C scheme has been structured to align with Stages 1 and 2 of the DfT's transport appraisal model outlined in Section 2.1.

Stage 1 included identifying the need for intervention and developing options to address a set of locally developed objectives derived from evidence based issues and opportunities (see OAR Part 1). These options were then sifted to arrive at a shortlist. Stage 2 included further appraisal of the shortlisted options from stage 1 where the recommended option is identified (see this OAR Part 2) and taken forward through an OBC.

In order to provide a strategic assessment including Phase 2, an illustrative comparator option was also appraised. The option includes an illustrative off -road route from Cambourne to Cambridge (Phase 1 and Phase 2) with a Park and Ride at the Water Works.

2.2.1 Stage 1 – Options generation and assessment

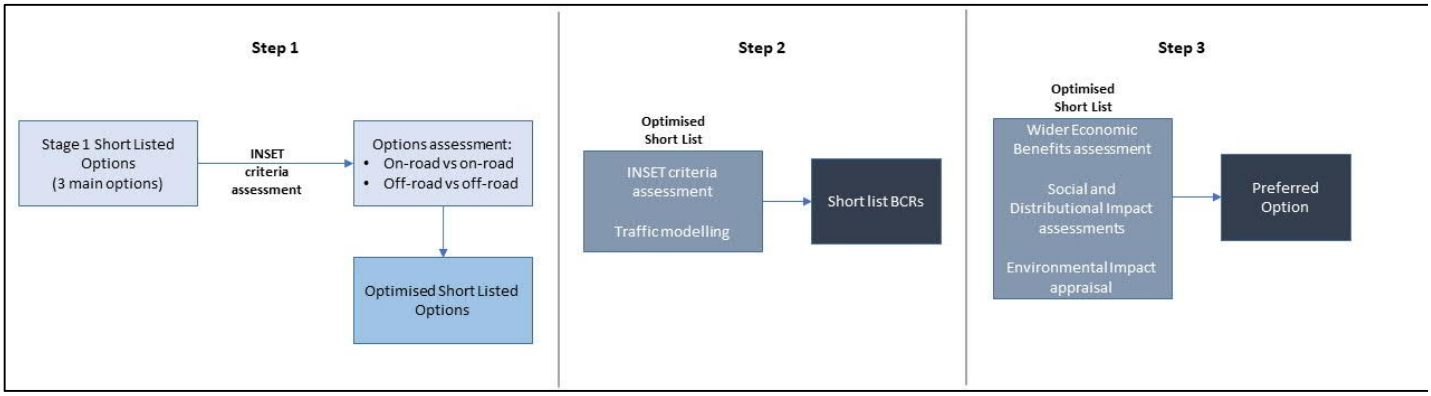
Stage 1 forms the basis of all previous options development and appraisal carried out for the SOBC published in 2016, and for subsequent further options appraisal work carried out post SOBC and documented in the End of Stage Report in advance of public consultation in September 2017. For further details of the processes undertaken see OAR Part 1 (Mott MacDonald, 2018).

2.2.2 Stage 2 – Further option assessment

Stage 2 of the appraisal process for the scheme aligns with Stage 2 of the WebTAG Transport Appraisal Process. This involved further assessment of the three best performing routes and the two recommended Park and Ride sites based on the Stage 1 results in order to arrive at a recommended Option.

Stage 2, like Stage 1, has been split into steps, with the short-listed options from Stage 1 undergoing further assessment and optimisation prior to more detailed appraisal (See **Figure 6**).

Figure 6: Stage 2 Options assessment stepped approach



Source: Mott MacDonald

Stage 2, Step 1 - The purpose of Step 1 was to refine the on-road and off-road options to arrive at a recommended for each. The process and results for Step 1 are set out in Section 7 of OAR Part 1.

The assessment of the options was undertaken using INSET, which applies weighted scoring to each option based on how well an option meets identified criteria. An overview of the structure and operation of INSET is detailed in Section 5 of this report.

Stage 2, Step 2 – The purpose of Step 2 is to assess the optimised shortlist of options to arrive at an initial recommended option. The process for this assessment and results for Step 2 are set out in Section 5 of OAR Part 2.

Following the use of INSET, the best performing on-road and off-road options between Madingley Mulch Roundabout and Cambridge City Centre (Phase 1) are subject to additional detailed assessment. A further option including new infrastructure between Cambourne and Madingley Mulch Roundabout (Phase 2) is also included for further appraisal to illustrate any potential step change in benefits resulting from a higher level of investment. This option is referred to as the Illustrative Comparator. The appraisal uses the selection criteria used in the INSET assessment for Step 1 with some additional criteria excluded at that stage, and repeats the exercise comparing the options against each other rather than simply comparing the variants of similar options i.e. the different on-road and off-road options. Each option is assessed with one of the two Park and Ride variants.

Also included in this assessment is the detailed economic appraisal of each option based on transport user benefits using traffic modelling outputs; specifically:

- SATURN modelling to assess traffic decongestion benefits;
- SATURN modelling and observed data to assess demand, and;

- TUBA assessment of passenger benefits.

Stage 2, Step 3 – the purpose of Step 3 is to refine the assessment carried out on the options presented in OAR Part 2, and apply additional levels of assessment, focusing on:

- Wider Economic Benefits assessment
- Social Impact Appraisal
- Environmental Impact assessment

The results of Stage 2, Step 3 will directly inform the recommended option presented within the OBC.

3 Options Development Between OAR Part 1 and Part 2

3.1 Introduction

Since the submission of OAR Part 1 there have been a number of developments which have resulted in changes to the options. These include the results of public consultation and stakeholder engagement, and the emerging Mayoral Vision for the wider strategic transport network for Cambridge.[6]

3.2 Consultation

A key aspect of the options assessment and refinement process is the incorporation of any findings and feedback from stakeholder and public consultation.

Since the original shortlisted options were developed, the results of a series of consultation and engagement events with stakeholders and public have been received. These included:

- Formal consultation: November 2017 - January 2018
- Key stakeholder workshops
- Market research

3.2.1 Formal public consultation

Through November 2017 to January 2018, formal public consultation was held on the shortlisted options. These are listed below and illustrated in **Figure 7** (these are the same options assessed as part of OAR Part 1).

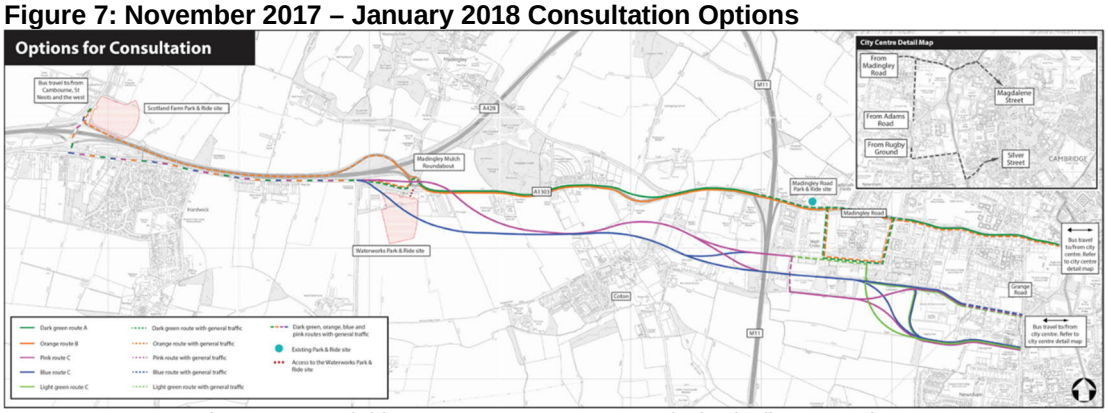
- **Option A**: An on-road option which includes the introduction of an inbound public transport lane on Madingley Road between Madingley Mulch Roundabout and Lady Margaret Road;
- **Option B**: An on-road tidal public transport lane on Madingley Road running between Madingley Mulch Roundabout and the entrance to Eddington (High Cross), and;
- **Option C**: An off-road public transport route running between Madingley Mulch Roundabout and Grange Road, Cambridge (Option C consists of three variants).

The main aims and objectives of the public consultation being:

- To present options to the widest range of people and representative groups affected by them;
- To provide them with an opportunity to give their views, and;
- To give full consideration to the views received in reporting to aid the politicians reaching a decision on the proposed Park and Ride site and Public Transport routes.

[6] CPCA Board - Mayoral Interim Transport Strategy Statement – 30th May 2018

Figure 7: November 2017 – January 2018 Consultation Options



Source: GCP – Cambourne to Cambridge Better Bus Journeys consultation leaflet, November 2017

Multiple drop-in events were held as well as the information being made available online and though the distribution of consultation brochures. The responses for the consultation were recorded using a consultation questionnaire available online and as a hard-copy.

A summary of the findings regarding the preference of the Park and Ride site, and route option can be found below. The complete findings can be found in GCP Cambourne to Cambridge Better Bus Journeys: Phase One Summary Report of Consultation Findings (CCC, 2018) [7].

Formal public consultation key findings

- The results from the consultation showed that there is a preference for Scotland Farm Park and Ride site with 54% of the respondents supporting it, the main themes being:
  - Access to the site before congestion and from the main road
  - Distance of the site to where they live
  - The site's potential positive impact
- The results also showed that the preferred route was Option B 'On-Road' with 40% of the respondents saying they preferred it.
- The main themes were about the positive impact to congestion it would make on Madingley Road, the use of existing infrastructure, and the potential impact the 'Off-Road' option would have on the environment and the congestion on Grange Road.

3.2.2 Key stakeholder workshops

Two key stakeholder workshops were held to discuss details of the optimised on and off-road options for Phase 1 of the scheme. The on-road workshop was held on 27th February 2018 and the off-road workshop was held on 1st March 2018.

The attendees at each workshop were presented with the optimised on-road and off-line options for Phase 1, as presented at the conclusion of OAR Part 1, and how they compared with the shortlisted options that went out to formal consultation. Attendees had the opportunity to clarify certain elements of the scheme before dividing into groups for discussion and feedback. For the on-road options workshop there were 30 attendees and for the off-road workshop there were 26 attendees. The attendees were from numerous different organisations.

[7] Greater Cambridge Partnership Cambourne to Cambridge Better Bus Journeys: Phase One Summary Report of Consultation Finding, which can be found on the GCP website.

Each discussion group were given plans of the route which were split down into 6 sections to allow for a more detailed response. The sections were as follows:

- **Section 1:** Madingley Much Area, including the roundabout junction with the A428;
- **Section 2:** Cambridge Road Area, Madingley Road running from Madingley Mulch Roundabout to Cambridge Road;
- **Section 3:** From Cambridge Road to the M11 junction. Includes the Madingley Road, Cambridge Road junction;
- **Section 4:** From M11 to Conduit Head Road;
- **Section 5:** From Conduit Head Road to Storey's Way, and;
- **Section 6:** From Storey's Way to Lady Margaret Road.

3.2.2.1 Workshop feedback - On-road options

The following bullet points summarise the feedback from the workshop on the different options presented for public consultation and the optimised on-road options presented in OAR Part 1 under the general themes of the discussions:

- **Route Users** – need to ensure that the route is safe for all users including pedestrians, cyclists and equestrians; all complimentary walking and cycling routes need to be made 'none-motorised' user routes to consider equestrians; design alterations, implementing a toucan / pelican crossing; encouraging the use of existing segregated parallel Greenway Route and extend behind Churchill College hedge; implementing a lightweight pedestrian and cycling bridge over M11.
- **Safety** – concerns over vulnerable road users and the two schools whose pupils would use the route or cross it.
- **Congestion** – concerns that the traffic lights would cause further congestion; traffic lights at the Madingley Road, Cambridge Road junction was controversial with some people in favour and some against this intervention. There were also concerns over congestion whilst works were being progressed.
- **Cost** – the cost of the scheme was discussed.
- **Environmental** – There were concerns over the impact an on-road option would have on the American Cemetery.
- **Route design** – discussions over if the public transport lanes were long enough to make a difference to improving the routes; if the public transport lanes were going in the right direction; if land can be acquired to have a public transport lane in each direction. A new on-road route was suggested, taking a public transport vehicle up the A428 past Madingley Mulch Roundabout and creating a new junction onto Cambridge Road. This will then later join Madingley Road approximately 0.8km west of the M11 junction.

On-road workshop consultation key findings

- The workshop consultation showed that there was little to no objection to a on-road bus route, however there were concerns about the more specific elements of the design, road safety and vulnerable road users.
- There were also more general comments surrounding the environmental impact and cost of the scheme as well as suggestions limiting car parking to the west of Cambridge.
- No direct preference was given for the any of the shortlisted on-road optinos or the optimised on-road option.

3.2.2.2 Workshop feedback - Off-road options

The following bullet points summarise the feedback from the discussion groups who attended the workshops on the different options presented at public consultation and the optimised off-road options presented in OAR Part 1 under the general themes of the discussions:

- **Environment** – concerns over the build-up of traffic at either end of the blue route (i.e. Grange Road) where it is currently already congested during peak hours; the impact the visibility of the routes will have on the environment (although less so with the blue route); the development of an off-road route will have large environmental impact on Coton village; the development of the route on the Green Belt will cause severe harm to the environment and as such needs to demonstrate very special circumstances. There were concerns with regards to the Orchard and its future. Flood risks were also a concern of the group. The off-road route would also cause severance for wildlife movements.
- **Community** – There are concerns of the impacts on existing foot and cycle paths around Coton which may cause leisure activities such as dog walking, horse riding and cycling to be in jeopardy; the agricultural operations of the area will be disturbed with an off-road route; there are fears that the off-road route will cause severance to the local community.
- **Safety** – the suggested routes are very close to houses and schools which stakeholders identified as a safety concern.
- **Practicality** – stakeholders believe that the pink and blue routes were not deemed appropriate for public transport vehicles due to the 90-degree angles and the narrow width of some routes such as Adams Road; it was decided that the blue route gave a much quicker journey time than the pink route; stakeholders were unclear how the large number of public transport vehicles would merge successfully at the ends of the routes which are already congested.
- **Cost** – the cost of off-road schemes is so much higher than on road and there were concerns about how much value for money there would be.
- **General** – there were concerns about excessive disruption to residents around Madingley Mulch Roundabout; an alternative option to enhance the flow of traffic was to improve Girton Interchange; stakeholders would like to see more direct links to employment areas to encourage their patronage; Coton residents could take advantage of the scheme if a stop was implemented and a transport hub facility should be developed to help interchanges between different modes of transport or different routes. Queries also revolved around CAM and how this would work with the off-road routes.

Off-road workshop consultation key findings

- As with the on-road workshop, there was not one clear preferred option.
- The majority of comments were with regards to an off-road route in general rather than one of the specific off-road options.
- It was agreed however, that an off-road option would provide a fast, rapid transport system.
- Both the Green and Blue routes had identified benefits which made them more preferable than the Pink route:
  - The Green route was considered to have the least environmental impacts, and;
  - The Blue route was considered more visually pleasing and provides the most direct route and will therefore be most successful for modal shift.
- Nonetheless concerns over the environment, safety and community were high on participants agenda with regards to the off-road route options.

3.2.3 Market Research

A series of five focus groups between 16th and 24th January with residents in and around Greater Cambridge was undertaken by Systra[8]. As well as the focus groups a workshop was undertaken with the Local Liaison Forum (LLF)[9] members.

The options presented to the focus groups and the workshop with the LLF were the same route options taken to consultation between November 2017 and January 2018, as shown in **Figure 7.**

The objectives of the focus groups and workshop were to gain a greater understanding of the stakeholders' views on the proposed Park and Ride Sites, and route options. A summary of the results can be found below, the complete analysis and information regarding the focus group and workshop can be found in Cambourne to Cambridge Better Bus Journeys Qualitative Research (Systra, 2018).[10]

Systra market research consultation key findings

- As a result of the focus groups with residents it was concluded that a larger number of residents preferred the Scotland Farm Park and Ride site due to it distance from the city centre, its smaller visual and ecological impact and the level of accessibility it would provide to the west of Cambridge.
- Residents also showed preference to Option C, with the primary reason for this being the greater reliability of the service and the associated walking and cycling provisions.
- Feedback following the workshop from LLF members also showed that most members preferred the Scotland Farm site, and that if they had to choose one of the three route options presented, they would choose Option B. The reason for Option B is because it was considered more flexible than Option A, and Less destructive and costly compared to Option C.

3.2.4 Option design changes in response to consultation

Whilst many suggestions made had been previously considered and discounted some of the responses were adopted into the final options for assessment which have been detailed below:

[8] Systra are an engineering group with specialist in transport planning consultancy

[9] Local Liaison Forum are members of the local community who have regular dialog with the project team of any major transport project

[10] Cambourne to Cambridge Better Bus Journeys Qualitative Research (Ref: 107005) which can be found on the GCP website.

- During the development of the options the M11 bridge was identified as a cause of congestion. Therefore, an additional traffic lane over the M11 is required: There were two options considered. The first being a separate pedestrian and cycle bridge, then converting the current walkway into an additional lane; or alternatively widening the bridge to encompass the extra lane and a combined pedestrian walkway. The workshop feedback on the on-road option showed preference for a separate cycle and pedestrian walkway so the pedestrian bridge was taken forward in the Low Cost options.
- Consultation showed general support for Option B, which included a tidal public transport lane. In order to operate a tidal public transport lane safely there would, as a minimum, be a need for gantries along the route. The gantries would not be well received by consultees. Therefore, we took the bi-directional public transport lanes and optimised the on-road option to include both inbound and out bound public transport priority.
- The consultees suggested that the proposed public transport lane from High Cross junction be removed from the on-road option. It is proposed to include this instead as part of the optimised option discussed further in Section 3.3 of this OAR.

3.3 Final Optimised Option

As the traffic modelling carried out in OAR Part 1 of the optimised route showed no significant advantages from a public transport lane from High Cross Junction and Lady Margaret Road, and reflecting the consultation responses, it was decided this section would not be included in this scheme and instead improved cycling facilities would be implemented. This will be undertaken outside of this business case and as such, will be assumed to be a committed scheme and will form part of the Do Minimum option.

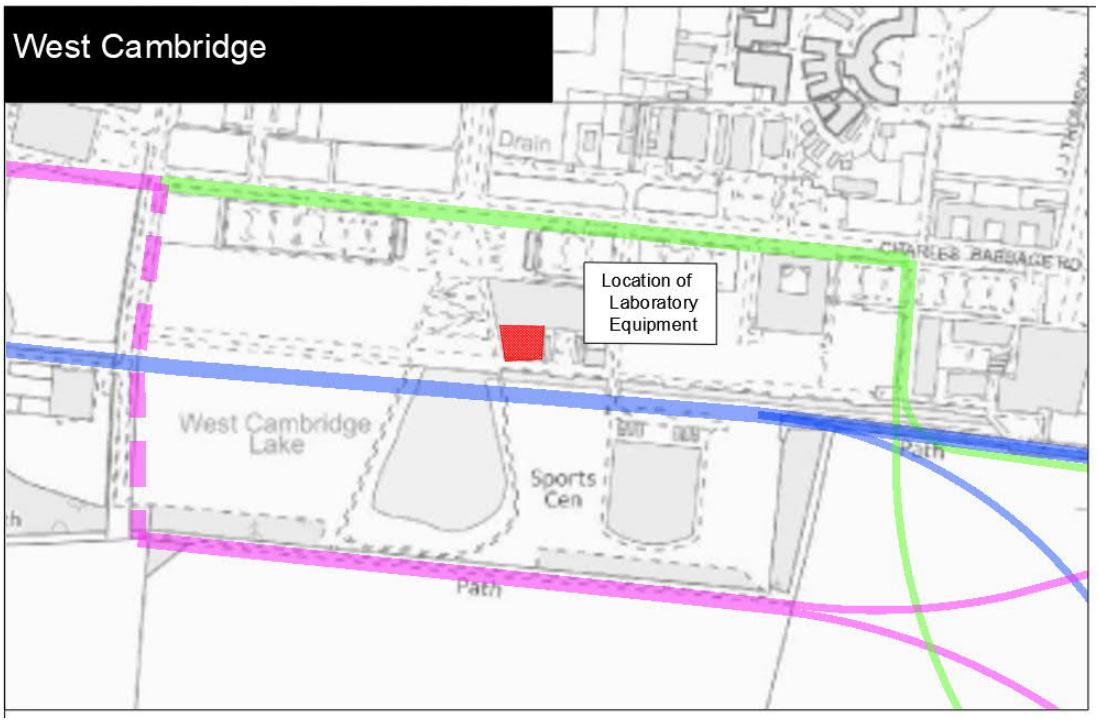
The traffic modelling also showed significant improvements from implementing changes to the M11 off and on slips and the junction with Madingley Road in order to allow traffic from the M11 off slip to use both lanes to turn right towards Cambridge. It was therefore decided that this would be included in the off-road options to be assessed in OAR Part 2.

3.4 West Cambridge Development

3.4.1 Background

During public consultation with stakeholders, most notably the University of Cambridge, it became apparent that there was additional, previously unknown information regarding the West Cambridge development site. Near the current blue route option is a highly sensitive laboratory shown in Figure 8. The laboratory equipment used within the MSM building is very sensitive to changes in Electromagnetic Interference (EMI) and vibrations and as such it has been decided to complete a review of the route options through this area. An initial site visit was undertaken on 26th February 2018 to inform the initial assessments which are summarised in the following sections.

Figure 8: Location of the highly sensitive laboratory equipment



Source: Mott MacDonald

3.4.2 Electro Magnetic Interference

3.4.2.1 Context

The laboratory equipment used within the MSM building is very sensitive to changes in ambient quasi-static magnetic flux density. The ambient magnetic flux density is characterised by the earth's magnetic field, and nearby large metallic objects, such as buses, which will cause perturbations to this field. If large enough, these perturbations may affect the operation of the laboratory equipment within the MSM building.

The MSM building of the Cambridge University houses equipment and laboratory devices that are sensitive to changes in the earth's magnetic field. Though the MSM equipment has operated with the present magnetic field disturbance, the ongoing project could result in a significant change to this disturbance through the introduction of a new public transport vehicle type (comprising different quantity and shape of materials having magnetic and conductive properties) and (or) new closer public transport routes.

3.4.2.2 Assessment

Without a prior knowledge of the new public transport vehicle design and other factors (such as neighbouring structures, elevators etc), a full 3D electromagnetic assessment would be difficult. Instead, an approximate model was used to characterize the decay of the disturbance created by typical magnetic materials used in a public transport vehicle design.

The model was then used to assess the local geomagnetic disturbance levels, to be expected due to the movement of public transport vehicles in close proximity to the MSM building.

3.4.2.3 Results

What Impact does this have on the current alignment?

The assessment shows that both the variation in the amount of the magnetic material and distance of the bus from the MSM building will impact on the level of geomagnetic perturbation. It shows that increase in the magnetic material will directly increase the level of perturbation, whereas increase in the distance will reduce the level of perturbation rapidly.

Using the assumptions presented in the EMI report, initial assessment suggests that the green route is unlikely to cause any issues to the existing equipment within the MSM building, whereas the blue route results indicate that problems could be caused. As noted above, these results are highly dependent on details of the final vehicles to be used as well as the final alignment and confirmation of the sensitivity of the equipment within the MSM building.

It should also be noted that the University of Cambridge has proposals to develop the area around the MSM building and that several new buildings are proposed in close proximity. Consideration of the impact of those buildings and associated construction and operational traffic will be required. It is not currently clear whether such impacts will be greater or lesser than those of C2C

3.4.3 Vibration

3.4.3.1 Introduction

As with EMI, initial discussions with the MSM building owners have indicated that the rear annexe of the building which houses electron microscopy equipment is also extremely sensitive to vibration. As such, a clear understanding of the potential levels of vibration from the proposed public transport scheme within this area will be required to ensure that any adverse impacts to the operation of the facility can be eliminated or minimised to acceptable levels.

3.4.3.2 Assessment

Since limited information is currently available regarding the MSM building structure, current vibration isolation measures and operational vibration limits, a technical note[11] has been produced that sets out the generic issues that are expected due to the construction and operation of the proposed public transport route near to such a sensitive receptor; provides a high-level comparison between current and potential future levels of vibration from the scheme; and outlines the range of potential mitigation measures that might be adopted to limit the vibration impacts from the scheme.

Initial estimates of vibration levels due to the proposed scheme, based on established guidance and measurements of comparable systems, are likely to exceed the specified vibration criteria. However, estimates of the existing vibration levels from road traffic indicate a significant possibility that these criteria are already being exceeded. Since it is believed that the equipment is currently operating satisfactorily, it is considered that the current vibration criteria specified by the MSM building operators are likely to be overly-conservative for the currently installed equipment.

Should the route Options through West Cambridge for this scheme be pursued, a more detailed assessment will be required to determine the potential vibration impacts of the scheme on the

[11] 392438-MMD-ENV-XX-TN-EN-0001 Potential Vibration Impacts at Cambridge University MSM Building, Mott MacDonald, 2018

operations of the MSM building equipment and what mitigation measures might be required (if any).

3.4.3.3 Results

What Impact does this have on the current alignment?

Initial assessment on vibration levels of the current route, based on available data, shows potential vibration of between 49 VdB and 52 VdB at the edge of the building structure. This exceeds the estimated equivalent limit of 42 VdB.

It should be noted that the existing vibration levels from Charles Babbage Road (location of the proposed light green route) has also been made using the same approach. The road is around 50m (160ft) from the nearest face of the MSM building. This provides an estimated ground surface vibration level of approximately 53 VdB, reducing to between 43 VdB and 46 VdB at the edge of the building structure. While this is closer to the equivalent limit of 42 VdB and within the expected margin of around 5 dB, this indicates that there is a significant possibility that the existing vibration levels due to road traffic are exceeding the specified NIST-A criteria.

As with the EMI, and perhaps more significantly, the University of Cambridge proposals to develop the area around the MSM building will probably have significant impact on vibration in the vicinity, particularly during the demolition phases. As such it is not currently clear whether these will be more or less significant than any impact associated with C2C.

3.4.4 Revised INSET

3.4.4.1 Development of scoring post OAR 1

As part of OAR (Part 1) INSET scoring was carried out on various sections of the off-road alignment in order to arrive at a recommended Route Alignment. Due to the additional information regarding the sensitive equipment in the MSM building, the OAR (Part1) INSET table has been reviewed for area 4: West Cambridge, this is only for the purposes of this technical note and will not replace the OAR 1 INSET assessment. A summary of the project updates and the effect that had on the scoring is shown in Table 3.

Table 3: Update to INSET Scoring

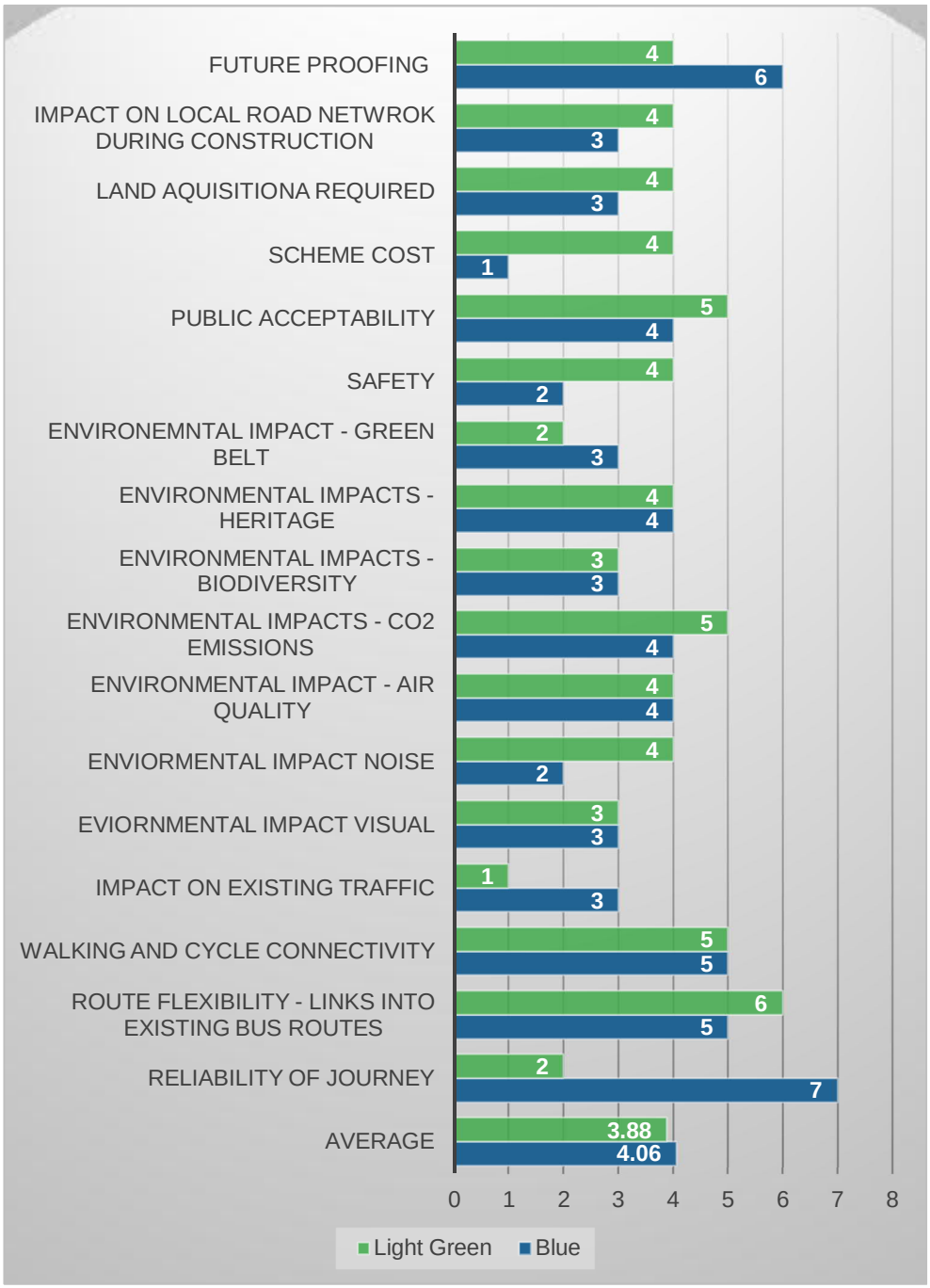
Assessment Criteria	Project Updates	Previous score	Updated Score
Environmental Impact – Noise	The assessments detailed in section 3.4.2 indicates that there may be some issues around EMI and vibration with the current blue route through the University West development.1 and indicates that there may be some issues around EMI and vibration with the current blue route through the University West development. Therefore, the score has been changed to reflect this new information. As there are no criteria to cover this it has been added to the “noise” criteria.	Blue route - 4	Blue route - 2
Environmental Impact – Biodiversity	Originally the M11 crossing was not part of the “Area 4” that was assessed. However, if the green route were chosen it would have a greater impact on the nature reserve to the east of the M11. Therefore, the light green route has been updated to reflect this.	Light Green Route - 4	Light Green Route - 3

Assessment Criteria	Project Updates	Previous score	Updated Score
Public Acceptability	Following the publishing of OAR 1 the results of the public consultation were received. As previously assumed there was support from the University for the Light green route. However, there were also comments from local stakeholders that it was more central. Although there were additional comments there was not enough to change the scores	Light Green Route - 5	No Change

Source: Mott MacDonald

Taking into account the updates highlighted in Table 3 the blue route overall scores higher than the pink or light green route as shown in Figure 9. This is in line with the original assessment in OAR (Part 1).

Figure 9: Area 4: West Cambridge INSET Scoring



Source: Mott MacDonald

Although the results are close overall the blue route scored the highest with the light green being ranked the next best. If we review all of the criteria, there are some in which light green scored significantly lower than blue. These include;

1. Reliability of Journey
2. Impact on Existing Traffic
3. Future proofing

All these criteria relate to the fact that the light green route is shared running along Charles Babbage Road. For the green route to be able to be more desirable these issues need to be addressed.

3.4.4.2 Design Changes

A revised alignment of the Light Green route, which will be referred to in this note as the Segregated Light Green route, proposes a segregated route to the south of Charles Babbage Road. A more detailed draft design has been developed and shown in Annex A.

The alignment is based on the proposed West Cambridge masterplan.[12]

3.4.4.3 Review of INSET changes based on proposed Segregated Light Green route

An additional INSET assessment was undertaken of the proposed Segregated Light Green route as shown in Annex A. Table 4 details which criteria has changed from the INSET assessment of the original Light Green route, the justification and details of the previous and new score.

Table 4: Justification of INSET scoring

Assessment Criteria	Detail of Change	Previous Score	Updated Score
Reliability of Journey	With the segregated route there is expected to be a greater reliability in journeys	2	6
Impact on existing traffic	The public transport vehicle will be segregated to there is expected to be a reduction in the impact of the scheme on existing traffic	1	3
Environmental – CO2 emissions	Previously this option showed a slight saving in Carbon. However, with the additional works required it is expected to now have a neutral impact	5	4
Safety	As shown on the proposed alignment in Annex A there are two break throughs of the segregated route onto Chares Babbage Road, as such road vehicles would have to cross a two public transport only lanes before accessing the road. It is expected this will have some safety impacts although mitigation methods could be used such as; clear signage, speed restrictions etc.	4	2
Scheme Cost	The previous design was using existing infrastructure so there was no cost. However, with the segregated route there will be new highway infrastructure and some junctions required.	4	3
Land Required	The previous design was using existing infrastructure so there was no land required. However, to incorporate a public transport only segregated section land to the south of Charles Babbage Road will be required.	4	3
Impact on Local Road Network	The previous design was using existing infrastructure so there was no construction required on Charles Babbage Road. However, the Segregated Light Green route would require infrastructure and junctions to be built.	4	2
Future Proofing	With the route now being segregated it provides opportunity for potential future schemes with minor changes.	4	6

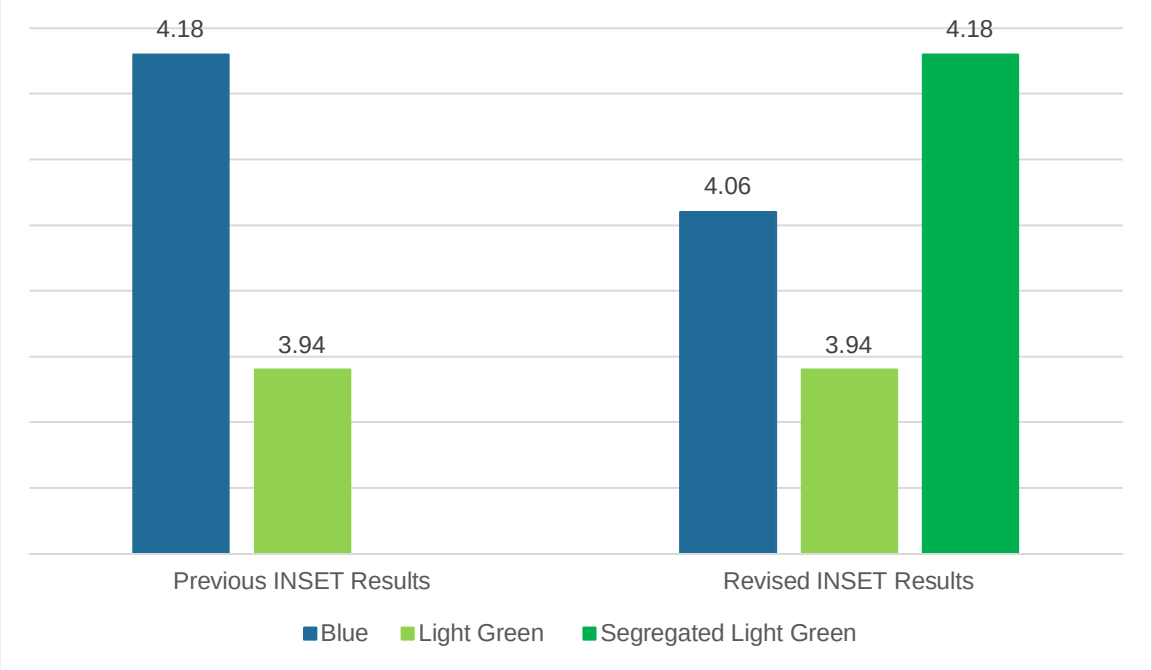
Source: Mott MacDonald

[12] http://www.westcambridge.co.uk/

3.4.4.4 Results

Figure 10 shows that with the changes detailed in Annex A, the Segregated Light Green route becomes the recommended route. It should be noted that the change from the previous blue route INSET results and the Revised INSET results is based on information highlighted in Figure. shows that with the changes detailed in Annex A, the Segregated Light Green route becomes the recommended route.

Figure 10: Comparison of INSET results



Source: Mott MacDonald

3.4.5 Summary

From an initial assessment of the impact of the current recommended off-road route it is suggested that there may be some issues around electromagnetic interference and vibration. However, these reviews are based on a number of assumptions and will require further investigation to conclusively assess the true impact.

Furthermore, whilst this impact has been incorporated into the INSET scoring the recommended off-road route is still the Blue option.

It has been suggested that in order for the light green route to align with the scheme vision and objectives the section on Charles Babbage road needs to be segregated. A proposed alignment was created and can be seen in Annex A. This alignment is based on the future masterplan for West Cambridge development, so consideration will need to be made on phasing.

A revised INSET assessment of the Segregated route was completed and this now becomes the recommended route over the blue route through area 4: West Cambridge.

The next step is to complete further, more detailed assessments of the electromagnetic interference and vibration impacts on the Laboratory equipment and discuss the alignment with the University of Cambridge. Given the close nature of the scores, either the Blue route or a Segregated green route would be considered acceptable to GCP.

What Impact does this have on the current alignment?

For the INSET assessment outlined in the following chaptersof this OAR (Part 2) report, the off-road route will be the blue route through Cambourne, Madingley Mulch Roundabout and Coton, with the light green crossing of the M11 and the light green segregated route through West Cambridge, connecting to Grange road from the Rifle Range track.

4 Options Assessment Stage 2, Step 2 - Final Options List

4.1 Introduction

The options assessed as part of Stage 2, Step 2 reflect the consultation feedback and consequential option refinement. These form the basis for what is reported in OAR Part 2 and are set out in this section.

4.2 Final options to be assessed

The final list of the options to be assessed in OAR Part 2 are:

- **Do Minimum**
- **Low Cost a** – Completion of recommended on-road Phase 1, and Park and Ride at Water Works
- **Low Cost b** – Completion of recommended on-road Phase 1, and Park and Ride at Scotland Farm
- **Do Something 1a** – Recommended off-road Phase 1, and Park and Ride at Water Works
- **Do Something 1b** – Recommended off-road Phase 1, and Park and Ride at Scotland Farm
- **Illustrative Comparator** - All above options tested against an illustrative comparator from Camborne to Cambridge. This comparator comprises an off-road scheme between Camborne and Grange Road with a Park and Ride at the Waterworks site[13], near to Madingley Mulch roundabout.

Detailed drawings of each option can be found in Annex A, with high-level route drawings and descriptions set out in the sections below.

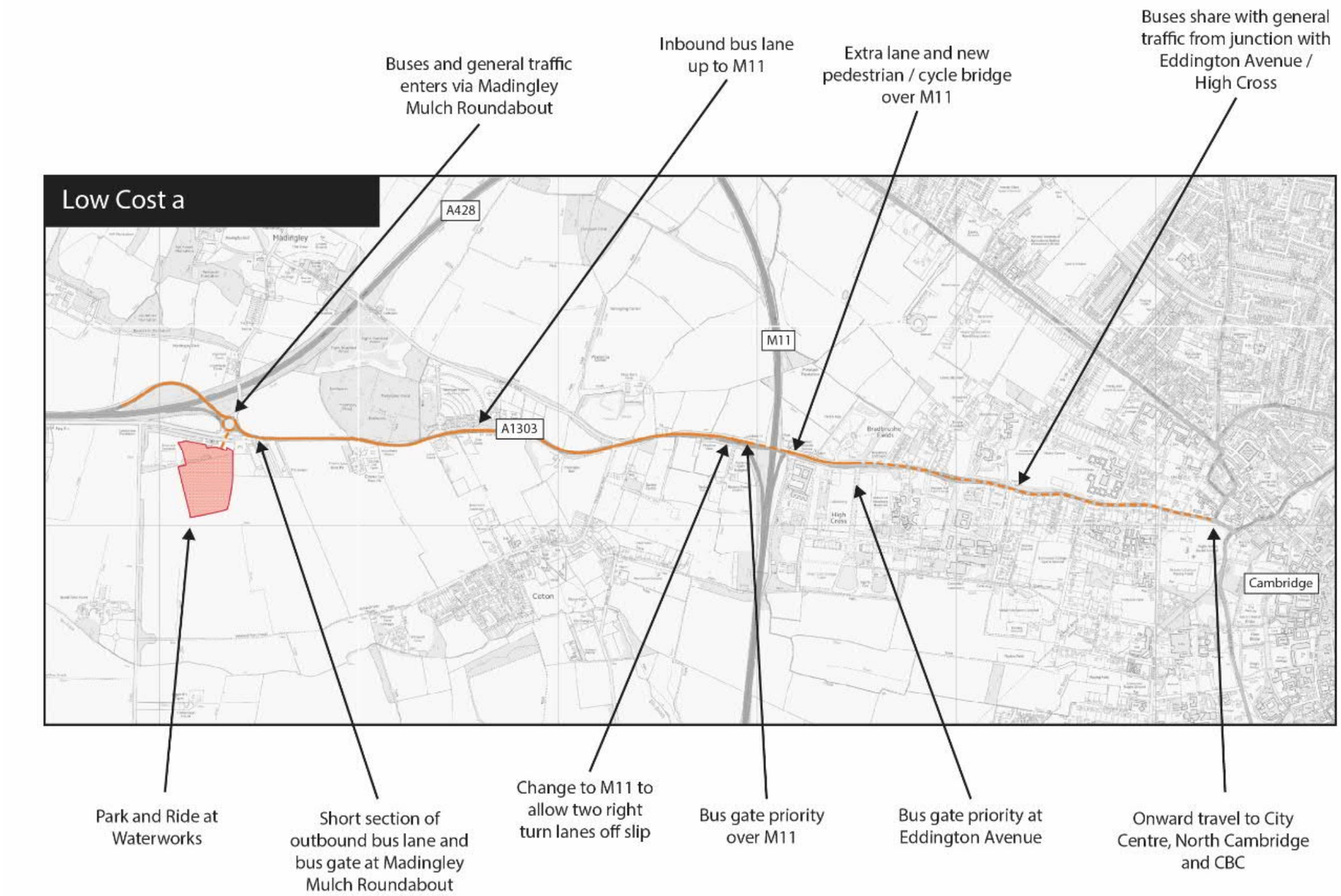
4.2.1 Do Minimum

The Do Minimum option comprises of highway improvements that will be completed prior to the delivery of C2C scheme. This is limited to improved cycle facilities along the Madingley Road between west Cambridge development site and Storeys Way.

[13] The illustrative comparator is used as a means to assess a strategic option and is not intended to preclude any options for Phase 2 including a Park and Ride at Scotland Farm

4.2.2 Low Cost a

Figure 11 - Low Cost a (Waterworks Park and Ride)



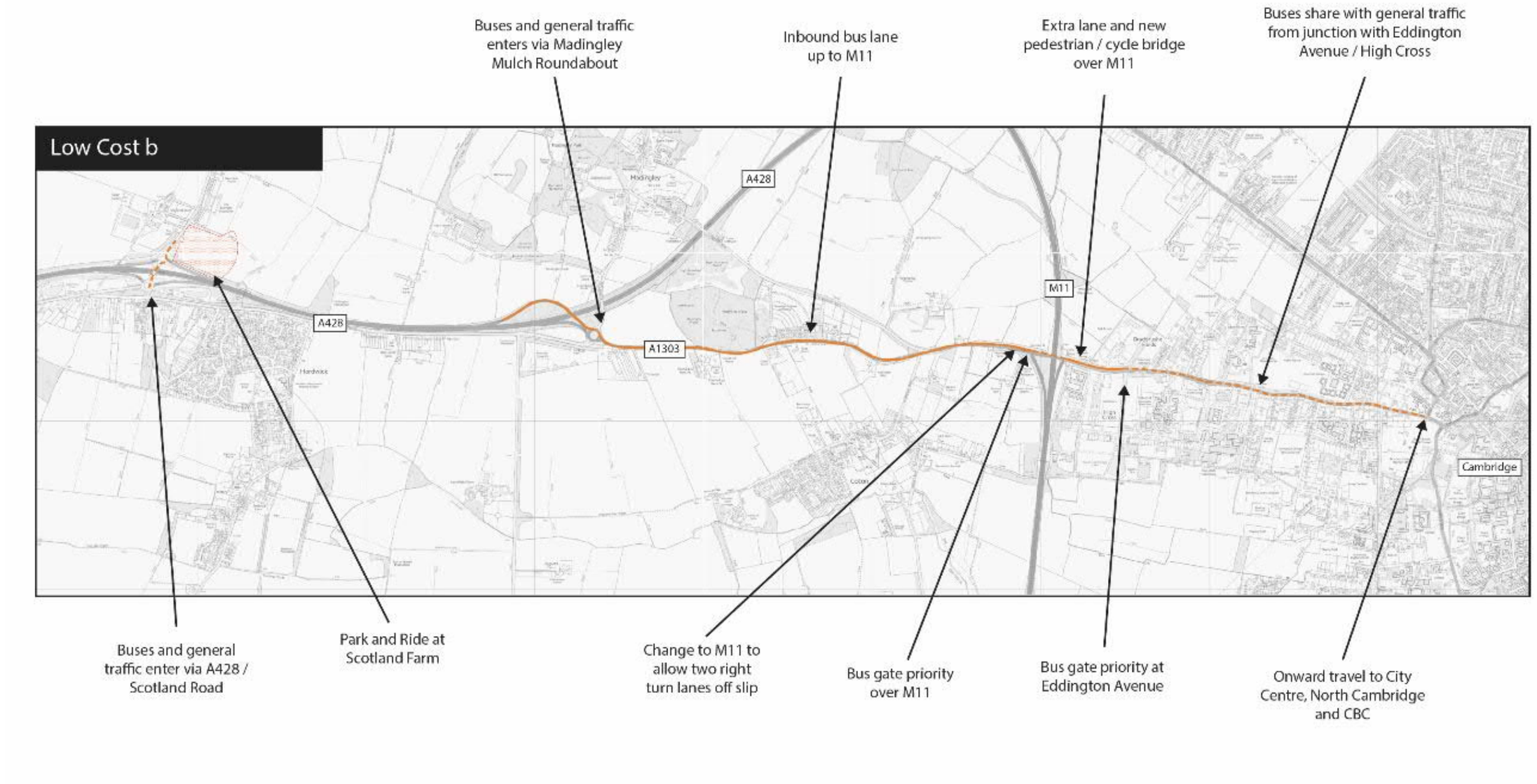
Source: Mott MacDonald, (© Crown Copyright. All Rights Reserved. OS License Number 100023205.2018)

Improvements to be implemented as part of Low Cost a option include:

- A new public transport lane on the A428;
- Signalisation of Madingley Roundabout;
- An east bound public transport lane from Madingley roundabout until it ties in to the existing public transport lane at the M11;
- Improvements to the on and off slip lanes at the M11;
- New cycle lanes between High Cross Junction and Lady Margaret Road;
- An east bound public transport lane from the M11 to High Cross junction, and;
- Amendments to the entrance and exit of the existing Madingley Road Park and Ride.
- An extra east bound lane over the M11, and junction improvements with the slip roads;
- A new footway cycle way bridge over the M11;
- A Park and Ride at Madingley Mulch Roundabout;
- Amendments to Madingley Mulch Roundabout to allow for entrance and exit of new Park and Ride site, and;
- Making St Neots Road between Long Road and Madingley Mulch Roundabout public transport vehicles only.

4.2.3 Low Cost b

Figure 12 - Low Cost b (Scotland Farm Park and Ride)



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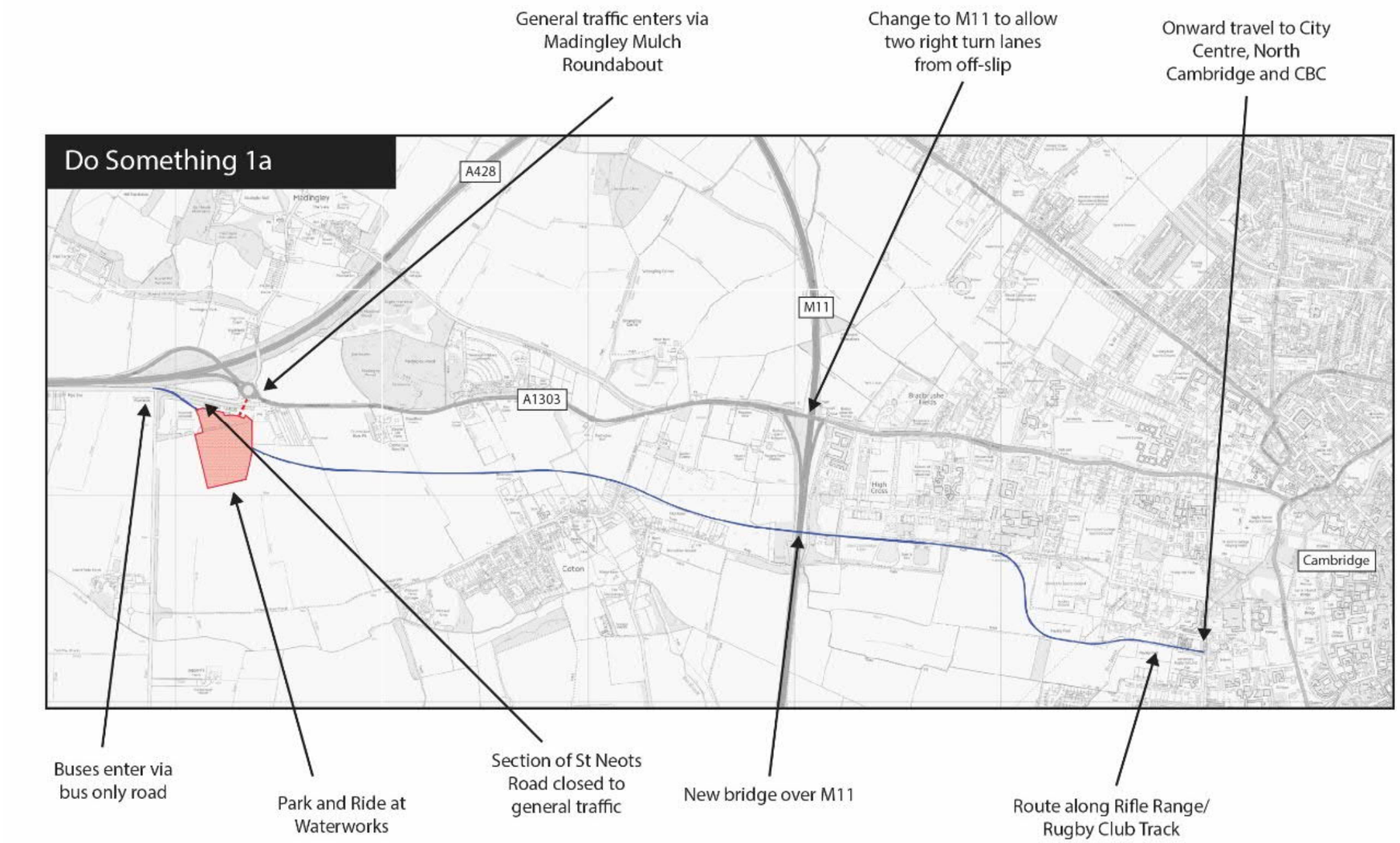
Improvements to be implemented as part of Low Cost b option include:

- A new public transport lane on the A428;
- Signalisation of Madingley Roundabout;
- An east bound public transport lane from Madingley roundabout until it ties in to the existing public transport lane at the M11;
- Improvements to the on and off slip lanes at the M11;
- New cycle lanes between High Cross Junction and Lady Margaret Road;
- An east bound public transport lane from the M11 to High Cross junction, and;
- Amendments to the entrance and exit of the existing Madingley Road Park and Ride.
- An extra east bound lane over the M11, and junction improvements with the slip roads;
- A new footway cycle way bridge over the M11;
- A Park and Ride at Scotland Farm Road;
- Amendments to Scotland Farm Road and at the northern A428 Hardwick Interchange roundabout to allow for entrance and exit of new Park and Ride site, and;
- Making St Neots Road between Long Road and Madingley Mulch Roundabout public transport vehicles only.

4.2.4 Do Something 1a

Figure 13 - Do Something 1a (Waterworks Park and Ride)



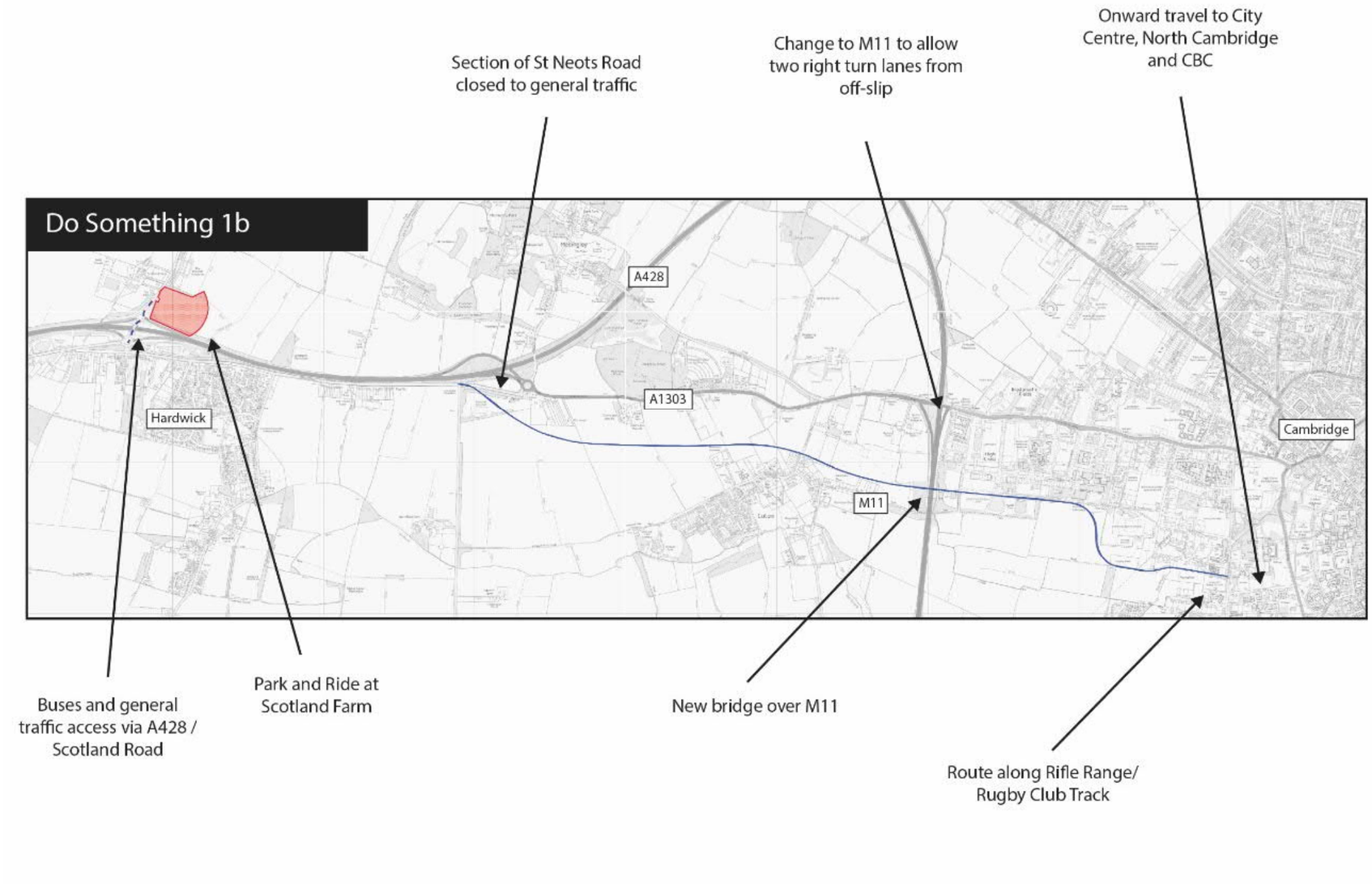
Source: Mott MacDonald, (© Crown Copyright. All Rights Reserved. OS License Number 100023205.2018)

Improvements to be implemented as part of the Do Something 1a option include:

- A segregated public transport route and cycle way from Long Road to Grange Road;
- A Park and Ride at Madingley Mulch Roundabout;
- Amendments to Madingley Mulch Roundabout to allow for entrance and exit of new Park and Ride site;
- Making St Neots Road between Long Road and Madingley Mulch Roundabout closed to general traffic;
- A new signalised junction on Cambridge Road at Coton Village;
- A new bridge crossing the M11 with footway/cycleway;
- A new signalised junction on Ada Lovelace Road;
- A new bridge across West Cambridge Lake;
- Amendments to Rifle Range access road for public transport route and footway/cycleway, and;
- New signalised junction on Grange Road with the Rifle Range access road.
- Improvements to the on and off slip lanes at the M11, and junction improvements with the slip roads to allow traffic from the M11 off slip to turn right from both lanes.

4.2.5 Do Something 1b

Figure 14 - Do Something 1b (Scotland Farm Park and Ride)



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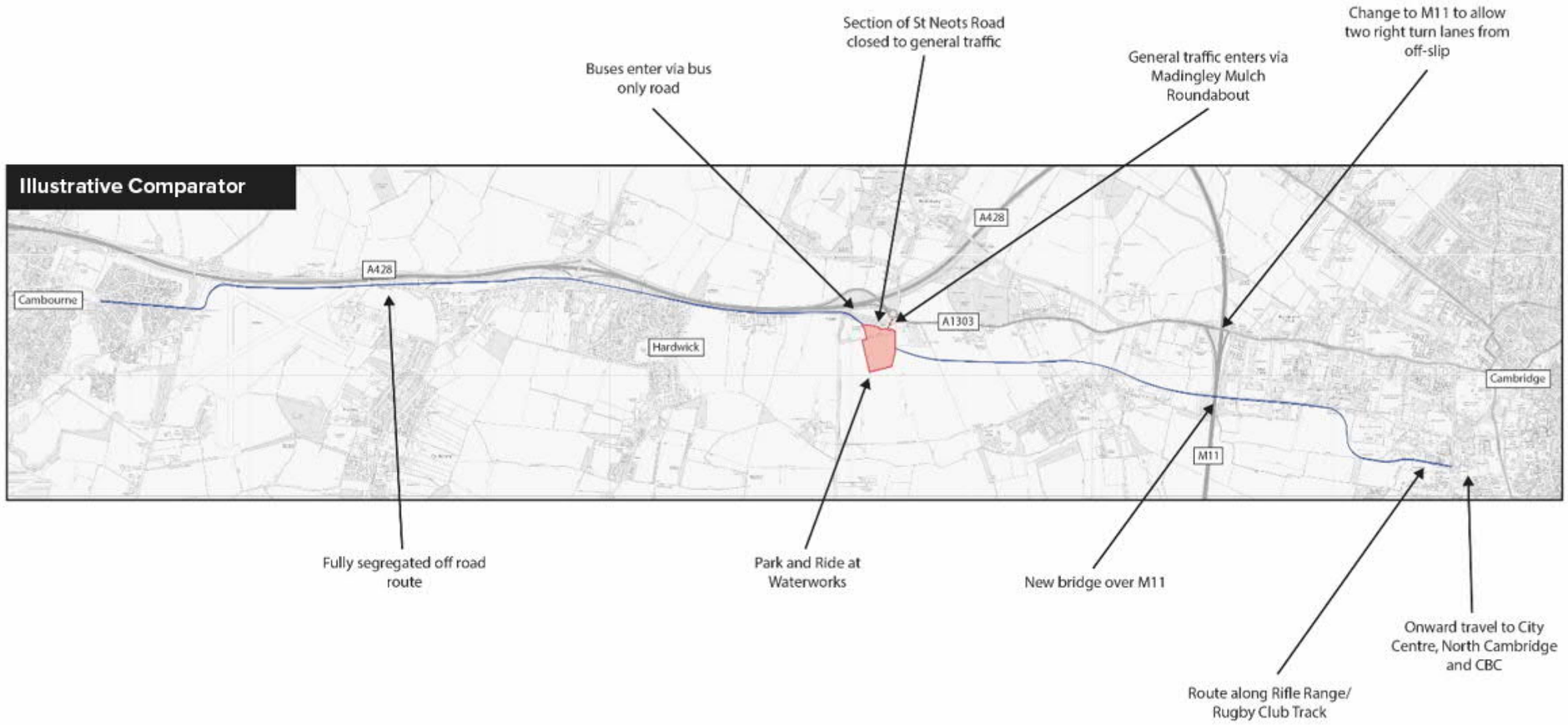
Improvements to be implemented as part of the Do Something 1b option include:

- A segregated public transport route and cycle route from Long Road to Grange Road;
- A Park and Ride at Scotland Farm Road;
- Amendments to Scotland Farm Road and at the northern A428 Hardwick Interchange roundabout to allow for entrance and exit of new Park and Ride site;
- Making St Neots Road between Long Road and Madingley Mulch Roundabout closed to general traffic;
- A new signalised junction on Cambridge Road at Coton Village;
- A new bridge crossing the M11 with footway cycleway;
- A new signalised junction on Ada Lovelace Road;
- A new bridge across West Cambridge Lake;
- Amendments to Rifle Range access road for public transport route and footway/cycleway, and;
- New signalised junction on Grange Road with the Rifle Range access road;
- Improvements to the on and off slip lanes at the M11, and junction improvements with the slip roads to allow traffic from the M11 off slip to turn right from both lanes.

4.2.6 Illustrative Comparator

Figure 15 - Illustrative Comparator



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Improvements to be implemented as part of the Illustrative Comparator include:

- A segregated public transport route and cycle way from Cambourne to Long Road (Phase 2);
- A segregated public transport route and cycle way from Long Road to Grange Road (Phase 1);
- A new signalised junction with St Neots Road to the east of Bourn Airfield;
- Amendments to the southern A428 Hardwick Interchange roundabout;
- A Park and Ride at Madingley Mulch Roundabout;
- Amendments to Madingley Mulch Roundabout to allow for entrance and exit of new Park and Ride site;
- Making St Neots Road between Long Road and Madingley Mulch Roundabout closed to general traffic;
- A new signalised junction on Cambridge Road at Coton Village;
- A new bridge crossing the M11 with footway/cycleway;
- A new signalised junction on Ada Lovelace Road;
- A new bridge across West Cambridge Lake;
- Amendments to Rifle Range access road for public transport route and footway/cycleway, and;
- New signalised junction on Grange Road with the Rifle Range access road.

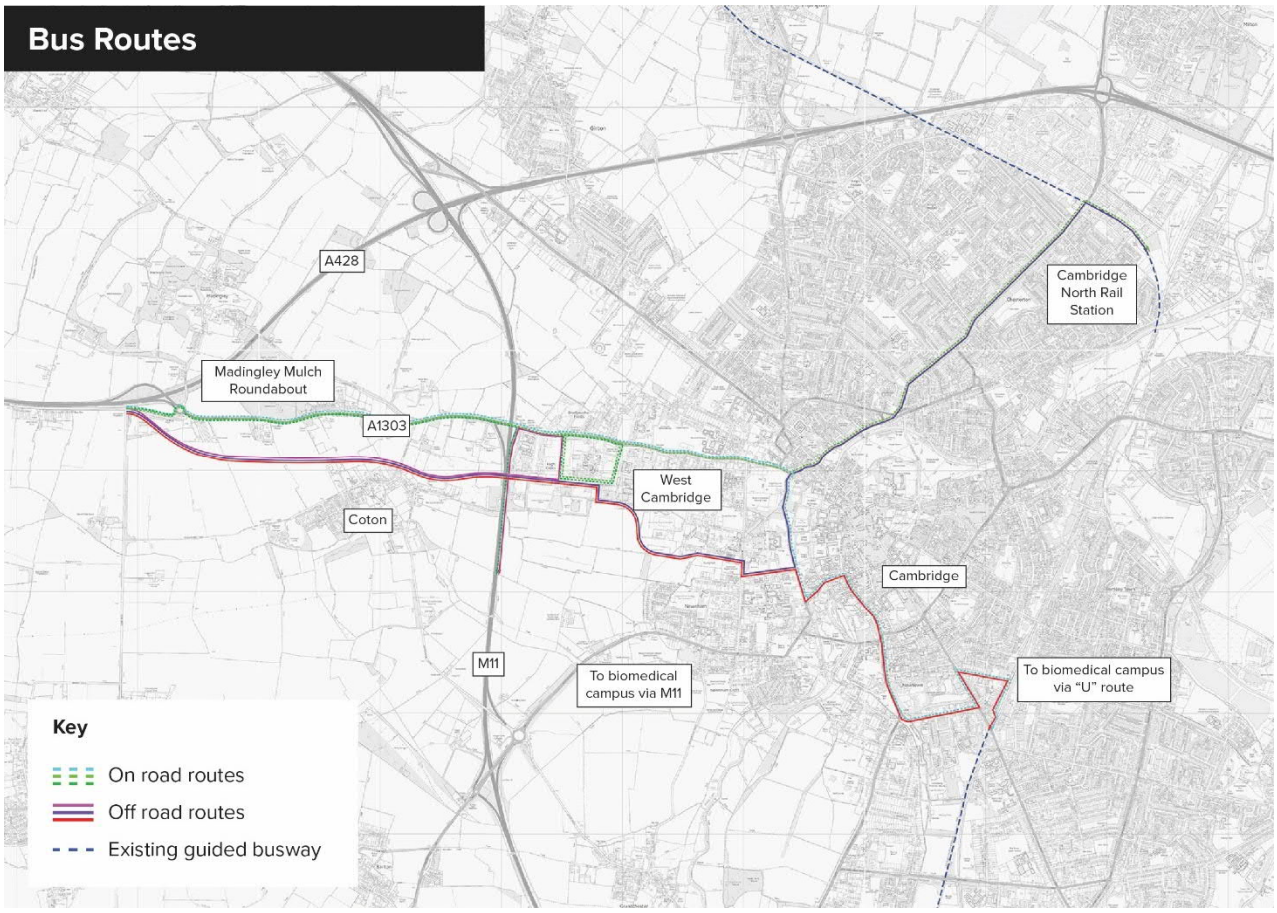
4.3 Public transport Routes Beyond Scheme

Where the proposed public transport routes enter Cambridge, the aim is to link the busses to areas with jobs and high amount of potential growth, the route options shown in Figure 17 were chosen following consultation. The nine busses an hour were split into;

- 3 vehicles to the biomedical campus – via the M11
- 3 vehicles to the biomedical campus – via Cambridge Rail Station
- 3 vehicles to the Science Park – via Cambridge North Rail Station

Further work will continue alongside public transport operators to ensure the route modelled at the final OBC stage represents the most realistic scenario. Additional routes could be considered, such as a route via West Cambridge and the new developments at Eddington and Darwin Green to the Cambridge Science Park.

Figure 16 – Proposed public transport route into Cambridge



Source: Mott MacDonald, (© Crown Copyright. All Rights Reserved. OS License Number 100023205.2018)

4.4 Summary of options

The final composition of the short-listed of the options assessed as part of Stage 2, Step 2 are set out in Table 5.

Table 5: Summary of Short-listed Options composition assessed as part of Stage 2 - Step 2

		Do Minimum	Low Cost a	Low Cost b	Do Something 1a	Do something 1b	Illustrative Comparator
P&R	P&R Water Works		✓		✓		✓
	Amendments to Madingley Mulch Roundabout to allow for entrance and exit of new P&R		✓		✓		✓
	P&R Scotland Farm			✓		✓	
	Amendments to Scotland Farm Road and at the northern A428 Hardwick Interchange roundabout to allow for entrance and exit of new			✓		✓	
On-Road improvements	A new bus lane on the A428;		✓	✓			
	Signalisation of Madingley Roundabout;		✓	✓			
	An east bound bus lane from Madingley roundabout until it ties in to the existing bus lane at the M11;		✓	✓			
	New cycle lanes between High Cross Junction and Lady Margaret Road;	✓	✓	✓	✓	✓	✓
	An east bound bus lane from the M11 to High Cross junction		✓	✓			
	Amendments to the entrance and exit of the existing Madingley Road Park and Ride.		✓	✓			
	Making St Neots Road between Long Road and Madingley Mulch Roundabout bus only.		✓	✓			
M11	Improvements to the on and off slip lanes at the M11;		✓	✓	✓	✓	✓
	An extra east bound lane over the M11		✓	✓			
	A new footway cycle way bridge over the M11;		✓	✓			
	A new bridge crossing the M11 with footway cycleway;				✓	✓	✓
Off Road Improvements	A segregated bus route and cycle route from Long Road to Grange Road;				✓	✓	✓
	Making St Neots Road between Long Road and Madingley Mulch Roundabout closed to general traffic;				✓	✓	✓
	A new signalised junction on Cambridge Road at Coton Village;				✓	✓	✓
	A new signalised junction on Ada Lovelace Road;				✓	✓	✓
	A new bridge across West Cambridge Lake;				✓	✓	✓
	Amendments to Rugby Club access road for busway and footway/cycleway				✓	✓	✓
	New signalised junction on Grange Road with the Rugby Club access road.				✓	✓	✓
	A segregated bus route and cycle way from Cambourne to Long Road (Phase 2);						✓
	A new signalised junction with St Neots Road to the east of Bourn Airfield;						✓
	Amendments to the southern A428 Hardwick Interchange roundabout;						✓

Source: Mott MacDonald

5 Options Assessment: INSET Assessment Process and Results

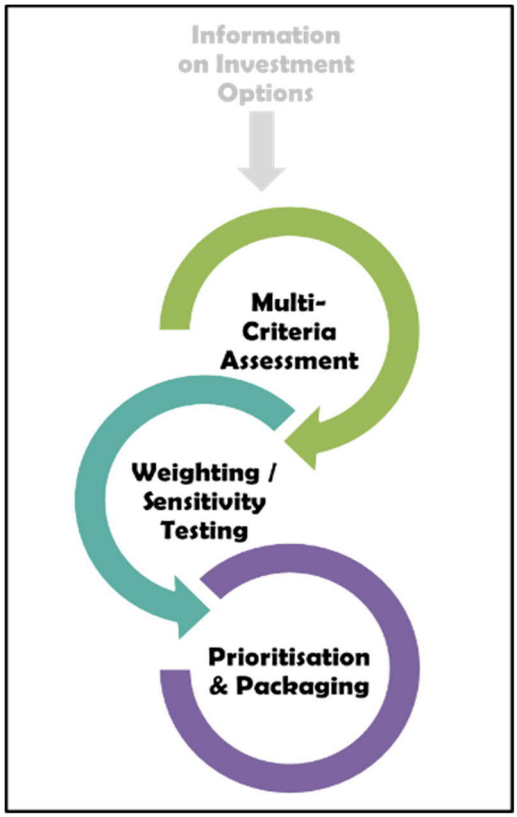
5.1 Our methodology

For the Stage 2, Step 2 options assessment, we applied Mott MacDonald's in-house Investment Sifting and Evaluation Tool (INSET) to assess options against 37 criteria developed to establish how well each option aligned with the criteria derived from the scheme objectives. Scoring was based on a combination of qualitive and quantitative assessment undertaken by the appropriate teams. This facilitated a comparison and ranking of the options.

5.2 INSET

INSET is a MCAF decision support toolkit developed in-house by Mott MacDonald which is used through the development of this scheme to carry out the initial sift. INSET is designed to be simple, flexible, replicable and transparent. It is based on Green Book compliant Multi-Criteria Decision Analysis (MCDA) and is an enhancement of the DfT's EAST (Early Assessment and Sifting Tool) process. It takes the previous MCAF assessments undertaken at earlier stages of the scheme and has developed and amended the criteria as required for the level of assessment being undertaken.

Figure 17: Mott MacDonald's Investment Sifting and Evaluation Tool (INSET)



Source: Mott MacDonald

INSET draws upon standard tools for comparing scheme options, and adds additional functionality to these existing tools. Mott MacDonald has developed INSET as an enhancement of EAST to support the evaluation of different options for large-scale investments and investment programmes. Crucially it enables:

- 'Active' sifting of options in real-time, supporting meetings, workshops and face-to-face engagement with a tool that can be used to facilitate discussions;
- The consideration of multiple economic scenarios as sifting and evaluation progresses, through manipulation of criteria weighting, to enable project teams to discuss what if 'issues as options are developed, and;
- The assessment of potential scheme packaging. INSET can assess one option against another and can also explore the merits of options being developed in isolation or as part of a package.

5.3 Assessment criteria

The assessment criteria for the options were generated from the scheme vision and objectives (these are set out in OAR Part 1). These are grouped into the following themes that have been selected to reflect the scheme objectives:

- Policy Fit
- Contribution to Economic Growth
- Contribution to improved transport network
- Contribution to quality of life
- Scheme Deliverability
- Stakeholder support

These themes were then broken down into 37 selection criteria which will be used to assess the different route options. The list of criteria used for Stage 2, Step 1 (as set out in OAR Part 1) are shown in Table 6 below.

Table 6: Assessment criteria as of OAR Part 1

Theme	Assessment criteria
Policy Fit	Cambridgeshire LTP3
	Highways England Road Investment Strategy (RIS)
	Greater Cambridge and Peterborough SEP
	Greater Cambridge City Deal
	South Cambridgeshire Draft Local Plan
	Cambridge City Draft Local Plan
Contribution to Economic Growth	Access to existing homes and jobs
	Supporting house construction
	Supporting job creation
	Increase in GVA
	Capacity
Contribution to improved transport network	Reliability of journey
	Route flexibility - Links into existing public transport routes
	Walking and cycle connectivity
	Impact on existing traffic
	Journey times

Theme	Assessment criteria
	Service frequency
	Mode share
	Connectivity to Park and Ride
Contribution to quality of life	Environmental impacts - Visual Impact
	Environmental impacts – Noise
	Environmental impacts - Air Quality
	Environmental impacts - CO_2 emissions
	Environmental impacts – Biodiversity
	Environmental impacts – Heritage
	Environmental impacts – Green Belt
	Safety
	Accessibility
Scheme Deliverability	Scheme Cost
	Engineering feasibility - construction method
	Land acquisition required
	Impact on local road network during construction
	Future proofing
	Legislative Powers
	Scheme Maintenance and Renewals
Stakeholder support	Public acceptability

Source: Mott Macdonald

5.3.1 Criteria revisions for Stage 2, Step 2

As part of the assessment of the options during Stage 2, Step 2 the criteria have been reviewed and where appropriate changed. None of the assessment criteria that have been altered were used to assess the options during Stage 2, Step 1 (OAR Part 1).

The assessment criteria that have been altered as shown in **Figure 18.**

Figure 18: Stage 2, Step 2 Criteria Revisions

Source: Mott MacDonald

The final list of updated assessment criteria used in Stage 2, Step 2 assessment of the options is shown in Table 7. The detailed descriptions of each assessment criteria are set out in Sections 5.4 to 5.9.

Table 7: Assessment criteria used in Stage 2

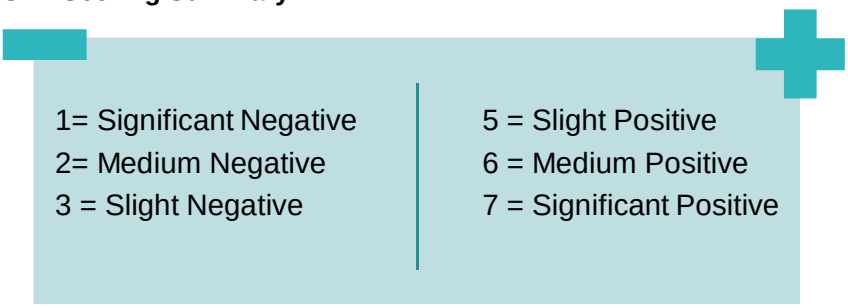
Theme	Assessment criteria
Policy Fit	Cambridgeshire LTP3
	Highways England Road Investment Strategy (RIS)
	Greater Cambridge and Peterborough SEP
	Greater Cambridge City Deal
	South Cambridgeshire Draft Local Plan
	Cambridge City Draft Local Plan
Contribution to Economic Growth	Labour Market and Activity
	Business investment and Growth
	Cambridge Positive Image
	Future potential growth post 2031
	Capacity
Contribution to improved transport network	Reliability of journey
	Route flexibility - Links into existing public transport routes
	Walking and cycle connectivity
	Impact on existing traffic
	Journey times
	Service frequency
	Mode share
	Connectivity to Park and Ride
Contribution to quality of life	Environmental impacts - Landscape Impact
	Environmental impacts – Noise
	Environmental impacts - Air Quality
	Environmental impacts - CO_2 emissions
	Environmental impacts – Biodiversity
	Environmental impacts – Heritage
	Environmental impacts – Green Belt
	Safety
	Accessibility
Scheme Deliverability	Scheme Cost
	Engineering feasibility - construction method
	Land acquisition required
	Impact on local road network during construction
	Future proofing
	Legislative Powers
	Scheme Maintenance and Renewals
Stakeholder support	Public acceptability

Source: Mott Macdonald

5.3.2 Assessment criteria scoring

For the basis of the evaluation it was decided to assess all options were on a 7-point scoring system, with 1 - 3 being a negative impact, 4 being no impact, neutral impact or as existing, and 5 - 7 being positive impacts.

Figure 19: INSET Scoring Summary



Source: Mott MacDonald

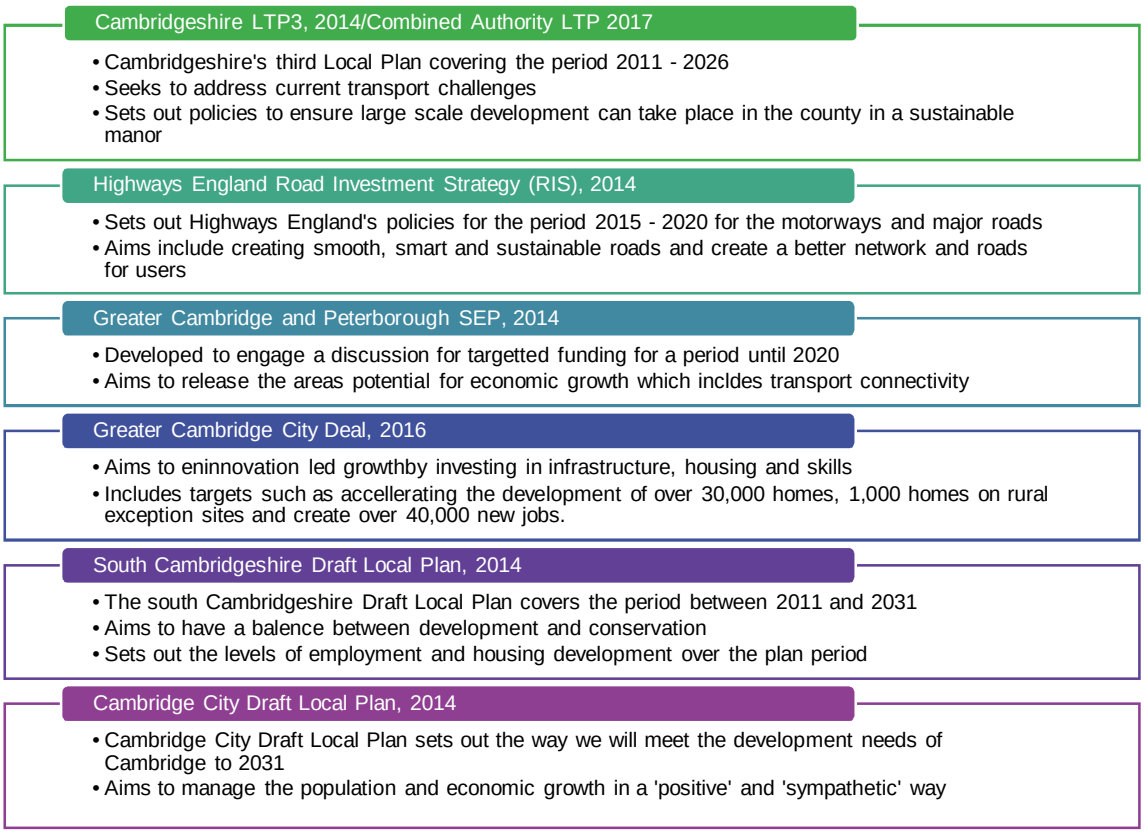
Figure 19 shows an overview of how the scoring range is decided but for each specific metric there is an individual scale for each criterion. Along with the INSET scoring a justification table has been completed which details the reasoning and underlying principles behind each score. A summary of which can be found under each theme in Section 5.4 to 5.9. The justification table can be found in Annex C.

Within the INSET table there is an option to weight the scores. It was decided that all the criteria will have a weighting of 1 so all criteria have the same weighting.

5.4 Theme 1 - Policy Fit

The following policies shown in **Figure 20** were used to assess each option on how well the options comply and fulfils each policy.

Figure 20: Theme 1 – Policy Fit Assessment Criteria Summary Descriptions



Source: Mott MacDonald

5.4.1 Assessment methodology

To assess the scheme options against the different policies, each policy has been read individually and each scheme has been analysed as to how well they achieve, align and support the policies. The assessment considers the transport and economic growth policies of the documents which the aim of the C2C scheme aims to achieve.

5.4.2 Assessment results

Table 8: Theme 1 – Policy Fit

	Do Minimum	Low Cost a	Low Cost b	Do Something 1a	Do Something 1b	Illustrative Comparator
Cambridgeshire LTP3	4	5	5	6	6	6
Highways England Road Investment Strategy (RIS)	4	6	6	6	6	6
Greater Cambridge and Peterborough SEP	4	6	6	7	7	7
Greater Cambridge City Deal	4	6	6	6	6	6
South Cambridgeshire Draft Local Plan	4	5	5	6	6	7
Cambridge City Draft Local Plan	4	6	6	6	6	6
Theme 1 Result Rank	6th	5th	4th	2nd	2nd	1st

Source: Mott MacDonald

Cambridge LTP3, 2014

All options have a close alignment with LTP3 policies. In particular the Do Something 1 and 2 options meet them, especially with regards to the following:

- Improving reliability of journey times, managing demand for road space and maximising capacity and efficiency of the existing network;
- Reducing the need to travel by private car and making sustainable modes of travel a viable, attractive alternative to private car use;
- Addressing the main causes of road accidents in Cambridge, and;
- Influencing national and local decisions on land use and transport planning.

As such the Do Something 1 and the Illustrative Comparator options come out with the highest scores.

Highways England Road Investment Strategy, 2014

All the options align to the strategy by contributing to connectivity targets, enabling construction, encouraging economic growth and supporting the smooth flow of traffic.

As such, all Low Cost, Do Something and Illustrative Comparator options have scored high within the assessment.

Greater Cambridge and Peterborough SEP, 2014

The Do Something and Illustrative Comparator align to more of the policies, especially with the implied preference for a segregated option:

'Our experience with the Busway and with Park & Ride services has demonstrated that travellers will choose to use the bus when a high quality service is provided'

A 'Busway' has been interpreted as a segregated route for public transport vehicles. As such only the 'Do Something' and 'Illustrative Comparator' options fulfil this, therefore increasing their INSET score.

Greater Cambridge City Deal, 2016

All options align with and partially fulfil the policies especially with regards to connecting new developments to employment and education opportunities in the city centre. The Do Something and Illustrative Comparator options would also provide greater the walking and cycling infrastructure and as such further fulfils part of the Greater Cambridge City Deal policy.

As the Low Cost, Do Something 1 and Illustrative Comparator options all align and partially fulfil the policy they have been given an equal INSET score.

South Cambridgeshire Draft Local Plan, 2014

The Low Cost options align but do not fulfil the policy. The policy states there needs to be a segregated high quality public transport route from new developments and along transport corridors as well as segregated high quality walking and cycling routes. Therefore, the Do Something 1 options only partially fulfil the policy by providing a segregated public transport, walking and cycling route. These options do not directly link the proposed new development to the city centre.

The Illustrative Comparator option fully aligns and fulfils the transport policies in the South Cambridgeshire Draft Local plan as they provide a direct and segregated public transport, walking and cycling route from proposed developments, such as Bourn Airfield, to Cambridge City Centre.

Cambridge City Draft Local Plan, 2014

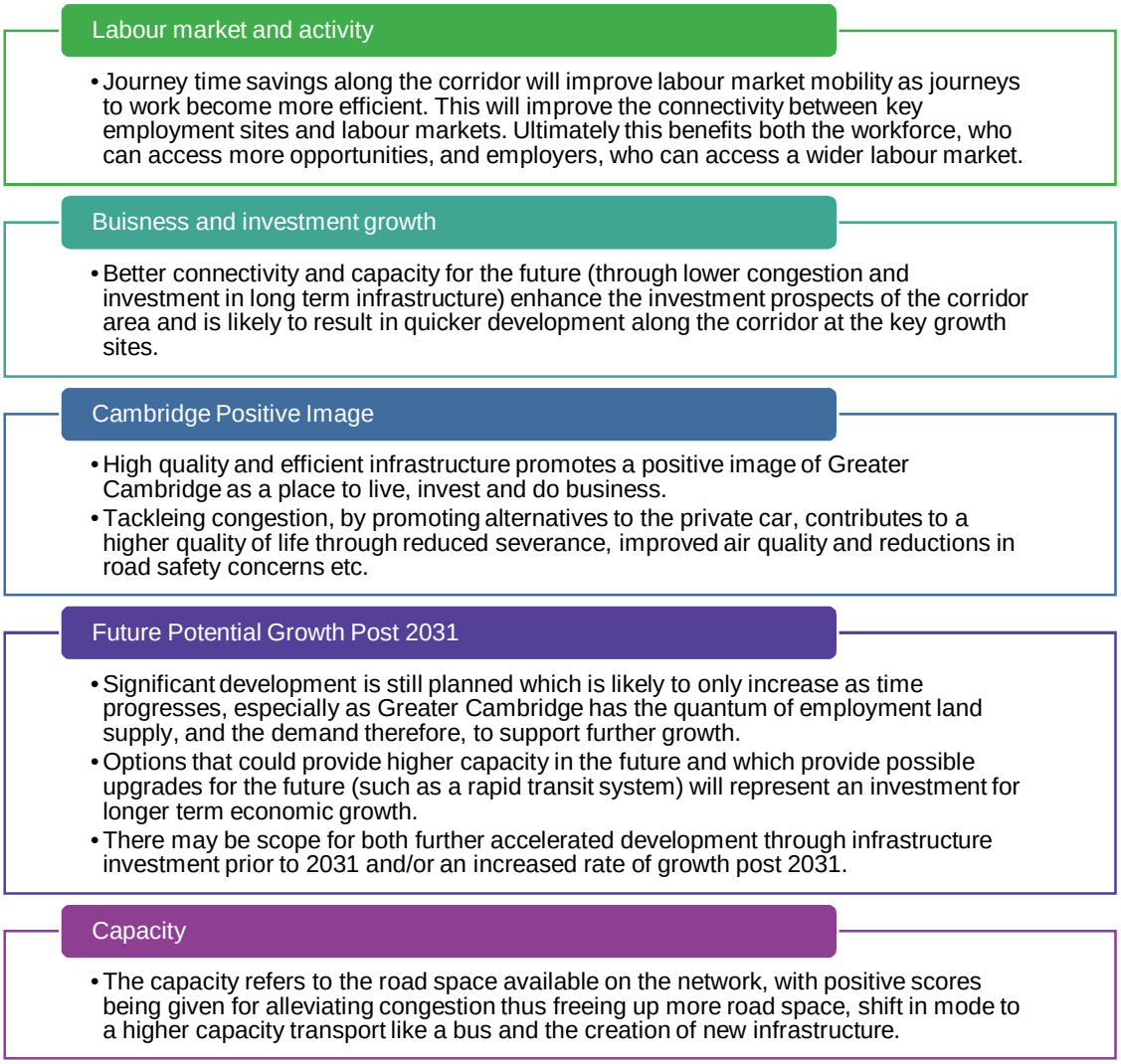
The Low Cost options align and partially fulfils the policy by supporting the development of Bourn Airfield and increasing public transport opportunities. The Low Cost a option also provides the walking and cycling routes to the proposed Park and Ride site.

The Do Something and Illustrative Comparator options all support the development of Bourn Airfield and increase the public transport opportunities to the city centre. The Do Something and Illustrative Comparator options also support the walking and cycling route. As such these options also align and partially fulfil the Cambridge City Centre Draft Local Plan policy.

5.5 Theme 2 - Contribution to Economic Growth

The following criteria has been grouped to cover contribution to economic growth, a more detailed description of each criteria is shown in **Figure 21.**

Figure 21: Theme 2 – Contribution to Economic Growth Assessment Criteria Summary Descriptions



Source: Mott MacDonald

5.5.1 Assessment methodology

The assessment for the criteria under this theme has been based on the previous assessment of high level options taken from the Strategic Economic Appraisal Report (2016)[14]. This was

[14] Greater Cambridge city deal - Strategic Economic Appraisal Report – 2016 Mott Macdonald

deemed appropriate as the assessment of an off-road and on-road options contained within this report was of a high level nature and therefore could still be applied to the current options list.

However, the options considered in the Strategic Economic Appraisal Report were based around the full Cambourne to Cambridge route, therefore as the Low Cost and Do Something 1 options only run between Madingley Mulch Roundabout and Cambridge City Centre the scoring of these options had to be adjusted to reflect the shorter nature of the route the options covered.

5.5.2 Assessment results

Table 9: Theme 2 - INSET Result Ranks

	Do Minimum	Low Cost a	Low Cost b	Do something 1a	Do Something 1b	Illustrative Comparator
Labour market and activity	4	5	5	6	6	7
Supporting house construction	4	5	5	6	6	7
Business investment and growth	4	5	5	6	6	7
Cambridge positive image	4	5	5	6	6	7
Future potential growth post 2031	4	5	5	6	6	7
Capacity	4	5	5	7	7	7
Theme 2 Result Rank	6th	4th	4th	2nd	2nd	1st

Source: Mott Macdonald

Labour market and activity

The route which scored the highest for supporting the labour market and activity the Illustrative Comparator. This is due to the fact it would be directly linking existing and new housing developments to the economic growth areas within and around the city centre. Its ability to reduce existing travel times and permitting the largest gains in access to opportunities for residents and labour markets for businesses also contributed to the high score.

Do Something 1a and Do Something 1b have also scored fairly high in INSET, however as these options only run between Madingley Mulch Roundabout and Cambridge City Centre, they do not directly link to any of the proposed substantial new developments, such as Bourn Airfield. As such they have not scored as high as the Illustrative Comparator.

The Low Cost options have a relatively low impact in labour market mobility whereas Do Minimum has practically no impact and so both have been scored low. Journey times will be less efficient than the Do Something and Illustrative Comparator options with lower reductions in journey times.

Buisness and investment growth

The Illustrative Comparator has been given the highest INSET scores due to the option creating high connectivity between residential developments and business areas would encourage businesses to invest in Cambridge as indicated in the appraisal of Wider Economic Benefits.

Do Something 1a and Do Something 1b have also been given a high score due to their ability to increase connectivity in Cambridge South would encourage businesses to invest. However, as the options are shorter in distance, they do not directly connect residential developments with areas of business and economic growth and so will be less effective than the Illustrative Comparator.

The Low Cost options would both have low impact on the business investment and growth criteria and as such has been given a lower score. The Do Minimum has no impact and business investment and growth has no relevance to this scheme option.

Cambridge Positive Image

The fixed, segregated, infrastructure found in Do Something options 1a, 1b and the Illustrative Comparator gives residents and businesses the confidence to make long term decisions creating a strong positive image for Cambridge and promotes the area to those looking to settle and work in the area. However, the route distance of Do Something options 1a and 1b result in a lesser impact of the positive image for Cambridge.

The Low Cost options do also promote the positive image of Cambridge but to a lesser extent than the Do Something options. The Low Cost options support gains in quality of life and accessibility, promoting Greater Cambridge as a hub to live and work.

The Do Minimum option as a scheme, although does promote Cambridge as a place to live and work, do so at a significantly lower extent than the Illustrative Comparator, Do Something 1 and Low Cost options.

Future Potential Growth Post 2031

The Illustrative Comparator option provides the greatest opportunity of adding further capacity for further post-2031 growth, supporting more sustainable travel patterns and growth due to the significant enhancements to connectivity in Cambridge. Do Something 1a and 1b also contribute to the potential growth but to a lesser extent than the Illustrative comparator.

Partially segregated nature of the Low Cost options means that scale of costs and upgrade to cater for further post 2031 growth will be higher, supporting more sustainable travel patterns and growth. Therefore, the INSET score for Low Cost options is less.

Capacity

Low Cost a and b will have a slight increase in capacity with previous traffic modelling showing that the improvements on the M11 Junction 13 bridge will help to reduce congestion along Madingley Road, with the introduction of a Park and Ride site encouraging a modal shift to public transport travel, it will aid with the capacity of the local network.

For the Do Something options 1a, 1b and the Illustrative Comparator there will be significant increase in capacity as there will be new infrastructure for the public transport route and the introduction of a Park and Ride site, encouraging a modal shift to public transport travel.

Furthermore, as part of these options there will be improvements to the off and on slips of the M11 and the junction with the A428 which will help reduce congestion.

5.6 Theme 3 - Contribution to Improved Transport Network

The following criteria has been grouped to cover the contribution to improving the transport network, a more detailed description of each criteria, the majority of which are public transport focused, is shown in **Figure 22.**

Figure 22: Theme 3 – Contribution to Improved Transport Network Assessment Criteria Description Summaries

Source: Mott MacDonald

5.6.1 Assessment methodology

The assessment of the options against the Theme 3 assessment criteria was based on the option designs and location of nearby users. However, for the following criteria results from the traffic modelling was used to support the scoring:

- Impact on existing Traffic
- Journey Times
- Service frequency
- Mode share

The assessment was based on results from the traffic modelling undertaken in OAR stage 1 where the three options for providing public transport priority on the A1303 Madingley Road west of Cambridge city centre have been tested using micro-simulation software PTV VISSIM[15]. The purpose of the study is to evaluate the impact of providing public transport infrastructure and junction changes on the overall operation of this stretch of road using journey time data.

5.6.2 Assessment results

Table 10: Theme 3 - INSET Result Ranks

	Do Minimum	Low Cost a	Low Cost b	Do something 1a	Do Something 1b	Illustrative Comparator
Reliability of journey	4	6	6	7	7	7
Route flexibility - Links into existing public transport routes	4	4	4	6	6	6
Walking and cycle connectivity	4	6	5	7	6	7
Impact on existing traffic	4	5	5	6	6	6
Journey times	4	5	5	7	6	7
Service frequency	4	7	7	7	7	7
Mode share	4	4	4	4	4	4
Connectivity to Park and Ride	4	6	7	6	7	6
Theme 3 Result Rank	6th	4th	4th	1st	3rd	1st

Source: Mott Macdonald

Reliability of Journey

The assessment of reliability of journey considered what improvements would be made to each option using the drawings produced by Skanska shown in Annex A.

For the Low Cost a and b there would be new inbound and outbound public transport lanes along Madingley road as well as junction priority at Madingley roundabout and High cross junction. This alongside improvements to the M11 junction, and adjacent junctions, which traffic modelling has shown is a source of congestion along the route, will improve journey reliability.

[15] Source: Adapted from VISSIM models produced by Atkins for the 2031 forecast

There is expected to be a higher reliability with the Do Something option 1a, 1b and the Illustrative Comparator as the route will be fully segregated, apart from the access to Scotland Farm P&R which is via the existing highway, which helps future proof against future congestion and will also include improvements to the M11 junction

Route Flexibility - Links into existing bus routes

The Low Cost options will have links similar to the existing network with stops along St Neots and Madingley Road.

With the Do Something options 1a, 1b and the Illustrative Comparator the additional off-road infrastructure will align with key stop locations at Cambourne, Hardwick, Cambridge West development and Grange Road.

Walking and Cycle connectivity

The Low Cost options a and b there will be improved walking and cycling provisions along Madingley Road and a new pedestrian and cycle footbridge over the M11 and the new Park and Ride sites which are accessible by walking and cycling routes.

The Do Something options 1a, 1b and the Illustrative Comparator all have improved cycling and walking connectivity with a dedicated cycle lane planned alongside the off-road public transport route as well as the new Park and Ride locations which are also accessible by walking and cycling.

The location of the Waterworks Park and Ride would allow for people to travel to the site in car and then cycle to Cambridge City Centre. Therefore, the Do Something 1a and Illustrative Comparator options have scored higher.

Impact on existing Traffic

The traffic modelling shows that there is an improved capacity for traffic with all options. Low Cost options a and b achieve this with the introduction of an additional public transport lanes and a road lane over the M11 bridge, and Do Something 1a, 1b, and the Illustrative Comparator achieve this due to the potential modal shift to public transport or bike and with the improvements to the M11 junction.

Journey Times

The traffic modelling showed that options Do Something 1a and the Illustrative Comparator have the greatest journey time savings. Low Cost a and b have a small improvement to journey time saved. The results also showed that the Scotland Farm P&R has the smallest journey time saved. Refer to section 6.5.1 for more detail on the journey time savings identified.

Service Frequency

It has been assumed that there will be an increase in Park and Ride public transport service frequency from 6 vehicles an hour to 9 vehicles an hour.

Mode Share

The modelling methodology at this stage assumes no change in mode share. This will be developed further for the final Business Case for the Recommended Option.

Connectivity to Park and Ride

The assessment of the options was based on the consultation results and reviews of the locations of the proposed Park and Ride. It was concluded that both Park and Rides are easily accessible by car, although there were concerns with some stakeholders that the AM and PM congestion would mean accessing the Park and Ride at Waterworks would be more difficult. However, based on its location near Cambourne, Hardwick and the proposed Bourn Airfield development allowing people to cycle to the park and ride Scotland Farm was deemed to be preferable.

5.7 Theme 4 - Contribution to Quality of Life

The following criteria have been grouped together to cover contribution to improved transport network, a more detailed description of each criteria is shown in **Figure 24**.

Figure 23: Theme 4 – Contribution to Quality of Life Assessment Criteria Summary Descriptions

Source: Mott MacDonald

5.7.1 Assessment methodology

There were three different assessments undertaken for the criteria in Theme 4.

5.7.1.1 Environmental Impact criteria

For the Environmental Impact criteria, the options assessment followed the principals for environmental appraisal as described in the Department for Transport's WebTAG Unit A3 Environmental Impact Appraisal guidance. The appraisal has largely been based on:

- Assessments carried out to date and reported on the GCP website;
- Updated desk studies;
- Site walk overs/drive overs between December 2017 and March 2018;
- Winter ecological surveys over the 2017/2018 season, and;
- Preliminary results from geophysical surveys for archaeology west of the M11.

5.7.1.2 Safety criteria

The Safety criteria are based on a safety review undertaken by an experienced road safety specialist who is qualified to undertake road safety audits. The assessment was undertaken by walking over the route and assessing where the proposed scheme will impact on road safety. Where the safety impacts of the proposal can be addressed by simple design measures the impact has been classed as slight. Where the safety impacts of the proposal need careful consideration in the detailed design of the scheme the measures the impact has been classed as medium. Where the safety impacts of the proposal need a re-design of the scheme the measures the impact has been classed as significant. This safety review has not removed the need to undertake formal road safety audits at appropriate stages in the development of the scheme design.

5.7.1.3 Accessibility criteria

The scoring for the Accessibility criteria has been based on reviews of planned developments and key job locations as highlighted in the consultation with the public such as the Biomedical Campus and Science Park.

5.7.2 Assessment results

Table 11: Theme 4 - INSET Result Ranks

	Do Minimum	Low Cost a	Low Cost b	Do something 1a	Do Something 1b	Illustrative Comparator
Environment impacts - Landscape Impact	4	2	2	2	2	2
Environment impacts - Noise	4	3	3	3	3	3
Environment impacts - Air Quality	4	5	5	5	5	5
Environmental impacts - CO2 emissions	4	4	4	4	4	4
Environmental impacts – Biodiversity	4	1	1	2	2	2
Environmental impacts – Heritage	4	2	2	2	2	2
Environmental impacts – Green Belt	4	3	3	2	2	2
Safety	4	3	3	2	2	2
Accessibility	4	5	5	5	5	7
Theme 4 Result Rank	1st	2nd	2nd	5th	5th	2nd

Source: Mott Macdonald

Environment Impacts - Landscape Impact

Landscape impacts were assessed against impacts on landscape pattern, landscape tranquillity, cultural receptors and landcover features.

The Low Cost options have no significant difference in the impact on landscape. Both Park and Rides have similar impacts on the landscape in their specific locations, so there is little difference between the options due to the Park and Ride locations. The main impacts on landscape would be trees and vegetation removed along the A1303 from Madingley Mulch Roundabout to the M11 and effects on the setting of the American Cemetery which could be slight to moderate adverse

All the Do Something options 1a, 1b and the Illustrative Comparator have the same impacts on landscape overall due to the commonality of the route between Grange Road and the Park and Ride sites. For the Illustrative Comparator, the route is alongside the existing A428 towards Bourne Airfield, and then across the airfield. As this is in a landscape dominated by the A428 they do not significantly alter the landscape up to Bourn Airfield. From the Waterworks site all the off-route options are across open fields, then through the Coton Orchard (near the Coton Conservation Area) and scrubland adjacent to the M11, and then through West Cambridge, before going across the Grange field to the Rifle Range track. The effect of on the landscape along this corridor is assessed as slight to moderate adverse.

Environment Impacts - Noise

The assessment of noise has considered the proximity of receptors (residential properties, commercial properties and educational facilities) in the appraisal.

The two Park and Ride sites both have residential properties near to the sites which will represent new noise receptors. With proper design to minimise noise effects the traffic noise impacts are considered negligible from either site although there will be occasional disturbances such as slamming doors, horns and car alarms which cannot be mitigated. There is no preference between sites on noise considerations.

Taking this into account, both Low Cost options have similar noise impacts to the Do Minimum option and are considered have neutral impacts.

The two Do Something options 1a and 1b have the same off-route noise implications, with some minor adverse effects likely to residential properties in the Coton area and along Grange Road from the very low level of public transport traffic. The section of additional route between Water Works site and Scotland Farm is near the A428 which is likely to mask any impact of the limited additional public transport traffic on this new section of route.

The Illustrative Comparator has the same routes as the Do Something options 1a and 1b except for the Phase 2 section which extends to Bourn Airfield adjacent to the A428. The level of traffic noise from the A428 means that any additional noise from the public transport route itself is likely to be imperceptible.

The Do Something and Illustrative Comparator options therefore are expected to have the same slight adverse effects.

Environment Impacts - Air Quality

A semi-quantitative air quality assessment of the six options has been undertaken. The assessment has been undertaken considering the following key aspects:

- Existing baseline conditions – risk of exceedances of air quality objectives and EU limit values;
- Number of properties affected;
- Potential changes in traffic data, and;
- Potential effects on the Cambridge City Air Quality Management Area (AQMA).

There is no substantive difference between options a and b for the Low Cost, Do Something 1 variations and the Illustrative Comparator as the only main difference between option a or b is the location of the Park and Ride sites. The Illustrative Comparator affects the largest number of receptors, this is due to this option resulting in a larger scheme compared to the other options and therefore this option has the potential to lead to the greatest improvements in air quality due to the anticipated modal shift and reduced road traffic over the largest distance. Although Do Something options 1a/1b and the Illustrative Comparator introduce vehicles into areas east of Madingley Mulch roundabout where no road traffic exists now the volume of public transport traffic would be very low and the vehicles will be of the highest current emission standard Euro 6. Where traffic is reduced and/or traffic movements are less affected by traffic stopping and starting along the existing road a modest improvement in air quality may be achieved. This is

not considered significant. As a result, the Low Cost options a/b and Do Something options 1a/1b do not have any significant differences as the main area of vehicular traffic is very similar between these schemes (i.e. Along Madingley Road).

Environment Impacts - CO_2 Emissions

Within WebTAG, at OBC stage, CO2 emissions are assessed as an input to the Net Present Value (NPV) of a scheme.

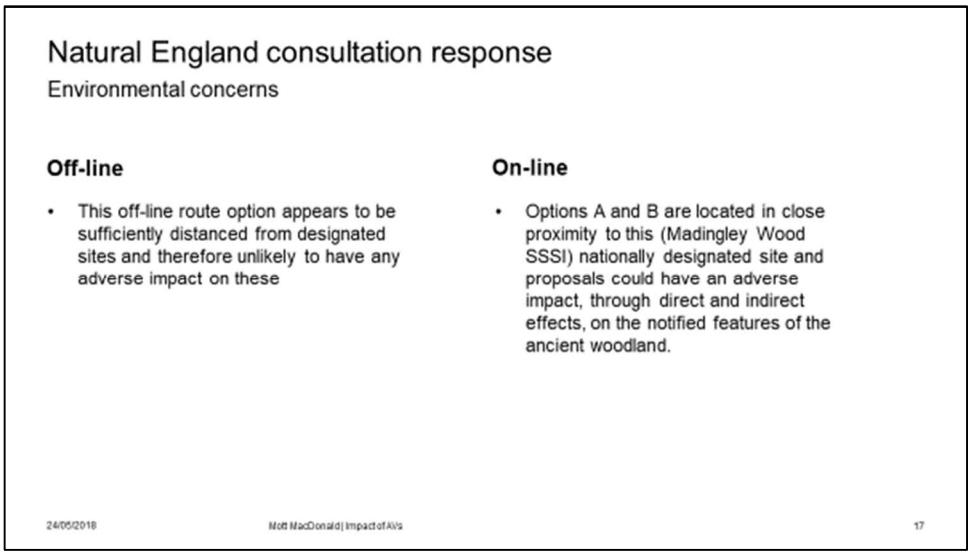
To inform this OAR report a qualitative appraisal of each option considered the potential change in CO_2 emissions for the operational phase only.

Operational carbon is assumed to be a minor benefit as the move to improved public transport is intended to reduce traffic generally. There is potential for car traffic to increase to offset any modal shift to public transport, but if congestion did not improve in the city this would deter car users and so overall it is anticipated there should be a moderate decrease in car travel into the city, with a reduction in CO_2 emissions. Due to this uncertainty the effect is deemed neutral for each scheme until detailed modelling is carried out for the final OBC.

Environment Impacts - Biodiversity

Biodiversity was assessed using the information collected from the winter surveys in 2017/2018. This data supplemented that which was already available for designated sites.

The Low Cost Options a and b have potential for increasing traffic along Madingley Road, which could have large adverse effects on the Madingley Wood SSSI. Natural England have highlighted this issue in their consultation response and indicated that they felt the on-road scheme could have adverse impacts.



Other than this the Do Minimum and Low Cost options a and b and the Illustrative Comparator all have similarly low potential impacts on biodiversity within the highway corridor

Low Cost option a has the Park and Ride site at the Waterworks, which could have a moderate impact on biodiversity at that site. The Park and Ride site at Scotland Road (Low Cost b) has neutral impact on biodiversity.

The section of the Illustrative Comparator between the Park and Ride site and Bourn Airfield has nothing of biodiversity value that exceeds what is present on the Do Something options 1a and 1b. Therefore, the Illustrative Comparator has the same biodiversity assessment as the Do Something options 1a and 1b respectively.

Do Something options 1a, 1b, the Illustrative Comparator all have an intermediate impact on the Waterworks site. Do Something options 1a and the Illustrative Comparator have the Park and Ride located in this area, and the Do Something option 1b has access onto the off-route section crossing the Waterworks site. All options have similar scales of impact on the wooded areas at this site. This site has protected species present and has important broadleaved habitat present with the result the impact is considered moderate adverse.

Both Do Something 1 options and the Illustrative Comparator have the same moderate adverse impact on the habitats between Coton Orchard and the M11, but otherwise all habitats or receptors are slightly impacted or have a neutral impact. These off-route assessments would be mitigated by planting and habitat creation. There is potential to increase biodiversity by additional compensation planting.

Environment Impacts - Heritage

The heritage appraisal considered the following features along each option:

- Built Heritage covering
  - Listed buildings (Grade I, Grade II and Grade II*)
  - Registered Park and Gardens (Grade I and Grade II)
  - Conservation Area
- Buried Archaeological Remains

Information on HER assets were obtained from CCC. Policy information for the appraisal were the SCDC Development Control Policies (2007), City of Cambridge local plan (2006) and the emerging SCDC and City of Cambridge local plans. A geophysical survey was carried out on accessible land that was suitable for such surveys and preliminary results have been used in this appraisal. The scope of the surveys was agreed with the County Archaeologist.

Built Heritage

The two low cost options both have a potential Moderate Adverse effect on the American Cemetery which is a unique and national important heritage site. The Do Something 1 Options and the Illustrative Comparator have a neutral effect on the American Cemetery.

The effect of the Low Cost Options on other built heritage assets (listed buildings and the Coton and West Cambridge conservation areas) are either slight adverse or neutral for all options.

Archaeology

The options for developing the Water Works Park and Ride site have a potential effect on buried archaeology (identified as to be in the area from aerial photographs and geophysical surveys). It is noted that the options with a Park and Ride at Scotland Farm still have the route traversing

the Waterworks Park and Ride site, so there is potential for impacts on buried archaeology at this site from the Scotland Farm Park and Ride options.

The Scotland Farm Park and Ride is located close to a number of buried archaeological sites. So there is potential for archaeological remains to be found on the site.

There is limited potential for impacts on buried archaeology for the Low Cost a and b due to the works being within the existing highway corridor but there is some potential for archaeological remains to be found in areas where these schemes are outside the existing highway corridor.

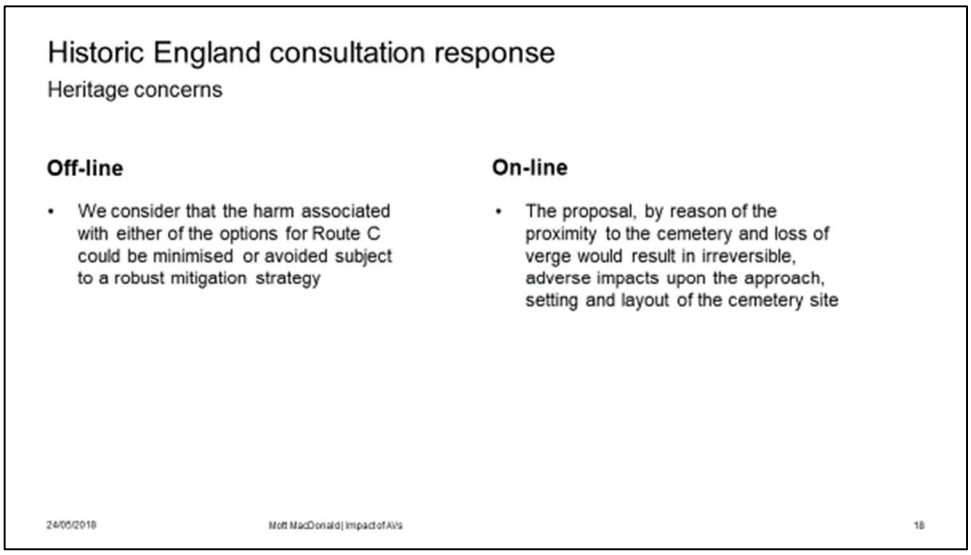
Outside of the P&R sites, there is potential for works to encounter archaeological assets from Madingley Mulch to Grange Road on all off-line options due to the prevalence of Cambridgeshire Historic Environment Record assets known to be in the area and the geophysical survey results.

The Illustrative Comparator largely cover areas already disturbed by existing development. However, there are some fields which are not yet disturbed and these are considered to have moderate to high potential for low to moderate importance assets to be encountered (ranging from Iron Age/Roman to World War II (linked to Bourne Airfield).

In summary the appraisal indicates that the on-road option could have a greater effect on built heritage than the off-road options (particularly the American Cemetery) with limited potential to mitigate these effects.

Although the off-road options have some minor effects on conservation areas and listed buildings there are potentially greater effects on buried archaeology. However, there are also greater opportunities for mitigating all these effects, either by avoiding any significant archaeological assets during scheme design or planting to minimise impacts on setting.

Thus the overall potential effect on the Heritage Environment for each option is considered to be Moderate Adverse – but the specific sensitivities vary between the on-route and off route options (please note in the extract below, Route C refers to the off-road route as consulted in 2017/2018).



Environment Impacts - Green Belt

The Green Belt has strong protection at both National and Local Level. When considering the acceptability of the principle of a public transport route development within the Green Belt, the key policy criteria states that development is not inappropriate if it preserves the openness of the Green Belt and does not conflict with the purposes of including land in the Green Belt. Local transport infrastructure is a specific type of development which is deemed suitable if it can demonstrate a requirement for a Green Belt location.

The Do Minimum option has no significant effect on the Green Belt.

The Low Cost options a and b both have the Park and Ride sites in the Green Belt but otherwise present similar impacts as the Do Minimum options.

Do Something options 1a, 1b, and the Illustrative Comparator all have the same route sections in Green Belt and both Park and Ride options are in the Green Belt as well. With appropriate mitigation and design they will increase pedestrian and cycle accessibility to the Green Belt, but will have a minor adverse impact on other aspects of Green Belt.

Safety

Whilst none of the options are considered unsafe, Do Something 1a, 1b, 2a and 2b will inherently have more safety related concerns as the proposed design includes introducing new highway infrastructure to an area which previously has none. Whereas the Low Cost a and b has proposed changes within an existing highway environment.

Although it is important that this is reflected in the assessment of the options, there are measures that can be undertaken during detailed design to address any potential safety issues. Without a comprehensive safety audit a full list of safety issues cannot be made, however based on a walk over by a safety auditor the following issues were raised:

All options

- Introduction of a 90-degree bend at the junction of St Neots' Road and Long Road if closing St Neots to general traffic (existing priority junction).

For Do Something options 1a, 1b and the Illustrative Comparator

- Route dissects local footpaths in fields to the north of the village of Coton.
- A wide radii is required at the proposed traffic signalised junction at Grange Road for public transport vehicle manoeuvres. The road at this point is quite narrow.

For the Illustrative Comparator

- Where the proposed route crosses St Neots Road to the west of Highfield Road to the east of Bourn airfield, forward visibility to proposed traffic signals could be restricted due to the vertical alignment created by the overbridge of the A428.
- There is a risk that drivers on one could be dazzled or confused by headlights where the route runs between two existing roads.

The option taken to OBC will be subject to a full safety assessment and appropriate mitigation measures will be taken to address safety issues during design development.

Accessibility

All options create a new Park and Ride site which will provide an interchange enabling motorists, cyclists and pedestrians to access the public transport network and destinations around Cambridge.

The Low Cost options a and b will provide a Park and Ride facility, in and outbound public transport priority measures including dedicated public transport lanes and junction priority, and improvements to a key area of congestion at the M11 junction meaning that people will have a more reliable journey and an express public transport route to key employment locations. Although, the final public transport routes will be decided by the operator.

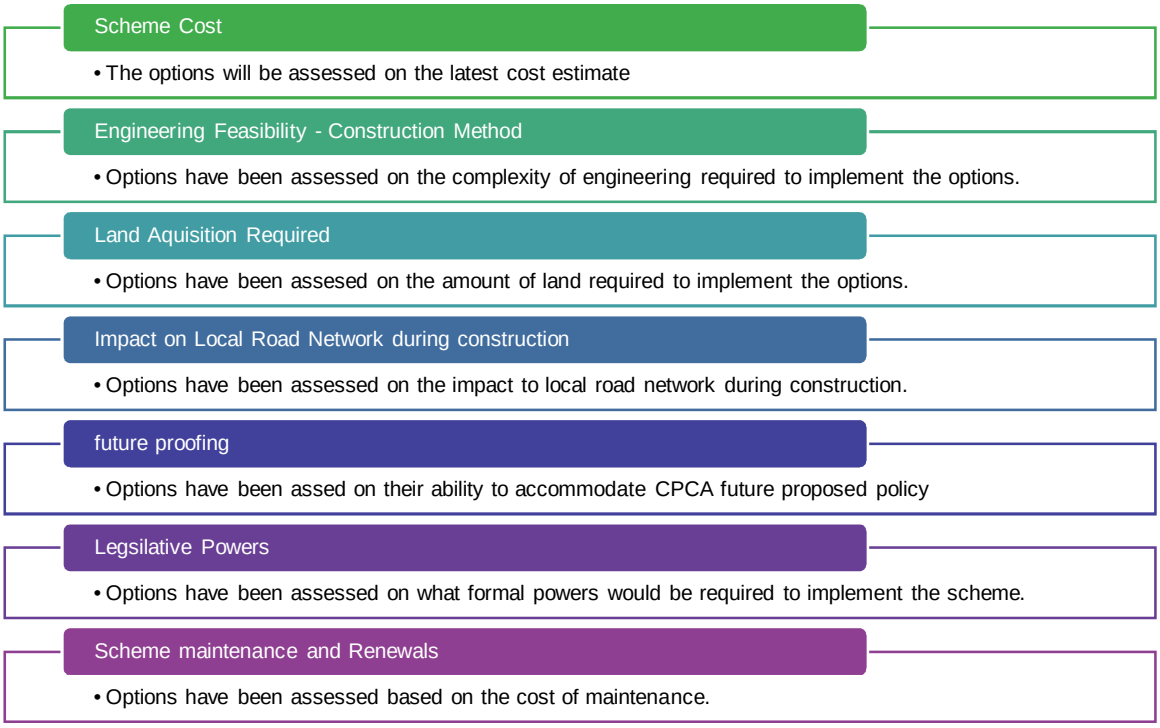
The Do Something options 1a and 1b will also provide accessibility through a new Park and Ride facility and an off-road route which will provide a reliable journey and an express route to key employment locations. They will also include improvements to a key area of congestion at the M11 junction meaning that people will have a more reliable journey along Madingley Road.

The Illustrative Comparator has scored the highest because they link the off-road public transport route to Cambourne and Bourn Airfield development, which will improve the journey time from existing and proposed housing and key job locations.

5.8 Theme 5 - Scheme Deliverability

The following criteria has been grouped to cover scheme deliverability, a more detailed description of each criteria is shown in **Figure 24.**

Figure 24: Theme 5 – Scheme Deliverability Assessment Criteria Summary Descriptions



Source: Mott MacDonald

5.8.1 Assessment methodology

The options have been assessed based on the drawings shown in Annex A.

For the purposes of the option cost, and the scheme maintenance and renewals criteria a high-level cost estimate and whole life cost summary was undertaken that provided the scoring for these respectively. Life cycle costing is a modelling method which considers both the up-front costs of installation or renewing highway assets and the various through-life costs such as maintenance, compensation for delays and so on. Process involves identifying activities during the life cycle (60 years), when the activity occurs and associated cost for the activity.

The future proofing criteria was based on an understanding of other regional transport proposals such as CAM and how based on these the designs tie in.

The review of the Legislative Powers is based on our experience bringing transport schemes through the required application routes.

5.8.2 Assessment results

Table 12: Theme 5 - INSET Result Ranks

	Do Minimum	Low Cost a	Low Cost b	Do something 1a	Do Something 1b	Illustrative Comparator
Scheme Cost	4	3	3	2	2	1
Engineering feasibility - construction method	4	1	1	2	2	1
Land acquisition required	4	3	3	2	2	2
Impact on local road network during construction	4	1	1	2	2	2
Future-proofing	4	4	4	7	6	7
Legislative Powers	4	3	3	2	2	2
Scheme Maintenance and Renewals	4	1	1	1	1	2
Theme 5 Result Rank	1st	5th	5th	2nd	3rd	3rd

Source: Mott Macdonald

Figure 25: Theme 5 – Scheme Deliverability Assessment Criteria Summary Descriptions

The cost was based on the high-level cost analysis undertaken by the Mott MacDonald estimating team. The results showed that the lowest cost was for Low Cost options a and b, with

Do Something option 1a and Do Something option 1b being the next highest cost, and the most expensive is the Illustrative Comparator.

It should also be noted that the having the Park and Ride located at Water Works rather than Scotland Farm has an overall slightly lower capital cost.

Engineering Feasibility - Construction Method

Whilst the Low Cost options a and b and Do Something option 1a and 1b have similar construction methods. However, the low cost options have been deemed to have a significantly more disruptive construction as it requires work to Madingley Road and the existing M11 bridge which will have to be kept live during the project.

For Do Something options 1a and 1b the public transport route will be mainly constructed off-road. However, as part of the improvements to the M11 junction some work will be required, however this will be less disruptive than Low Cost option a and b.

The Illustrative Comparator has the highest complexity of engineering as it requires not only the changes detailed in Do Something options 1a and 1b but also additional changes to junctions in Phase 2.

Land Aquisition Required

All options will require land for the Park and Ride locations. However due to the off-road running of the Do Something options 1a, 1b and the Illustrative Comparator greater areas of land will be required. Mainly agricultural land will be required for off-line options, with no residential land take. On-road options may take some residential land.

Impact in Local Road Network during Construction

Due to the need to add additional lanes to the M11 junction whilst keeping it operational Low Cost option a and b will have the greatest impact on the local road network during construction. Also, the traffic modelling shows this is a key area of congestion so the impact of roadworks in this area will be quite significant.

The Do Something options 1a, 1b and the Illustrative Comparator will have some impact due to the need to cross existing roads, and for the minor improvements to the M11 junction. However, apart from the area around Madingley Mulch Roundabout and the M11, the locations of the crossings do not currently experience high levels of congestion so the impact should not be significant.

Future Proofing

During the drafting of OAR Part 1, the emerging CPCA policy for transport within Cambridge began to emerge. Whilst the emerging vision for CAM doesn't alter the need for intervention and the strategic case that is driving the C2C scheme, in view of the scale of the ambition of the CAM program it was decided to consider how C2C can be developed in a way which complements the CAM aspirations and, as such, ensures future-proofing.

The Low Cost options will have no impact on the emerging mayoral vision as they focus on on-road improvements.

With the Do Something and Illustrative Comparator options being either fully off-road or partially off-road this allows for them to support future schemes and can be easily adapted. It was also noted that the Water Works Park and Ride location better aligns with the CAM vision as it will provide easier access for vehicles without needing to use the existing highway network or construct new structures in order to access the Scotland Farm P&R site.

Legislative Powers

All options will require some form of legislative power for implementation, Low Cost options a and b will both require a planning application, whereas Do Something options 1a and 1b, and the Illustrative Comparator could be delivered by means of a Transport and Works Act Order.

Scheme Maintenance and Renewals

A whole life cost analysis was undertaken by Mott MacDonald, with the Illustrative Comparator being the lowest annual cost. Low Cost options a and b, and Do Something options 1a and 1b were all similar in cost and were higher than the Illustrative Comparator.

5.9 Theme 6 - Stakeholder Support

The following criteria covers stakeholder support a more detailed description of each criteria is shown in **Figure 26.**

Figure 26: Theme 6 – Stakeholder Support Assessment Criteria Summary Description

Public Acceptability

- Options have been assessed based on the consultation.

5.9.1 Assessment methodology

The options scores were based on the results from the consultation held between November 2017 and January 2018, this includes:

- Public consultation questionnaire
- Stakeholder meetings
- Systra market research

5.9.2 Assessment results

Table 13: Theme 6 - INSET Result Ranks

	Do Minimum	Low Cost a	Low Cost b	Do something 1a	Do Something 1b	Illustrative Comparator
Public Acceptability	4	5	6	5	6	5
Theme 6 Result Rank	6th	3rd	1st	3rd	1st	3rd

Source: Mott Macdonald

With the result of the consultation questionnaire and residents' focus groups preferring Route C (off-road) to Route A (on-road), this shows that there is some stakeholder support for the off-road route. As well as the route options the Park and Ride site location was consulted on and the results showed that the recommended location was Scotland Farm. These results were combined to get the scores.

5.10 Results

The INSET results shown in Table 14 show that the emerging strategic route is the Illustrative Comparator. However, further assessment and consultation for Phase 2 of the scheme will determine a complete recommended option for the Business Case.

Table 14: Stage 2, Step 2 Assessment Results

Option	INSET Scoring Summary Ranks
Do Minimum	Ranked 6th
Low Cost a	Ranked 5th
Low Cost b	Ranked 4th
Do Something 1a	Ranked 2nd
Do Something 1b	Ranked 3rd
Illustrative Comparator	Ranked 1st

Source: Mott MacDonald

6 Options Assessment: Benefit Cost Ratios Assessment Process and Results

The modelling of the project to date has been based on the strategic Cambridge Strategic Regional Model (CSRM2). That, however, was built to assess strategic options and is not detailed enough for the development of the options as it proceeds through the business case process and is assessed in progressively greater detail. As such the CSRM2 has been locally refined to provide a modelling approach to support this Business Case Update.

6.1 Highway Modelling

6.1.1 2015 Base Year Model

The base year CSRM2 SATURN highway model structure was initially reviewed along the A428/A1303 corridor. Additional local road links were added to the network to ensure that the forecast schemes could be assessed accurately. In particular additional local roads were included in Cambourne close to the of the proposed off-road public transport link.

The modelled flows at various points along the A428/A1303 corridor were compared to the observed data available to ensure the model was accurately reflecting current base year (2015) flows. In addition to the observed data used as part of the CSRM2 calibration and validation, additional A428 November 2015 data taken from WebTRIS was used together with observed vehicles entering and exiting Madingley Park and Ride site.

In the AM peak, the modelled flow on the M11 J13 southbound on-slip was lower than observed and there was some inconsistency between A428 data available from WebTRIS, but at all the locations modelled flows met the WebTAG validation criteria.

In the interpeak, the A428 westbound modelled flow just west of the A1303 junction was higher than the observed data from the CSRM2 validation but did match an equivalent WebTRIS site. At all other locations modelled flows met the WebTAG validation criteria.

In the PM peak, there is insufficient modelled flow westbound on the A1303 and A428 west of the M11 but the right levels of modelled flow east of the M11. All eastbound modelled flows and all locations east of the M11 meet the WebTAG validation criteria.

Detailed tables showing the comparison of observed and modelled base year flows are contained within Annex D.

The modelled journey times along the A1303 were also compared to observed travel times. The CSRM2 journey time route along the A1303 and then out along the A10 was subdivided to concentrate on the A1303 section between the A428 and Grange Road in more detail.

In the AM peak the observed eastbound travel times between the A428 and M11 of over 20 minutes could not be replicated by the model. Similarly, the observed travel time of 7 minutes in the westbound direction west of the M11 in the PM peak could not be replicated by the model. Contra-peak direction and interpeak travel times were all replicated well by the model.

Investigation into these large observed peak direction travel times revealed that roadworks had been in place along the A1303 during the time that the observed travel times were recorded. Comparisons of observed flow and travel time data between the model base year of 2015 and

the subsequent year, 2016 when the roadworks was no longer in place were undertaken. These showed that peak direction flows were reduced with the roadworks and journey times were significantly slower.

Detailed tables showing the comparison of observed and modelled base year and 2016 journey times are contained within Annex D.

The comparison of modelled PM peak outbound journey times against the 2016 observed data shows that the model travel times compare well with the observed data. The AM peak inbound modelled travel times are still quicker than the 2016 observed data but this is to be expected as the 2015 traffic flow levels are lower than those observed in 2016.

6.1.2 2031 Forecast Year Model

The 2031 CSRM2 Foundation Case networks and matrices were used as the starting point for the assessments. The Foundation Case represents a scenario which is consistent with the currently proposed Local Plans for the four LADs represented in CSRM2 (Cambridge City, South Cambridgeshire, Huntingdonshire and East Cambridgeshire). This includes local assumptions on housing, employment and other developments, along with transport schemes which are either committed or expected to be required to support development.

The additional network links added to the base year networks were similarly added to the forecast year networks. Separate networks were then created for the Do Minimum, the four Do Something options and the Illustrative Comparator described in Chapter 4.

In addition to the network changes new public transport services from the new Park and Ride sites were included. It was assumed that 9 services per hour would be provided from the new Park and Ride sites with 3 services per hour travelling to Cambridge North rail station, 3 services per hour to Biomedical campus via the M11 and 3 further services per hour to the Biomedical Campus via the A1307.

The P&R bus service currently serving Madingley Park and Ride site was removed with the closure of this site. Existing buses travelling along the A1303 corridor were assumed to use the new public transport lane provision in all options.

6.2 Demand Modelling

The demand modelling has been based on a simplified and transparent approach, rather than using the full CSRM2 demand model.

The key input data for the demand model is:

- Observed P&R patronage data, ideally for all sites in Cambridge, but at the very least for Madingley Road.
- Base year and forecast year Do Minimum SATURN networks
- Base year and forecast year Do Minimum SATURN matrices
- Assignments of above matrices to corresponding networks
- Base year and forecast year P&R demand matrices from CSRM2

Firstly, the P&R capture rate was estimated. Based on the current P&R bus stopping pattern, a subset of city centre model zone destinations for which P&R is a feasible option has been identified. This was cross-checked against the corresponding 2015 base year P&R demand matrices from CSRM2. A select link analysis on the inbound direction of the main radial route on the approach to Madingley P&R car park was then carried out in the base year SATURN model.

The number of trips from the select link matrix to the previously identified city centre zones was then calculated and divided by the observed number of car trips at each P&R site to provide the P&R capture rate for each time period. The following tables show the capture rates calculated.

Table 15: AM Peak (0800-0900) P&R Capture Rates

P&R Site	All inbound car trips on P&R approach	Inbound car trips to city centre zones on P&R approach	Observed P&R car trips	P&R capture rate
Madingley	969	359	148	0.41

Table 16: Interpeak (1000-1600 average) P&R Capture Rates

P&R Site	All inbound car trips on P&R approach	Inbound car trips to city centre zones on P&R approach	Observed P&R car trips	P&R capture rate
Madingley	399	147	66	0.45

Table 17: PM Peak (1700-1800) P&R Capture Rates

P&R Site	All inbound car trips on P&R approach	Inbound car trips to city centre zones on P&R approach	Observed P&R car trips	P&R capture rate
Madingley	373	174	14	0.08

The next step was to apply the Madingley Road P&R capture rate identified above to the 2031 forecast year trip totals, focussing on the P&R site(s) on the A428/A1303 corridor. To do this, the forecast year Do Minimum CSRM2 P&R matrix was added to the forecast SATURN highway car matrix for each time period to obtain a total car+P&R matrix. These combined car+P&R matrices were assigned to the forecast SATURN networks and a select link analysis undertaken on the inbound direction of the main radial route on the approach to the P&R car park. From the select link analysis, the destination zones for which P&R is not an option for the new services were masked out and the capture rate applied to the remaining trips. This produced a matrix of inbound P&R trips.

Information from the CSRM2 Demand Model report provided the proportion of inbound AM trips retuning in the interpeak and pm peak. These factors were then applied to the transposed matrix of inbound P&R trips to obtain matrices of outbound P&R trips.

The final ‘Do Something’ forecast highway matrices were then produced by replacing P&R trips in the highway car+P&R matrix with a car trip from the true origin (inbound) or to the true destination (outbound) to/from the P&R site only (i.e. removing the car trip between P&R site and city centre). The assignment of these matrices provided the Do Something and Illustrative Comparator forecasts.

All of the steps were undertaken for car trips only. LGV and HGV CSRM2 forecast trip matrices were produced using RTF15 traffic growth and the same forecast matrices assigned in both Do Minimum, Do Something and Illustrative Comparator assessments.

6.3 Economic Appraisal methodology

A spreadsheet-based calculation has been used to estimate benefits to:

- Existing and new P&R passengers
- Existing bus-only passengers

Travel time savings in the weekday AM peak hour, interpeak and PM peak hour to bus passengers have been estimated by comparing journey times between Cambourne and Grange Road in Cambridge, combining car legs and bus legs of the journey as appropriate for each option. Travel time benefits accruing in the weekday off-peak period and at weekends have not been assessed in line with the SOBC.

Traffic decongestion benefits resulting from providing the additional public transport infrastructure have been calculated using TUBA (Transport Users Benefit Appraisal) program, which carries out an economic appraisal in accordance with published DfT guidance. Vehicle, time, and distance matrices were also taken from the CSRM2 SATURN Do Minimum, Do Something and Illustrative Comparator assignments.

6.4 Option Costs

Table 18 below details the capital costs associated with each option divided into construction, design, testing and commissioning, and management costs.

Table 18: Scheme Capital Costs (£'000s, 2018 prices)

	Low Cost a	Low Cost b	Do Something 1a	Do Something 1b	Illustrative Comparator
Construction	26,482	26,957	50,992	56,518	88,109
Design	3,972	4,043	7,649	8,478	13,216
Testing & Commissioning	265	270	510	565	881
Management	2,648	2,696	5,099	5,652	8,811
Land	3,560	3,340	3,600	4,260	7,970
Statutory Undertakers	400	400	750	750	1,100
TOTAL	37,327	37,706	68,600	76,223	120,087

Source: Mott MacDonald

The table shows that the lowest cost was for Low Cost options a and b, with Do Something option 1a and Do Something option 1b being the next highest cost, and the most expensive is the Illustrative Comparator. In each case, a Park and Ride site at Water Works (option a) is cheaper than a site at Scotland Farm (option b)

Table 19 below summarises the operation and maintenance costs associated with each option over a 60 year appraisal period. This includes annual maintenance and renewals of new infrastructure as well as public transport vehicle purchase and operating costs.

Table 19: Scheme Operational and Maintenance Costs (£, 2010 prices discounted to 2010)

	Low Cost a	Low Cost b	Do Something 1a	Do Something 1b	Illustrative Comparator
Operational and Maintenance Costs (£)	£33,683	£33,771	£39,013	£33,575	£36,844

Source: Mott MacDonald

The least expensive option is the Illustrative Comparator due to fewer new public transport vehicles assumed to be required.

A 20% risk allowance has been added on top of the construction costs of the scheme. Additionally, a risk allowance has been added on top of the land costs for each option.

Table 20: Scheme options risk allowance (£000s, 2018 price basis)

	Low Cost a	Low Cost b	Do Something 1a	Do Something 1b	Illustrative Comparator
Construction costs risk allowance	5,296	5,391	11,069	12,202	18,448
Land costs risk allowance	4,280	4,280	2,600	2,620	3,130

Source: Mott MacDonald

In line with WebTAG guidance, inflation has not been taken included in the costs. A 44% optimism bias has been applied in line with WebTAG guidance to the capital costs to reflect the current level of design detail for the emerging recommended option. No optimism bias has been applied to the operational and maintenance costs in line with guidance.

6.4.1 Present value of costs

The overall Present Value of Costs (PVC) for the options is shown in Table 21.

Table 21: Scheme present value costs (£000s, 2010 market prices, discounted to 2010)

	Low Cost a	Low Cost b	Do Something 1a	Do Something 1b	Illustrative Comparator
Investment PVC	50,212	50,712	81,946	90,751	139,841
Operating PVC	33,683	33,771	39,013	33,575	36,844
Overall PVC	**83,895**	**84,482**	**120,959**	**124,326**	**176,685**

Source: Mott MacDonald

6.5 Economic Appraisal Results

6.5.1 Public transport journey time savings

The tables below detail the journey time savings in 2031 for journeys between Cambourne and Grange Road in Cambridge for each option and time period using the Park and Ride service,

including an allowance for a reduction in waiting time due to an increase from 6 Park and Ride vehicles an hour to 9 vehicles an hour.

The signalisation of Madingley Mulch roundabout in the low cost options results in additional travel time along the corridor. However, in the AM and PM peak the inbound journey times saved by vehicles using the public transport lane provided and bypassing the traffic queues outweighs the additional journey time at Madingley Mulch roundabout.

The Do Something 1 options result in the highest amount of journey time savings. The journey time benefits are less for the Illustrative Comparator as the speed of vehicles along the off-road public transport lane is lower than an equivalent car journey along the parallel A428. However, if following consultation of Phase 2, Scotland Farm is the preferred option, the difference to the Illustrative Comparator is that public transport vehicles will be required to route away from the off-road public transport lane to access the Park and Ride site at Scotland Farm which will extend the travel time for journeys.

It is possible that further design work for the Madingley Mulch roundabout and the access route for vehicles from the off-road public transport lane into Scotland Farm would mitigate some of the journey time disbenefits currently predicted.

Table 22: 2031 Inbound journey time savings – Cambourne to Grange Road (secs)

Option	AM Peak (0800-0900)	Interpeak (1000-1600 average	PM Peak (1700-1800)
Low Cost a	317	-12	223
Low Cost b	375	49	232
Do Something 1a	751	346	616
Do Something 1b	604	212	455
Illustrative Comparator	724	318	505

Source: Mott MacDonald

Table 23: 2031 Outbound journey time savings – Cambourne to Grange Road (secs)

Option	AM Peak (0800-0900)	Interpeak (1000-1600 average	PM Peak (1700-1800)
Low Cost a	62	-82	95
Low Cost b	-6	-109	-3
Do Something 1a	461	417	826
Do Something 1b	-76	190	559
Illustrative Comparator	290	252	764

Source: Mott MacDonald

6.5.2 Park and Ride demand

The options assessed compare Park and Ride sites at Waterworks (options a and the Illustrative Comparator) and Scotland Farm (options b). The analysis undertaken shows that a Park and Ride site situated at Scotland Farm, further out of Cambridge would attract most passengers.

Table 24: 2031 Park and Ride demand (car trips to site)

Park and Ride site location	AM Peak (inbound)	Interpeak (average of inbound and outbound)	PM Peak (outbound)
Madingley Road	146	70	155
Waterworks (options a)	230	116	283

Park and Ride site location	AM Peak (inbound)	Interpeak (average of inbound and outbound)	PM Peak (outbound)
Scotland Farm (options b)	344	188	453

Source: Mott MacDonald

6.5.3 Decongestion benefits

The TUBA assessments run for each option resulted in model noise outweighing any possible decongestion benefits along the corridor as a result of the scheme options. Therefore, it has been assumed that there are no decongestion benefits resulting from the scheme.

6.5.4 Analysis of Monetised Costs and Benefits

The BCR is the ratio of the Present Value of Benefits (PVB)[16] over the Present Value of Costs (PVC)[17], and indicates how much benefit is obtained for each unit of cost. This compares the benefits accrued to public transport passengers as a result of journey time savings with the costs associated with constructing, maintaining and operating each option.

Table 25 presents an Analysis of Monetised Costs and Benefits for each of the options.

The resulting scheme BCRs are fairly low. Public transport journey time benefits are predicted together with an increase in public transport passenger numbers but the resulting benefits are insufficient to outweigh the scheme costs which include the provision of a new pedestrian bridge over the M11 in all options together with varying amounts of on-road or new off-road public transport lanes and new vehicles.

Table 25: Analysis of Monetised Costs and Benefits (£'000s, 2010 prices discounted to 2010)

	Low Cost a	Low Cost b	Do Something 1a	Do Something 1b	Illustrative Comparator
Public transport Passenger PVB	2,213	2,604	23,411	18,990	20,763
Decongestion PVB	0	0	0	0	0
Total Present Value Benefits (PVB)	**2,213**	**2,604**	**23,411**	**18,990**	**20,763**
Present Value Costs (PVC)	**83,895**	**84,482**	**120,959**	**124,326**	**176,685**
Benefit Cost Ratio (BCR)	**0.03**	**0.03**	**0.19**	**0.15**	**0.12**

Source: Mott MacDonald

6.6 Value for Money

The Value for Money (VfM) takes into account the monetised impacts vs the scheme costs presented as a Benefit to Cost Ratio, as well as the findings from any qualitative and non-monetised assessments.

[16] PVB is the present value of the future stream of estimated benefits of an option over 60 years discounted to the DfT's base year of 2010

[17] PVC is the present value of the future stream of estimated costs of an option over 60 years discounted to the DfT's base year of 2010

The approach to the assessment of Value for Money (VfM) of City Deal schemes, as set out in the City Deal Assurance Framework, reflects this by stating that schemes scoring a BCR less than 2:1 will still be considered for funding if they can demonstrate a compelling case for investment based on meeting the objectives of the City Deal. For example, unlocking barriers to growth, delivering wider economic benefits, environmental and social benefits. As long as the scheme provides a robust evidence base with a proportionate level of quantitative and qualitative analysis to demonstrate that the scheme represents good value for money and can meet the policy objectives of the City Deal, these do not need to be included in the central benefit-cost analysis.[18]

As shown Table 25 the BCR's for the proposed the C2C schemes is below the required 2:1 ratio. This calls into question reliance on the BCR for assessing the emerging recommended option.

Within the Economic Case for the Business Case Update[19] a series of sensitivity testing was undertaken with the final VfM statement showing that the emerging recommended option is the Illustrative Comparator.

6.6.1 VfM sensitivity test 1

Table 26: VfM sensitivity test 1 - Analysis of Monetised Costs and Level 1, 2 and 3 Benefits

Benefit (£,000m)	Illustrative Comparator
Public transport Passenger PVB	20,763
Wider Impacts Transport Appraisal	3,005
Total Present Value Benefits (PVB)	**23,768**
Wider Economic Benefits[20]	78,700
Total Value of Benefits	102,459
Present Value Costs (PVC)	176,685
OVERALL IMPACT	
"Total benefits ratio"	**0.58**

Source: Mott MacDonald

6.6.2 VfM sensitivity test 2

Table 27: VfM sensitivity test 2 - Analysis of Monetised Costs and Wider Economic Benefits at Greater Cambridge local level

Benefit (£,000m)	Illustrative Comparator
GVA benefits – Greater Cambridge level	679,300
Present Value Costs (PVC)	176,685
OVERALL IMPACT	
"Local WEBs ratio"	**3.84**

Source: Mott MacDonald

[18] City Deal Assurance Framework

[19] Business Case Update – Economic Case 392438-MMD-BCA-XX-RP-BC-0007

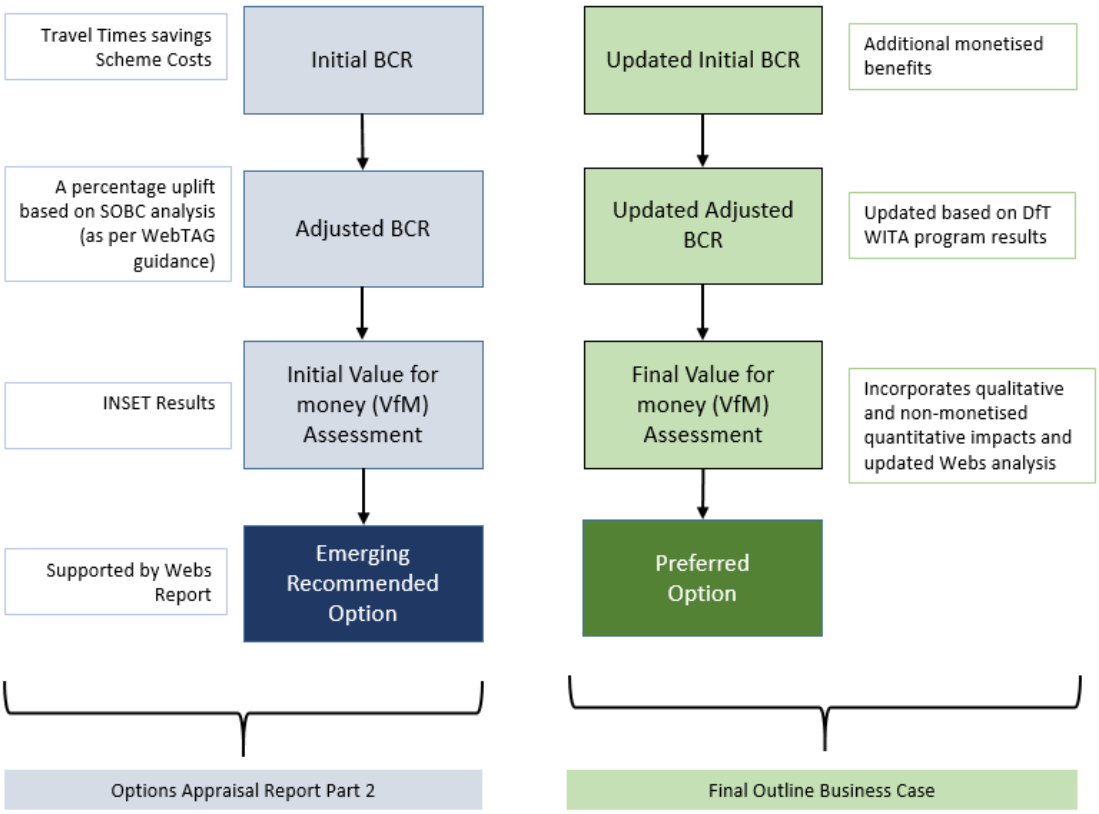
[20] This value does not include option and non-use values – these are reported within the AST as social benefits.

7 Emerging Strategic Option

7.1 Emerging strategic option

The process to arrive at the emerging recommended option is shown in Figure 27.

Figure 27: Assessment process for recommended route option

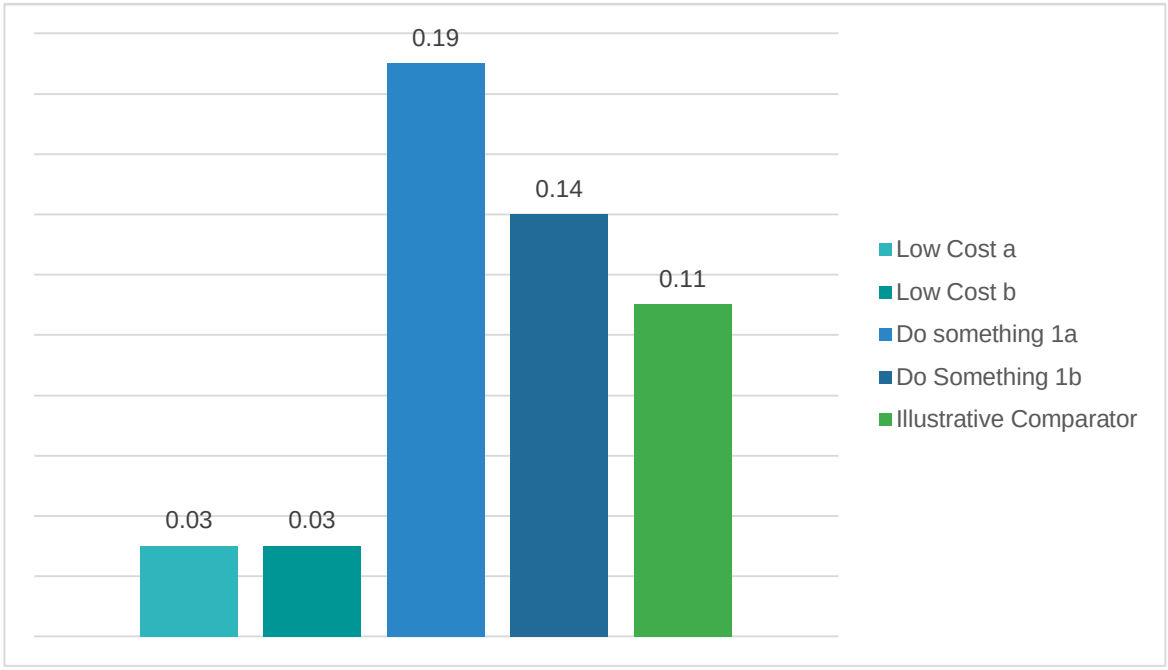


Source: Mott MacDonald

7.1.1 Initial BCR

The initial BCR showed that the emerging option was **Do Something 1a.**

Figure 28: BCR Results



Source: Mott MacDonald

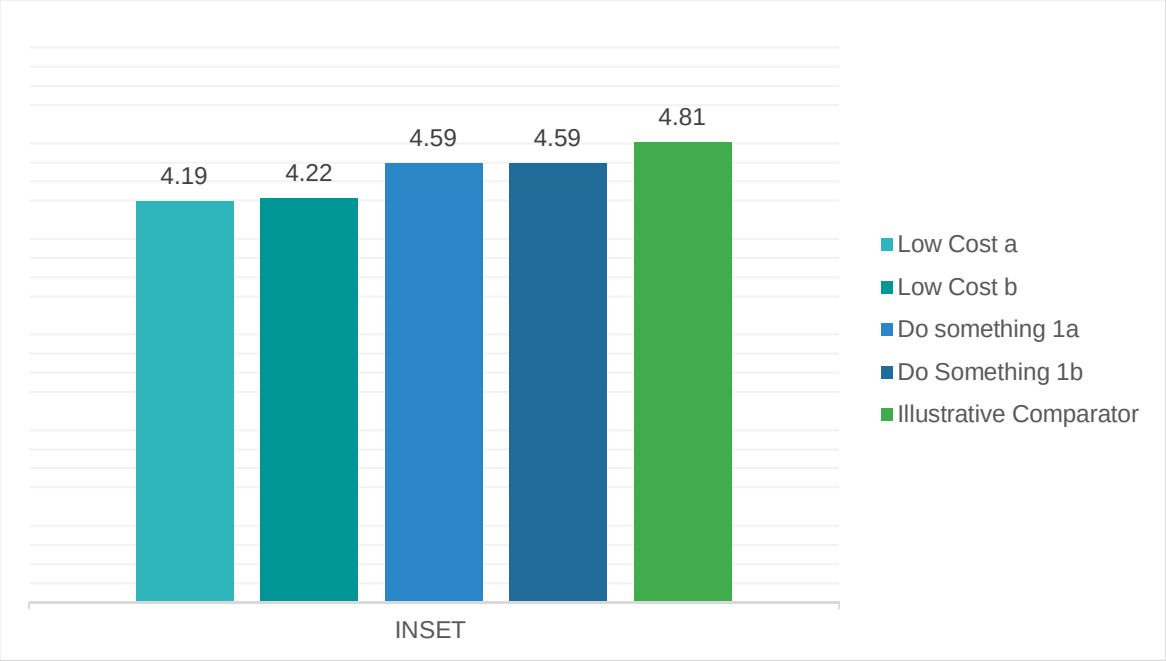
7.1.2 Adjusted BCR

The initial BCR results are below the required 2:1 ratio. Therefore, an adjusted BCR was developed based on a percentage uplift detailed in the strategic outline business case (SOBC). As the uplift was applied to all the BCRs the emerging recommended option was still **Do Something 1a.**

7.1.3 INSET Assessment

The INSET assessment results showed that an emerging option could potentially be the Illustrative Comparator**.**

Figure 29: INSET Results



Source: Mott MacDonald

7.1.3.1 Value for Money (VfM) Assessment

From the appraisal undertaken to date we have identified a Specific Route Alignment which performs best from Madingley Mulch Roundabout to Grange Road, which is option Do Something 1a. However, the results from the INSET, which covers a wide variety of criteria shows that there are benefits from implementing the Illustrative Comparator which incorporated both the phase 1 section to Madingley Roundabout (i.e. Do Something 1a/1b) and the phase 2 extension to Cambourne. As can be seen from Table 7.1.3.1 and elsewhere, the choice of Park and Ride site has a marginal impact on the overall scheme economics.

Whilst the High Cost Alternative (phase 2) has not been fully appraised and is subject to further consultation, the INSET appraisal confirms that extending the scheme west to Cambourne would deliver additional benefits. Specifically, the Illustrative Comparator would ensure that the scheme serves potential development in Cambourne West and Bourn Airfield. At the present point in time, and until the South Cambridgeshire Local Plan is adopted, these developments cannot be considered to be fully committed, but from a strategic point of view, there is a strong alignment between the Illustrative Comparator and the draft Local Plan.

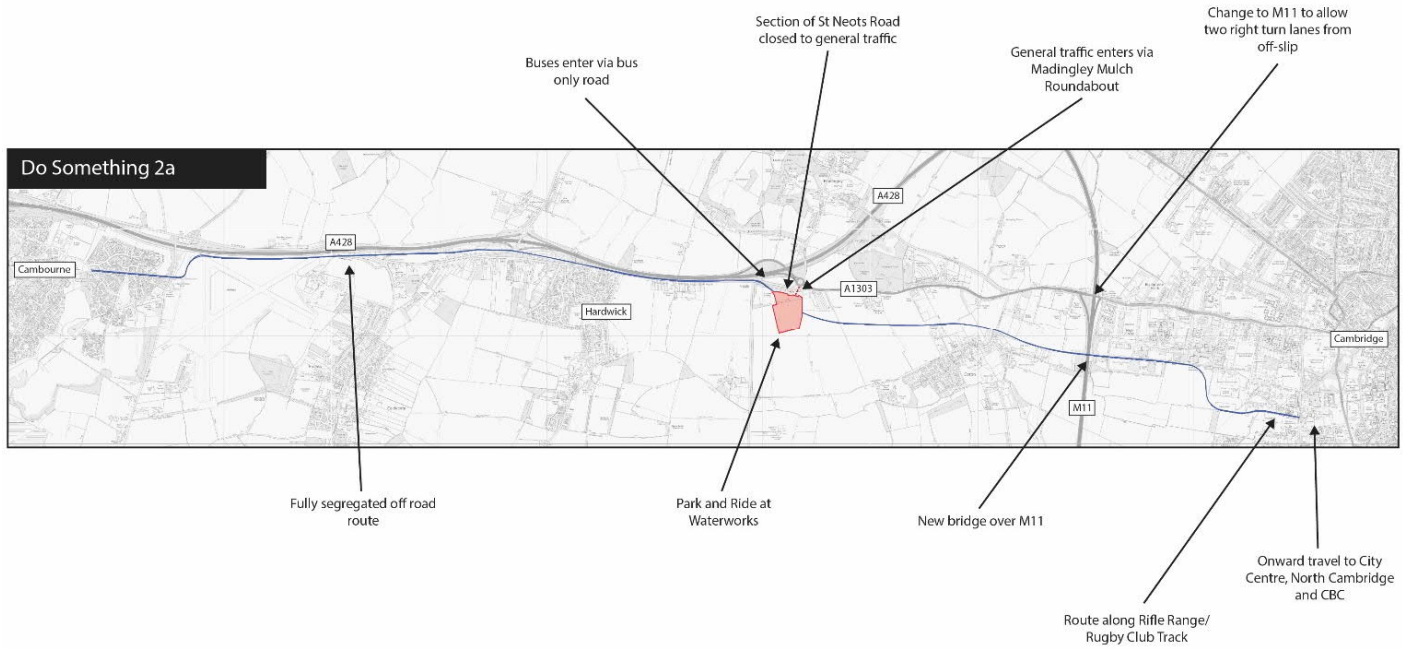
To support the INSET assumption that the **emerging strategic option is the Illustrative Comparison** a Value for money assessment (VfM) was undertaken using a WEB report published in 2016[21]. WEB appraisal of the Illustrative Comparison confirms that there is a high level of growth associated with provision of a full off-road public transport route to unlock development opportunity on the corridor.

[21] Strategic Economic Appraisla of A428-A1303 Bus Scheme – Wider Economic Benefits, August 2016

7.2 Emerging Conclusions and Next Steps

Following the results of the INSET scoring, BCR calculation and consideration of the WEB appraisal, the emerging strategic option is the **Illustrative Comparator**. For the purposes of the assessment in this report, the Illustrative Comparator is based on the Waterworks Park and Ride site, but as can be seen in Figure 7.1.3.1 and elsewhere, the Scotland Farm site would be likely to generate similar benefits and the two should be seen as interchangeable at this stage.

Figure 30 - Illustrative Comparator



Source: Mott MacDonald, (© Crown Copyright. All Rights Reserved. OS License Number 100023205.2018)

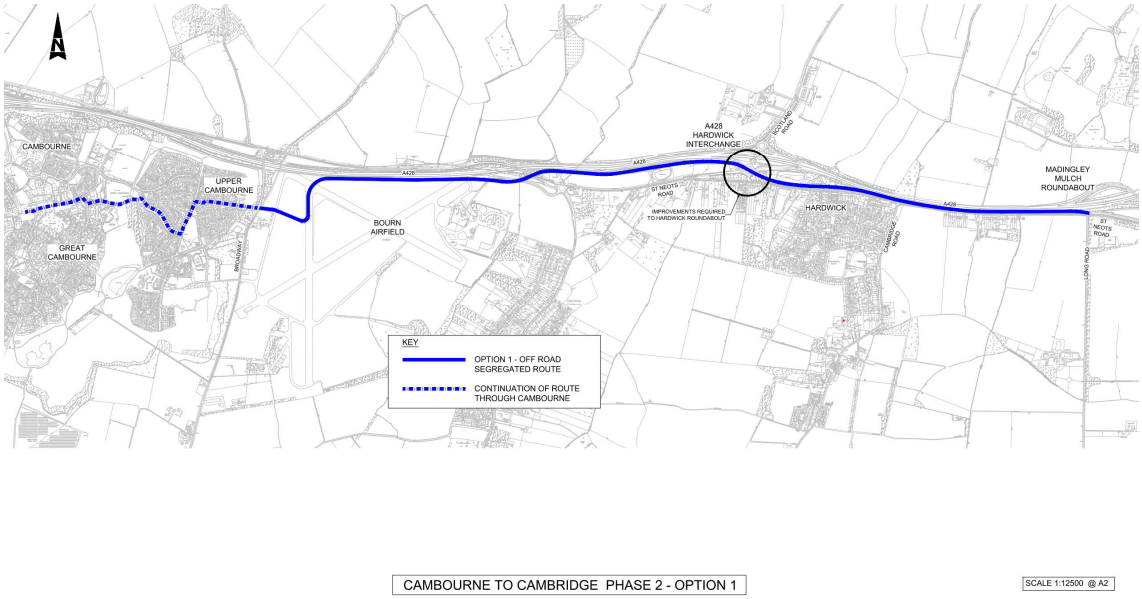
This is due to the indication from both the INSET scoring and the supporting value for money report that providing some infrastructure between Cambourne and Madingley Mulch Roundabout will deliver additional benefits.

However, the value for money report only considered an off road route from Cambourne to Cambridge, and did not consider any other options. Also, specific options for the Phase 2 section between Cambourne and Madingley Mulch Roundabout have yet to be consulted on and as such consideration and assessment of all options should be undertaken to the same extent as Phase 1. These options, which will be assessed in a subsequent OAR document could include combinations of the following:

- Phase 2 alignments
  - Off Road Segregated
  - On Road with junction improvements
  - On Road Public Transport Priority
- Park and Ride
  - Scotland Farm
  - Waterworks

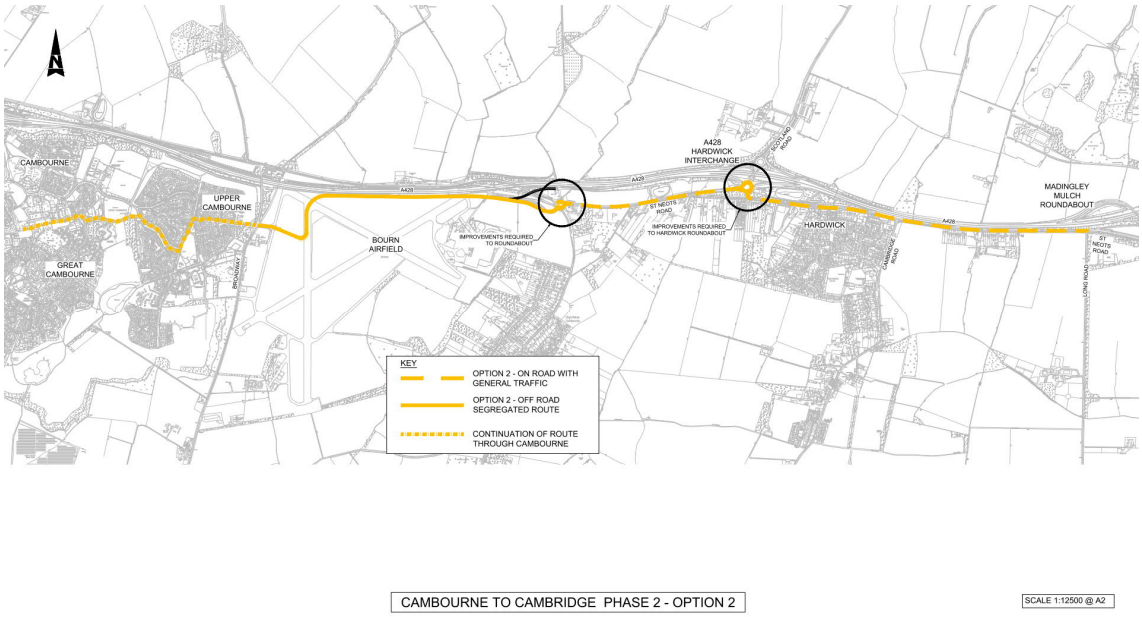
The following figures show indicative layouts that will be developed for consultation. In all options it is assumed that the section between Cambourne and through the proposed Bourn Airfield Development is a segregated off-road route.

Figure 31: Phase 2 - Off Road Segregated



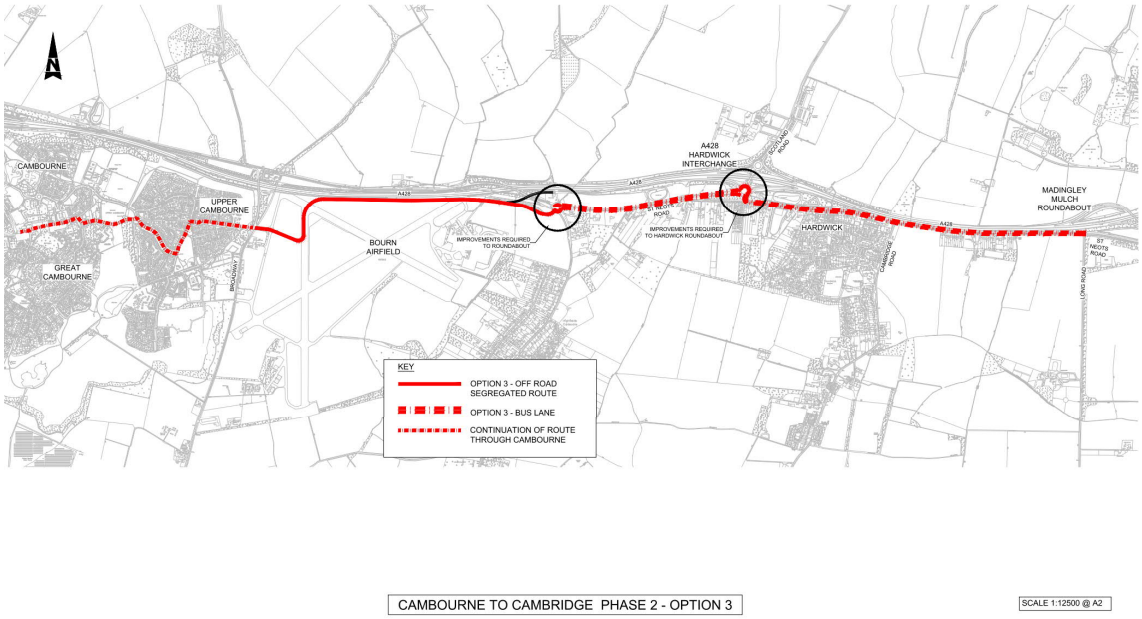
Source: Skanska

Figure 32: Phase 2 – On-Road Junction Improvement



Source: Skanska

Figure 33: Phase 2 – On Road Public Transport Priority



Source: Skanska

Once the Phase 2 route option has been consulted on and confirmed, which will also allow a recommended Park and Ride to be selected, an updated BCR and VfM assessment will need to

be undertaken. The assessments will use information from public consultation and further Phase 2 work outlined above to arrive at a final recommended option as part of the final OBC.

This would include:

- Collation of additional monetised benefits
- Results from the Wider Impacts in Transport Appraisal (WITA) analysis
- Updated WEBs analysis
  - transport economic benefits
  - wider economic benefits
  - Social and distributional impacts
  - environmental constraints.

Annex

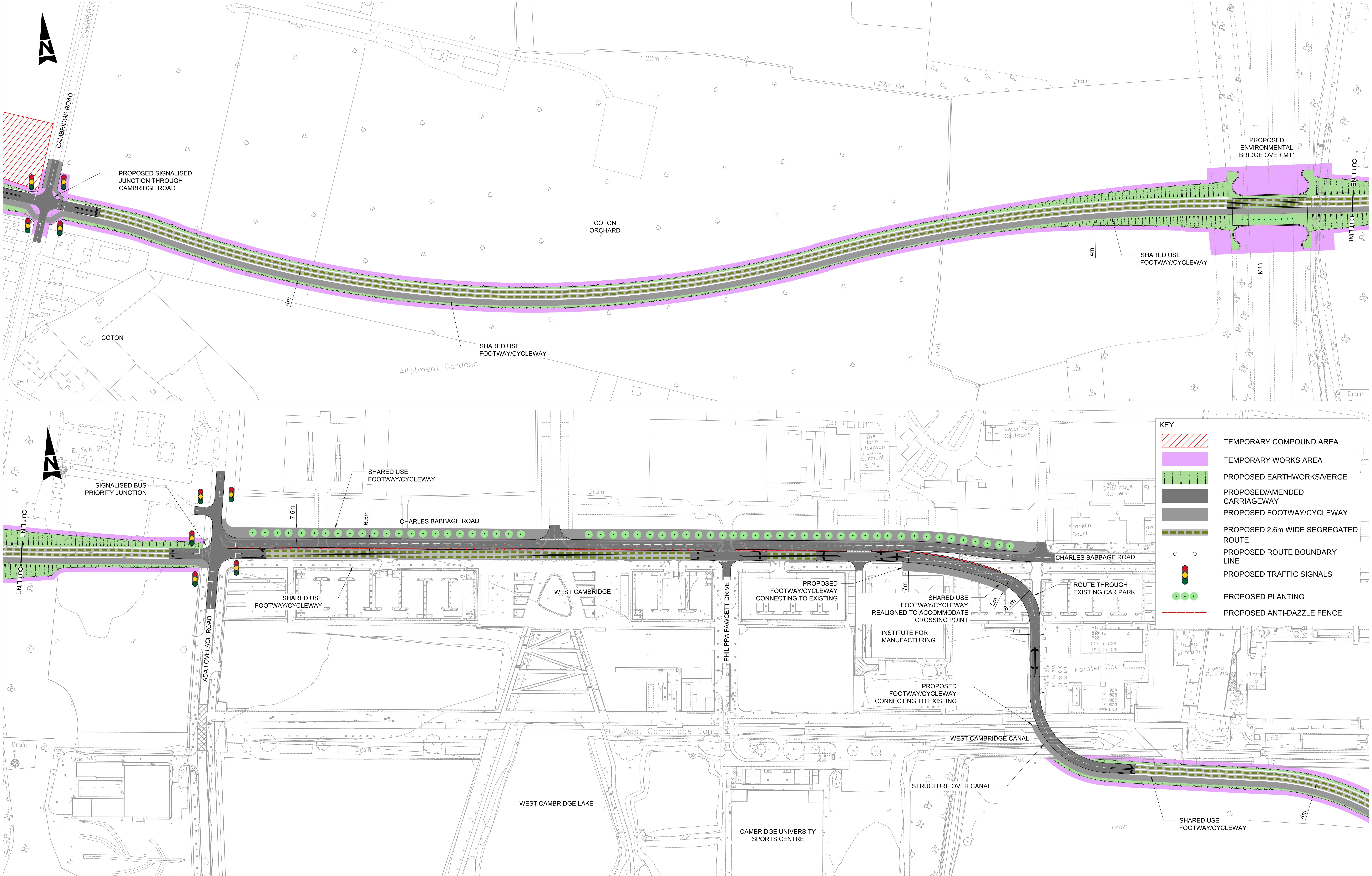
A. Option Drawings

A.1 Segregated West Cambridge Alignment

Rev B
Drawing Number 5020059_HW_FS_190
Status I

DO NOT SCALE

A1



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Rev	Description	By	Date	Chk'd	Auth	Stat	Purpose of Issue	Date	Auth
B	ALIGMENT AMENDED	DMB	12.06.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
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Project
A428 CAMBOURNE TO CAMBRIDGE PROJECT

Title
OFF ROAD ALTERNATIVE ROUTE
WEST CAMBRIDGE ALIGNMENT
SHEET 1 OF 1

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB	SPW	ADB
	Date 29/5/18	Date 29/5/18	Date 31/5/18

Status	Drawing Number	Rev
I	5020059_HW_FS_190	B

File Location: P:\GBIPD\ESol\05 Cambridgeshire Highways\Cambridge Busways – A428 & Western Orbit\900 CAD & BIM\910 Drawings\A428 Cambridge to Cambourne\5020059_HW_FS_190_RevB Alternative route through West Cambridge.dwg

A.2 Low Cost a: Completion of recommended on-road + Park & Ride at Waterworks

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D	NOTES UPDATED	JE	12.12.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
C	WORKS EAST OF HIGH CROSS REINSTATED	JE	26.07.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
B	WORKS EAST OF HIGH CROSS OMITTED	DMB	31.05.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
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Title
LOW COST A
ON ROAD + WATERWORKS
SHEET 1 OF 4

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB, Date 21.05.18	SPW, Date 21.05.18	ADB, Date 21.05.18

Project
CAMBOURNE TO CAMBRIDGE
BETTER PUBLIC TRANSPORT PROJECT

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Rev D

Drawing Number 5020059_HW_FS_111

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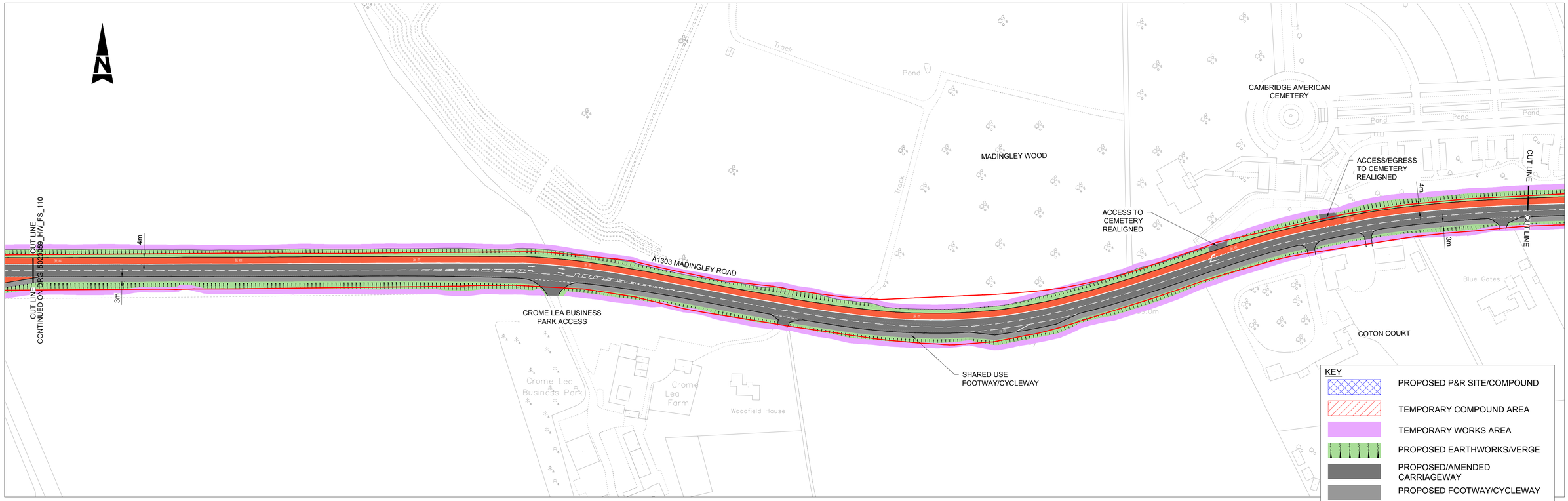

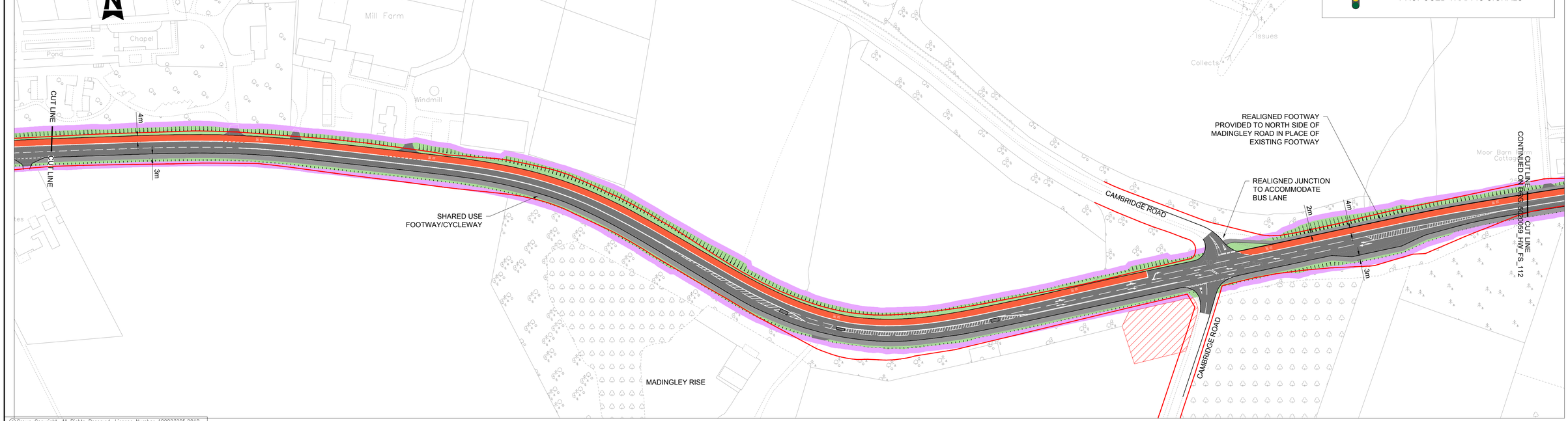

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B	WORKS EAST OF HIGH CROSS OMITTED	DMB	31.05.18	SPW	ADB
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Project
CAMBOURNE TO CAMBRIDGE BETTER PUBLIC TRANSPORT PROJECT

Title
LOW COST A
ON ROAD + WATERWORKS
SHEET 2 OF 4

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Status	Drawing Number	Rev
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B	WORKS EAST OF HIGH CROSS OMITTED	DMB	31.05.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
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SHEET 3 OF 4

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Status	Drawing Number	Rev
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KEY

▨	PROPOSED P&R SITE/COMPOUND
▨	TEMPORARY COMPOUND AREA
■	TEMPORARY WORKS AREA
🟩	PROPOSED EARTHWORKS/VERGE
■	PROPOSED/AMENDED CARRIAGEWAY
■	PROPOSED FOOTWAY/CYCLEWAY
🟥	PROPOSED PUBLIC TRANSPORT LANE
■	PROPOSED CYCLE LANE
—	EXISTING HIGHWAY BOUNDARY
🚦	PROPOSED TRAFFIC SIGNALS

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(ENTER 'NONE' IF APPLICABLE)

Rev	Description	By	Date	Chk'd	Auth	Stat	Purpose of Issue	Date	Auth
D	NOTES UPDATED	JE	12.12.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
C	WORKS EAST OF HIGH CROSS REINSTATED	JE	26.07.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
B	WORKS EAST OF HIGH CROSS OMITTED	DMB	31.05.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
A	ORIGINAL	–	–	–	–	I	OPTIONS APPRAISAL REPORT		

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Project
CAMBOURNE TO CAMBRIDGE
BETTER PUBLIC TRANSPORT PROJECT

Title
LOW COST A
ON ROAD + WATERWORKS
SHEET 4 OF 4

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB Date 21.05.18	SPW Date 21.05.18	ADB Date 21.05.18

Status	Drawing Number	Rev
I	5020059_HW_FS_113	D

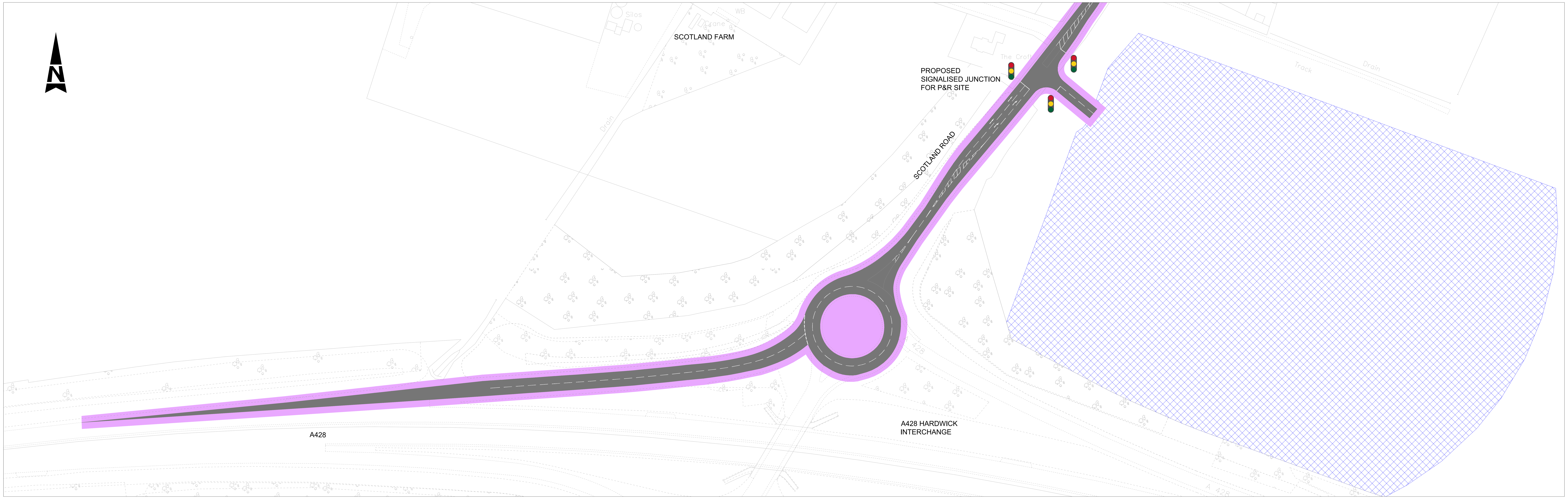
P:\GBIPD\ESol\05 Cambridgeshire Highways\Cambridge Busways – A428 & Western Orbit\900 CAD & BIM\910 Drawings\A428 Cambridge to Cambourne\5020059_HW_FS_110–113 Low Cost A – On Road + Waterworks (Op 1) – RevD.dwg

A.3 Low Cost b: Completion of recommended on-road + P&R at Scotland Farm

DO NOT SCALE

A1

Status I | Drawing Number 5020059_HW_FS_120 | Rev D



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS

CONSTRUCTION
(ENTER 'NONE' IF APPLICABLE)
MAINTENANCE/CLEANING
(ENTER 'NONE' IF APPLICABLE)
USE
(ENTER 'NONE' IF APPLICABLE)
DECOMMISSIONING/DEMOLITION
(ENTER 'NONE' IF APPLICABLE)

Rev	Description	By	Date	Chk'd	Auth	Stat	Purpose of Issue	Date	Auth
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Project
CAMBOURNE TO CAMBRIDGE
BETTER PUBLIC TRANSPORT PROJECT

Title
LOW COST B
ON ROAD + SCOTLAND FARM
SHEET 1 OF 4

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB, Date 21.05.18	SPW, Date 21.05.18	ADB, Date 21.05.18

Status	Drawing Number	Rev
I	5020059_HW_FS_120	D

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Drawing Name: 5020059_HW_FS_120–123 Low Cost B – On Road + Scotland Farm (Op 2) – RevD.dwg

P:\GBIPD\ESol\05 Cambridgeshire Highways\Cambridge Busways – A428 & Western Orbit\900 CAD & BIM\910 Drawings\A428 Cambridge to Cambourne\5020059_HW_FS_120–123 Low Cost B – On Road + Scotland Farm (Op 2) – RevD.dwg

Rev D | Drawing Number 5020059_HW_FS_121 | Status I

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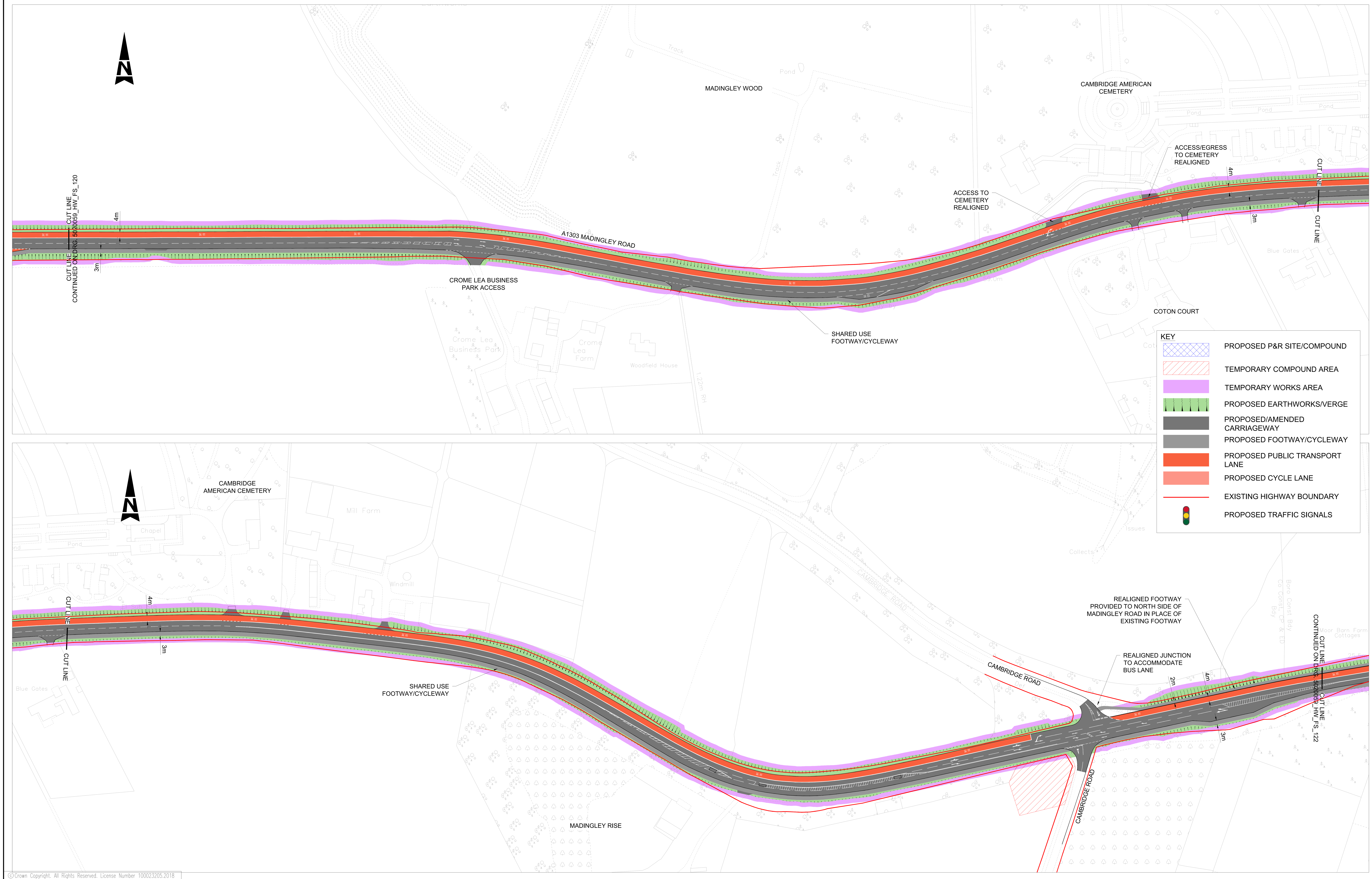

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MAINTENANCE/CLEANING	(ENTER 'NONE' IF APPLICABLE)
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Project
CAMBOURNE TO CAMBRIDGE BETTER PUBLIC TRANSPORT PROJECT

Title
LOW COST B
ON ROAD + SCOTLAND FARM
SHEET 2 OF 4

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB	SPW	ADB
	Date 21.05.18	Date 21.05.18	Date 21.05.18

Status	Drawing Number	Rev
I	5020059_HW_FS_121	D

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DO NOT SCALE

A1

Status	Drawing Number	Rev
I	5020059_HW_FS_122	D

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MAINTENANCE/CLEANING
(ENTER 'NONE' IF APPLICABLE)

USE
(ENTER 'NONE' IF APPLICABLE)

DECOMMISSIONING/DEMOLITION
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Project
CAMBOURNE TO CAMBRIDGE
BETTER PUBLIC TRANSPORT PROJECT

Title
LOW COST B
ON ROAD + SCOTLAND FARM
SHEET 3 OF 4

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB	SPW	ADB
	Date 21.05.18	Date 21.05.18	Date 21.05.18

Status	Drawing Number	Rev
I	5020059_HW_FS_122	D

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Rev D

Drawing Number 5020059_HW_FS_122

Status I

DO NOT SCALE

A1

KEY

- PROPOSED P&R SITE/COMPOUND
- TEMPORARY COMPOUND AREA
- TEMPORARY WORKS AREA
- PROPOSED EARTHWORKS/VERGE
- PROPOSED/AMENDED CARRIAGEWAY
- PROPOSED FOOTWAY/CYCLEWAY
- PROPOSED PUBLIC TRANSPORT LANE
- PROPOSED CYCLE LANE
- EXISTING HIGHWAY BOUNDARY
- PROPOSED TRAFFIC SIGNALS

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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MAINTENANCE/CLEANING
(ENTER 'NONE' IF APPLICABLE)

USE
(ENTER 'NONE' IF APPLICABLE)

DECOMMISSIONING/DEMOLITION
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CAMBOURNE TO CAMBRIDGE
BETTER PUBLIC TRANSPORT PROJECT

Title
LOW COST B
ON ROAD + SCOTLAND FARM
SHEET 4 OF 4

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB	SPW	ADB
	Date 21.05.18	Date 21.05.18	Date 21.05.18

Status	Drawing Number	Rev
I	5020059_HW_FS_123	D

File Location: P:\GBIPD\ESol\05 Cambridgeshire Highways\Cambridge Busways - A428 & Western Orbit\900 CAD & BIM\910 Drawings\A428 Cambridge to Cambourne\
Drawing Name: 5020059_HW_FS_120-123 Low Cost B - On Road + Scotland Farm (Op 2) - RevD.dwg

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A.4 Do Something 1a: Recommended off-road + P&R at Water works

Rev D | Drawing Number 5020059_HW_FS_140 | Status I

DO NOT SCALE

A1

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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CONSTRUCTION
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MAINTENANCE/CLEANING
(ENTER 'NONE' IF APPLICABLE)
USE
(ENTER 'NONE' IF APPLICABLE)
DECOMMISSIONING/DEMOLITION
(ENTER 'NONE' IF APPLICABLE)

Rev	Description	By	Date	Chk'd	Auth	Stat	Purpose of Issue
D	NOTES UPDATED	JE	12.12.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT
C	ROUTE AMENDED THROUGH WEST CAMBRIDGE	DMB	01.08.18	SPW	MBS	I	OPTIONS APPRAISAL REPORT
B	WORKS EAST OF HIGH CROSS OMITTED	DMB	31.05.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT
A	ORIGINAL	–	–	–	–	I	OPTIONS APPRAISAL REPORT

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Project: CAMBOURNE TO CAMBRIDGE BETTER PUBLIC TRANSPORT PROJECT

Title: DO SOMETHING 1A OFF ROAD PHASE 1 + WATERWORKS SHEET 1 OF 5

Original Scale	Designed/Drawn	Checked	Authorised
As Shown	DMB Date 21.05.18	SPW Date 21.05.18	ADB Date 21.05.18

Status: I | Drawing Number: 5020059_HW_FS_140 | Rev: D

File Location: P:\GBIPD\ESol\05 Cambridgeshire Highways\Cambridge Busways - A428 & Western Orbit\900 CAD & BIM\910 Drawings\A428 Cambridge to Cambourne\5020059_HW_FS_140-144 Do-Som 1A - Off Road Phase 1 + Waterworks (Op 4) - RevDJE.dwg

Rev D

Drawing Number 5020059_HW_FS_141

Status I

DO NOT SCALE

A1 0 10 100

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS
CONSTRUCTION
(ENTER 'NONE' IF APPLICABLE)
MAINTENANCE/CLEANING
(ENTER 'NONE' IF APPLICABLE)
USE
(ENTER 'NONE' IF APPLICABLE)
DECOMMISSIONING/DEMOLITION
(ENTER 'NONE' IF APPLICABLE)

Rev	Description	By	Date	Chk'd	Auth
D	NOTES UPDATED	JE	12.12.18	SPW	ADB
C	ROUTE AMENDED THROUGH WEST CAMBRIDGE	DMB	01.08.18	SPW	MBS
B	WORKS EAST OF HIGH CROSS OMITTED	DMB	31.05.18	SPW	ADB
A	ORIGINAL	–	–	–	–

Stat	Purpose of Issue	Date	Auth
I	OPTIONS APPRAISAL REPORT		
I	OPTIONS APPRAISAL REPORT		
I	OPTIONS APPRAISAL REPORT		
I	OPTIONS APPRAISAL REPORT		

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Project

CAMBOURNE TO CAMBRIDGE BETTER PUBLIC TRANSPORT PROJECT

Title

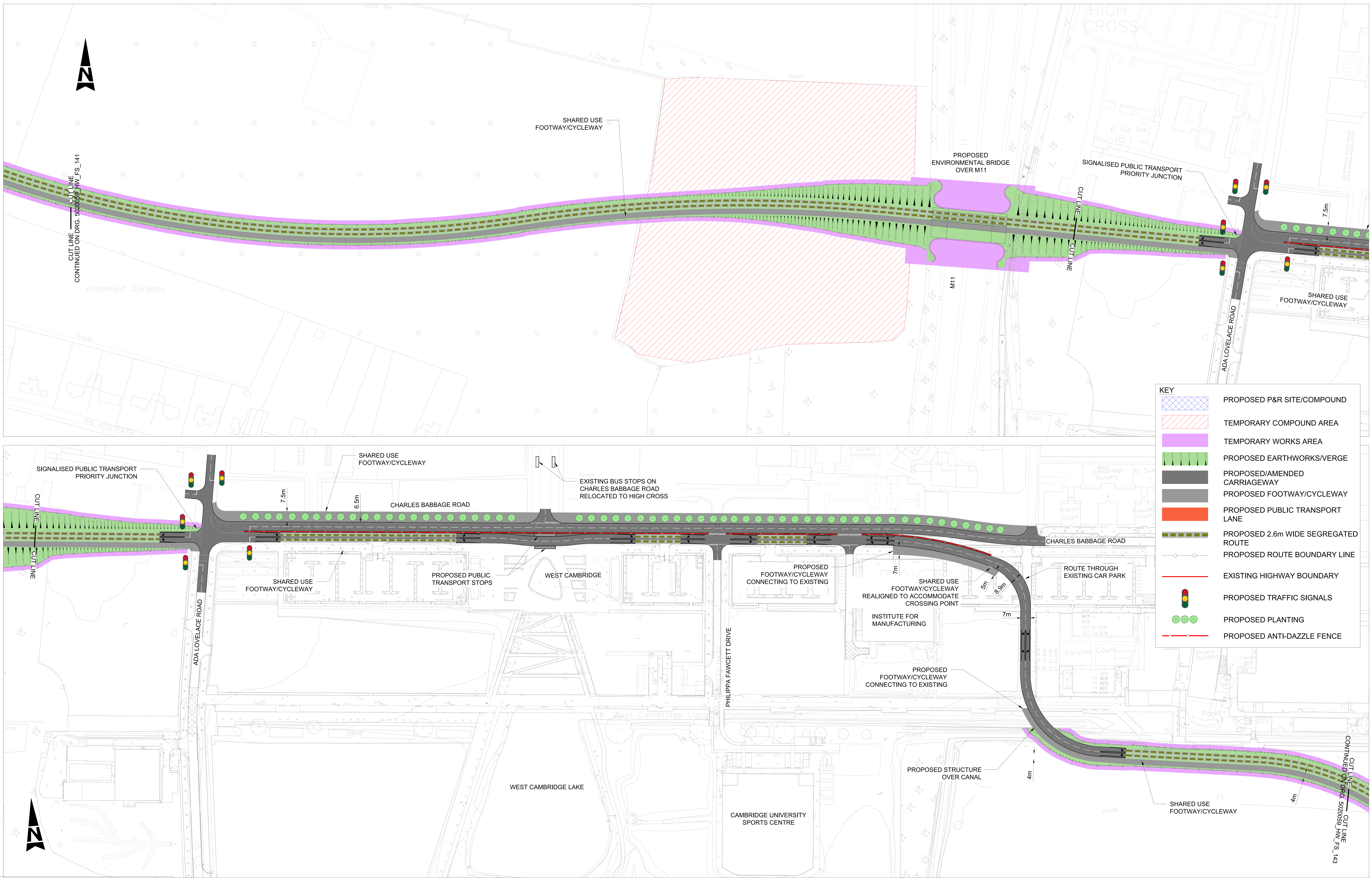
DO SOMETHING 1A
OFF ROAD PHASE 1 + WATERWORKS
SHEET 2 OF 5

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB Date 21.05.18	SPW Date 21.05.18	ADB Date 21.05.18

Status	Drawing Number	Rev
I	5020059_HW_FS_141	D

File Location: P:\GBIPD\ESol\05 Cambridgeshire Highways\Cambridge Busways – A428 & Western Orbit\900 CAD & BIM\910 Drawings\A428 Cambridge to Cambourne\5020059_HW_FS_140-144 Do-Som 1A – Off Road Phase 1 + Waterworks (Op 4) – RevDJE.dwg Date: Dec 13, 2018 – 11:24am

Drawing Name: 5020059_HW_FS_140-144 Do-Som 1A – Off Road Phase 1 + Waterworks (Op 4) – RevDJE.dwg Plotted by: BOWDENJ



SHARED USE FOOTWAY/CYCLEWAY
CUT LINE
CUT LINE CONTINUED ON DRG. 5020059_HW_FS_141
PROPOSED ENVIRONMENTAL BRIDGE OVER M11
SIGNALISED PUBLIC TRANSPORT PRIORITY JUNCTION
M11
7.5m
ADA LOVELACE ROAD
SHARED USE FOOTWAY/CYCLEWAY
SIGNALISED PUBLIC TRANSPORT PRIORITY JUNCTION
SHARED USE FOOTWAY/CYCLEWAY
7.5m
6.5m
CHARLES BABBAGE ROAD
EXISTING BUS STOPS ON CHARLES BABBAGE ROAD RELOCATED TO HIGH CROSS
SHARED USE FOOTWAY/CYCLEWAY
PROPOSED PUBLIC TRANSPORT STOPS
WEST CAMBRIDGE
PROPOSED FOOTWAY/CYCLEWAY CONNECTING TO EXISTING
7m
SHARED USE FOOTWAY/CYCLEWAY REALIGNED TO ACCOMMODATE CROSSING POINT
5m
8.9m
7m
ROUTE THROUGH EXISTING CAR PARK
CHARLES BABBAGE ROAD
INSTITUTE FOR MANUFACTURING
PROPOSED FOOTWAY/CYCLEWAY CONNECTING TO EXISTING
PHILIPPA FAWCETT DRIVE
PROPOSED STRUCTURE OVER CANAL
4m
WEST CAMBRIDGE LAKE
CAMBRIDGE UNIVERSITY SPORTS CENTRE
SHARED USE FOOTWAY/CYCLEWAY
4m
CUT LINE CONTINUED ON DRG. 5020059_HW_FS_143
KEY
PROPOSED P&R SITE/COMPOUND
TEMPORARY COMPOUND AREA
TEMPORARY WORKS AREA
PROPOSED EARTHWORKS/VERGE
PROPOSED/AMENDED CARRIAGEWAY
PROPOSED FOOTWAY/CYCLEWAY
PROPOSED PUBLIC TRANSPORT LANE
PROPOSED 2.6m WIDE SEGREGATED ROUTE
PROPOSED ROUTE BOUNDARY LINE
EXISTING HIGHWAY BOUNDARY
PROPOSED TRAFFIC SIGNALS
PROPOSED PLANTING
PROPOSED ANTI-DAZZLE FENCE

Rev D | Drawing Number 5020059_HW_FS_142 | Status I

DO NOT SCALE

A1

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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CONSTRUCTION
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MAINTENANCE/CLEANING
(ENTER 'NONE' IF APPLICABLE)
USE
(ENTER 'NONE' IF APPLICABLE)
DECOMMISSIONING/DEMOLITION
(ENTER 'NONE' IF APPLICABLE)

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Project
CAMBOURNE TO CAMBRIDGE
BETTER PUBLIC TRANSPORT PROJECT

Title
DO SOMETHING 1A
OFF ROAD PHASE 1 + WATERWORKS
SHEET 3 OF 5

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB Date 21.05.18	SPW Date 21.05.18	ADB Date 21.05.18

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I	5020059_HW_FS_142	D

P:\GBIPD\ESol\05 Cambridgeshire Highways\Cambridge Busways - A428 & Western Orbit\900 CAD & BIM\910 Drawings\A428 Cambridge to Cambourne\5020059_HW_FS_140-144 Do-Som 1A - Off Road Phase 1 + Waterworks (Op 4) - RevDJE.dwg

KEY

- PROPOSED P&R SITE/COMPOUND
- TEMPORARY COMPOUND AREA
- TEMPORARY WORKS AREA
- PROPOSED EARTHWORKS/VERGE
- PROPOSED/AMENDED CARRIAGEWAY
- PROPOSED FOOTWAY/CYCLEWAY
- PROPOSED PUBLIC TRANSPORT LANE
- PROPOSED 2.6m WIDE SEGREGATED ROUTE
- PROPOSED ROUTE BOUNDARY LINE
- EXISTING HIGHWAY BOUNDARY
- PROPOSED TRAFFIC SIGNALS

DO NOT SCALE

A1

Rev D | Drawing Number 5020059_HW_FS_143 | Status I

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Title
DO SOMETHING 1A
OFF ROAD PHASE 1 + WATERWORKS
SHEET 4 OF 5

Original Scale	Designed/Drawn	Checked	Authorised
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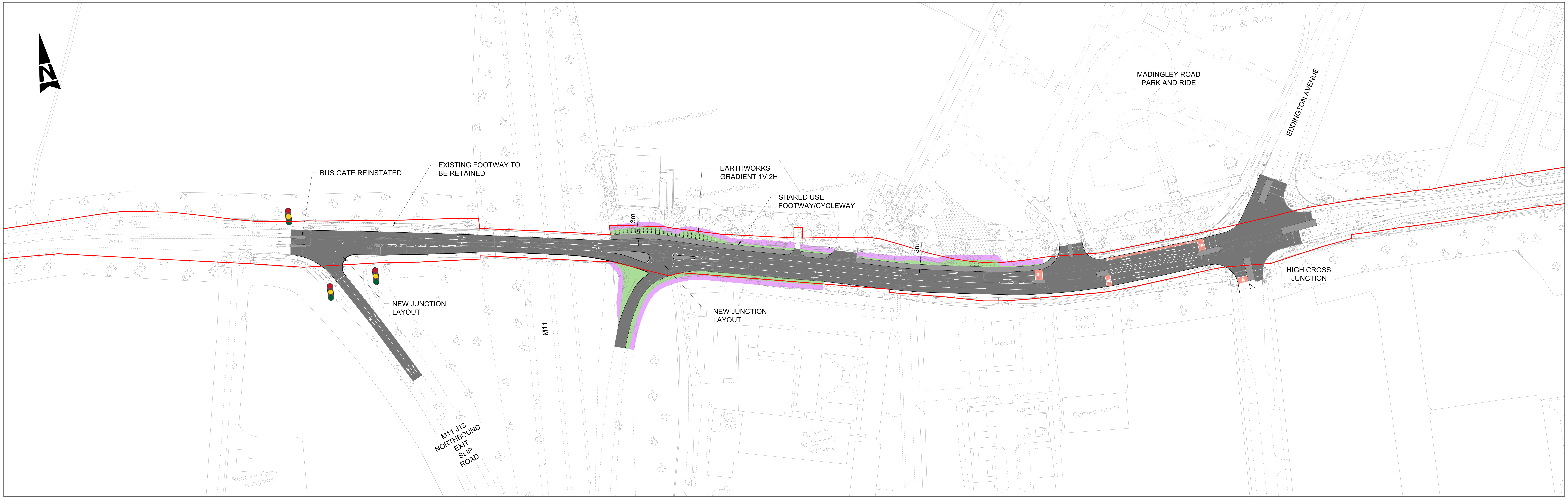
Rev D

Drawing Number 5020059_HW_FS_144

Status I

DO NOT SCALE

A1



KEY

- TEMPORARY WORKS AREA
- PROPOSED EARTHWORKS/VERGE
- PROPOSED/AMENDED CARRIAGEWAY
- PROPOSED FOOTWAY/CYCLEWAY
- EXISTING CYCLE LANE
- EXISTING HIGHWAY BOUNDARY
- PROPOSED TRAFFIC SIGNALS

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Title
DO SOMETHING 1A
OFF ROAD PHASE 1 + WATERWORKS
SHEET 5 OF 5

Project
CAMBOURNE TO CAMBRIDGE
BETTER PUBLIC TRANSPORT PROJECT

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB, Date 21.05.18	SPW, Date 21.05.18	ADB, Date 21.05.18

Status	Drawing Number	Rev
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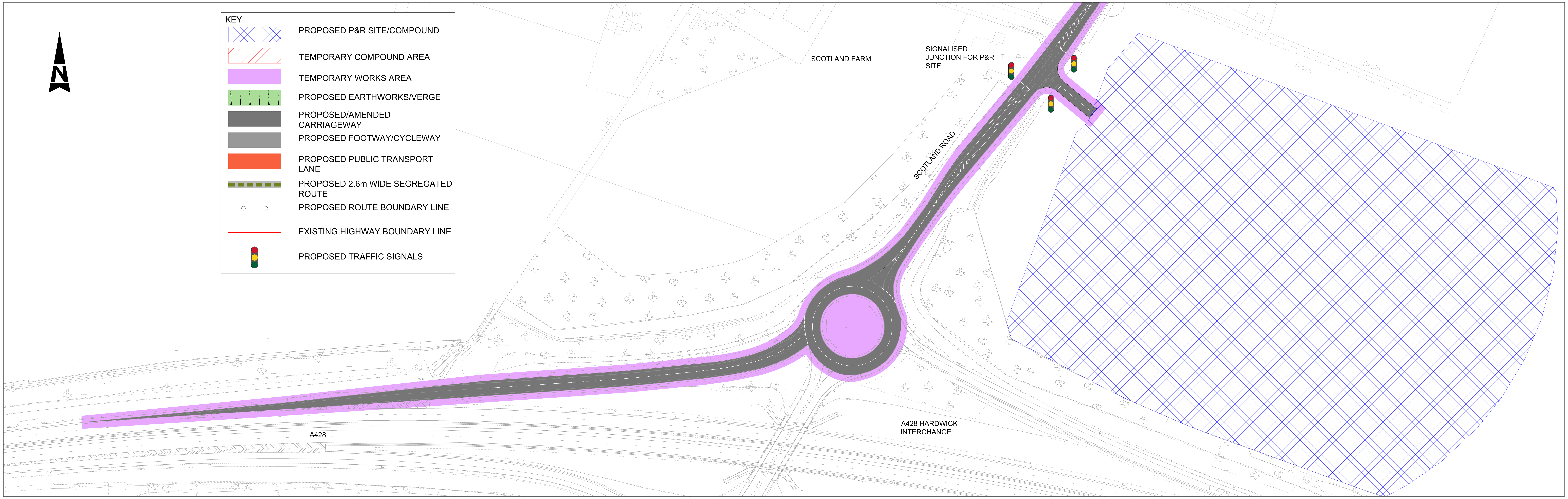
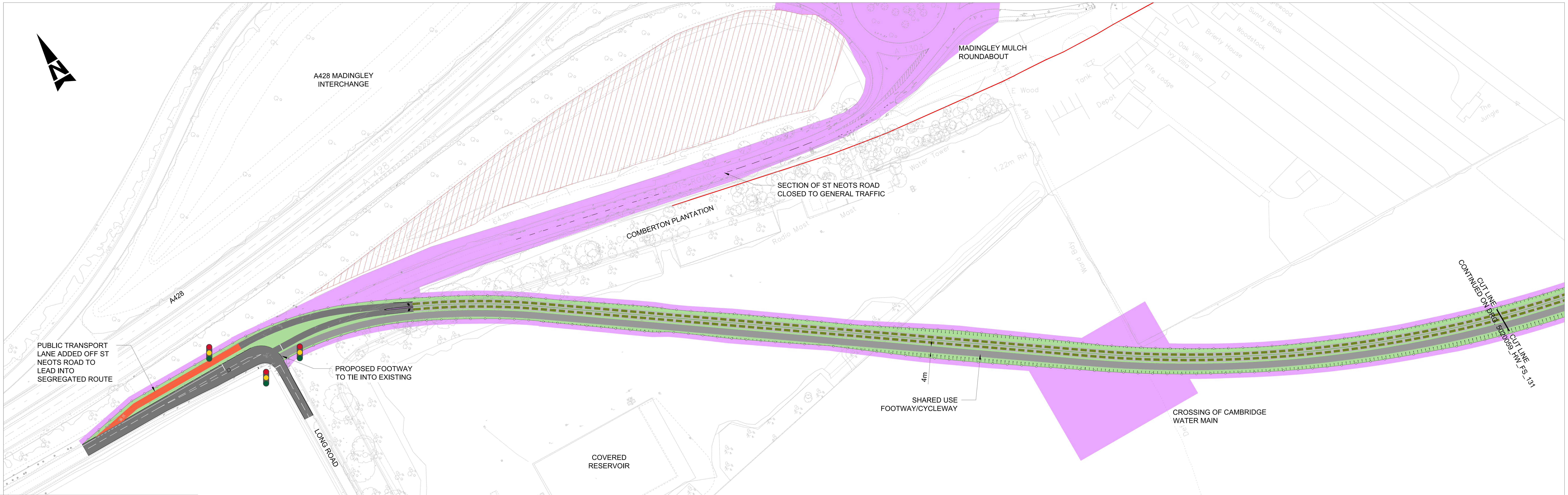
A.5 Do Something 1b: Recommended off-road + P&R at Scotland Farm

Rev D
Drawing Number 5020059_HW_FS_130
Status I

DO NOT SCALE

A1





SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS

CONSTRUCTION
(ENTER 'NONE' IF APPLICABLE)
MAINTENANCE/CLEANING
(ENTER 'NONE' IF APPLICABLE)
USE
(ENTER 'NONE' IF APPLICABLE)
DECOMMISSIONING/DEMOLITION
(ENTER 'NONE' IF APPLICABLE)

Rev	Description	By	Date	Chk'd	Auth	Stat	Purpose of Issue	Date	Auth
D	NOTES UPDATED	JE	12.12.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
C	ROUTE AMENDED THROUGH WEST CAMBRIDGE	DMB	01.08.18	SPW	MBS				
B	WORKS EAST OF HIGH CROSS OMITTED	DMB	31.05.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
A	ORIGINAL	–	–	–	–	I	OPTIONS APPRAISAL REPORT		

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Project
CAMBOURNE TO CAMBRIDGE
BETTER PUBLIC TRANSPORT PROJECT

Title
DO SOMETHING 1B
OFF ROAD PHASE 1 + SCOTLAND FARM
SHEET 1 OF 5

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB, Date 21.05.18	SPW, Date 21.05.18	ADB, Date 21.05.18

Status	Drawing Number	Rev
I	5020059_HW_FS_130	D

File Location: P:\GBIPD\ESol\05 Cambridgeshire Highways\Cambridge Busways - A428 & Western Orbit\900 CAD & BIM\910 Drawings\A428 Cambridge to Cambourne\5020059_HW_FS_130-134 Do-Som 1B - Off Road Phase 1 + Scotland Farm (Op 3) - RevDJE.dwg

Rev D

Drawing Number 5020059_HW_FS_131

Status I

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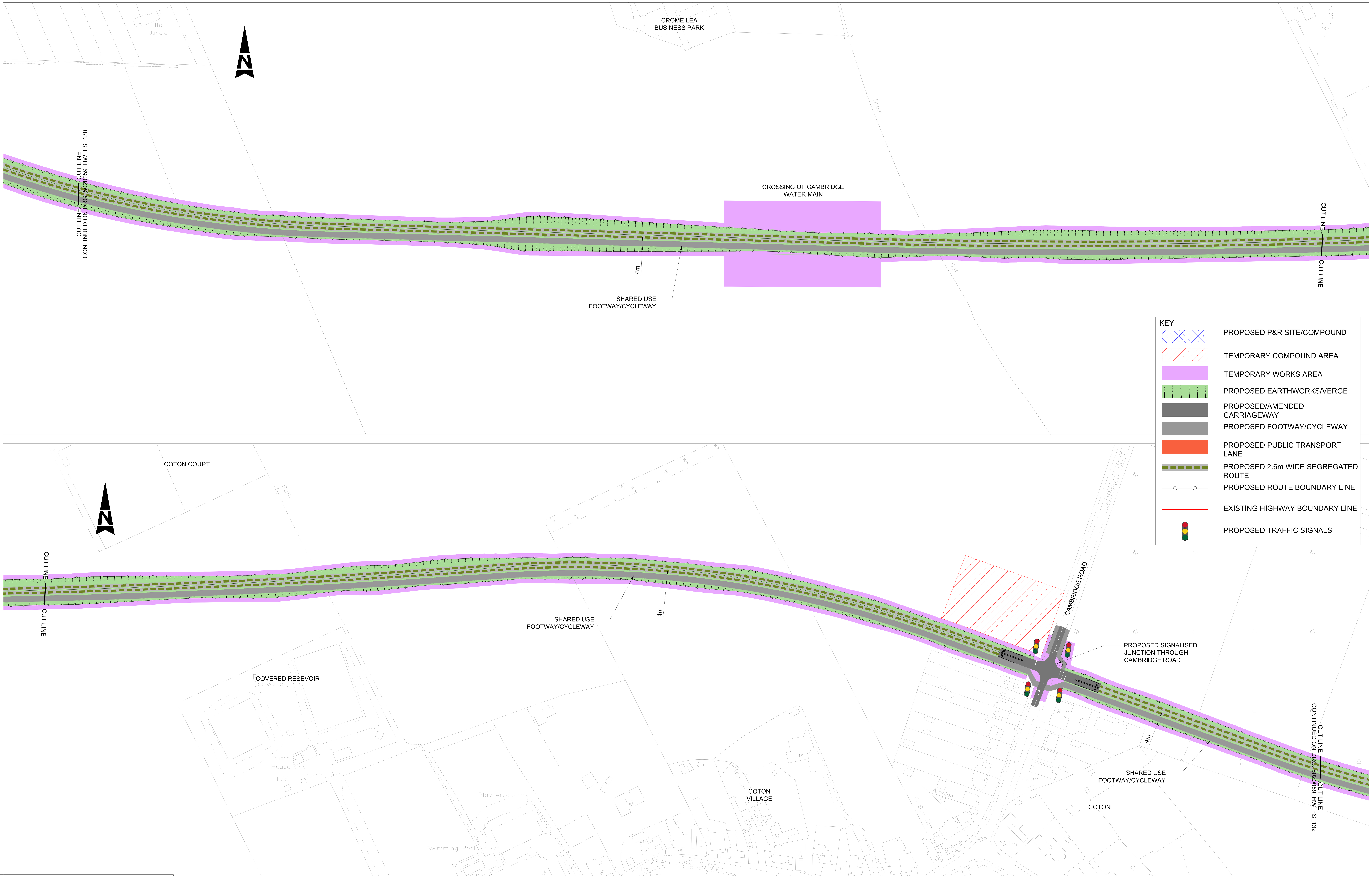

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MAINTENANCE/CLEANING	(ENTER 'NONE' IF APPLICABLE)
USE	(ENTER 'NONE' IF APPLICABLE)
DECOMMISSIONING/DEMOLITION	(ENTER 'NONE' IF APPLICABLE)

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A	ORIGINAL	–	–	–	–	I	OPTIONS APPRAISAL REPORT		

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Project

CAMBOURNE TO CAMBRIDGE
BETTER PUBLIC TRANSPORT PROJECT

Title

DO SOMETHING 1B
OFF ROAD PHASE 1 + SCOTLAND FARM
SHEET 2 OF 5

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB Date 21.05.18	SPW Date 21.05.18	ADB Date 21.05.18

Status	Drawing Number	Rev
I	5020059_HW_FS_131	D

P:\GBIPD\ESol\05 Cambridgeshire Highways\Cambridge Busways – A428 & Western Orbit\900 CAD & BIM\910 Drawings\A428 Cambridge to Cambourne\5020059_HW_FS_130-134 Do-Som 1B – Off Road Phase 1 + Scotland Farm (Op 3) – RevDJE.dwg

Rev D

Drawing Number 5020059_HW_FS_132

Status I

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SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
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USE
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A	ORIGINAL	–	–	–	–

Stat	Purpose of Issue	Date	Auth
I	OPTIONS APPRAISAL REPORT		
I	OPTIONS APPRAISAL REPORT		
I	OPTIONS APPRAISAL REPORT		
I	OPTIONS APPRAISAL REPORT		

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Project

CAMBOURNE TO CAMBRIDGE
BETTER PUBLIC TRANSPORT PROJECT

Title

DO SOMETHING 1B
OFF ROAD PHASE 1 + SCOTLAND FARM
SHEET 3 OF 5

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB Date 21.05.18	SPW Date 21.05.18	ADB Date 21.05.18

Status	Drawing Number	Rev
I	5020059_HW_FS_132	D

File Location: P:\GBIPD\ESol\05 Cambridgeshire Highways\Cambridge Busways – A428 & Western Orbit\900 CAD & BIM\910 Drawings\A428 Cambridge to Cambourne\5020059_HW_FS_130-134 Do-Som 1B – Off Road Phase 1 + Scotland Farm (Op 3) – RevDJE.dwg Date: Dec 10, 2018 – 11:10am Plotted by: LEONARDJ

Drawing Name: 5020059_HW_FS_130-134 Do-Som 1B – Off Road Phase 1 + Scotland Farm (Op 3) – RevDJE.dwg

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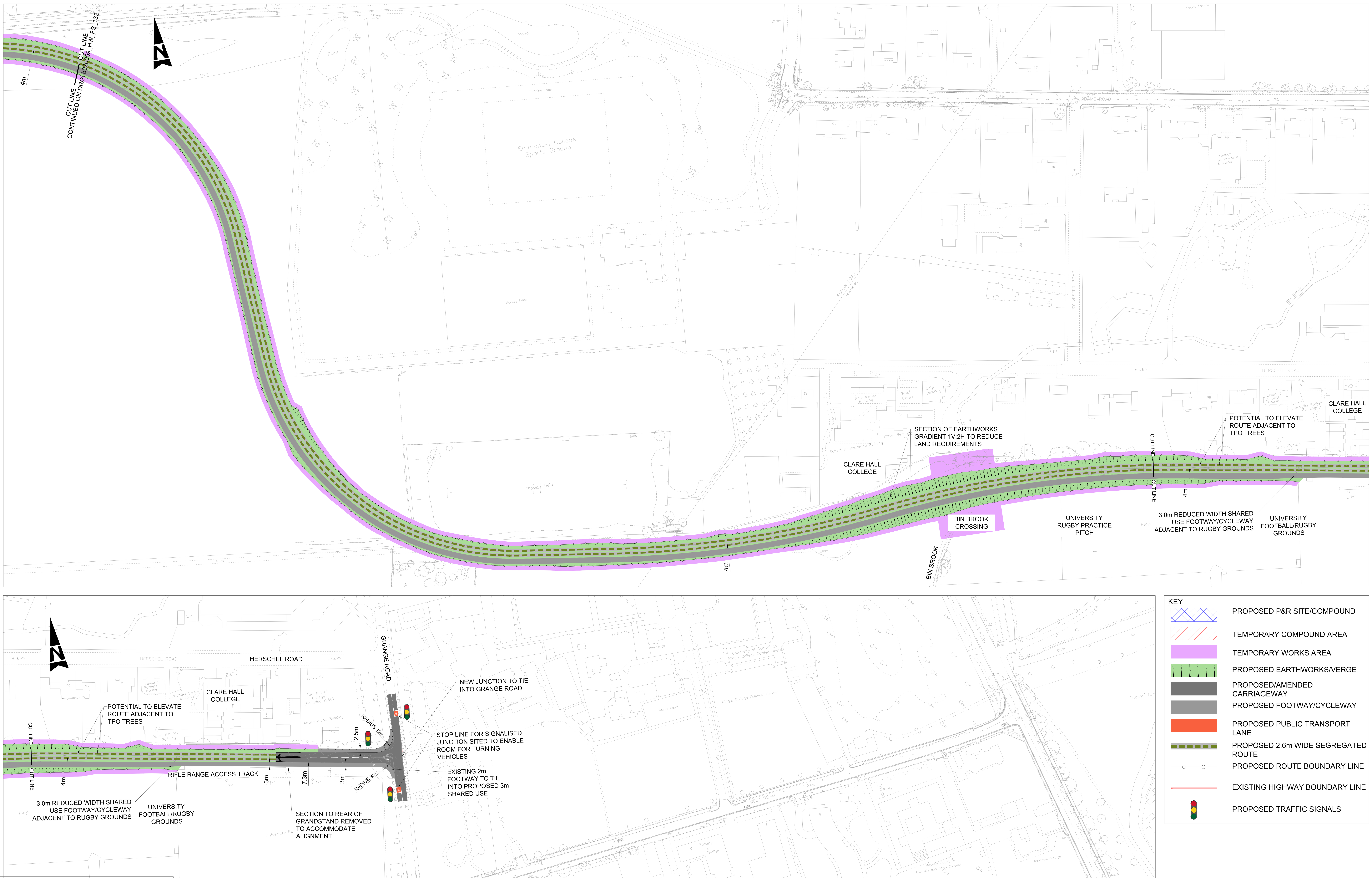
Rev D | Drawing Number 5020059_HW_FS_133 | Status I



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USE: (ENTER 'NONE' IF APPLICABLE)
DECOMMISSIONING/DEMOLITION: (ENTER 'NONE' IF APPLICABLE)

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Project: CAMBOURNE TO CAMBRIDGE BETTER PUBLIC TRANSPORT PROJECT

Title: DO SOMETHING 1B OFF ROAD PHASE 1 + SCOTLAND FARM SHEET 4 OF 5

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB Date 21.05.18	SPW Date 21.05.18	ADB Date 21.05.18

Status	Drawing Number	Rev
I	5020059_HW_FS_133	D

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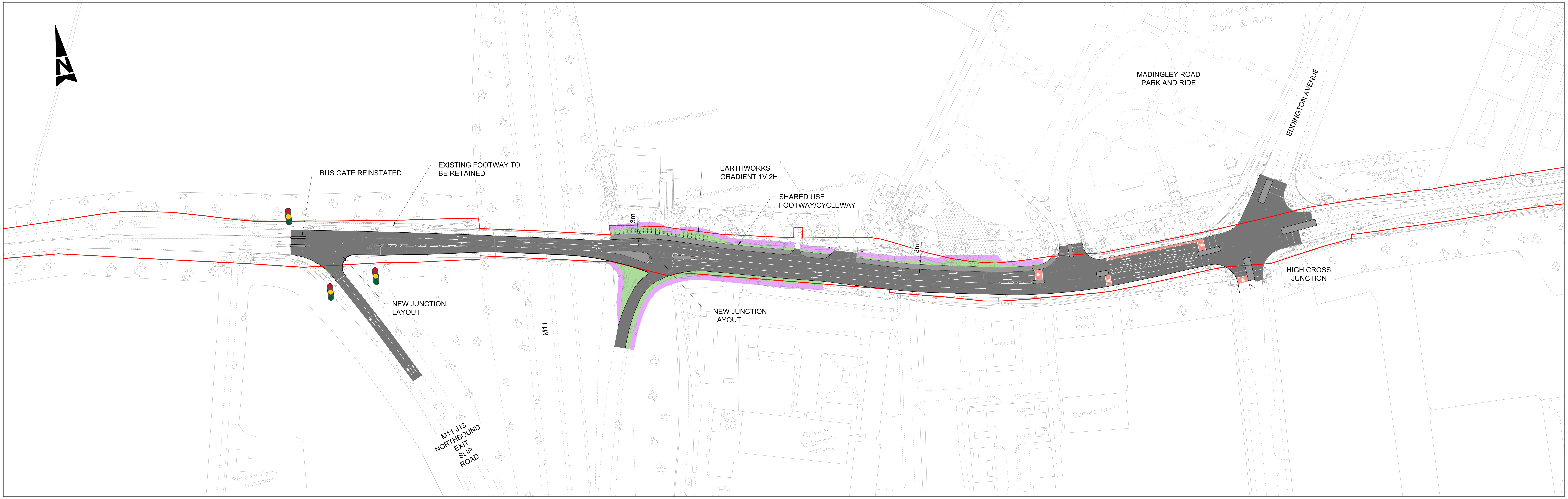

KEY

- TEMPORARY WORKS AREA
- PROPOSED EARTHWORKS/VERGE
- PROPOSED/AMENDED CARRIAGEWAY
- PROPOSED FOOTWAY/CYCLEWAY
- EXISTING CYCLE LANE
- EXISTING HIGHWAY BOUNDARY
- PROPOSED TRAFFIC SIGNALS

DO NOT SCALE

A1

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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USE
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Project
CAMBOURNE TO CAMBRIDGE
BETTER PUBLIC TRANSPORT PROJECT

Title
DO SOMETHING 1B
OFF ROAD PHASE 1 + SCOTLAND FARM
SHEET 5 OF 5

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB Date 21.05.18	SPW Date 21.05.18	ADB Date 21.05.18

Status	Drawing Number	Rev
I	5020059_HW_FS_134	D

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A.6 Illustrative Comparator: Recommended off-road Phase 1 and 2 + P&R at Water works

Rev D

Drawing Number 5020059_HW_FS_160

Status I

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SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS
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MAINTENANCE/CLEANING
(ENTER 'NONE' IF APPLICABLE)
USE
(ENTER 'NONE' IF APPLICABLE)
DECOMMISSIONING/DEMOLITION
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Project

CAMBOURNE TO CAMBRIDGE BETTER PUBLIC TRANSPORT PROJECT

Title

ILLUSTRATIVE COMPARATOR
OFF ROAD PHASE 1 & 2 + WATERWORKS
SHEET 1 OF 7

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB, Date 21/05/18	SPW, Date 21/05/18	ADB, Date 21/05/18

Status	Drawing Number	Rev
I	5020059_HW_FS_160	D

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A1

Status: I | Drawing Number: 5020059_HW_FS_161 | Rev: D

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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CONSTRUCTION
(ENTER 'NONE' IF APPLICABLE)

MAINTENANCE/CLEANING
(ENTER 'NONE' IF APPLICABLE)

USE
(ENTER 'NONE' IF APPLICABLE)

DECOMMISSIONING/DEMOLITION
(ENTER 'NONE' IF APPLICABLE)

Rev	Description	By	Date	Chk'd	Auth	Stat	Purpose of Issue	Date	Auth
D	NOTES UPDATED	JE	12.12.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
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B	WORKS EAST OF HIGH CROSS OMITTED	DMB	31.05.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
A	ORIGINAL	–	–	–	–	I	OPTIONS APPRAISAL REPORT		

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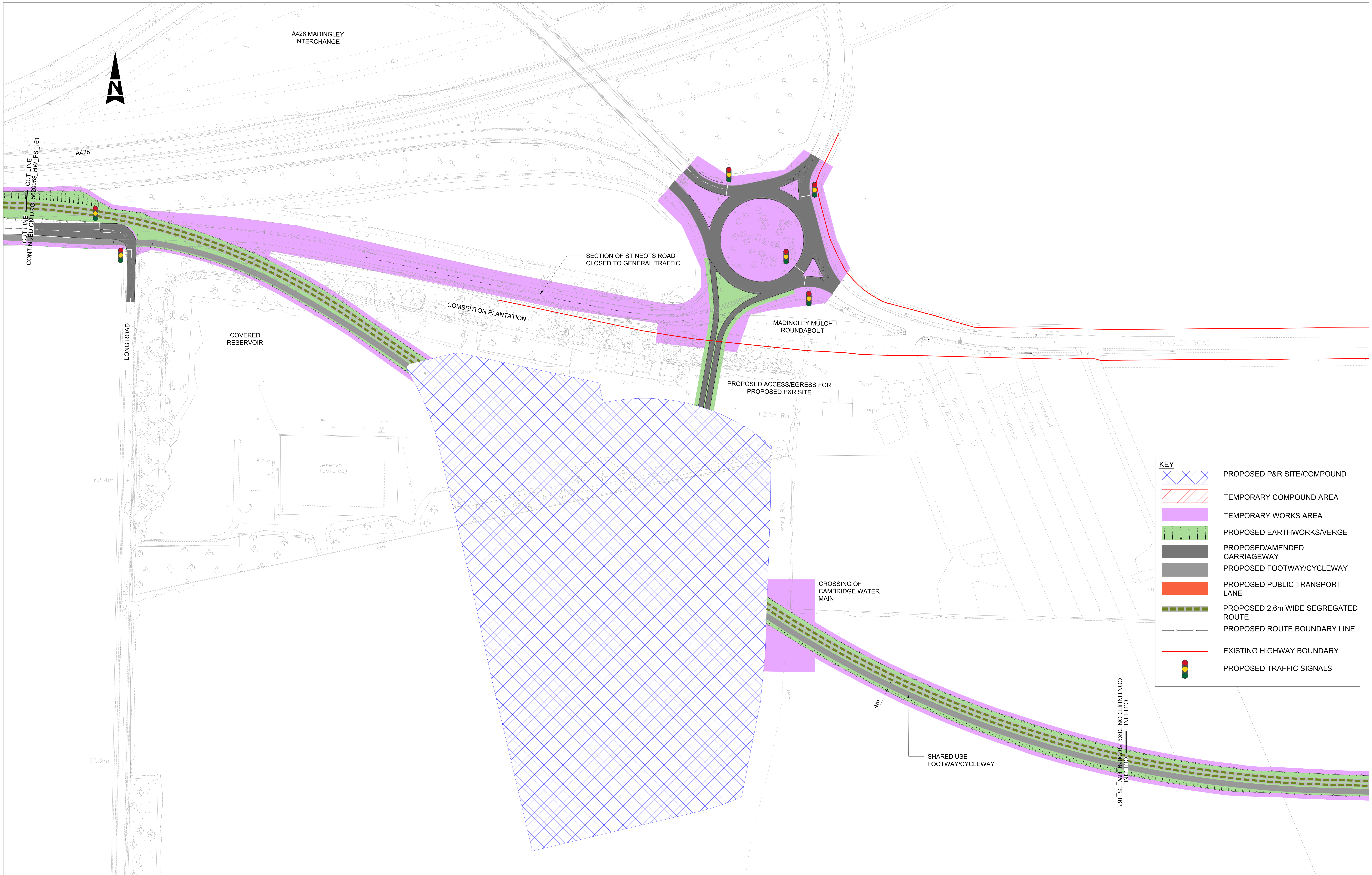
Project
CAMBOURNE TO CAMBRIDGE
BETTER PUBLIC TRANSPORT PROJECT

Title
ILLUSTRATIVE COMPARATOR
OFF ROAD PHASE 1 & 2 + WATERWORKS
SHEET 2 OF 7

Original Scale	Designed/Drawn	Checked	Authorised
As Shown	DMB	SPW	ADB
	Date 21/05/18	Date 21/05/18	Date 21/05/18

Status	Drawing Number	Rev
I	5020059_HW_FS_161	D

File Location: P:\GBIPD\ESol\05 Cambridgeshire Highways\Cambridge Busways – A428 & Western Orbit\900 CAD & BIM\910 Drawings\A428 Cambridge to Cambourne\5020059_HW_FS_160–165_169 Illustrative Comparator – Off Road Phase 1+2 + Waterworks (Op 6) – RevD.dwg



DO NOT SCALE

A1

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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Project
CAMBOURNE TO CAMBRIDGE BETTER PUBLIC TRANSPORT PROJECT

Title
ILLUSTRATIVE COMPARATOR OFF ROAD PHASE 1 & 2 + WATERWORKS SHEET 3 OF 7

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB	SPW	ADB
	Date 21/05/18	Date 21/05/18	Date 21/05/18

Status	Drawing Number	Rev
I	5020059_HW_FS_162	D

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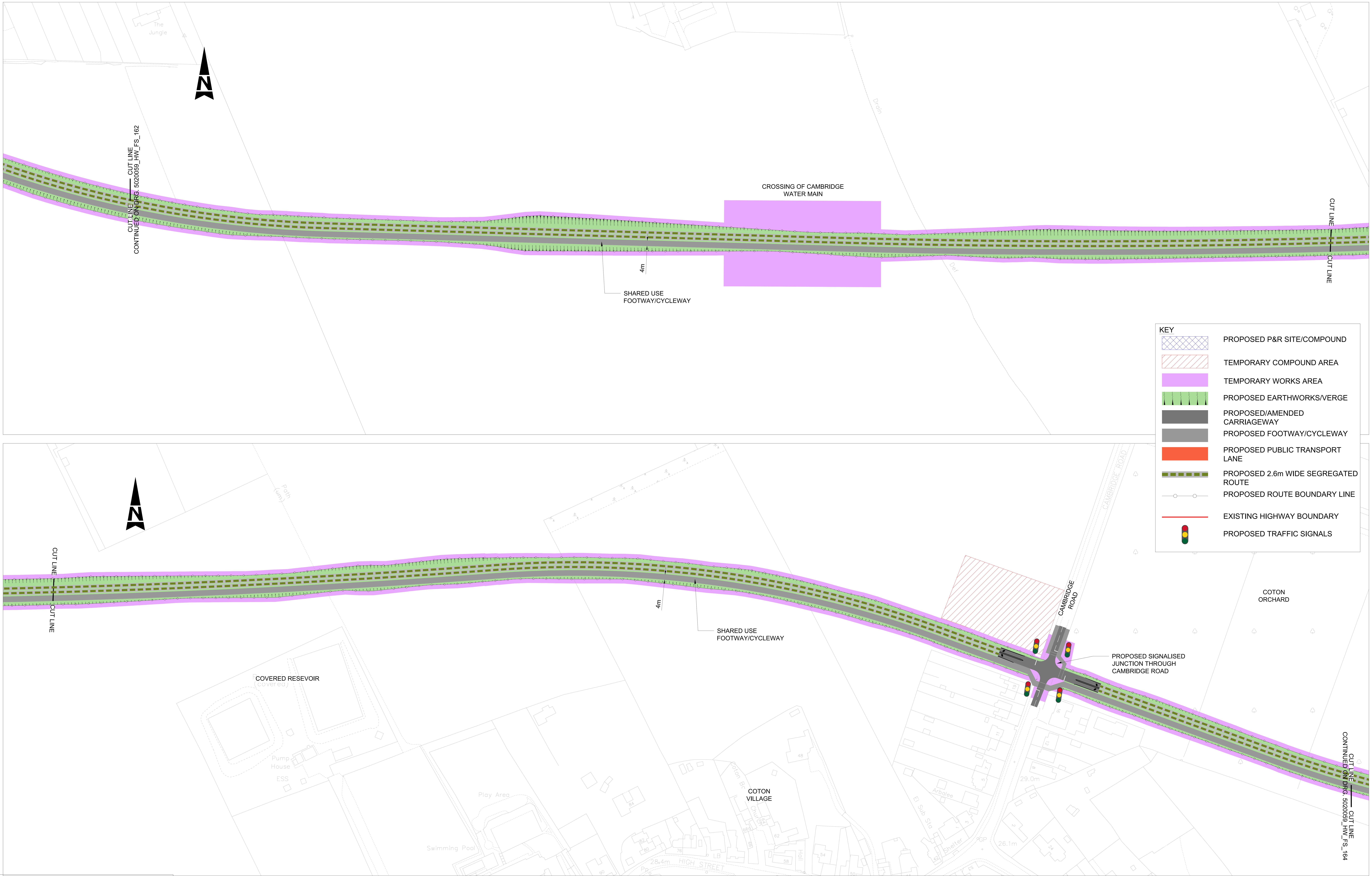

Rev D

Drawing Number 5020059_HW_FS_163

Status I

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A1

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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USE
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Project
CAMBOURNE TO CAMBRIDGE
BETTER PUBLIC TRANSPORT PROJECT

Title
ILLUSTRATIVE COMPARATOR
OFF ROAD PHASE 1 & 2 + WATERWORKS
SHEET 4 OF 7

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB, Date 21/05/18	SPW, Date 21/05/18	ADB, Date 21/05/18

Status	Drawing Number	Rev
I	5020059_HW_FS_163	D

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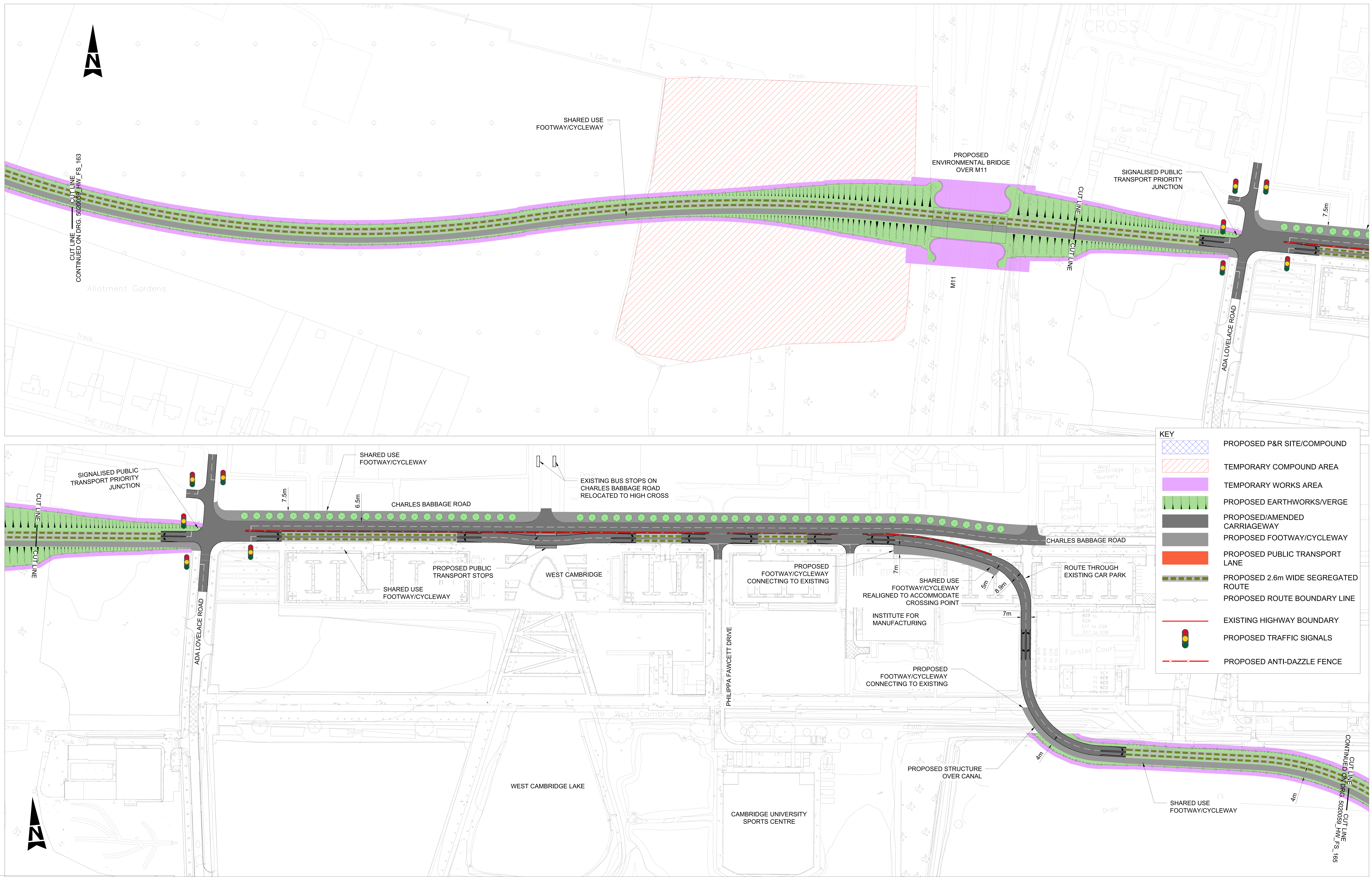

Rev D | Drawing Number 5020059_HW_FS_164 | Status I

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Project
CAMBOURNE TO CAMBRIDGE BETTER PUBLIC TRANSPORT PROJECT

Title
ILLUSTRATIVE COMPARATOR OFF ROAD PHASE 1 & 2 + WATERWORKS SHEET 5 OF 7

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB Date 21/05/18	SPW Date 21/05/18	ADB Date 21/05/18

Status	Drawing Number	Rev
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Drawing Name: 5020059_HW_FS_160-165_169 Illustrative Comparator - Off Road Phase 1+2 + Waterworks (Op 6) - RevD.dwg

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Rev D

Drawing Number 5020059_HW_FS_165

Status I

DO NOT SCALE

A1

KEY

- PROPOSED P&R SITE/COMPOUND
- TEMPORARY COMPOUND AREA
- TEMPORARY WORKS AREA
- PROPOSED EARTHWORKS/VERGE
- PROPOSED/AMENDED CARRIAGEWAY
- PROPOSED FOOTWAY/CYCLEWAY
- PROPOSED PUBLIC TRANSPORT LANE
- PROPOSED 2.6m WIDE SEGREGATED ROUTE
- PROPOSED ROUTE BOUNDARY LINE
- EXISTING HIGHWAY BOUNDARY
- PROPOSED TRAFFIC SIGNALS

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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(ENTER 'NONE' IF APPLICABLE)
DECOMMISSIONING/DEMOLITION
(ENTER 'NONE' IF APPLICABLE)

Rev	Description	By	Date	Chk'd	Auth	Stat	Purpose of Issue	Date	Auth
D	NOTES UPDATED	JE	12.12.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
C	ROUTE AMENDED THROUGH WEST CAMBRIDGE	DMB	01.08.18	SPW	MBS	I	OPTIONS APPRAISAL REPORT		
B	WORKS EAST OF HIGH CROSS OMITTED	DMB	31.05.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
A	ORIGINAL	–	–	–	–	I	OPTIONS APPRAISAL REPORT		

Client

GREATER CAMBRIDGE PARTNERSHIP
Growing and sharing prosperity
Delivering our City Deal

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Project

CAMBOURNE TO CAMBRIDGE BETTER PUBLIC TRANSPORT PROJECT

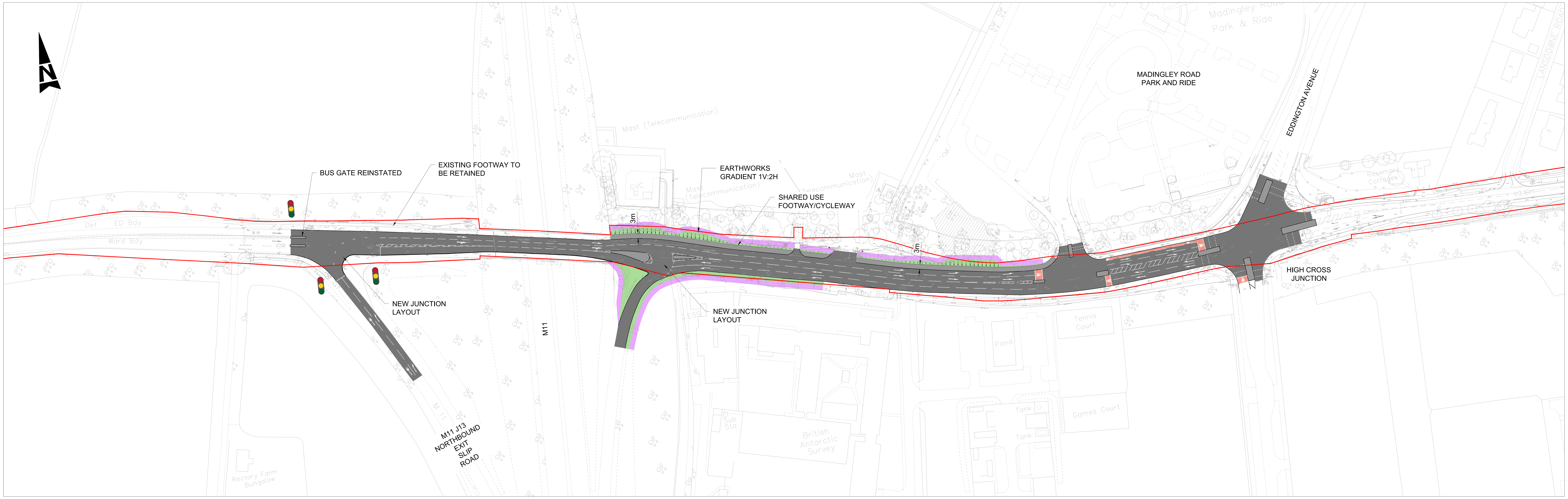
Title

ILLUSTRATIVE COMPARATOR OFF ROAD PHASE 1 & 2 + WATERWORKS SHEET 6 OF 7

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB Date 21/05/18	SPW Date 21/05/18	ADB Date 21/05/18

Status	Drawing Number	Rev
I	5020059_HW_FS_165	D

File Location: P:\GBIPD\ESol\05 Cambridgeshire Highways\Cambridge Busways - A428 & Western Orbit\900 CAD & BIM\910 Drawings\A428 Cambridge to Cambourne\5020059_HW_FS_160-165_169 Illustrative Comparator - Off Road Phase 1+2 + Waterworks (Op 6) - RevD.dwg



KEY

- TEMPORARY WORKS AREA
- PROPOSED EARTHWORKS/VERGE
- PROPOSED/AMENDED CARRIAGEWAY
- PROPOSED FOOTWAY/CYCLEWAY
- EXISTING CYCLE LANE
- EXISTING HIGHWAY BOUNDARY
- PROPOSED TRAFFIC SIGNALS

DO NOT SCALE

A1

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS

CONSTRUCTION	(ENTER 'NONE' IF APPLICABLE)
MAINTENANCE/CLEANING	(ENTER 'NONE' IF APPLICABLE)
USE	(ENTER 'NONE' IF APPLICABLE)
DECOMMISSIONING/DEMOLITION	(ENTER 'NONE' IF APPLICABLE)

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B	WORKS EAST OF HIGH CROSS OMITTED & DWG NO. CHANGE TO 169	DMB	31.05.18	SPW	ADB	I	OPTIONS APPRAISAL REPORT		
A	ORIGINAL	–	–	–	–	I	OPTIONS APPRAISAL REPORT		

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Project

CAMBOURNE TO CAMBRIDGE
BETTER PUBLIC TRANSPORT PROJECT

Title

ILLUSTRATIVE COMPARATOR
OFF ROAD PHASE 1 & 2 + WATERWORKS
SHEET 7 OF 7

Original Scale	Designed/Drawn	Checked	Authorised
1:1250	DMB Date 21/05/18	SPW Date 21/05/18	ADB Date 21/05/18

Status	Drawing Number	Rev
I	5020059_HW_FS_169	D

Rev D
Drawing Number 5020059_HW_FS_169
Status I

P:\GBIPD\ESol\05 Cambridgeshire Highways\Cambridge Busways - A428 & Western Orbit\900 CAD & BIM\910 Drawings\A428 Cambridge to Cambourne\5020059_HW_FS_160-165_169 Illustrative Comparator - Off Road Phase 1+2 + Waterworks (Op 6) - RevD.dwg

B. INSET Tables

CAMBOURNE TO CAMBRIDGE BETTER BUS JOUREYS - ROUTE OPTION SELECTION
INVESTMENT SIFTING AND EVALUATION TOOL (INSET)

Cambourne to Cambridge

No.	Name	1. Policy Fit						2. Contribution to Economic Growth						3. Contribution to Improved Transport Network							
		Cambridgeshire LTP3	Highways England Road Investment Strategy (RIS)	Greater Cambridge and Peterborough SEP	Greater Cambridge City Deal	South Cambridgeshire Draft Local Plan	Cambridge City Draft Local Plan	Labour market and activity	Supporting house construction	Business investment and growth	Cambridge positive image	Future potential growth post 2031	Capacity	Reliability of journey	Route flexibility - Links into existing bus routes	Walking and cycle connectivity	Impact on existing traffic	Journey times	Service frequency	Mode share	Connectivity to Park and Ride
1	Do Minimum	4: No Relevance to the Scheme	4: No Relevance to the Scheme	4: No Relevance to the Scheme	4: No Relevance to the Scheme	4: No Relevance to the Scheme	4: No Relevance to the Scheme	4: No Relevance to the Scheme	4: No Relevance to the Scheme	4: No Relevance to the Scheme	4: No Relevance to the Scheme	4: No Relevance to the Scheme	4: No Change	4: No Impact	4: Similar to existing	4: No Change	4: No Impact	4: No Change	4: No Change	4: No Change	4: No Access Required
2	Low Cost a	5: Aligns with Policy	6: Aligns and partially fulfils policy	6: Aligns and partially fulfils policy	6: Aligns and partially fulfils policy	5: Aligns with Policy	6: Aligns and partially fulfils policy	5: Low impact in Labour market mobility	5: Low number of new houses supported for construction	5: Low impact on business investment and growth	5: Low promotion of positive image	5: Low support for future growth	5: Slight increase	6: Partially Segregated with junction priority	4: Similar to existing	6: Improved cycle infrastructure	5: Slight improvement in capacity for traffic	5: Minor Improvements	7: Significant Increase in Service	4: No Change	6: Good access by Car
3	Low Cost b	5: Aligns with Policy	6: Aligns and partially fulfils policy	6: Aligns and partially fulfils policy	6: Aligns and partially fulfils policy	5: Aligns with Policy	6: Aligns and partially fulfils policy	5: Low impact in Labour market mobility	5: Low number of new houses supported for construction	5: Low impact on business investment and growth	5: Low promotion of positive image	5: Low support for future growth	5: Slight increase	6: Partially Segregated with junction priority	4: Similar to existing	5: Improved Cycle connectivity	5: Slight improvement in capacity for traffic	5: Minor Improvements	7: Significant Increase in Service	4: No Change	7: Good access to park and ride by foot or car
4	Do Something 1a	6: Aligns and partially fulfils policy	6: Aligns and partially fulfils policy	7: Aligns and Fulfils policy in Full	6: Aligns and partially fulfils policy	6: Aligns and partially fulfils policy	6: Aligns and partially fulfils policy	6: Medium impact in Labour market mobility	6: Medium number of new houses supported for construction	6: Medium impact on business investment and growth	6: Medium promotion of positive image	6: Medium support for future growth	7: Significant Increase	7: Fully segregated with junction priority	6: Aligned with existing bus routes (Servicing City Centre)	7: Improved cycle infrastructure and connectivity	6: Medium improvement in capacity for traffic	7: Major Improvements	7: Significant Increase in Service	4: No Change	6: Good access by Car
5	Do Something 1b	6: Aligns and partially fulfils policy	6: Aligns and partially fulfils policy	7: Aligns and Fulfils policy in Full	6: Aligns and partially fulfils policy	6: Aligns and partially fulfils policy	6: Aligns and partially fulfils policy	6: Medium impact in Labour market mobility	6: Medium number of new houses supported for construction	6: Medium impact on business investment and growth	6: Medium promotion of positive image	6: Medium support for future growth	7: Significant Increase	7: Fully segregated with junction priority	6: Aligned with existing bus routes (Servicing City Centre)	6: Improved cycle infrastructure	6: Medium improvement in capacity for traffic	6: Some Improvements	7: Significant Increase in Service	4: No Change	7: Good access to park and ride by foot or car
6	Illustrative Comparator	6: Aligns and partially fulfils policy	6: Aligns and partially fulfils policy	7: Aligns and Fulfils policy in Full	6: Aligns and partially fulfils policy	7: Aligns and Fulfils policy in Full	6: Aligns and partially fulfils policy	7: High impact in Labour market mobility	7: High number of new houses supported for construction	7: High impact on business investment and growth	7: High promotion of positive image	7: High support for future growth	7: Significant Increase	7: Fully segregated with junction priority	6: Aligned with existing bus routes (Servicing City Centre)	7: Improved cycle infrastructure and connectivity	6: Medium improvement in capacity for traffic	7: Major Improvements	7: Significant Increase in Service	4: No Change	6: Good access by Car

Cambourne to Cambridge

No.	Name	4. Contribution to Quality of Life									5. Scheme Deliverability							6. Stakeholder Support		WEIGHTED SCORE FOR THEME
		Environment impacts - Landscape Impact	Environment impacts - Noise	Environment impacts - Air Quality	Environmental impacts - CO2 emissions	Environmental impacts – Biodiversity	Environmental impacts – Heritage	Environmental impacts – Green Belt	Safety	Accessibility	Scheme Cost	Engineering feasibility - construction method	Land acquisition required	Impact on local road network during construction	Future-proofing	Legislative Powers	Scheme Maintenance and Renewals	Public acceptability	Safety	
1	Do Minimum	4: No or neutral Visual Impact	4: No or neutral Noise Impact	4: No or neutral Air Quality Impact	4: No or neutral Impact	4: No or neutral Impact	4: No or neutral Effect	4: No or neutral Impact	4: No Impact or as existing	4: No Change to existing links to the network	4: No Cost	4: Normal Construction Methods	4: No Impact	4: No Impact	4: No Impact on potential future proposed schemes	4: No Powers Required	4: No Cost	4: No Preference overall	**4.00**	**4.00**
2	Low Cost a	2: Moderate Landscape Impact	3: Slight Noise Impact	5: Slight Air Quality Benefit	4: No or neutral Impact	1: Large impact on biodiversity & Ecology	2: Route has Moderate Adverse Effect on Historic Environment	3: Route through green belt (smaller area)	3: Slight interactions with other road users	5: Accessibility provided to some opportunities	3: New highway infrastructure	1: Significant Disruptive Construction Required	3: Land required	1: Significant Impact	4: No Impact on potential future proposed schemes	3: Conventional Planning Solution	1: High Cost >2M	5: Some stakeholder support	**4.22**	**4.22**
3	Low Cost b	2: Moderate Landscape Impact	3: Slight Noise Impact	5: Slight Air Quality Benefit	4: No or neutral Impact	1: Large impact on biodiversity & Ecology	2: Route has Moderate Adverse Effect on Historic Environment	3: Route through green belt (smaller area)	3: Slight interactions with other road users	5: Accessibility provided to some opportunities	3: New highway infrastructure	1: Significant Disruptive Construction Required	3: Land required	1: Significant Impact	4: No Impact on potential future proposed schemes	3: Conventional Planning Solution	1: High Cost >2M	6: Medium Stakeholder support	**4.24**	**4.24**
4	Do Something 1a	2: Moderate Landscape Impact	3: Slight Noise Impact	5: Slight Air Quality Benefit	4: No or neutral Impact	2: Medium impact on biodiversity & Ecology	2: Route has Moderate Adverse Effect on Historic Environment	2: Route through green belt (closer proximity to existing development)	2: Medium interactions with other road users	5: Accessibility provided to some opportunities	2: New highway infrastructure and complex junctions	2: Medium Disruptive Construction Required	2: Land required (greater area)	2: Medium Impact	7: Route supports future schemes	2: Amendment of a secondary legislation required	1: High Cost >2M	5: Some stakeholder support	**4.70**	**4.70**
5	Do Something 1b	2: Moderate Landscape Impact	3: Slight Noise Impact	5: Slight Air Quality Benefit	4: No or neutral Impact	2: Medium impact on biodiversity & Ecology	2: Route has Moderate Adverse Effect on Historic Environment	2: Route through green belt (closer proximity to existing development)	2: Medium interactions with other road users	5: Accessibility provided to some opportunities	2: New highway infrastructure and complex junctions	2: Medium Disruptive Construction Required	2: Land required (greater area)	2: Medium Impact	6: Route supports future schemes with minor alignment changes	2: Amendment of a secondary legislation required	1: High Cost >2M	6: Medium Stakeholder support	**4.68**	**4.68**
6	Illustrative Comparator	2: Moderate Landscape Impact	3: Slight Noise Impact	5: Slight Air Quality Benefit	4: No or neutral Impact	2: Medium impact on biodiversity & Ecology	2: Route has Moderate Adverse Effect on Historic Environment	2: Route through green belt (closer proximity to existing development)	2: Medium interactions with other road users	7: Accessibility provided to all opportunities	1: New highway infrastructure and structure	1: Significant Disruptive Construction Required	2: Land required (greater area)	2: Medium Impact	7: Route supports future schemes	2: Amendment of a secondary legislation required	2: Medium Cost 1M to 2M	5: Some stakeholder support	**4.89**	**4.89**

C. Justification Table

	Criteria	Do Minimum	Low Cost a	Low Cost b	Do Something 1a	Do Something 1b	Illustrative Comparator
	Environment impacts - Landscape Impact	Neutral impact on landscape character due to cycle lane between High Cross Junction and Lady Margaret Road being in an urbanised environment within the existing road corridor.	Waterworks P&R conflicts with existing landscape pattern and may affect the setting of the landscape directly south. Landscape impacts are largely contained within the existing road corridor - primarily the removal of existing trees and vegetation. The proposal conflicts with some local policies protecting local character and would have an iindirect impact on setting of the Madingly Wood SSSI through the removal of trees adjacent to the SSSI. The widened corridor may also affect the setting of the American Military Cemetery. Likely to have slight to moderate adverse effects along the route, with the main impacts around the American Cemetery/SSSI.	Scotland Farm P&R conflicts slightly with existing landscape pattern and may affect the setting of the landscape directly north but this is tempered by its proximity to an existing junction. Landscape impacts are largely contained within the existing road corridor - primarily the removal of existing trees and vegetation. The proposal conflicts with some local policies protecting local character and would have an indirect impact on setting of the Madingley Wood SSSI through the removal of trees adjacent to SSSI. The widened corridor may also affect the setting of the American Military Cemetery. Scotland Farm P&R conflicts slightly with existing landscape pattern and may affect the setting of the landscape directly north but this is tempered by its proximity to an existing junction. Likely to have slight to moderate adverse effects along the route, with the main impacts around the American Cemetery/SSSI.	Waterworks P&R conflicts with existing landscape pattern and may affect the setting of the landscape directly south. Route crosses open countryside from Madingley Mulch to Coton affecting field pattern. The proposal would also affect the setting of Coton Conservation Area as well as the Coton Orchard area. Passing beyond West Cambridge into the West Fields, the proposal would introduce public transport traffic into an area currently free from vehicular movement and adversely affect the setting of the surrounding landscape. Likely to have slight to moderate adverse effects along the route.	Scotland Farm P&R conflicts slightly with existing landscape pattern and may affect the setting of the landscape directly north but this is tempered by its proximity to an existing junction. From the P&R to Madingly Mulch the site is largely adjacent to existing A428 and not likely to have significant impact on landscape character. Then the route passes through the Waterworks site and impacts are the same as for Do Something 1a to Grange Road Likely to have slight to moderate adverse effects along the route.	West of the Waterworks P&R site the proposal runs parallel and in close proximity to the A428, limiting its impact upon the existing landscape. Then from the P&R site the landscape impacts are the same as for Do Something 1a.
	Environment impacts - Noise	No Impact.	Since this Option is an online scheme, changes in traffic flow or composition that would result in significant changes in noise are unlikely. Although Waterworks Park and Ride is new and there are residential receptors in the vicinity, it is considered that standard good design can be applied such that noise changes at these receptors is minimal	Since this Option is an online scheme, changes in traffic flow or composition that would result in significant changes in noise are unlikely. Although Scotland Farm Park and Ride is new and there are residential receptors adjacent to the site , it is considered that standard good design can be applied such that noise changes at these receptors is minimal	Traffic, hence noise level at adjacent properties is unlikely to change so much that noise levels will alter significantly, so are judged to remain unchanged on the A1303 and A428. Noise changes will depend on existing background noise levels, and for the majority of this option these are likely to be dominated by distant (A1303, A428, M11) and localised (Cambridge Road, Grange Road, M11) road traffic. Given that the number of vehicles proposed is relatively low, the majority of impacts will be negligible, however there will be some minor adverse impacts to the rear of some properties. There will be opportunities for mitigation such as acoustic barriers which will reduce these impacts further. The Waterworks Park and Ride would be at Madingley Mulch Interchange. Although the Park and Ride is new and there are residential receptors in the vicinity, it is considered that mitigation can be applied such that noise changes at these receptors is minimal	Option 1b follows the same alignment as Option 1a and similar comments apply, with the difference being the location of the Scotland Farm Park and Ride further west along the A428. Although the Park and Ride is new and there are residential receptors in the vicinity, it is considered that mitigation can be applied such that noise changes at these receptors is minimal.	As Option 1a except the route is extended to the west to Cambourne. The extension forms a dedicated public transport route aligned between the A428 and St Neots Road. Any increases in noise levels will depend on the current and future contribution to overall traffic noise from the A428 and St. Neots Road. It is likely that noise from these sources will exceed that of the illustrative comparator, thus impacts from this section are considered negligible.

	Criteria	Do Minimum	Low Cost a	Low Cost b	Do Something 1a	Do Something 1b	Illustrative Comparator
Contribution to Quality of Life	Environment impacts - Air Quality	No Impact.	There are 605 receptors within 200 metres of Low Cost A. The Scheme as a whole is likely to reduce congestion along Madingley Road and therefore has the potential to improve air quality. This improvement could be offset by the additional public transport lane on certain parts of Madingley Road (A1303), however as an additional lane would be used by public transport vehicles only, which would operate a low frequency, and would meet Euro VI standards this would have no significant effect on air quality at nearby receptors. The Scheme may lead to an improvement in air quality in the AQMA due to a modal shift through the provision of increased public transport capacity and reducing the number of private vehicles in the city centre AQMA. All changes in air quality are predicted to be small and considering the small number of receptors within 200 meters would not significantly affect the Net Present Value if a full WebTAG assessment based on traffic data was to be undertaken.	There are 662 receptors within 200 metres of Low Cost B. The impact of this scheme do not differ significantly from Low Cost a, the impacts will be as described in Low Cost a.	There are 649 receptors within 200 metres of Do Something 1a. This route introduces vehicles to areas where no vehicles operate now (from Madingley Mulch to Grange Road). However, as the off road route would be used by public transport vehicles only, which would operate a low frequency, and would meet Euro VI standards this would have no significant effect on air quality at nearby receptors. The remaining impacts are described for Madingley Road under Low Cost a/b and would be similar for this Option.	There are 717 receptors within 200 metres of Do Something 1b due to the increased distance from Scotland Farm P&R site to Grange Road. However, otherwise the impacts would be largely as for Do Something 1a with 68 additional properties experiencing potentially marginal improvement in air quality.	There are 1321 receptors within 200 metres of the illustrative comparator, due to the increased distance the scheme footprint covers to Bourn Airfield. The increase size of this option has the potential to lead to greater improvements in air quality as more receptors have the potential to be affected along existing roads.
	Environmental impacts - CO2 emissions	No Impact.	Operational P&R Carbon deemed similar between Waterworks and Scotland Farm sites. Operational deemed neutral (on basis of current technology - in reality technology / fuel changes likely to see drop in operational carbon). Scheme has higher carbon than Do Minimum but less than Do Something 1a/1b/illustrative comparator	Operational P&R Carbon deemed similar between Waterworks and Scotland Farm sites. Operational deemed neutral (on basis of current technology - in reality technology / fuel changes likely to see drop in operational carbon). Scheme has higher carbon than Do Minimum but less than Do Something 1a/1b/illustrative comparator	Operational P&R Carbon deemed similar between Waterworks and Scotland Farm sites. Operational deemed neutral (on basis of current technology - in reality technology / fuel changes likely to see drop in operational carbon). Scheme has higher carbon than Do Minimum and Low Cost A / B but less than the illustrative comparator	Operational P&R Carbon deemed similar between Waterworks and Scotland Farm sites. Operational deemed neutral (on basis of current technology - in reality technology / fuel changes likely to see drop in operational carbon). Scheme has higher carbon than Do Minimum and Low Cost A / B but less than the illustrative comparator	Operational P&R Carbon deemed similar between Waterworks and Scotland Farm sites. Operational deemed neutral (on basis of current technology - in reality technology / fuel changes likely to see drop in operational carbon). Scheme has higher carbon than other options as a result of increased works and scale of operational scheme
	Environmental impacts – Biodiversity	Madingley Wood SSSI has High value and will be impacted adversely by continuing high, or increasing levels of traffic emmissions. Do Min will not change current scale of effect - neutral effect.	Madingley Wood SSSI has High value and will be impacted adversely by continuing high, or increasing levels of traffic emmissions. Large adverse potential impact on this SSSI from Scheme until traffic emmissions impact is assessed for full OBC. Waterworks area has High biodiversity value for habitat and protected species, and intermediate impact through loss of wooded area from P&R resulting in decrease in biodiversity which will be mitigated by sensitive design and planting for the P&R. Works will have minor impacts on remainder of A1303 corridor and the route from Hardwick to Madingley Mulch.	Madingley Wood SSSI has High value and will be impacted adversely by continuing high, or increasing levels of traffic emmissions. Large adverse potential impact on this SSSI from Scheme from Scheme until traffic emmissions impact is assessed for full OBC. Works will have minor impacts on remainder of A1303 corridor and the route from Hardwick to Madingley Mulch.	Madingley Wood SSSI could see some benefit by reducing traffic , but assessed as neutral until traffic emmissions impact is assessed for full OBC. Waterworks area has High biodiversity value for habitat and protected species, and intermediate impact through loss of wooded area from P&R resulting in decrease in biodiversity which will be mitigated by sensitive design and planting for the P&R. Coton Orchard to M11 area (UK BAP habitat and potential for protected species) will have intermediate impact similar to Waterworks P&R site. Otherwise route has minor impacts on Grange Fields (GCN protected species and locally important habitats), Coton Path Hedgerow CWS. The two City wildlife sites would have limited direct	Madingley Wood SSSI could see some benefit by reducing traffic , but assessed as neutral until traffic emmissions impact is assessed for full OBC. Waterworks area has High biodiversity value for habitat and protected species, and intermediate impact through loss of wooded area from route corridor resulting in decrease in biodiversity which will be mitigated by sensitive design and planting for the P&R. Coton Orchard to M11 area (UK BAP habitat and potential for protected species) will have intermediate impact similar to Waterworks P&R site. Otherwise route has minor impacts on Grange Fields (GCN protected species and locally important habitats), Coton Path Hedgerow CWS. The two City wildlife sites would have limited direct	As scheme between P&R and Bourn Airfield has low biodiversity value and works is largely adjacent to existing A428 there is no significant difference between the illustrative comparator and 1a.

	Criteria	Do Minimum	Low Cost a	Low Cost b	Do Something 1a	Do Something 1b	Illustrative Comparator
	Environmental impacts – Heritage	No Impact.	It is considered a low to moderate impact on the form and context of the Memorial and attached walls, steps and pool at the American Military Cemetery from the proximity of the scheme to the edge of the park and garden with increased visibility of traffic and potential changes to road frontage of the asset cause a low to moderate adverse effect overall. A number of listed buildings adjacent to Madingley Road east of M11 could have slight adverse effect due to proximity of scheme.	It is considered a low to moderate impact on the form and context of the Memorial and attached walls, steps and pool at the American Military Cemetery from the proximity of the scheme to the edge of the park and garden with increased visibility of traffic and potential changes to road frontage of the asset cause a low to moderate adverse effect overall. A number of listed buildings adjacent to Madingley Road east of M11 could have slight adverse effect due to proximity of scheme.	Proximity of numerous HER Assets and features on aerial photographs and geophysical surveys of the Waterworks P&R indicates high likelihood of some historic environment assets on this route. Major impact likely resulting in moderate adverse effect on low/moderate value assets. Coton Village Conservation Area and Church of St Peter in Coton - potential minor adverse (Slight) due to proximity of route to setting of the church West Cambridge Conservation Area - slight adverse effect due to changes in road layout along Grange Road. Setting of heritage assets (backing onto scheme at 5a/5b Herschel Road - locally listed) and Nr 49 Grange Road (Grade II) - slight adverse effect	Proximity of numerous HER Assets to Scotland Farm P&R and the route indicates high likelihood of some historic environment assets on this route. Major impact likely resulting in moderate effect on low/moderate value assets Coton Village Conservation Area and Church of St Peter in Coton - potential minor adverse (Slight) due to proximity of route to setting of the church West Cambridge Conservation Area - slight adverse effect due to changes in road layout along Grange Road. Setting of heritage assets (backing onto scheme at 5a/5b Herschel Road - locally listed) and Nr 49 Grange Road (Grade II) - slight adverse effect	Proximity of numerous HER Assets and features on aerial photographs and geophysical surveys of the Waterworks P&R indicates high likelihood of some historic environment assets on this route. Major effect likely resulting in moderate impact on low/moderate value assets. Coton Village Conservation Area and Church of St Peter in Coton - potential minor adverse (Slight) due to proximity of route to setting of the church West Cambridge Conservation Area - slight adverse effect due to changes in road layout along Grange Road. Setting of heritage assets (backing onto scheme at 5a/5b Herschel Road - locally listed) and Nr 49 Grange Road (Grade II) - slight adverse effect
	Environmental impacts – Green Belt	No Impact.	The Park and Ride site at the Waterworks is in the Green Belt but otherwise no change as rest of route is in existing highway corridor.	The Park and Ride site at Scotland Road is in the Green Belt - but otherwise no change as rest of route is in existing highway corridor	Park and Ride site at Waterworks is in Green Belt as is a large part of the route for the puiblic transport route to Grange Road. As it passes through West Cambridge it is not in Green Belt. Nearer Coton may have some moderate impact upon the Green Belt which would be mitigated by good design and route selection so it is less visible in the surrounding landscape. East of the M11 the route crosses Grange Field and is within the Green Belt and around down the Rifle Range Road, all in the Green Belt. The alignment of route will be designed to minimise impact on the Green Belt, so that the overall impact is appraised to be minor adverse.	Park and Ride at Scotland Farm is in the Green Belt, as is the route from there to Grange Road. As it passes through West Cambridge it is not in Green Belt. From the Madingley Mulch area to Grange Road the impact on Green Belt is the same as for 1a. Between the Scotland Farm Park and Ride site to Madingley Mulch the route is between two roads, so although in the Green Belt it is appraised to have no impact on the Green Belt. So overall the impact is very similar to 1a.	The additional section from the Waterworks site to Bourn Airfield is largely outside the Green Belt after it passes the Hardwick Interchange - so the overall impact on Green Belt is as for 1a.
	Safety	No change from existing.	There will be a limited impact on road safety associated with this option. There are two locations where safety may be compromised and will need to be given consideration during detailed design. The junction of St Neots Road and Long Road and where the main cycle route crosses from the northern to the southern footway of the A1303 to the east of the M11.	There will be a limited impact on road safety associated with this option. There are two locations where safety may be compromised and will need to be given consideration during detailed design. The junction of St Neots Road and Long Road and where the main cycle route crosses from the northern to the southern footway of the A1303 to the east of the M11.	This option will have a medium impact on road safety. In addition to the issues identified in the low costs options consideration will also need to be given to ensuring the safety of the design as it passes Coton Village. The junction between the route and Grange Road will also need to be carefully designed due to the limited width of Grange Road at this point.	This option will have a medium impact on road safety. In addition to the issues identified in the low costs options consideration will also need to be given to ensuring the safety of the design as it passes Coton Village and as in the redesignation of the pedestrian and cyclist route to the south of Charles Babbage Road to a public transport route. The junction between the new public transport route and Grange Road will also need to be carefully designed due to the limited width of Grange Road at this point.	This option will have a medium impact on road safety. In addition to the issues identified in the Do Something 1 options consideration will also need to be given to ensuring the safety of the design the proposed route crosses over St Neots Road to the west of Highfields Road. consideration will also need to be given to the use of fencing to shield the interaction of headlights between vehicles on the A428, the public transport route and St Neots Road for the section of the route where the route is between the A428 and St Neots Road.
	Accessibility	No change to existing links.	Through providing a P&R facility, additional public transport lanes, junction priority and an express service this option provides connections to key employment locations.	Through providing a P&R facility, additional public transport lanes, junction priority and an express service this option provides connections to key employment locations.	Through providing a P&R facility and an express service this option provides connections to key employment locations.	Through providing a P&R facility and an express service this option provides connections to key employment locations.	By connecting the route to existing and proposed housing in Hardwick, Bourn Airfield and Cambourne this option provides links from users to key employment locations.
	Scheme Cost	No change from existing.	This option represents the lowest overall cost.	This option is the second lowest cost but is only marginally more expensive than low cost option a, therefore they have been scored the same.	This option is approximately 3x the cost of option 1a.	This option is 10% more expensive than do something 1a but close enough that they have been scored the same.	The illustrative comparator is the highest cost option being 37% more expensive than the Do Something 1b option.
	Engineering feasibility - construction method	No construction required.	Requires some complex construction including changes to the M11 bridge, an additional footbridge over the M11 and changes to the configuration of Madingley roundabout.	Requires some complex construction including changes to the M11 bridge, an additional footbridge over the M11 and adding a slip lane to the A428.	Requires small amount of complex construction including a new road bridge over M11 and changes to the configuration of Madingley roundabout.	Requires small amount of complex construction including a new road bridge over M11, changes to the configuration of Madingley roundabout and adding a slip lane to the A428.	Requires a significant amount of complex construction including a new road bridge over M11, changes to the configuration of Madingley roundabout, new road bridge over St Neots Rd and changes to St Neots roundabout.
	Land acquisition required	No Land required.	Land required for Water Works P&R.	Land required for Scotland Farm P&R.	Land required for Water Works P&R and offline route.	Land required for Scotland Farm P&R and offline route.	Land required for Water Works P&R and offline route.

	Criteria	Do Minimum	Low Cost a	Low Cost b	Do Something 1a	Do Something 1b	Illustrative Comparator
Scheme Deliverability	Impact on local road network during construction	No impact.	Significant Impact on the A428, M11 bridge during construction, and impact on Madingley roundabout.	Significant Impact on the A428, M11 bridge during construction, and impact on A428 during construction of the slip road.	Medium impact on road network during construction as most of the work will be offline with some disruptions to build a bridge over the M11 and changes to Madingley roundabout. There will also be improvements to the M11 on and off slip and the junction with Madingley Road.	Medium impact on road network during construction as most of the work will be offline with some disruptions to build a bridge over the M11 and changes to Madingley roundabout. There will also be improvements to the M11 on and off slip and the junction with Madingley Road.	Medium impact on road network during construction as most of the work will be offline with some disruptions to build a bridge over the M11 and changes to Madingley roundabout. There will also be improvements to the M11 on and off slip and the junction with Madingley Road.
	Future-proofing	No impact.	No impact.	No impact.	As the route is fully offline it will support future schemes.	As the route is mainly offline it will support future schemes with minor changes.	As the route is fully offline it will support future schemes.
	Legislative Powers	No powers required.	Conventional planning solutions required.	Conventional planning solutions required.	Requires the amendment to a schedule of the TWA for powers to build.	Requires the amendment to a schedule of the TWA for powers to build.	Requires the amendment to a schedule of the TWA for powers to build.
	Scheme Maintenance and Renewals	Non required.	High cost for maintenance.	High cost for maintenance.	High cost for maintenance.	High cost for maintenance.	Medium cost for maintenance.
Stakeholder Support	Public acceptability	No Preference overall.	The consultation was not based on the final OAR2 options. As such there was deemed to be no preference overall for this option as the majority of respondents preferred the off road and the Scotland Farm Park and Ride.	The consultation was not based on the final OAR2 options. As such there was deemed to be some stakeholder support for this option as although the majority of respondents preferred the off road option they stated a preference for the Scotland Farm Park and Ride site over Water Works.	The consultation was not based on the final OAR2 options. As such there was deemed to be some stakeholder support for this option as although the majority of respondents preferred Scotland Farm Park and Ride site over Water Works Site they stated a preference for the off road options	The consultation was not based on the final OAR2 options. As such there was deemed to be Medium stakeholder support for this option as the majority of respondents preferred Scotland Farm Park and Ride site over Water Works Site and the off road option.	The consultation was not based on the final OAR2 options. As such there was deemed to be some stakeholder support for this option as although the majority of respondents preferred Scotland Farm Park and Ride site over Water Works Site they stated a preference for the off road options

D. Base year traffic model validation

D.1 Traffic Flow validation

Table 28: AM Peak CSRM2 Flow Locations

							WebTAG validation criteria		
Location	Direction	Observed (vehs)	Modelled (vehs)	Diff	% Diff	GEH	Flow	GEH	Overall
A1303 Madingley Road	EB	596	621	25	4%	1.0	√	√	√
A1303 Madingley Road	WB	481	500	19	4%	0.8	√	√	√
A428, between A1303 and M11-A14	EB	1616	1520	-96	-6%	2.4	√	√	√
A428, between M11-A14 and A1303	WB	787	791	4	0%	0.1	√	√	√
Madingley Rd	OUT	385	399	14	4%	0.7	√	√	√
Madingley Rd	IN	1105	1087	-18	-2%	0.6	√	√	√
Madingley Road	OUT	607	626	19	3%	0.8	√	√	√
Madingley Road	IN	773	743	-30	-4%	1.1	√	√	√
St Neots Road	EB	226	273	47	21%	3.0	√	√	√
St Neots Road	WB	186	108	-78	-42%	6.5	√	x	√
A428 east of Cambourne	EB	1981	1763	-218	-11%	5.0	√	X	√
A428 east of Cambourne	WB	1155	1280	125	11%	3.6	√	√	√

Source: Mott Macdonald

Table 29: AM Peak Other Flow Locations

							WebTAG validation criteria		
Location	Direction	Observed (vehs)	Modelled (vehs)	Diff	% Diff	GEH	Flow	GEH	Overall
Madingley P&R	In	130	172	42	33%	3.4	√	√	√
Madingley P&R	out	11	34	23	206%	4.8	√	√	√
M11 J13 sb onslip	SB	324	203	-121	-37%	7.5	x	x	x
A428 eastbound offslip to A1303	EB	659	598	-61	-9%	2.4	√	√	√
A428 eb between A1303 and M11/A14	EB	1615	1520	-95	-6%	2.4	√	√	√
A428 westbound onslip from A1303	WB	434	521	86	20%	3.9	√	√	√
A428 wb between M11/A14 and A1303	WB	750	790	41	5%	1.5	√	√	√
A428 eb offslip to St Neot's Road	EB	265	232	-33	-12%	2.1	√	√	√
A428 main cway at St Neot's Road	EB	1972	1530	-442	-22%	10.6	x	x	x
A428 wb off slip to St Neot's Road	WB	189	233	43	23%	3.0	√	√	√
A428 main cway at St Neot's Road	WB	1003	1079	76	8%	2.3	√	√	√
A428 eb between A1198 and A1303	EB	2225	1763	-462	-21%	10.4	x	x	x

							WebTAG validation criteria		
A428 wb between A1303 and A1198	WB	1259	1280	21	2%	0.6	√	√	√
M11 north of J13	NB	2249	2241	-8	0%	0.2	√	√	√
M11 north of J13	SB	2719	2787	68	3%	1.3	√	√	√

Source: Mott MacDonald

Table 30: Interpeak CSRM2 Flow Locations

							WebTAG validation criteria		
Location	Direction	Observed (vehs)	Modelled (vehs)	Diff	% Diff	GEH	Flow	GEH	Overall
A1303 Madingley Road	EB	not surveyed							
A1303 Madingley Road	WB	not surveyed							
A428, between A1303 and M11-A14	EB	568	569	0	0%	0.0	√	√	√
A428, between M11-A14 and A1303	WB	600	600	0	0%	0.0	√	√	√
Madingley Rd	OUT	438	468	30	7%	1.4	√	√	√
Madingley Rd	IN	478	496	18	4%	0.8	√	√	√
Madingley Road	OUT	not surveyed							
Madingley Road	IN	not surveyed							
St Neots Road	EB	121	117	-4	-3%	0.4	√	√	√
St Neots Road	WB	121	72	-49	-41%	5.0	√	x	√
A428 east of Cambourne	EB	825	959	134	16%	4.5	X	√	√
A428 east of Cambourne	WB	853	1072	219	26%	7.1	x	x	x

Source: Mott MacDonald

Table 31: Interpeak Other Flow Locations

							WebTAG validation criteria		
Location	Direction	Observed (vehs)	Modelled (vehs)	Diff	% Diff	GEH	Flow	GEH	Overall
Madingley P&R	In	51	100	49	96%	5.7	√	x	√
Madingley P&R	out	64	99	35	54%	3.8	√	√	√
M11 J13 sb onslip	SB	457	412	-45	-10%	2.2	√	√	√
A428 eastbound offslip to A1303	EB	405	436	31	8%	1.5	√	√	√
A428 eb between A1303 and M11/A14	EB	561	569	8	1%	0.3	√	√	√
A428 westbound onslip from A1303	WB	455	457	2	1%	0.1	√	√	√
A428 wb between M11/A14 and A1303	WB	590	600	10	2%	0.4	√	√	√
A428 eb offslip to St Neot's Road	EB	118	120	1	1%	0.1	√	√	√
A428 main cway at St Neot's Road	EB	839	839	0	0%	0.0	√	√	√
A428 wb off slip to St Neot's Road	WB	142	132	-10	-7%	0.9	√	√	√
A428 main cway at St Neot's Road	WB	902	925	23	3%	0.8	√	√	√
A428 eb between A1198 and A1303	EB	954	959	4	0%	0.1	√	√	√
A428 wb between A1303	WB	1017	1072	56	5%	1.7	√	√	√

							WebTAG validation criteria		
and A1198									
M11 north of J13	NB	1976	2014	38	2%	0.8	√	√	√
M11 north of J13	SB	1903	1929	27	1%	0.6	√	√	√

Source: Mott MacDonald

Table 32: PM Peak CSRM2 Flow Locations

Location	Direction	Observed (vehs)	Modelled (vehs)	Diff	% Diff	GEH	WebTAG validation criteria Flow	GEH	Overall
A1303 Madingley Road	EB	508	526	18	4%	0.8	√	√	√
A1303 Madingley Road	WB	1185	881	-304	-26%	9.4	x	x	x
A428, between A1303 and M11-A14	EB	815	823	8	1%	0.3	√	√	√
A428, between M11-A14 and A1303	WB	1357	1224	-134	-10%	3.7	√	√	√
Madingley Rd	OUT	960	1010	50	5%	1.6	√	√	√
Madingley Rd	IN	409	413	4	1%	0.2	√	√	√
Madingley Road	OUT	575	580	5	1%	0.2	√	√	√
Madingley Road	IN	536	546	10	2%	0.4	√	√	√
St Neots Road	EB	175	171	-4	-2%	0.3	√	√	√
St Neots Road	WB	203	160	-44	-21%	3.2	√	√	√
A428 east of Cambourne	EB	1253	1358	105	8%	2.9	√	√	√
A428 east of Cambourne	WB	2301	2011	-290	-13%	6.2	√	x	√

Source: Mott MacDonald

Table 33: PM Peak Other Flow Locations

							WebTAG validation criteria		
Location	Direction	Observed (vehs)	Modelled (vehs)	Diff	% Diff	GEH	Flow	GEH	Overall
Madingley P&R	In	13	36	23	177%	4.6	√	√	√
Madingley P&R	out	170	193	23	13%	1.7	√	√	√
M11 J13 sb onslip	SB	847	658	-189	-22%	6.9	x	x	X
A428 eastbound offslip to A1303	EB	437	536	99	23%	4.5	√	√	√
A428 eb between A1303 and M11/A14	EB	801	823	22	3%	0.8	√	√	√
A428 westbound onslip from A1303	WB	1098	879	-218	-20%	6.9	x	x	X
A428 wb between M11/A14 and A1303	WB	1331	1224	-107	-8%	3.0	√	√	√
A428 eb offslip to St Neot's Road	EB	216	212	-4	-2%	0.2	√	√	√
A428 main cway at St Neot's Road	EB	1071	1146	75	7%	2.3	√	√	√
A428 wb off slip to St Neot's Road	WB	344	341	-4	-1%	0.2	√	√	√
A428 main cway at St Neot's Road	WB	2091	1762	-329	-16%	7.5	x	x	x
A428 eb between A1198 and A1303	EB	1282	1358	76	6%	2.1	√	√	√
A428 wb between A1303	WB	2308	2011	-297	-13%	6.4	√	x	√

							WebTAG validation criteria		
and A1198									
M11 north of J13	NB	2649	2744	95	4%	1.8	√	√	√
M11 north of J13	SB	2335	2443	108	5%	2.2	√	√	√

Source: Mott MacDonald

D.2 Journey Time Validation

Table 34: AM Peak A1303 Journey Times (mins:secs)

Location	2015 observed time	2016 observed time	Modelled time (2015)	2015 obs - mod	2016 obs - mod
A1303 eastbound					
Madingley Mulch Roundabout	00:00	00:00	00:00		
M11 J13 sb on-slip	21:01	10:25	06:53	14:08	03:32
Grange Road	26:01	16:24	12:08	13:53	04:16
A1303 westbound					
Grange Road	00:00	00:00	00:00		
M11 J13 sb on-slip	03:03	03:04	03:07	-00:04	-00:03
Madingley Mulch Roundabout	06:19	06:18	06:23	-00:04	-00:05

Source: Mott MacDonald

Table 35: Interpeak A1303 Journey Times (mins:secs)

Location	2015 observed time	2016 observed time	Modelled time (2015)	2015 obs - mod	2016 obs - mod
A1303 eastbound					
Madingley Mulch Roundabout	00:00	00:00	00:00		
M11 J13 sb on-slip	03:30	03:04	03:29	00:01	-00:25
Grange Road	06:47	06:09	07:01	-00:04	-00:52
A1303 westbound					
Grange Road	00:00	00:00	00:00		

Location	2015 observed time	2016 observed time	Modelled time (2015)	2015 obs - mod	2016 obs - mod
M11 J13 sb on-slip	03:14	02:51	03:05	00:09	-00:14
Madingley Mulch Roundabout	06:19	06:03	06:22	-00:03	-00:19

Source: Mott MacDonald

Table 36: PM Peak A1303 Journey Times (mins:secs)

Location	2015 observed time	2016 observed time	Modelled time (2015)	2015 obs - mod	2016 obs - mod
A1303 eastbound					
Madingley Mulch Roundabout	00:00	00:00	00:00		
M11 J13 sb on-slip	03:19	03:05	03:26	-00:07	-00:21
Grange Road	07:42	07:43	07:03	00:39	00:40
A1303 westbound					
Grange Road	00:00	00:00	00:00		
M11 J13 sb on-slip	07:01	03:19	03:13	03:48	00:06
Madingley Mulch Roundabout	10:21	06:39	07:15	03:06	-00:36

Source: Mott MacDonald