

# Making Meaningful Connections

Consultation Technical Report:  
Appendices

**East West Rail Consultation:  
31 March – 9 June 2021**

This document contains the Appendices of the full Consultation Technical Report. To access the full Consultation Technical Report, please visit [www.eastwestrail.co.uk](http://www.eastwestrail.co.uk)



## A. Sponsor’s Requirements

### Notes

These Sponsor’s Requirements, together with the Programme-Wide Output Specification (PWOS) included in Appendix B, set out the Project Objectives referred to in Chapter 3 of the Technical Report.

The Sponsor’s Requirements are set by the DfT and cover the outcomes and benefits that the DfT expects EWR Co to deliver as a result of the Project. Together with the PWOS, they apply to the whole Project and build on the Strategic Objectives that were used to develop and decide on a Preferred Route Option between Bedford and Cambridge.

The version of the Sponsor’s Requirements presented here was drafted to set the direction of the design and contains draft proposed requirements on the delivery of the Project which the Project as described in this Technical Report has sought to meet.

The use of the term ‘the Railway’ in the Sponsor’s Requirements is equivalent to the Project.

### 1. Purpose

- 1.1. East West Rail (“The Railway”) shall be developed to improve and create direct connectivity by rail across the Oxford to Cambridge Arc, through the introduction of passenger services between Oxford and Milton Keynes, Oxford and Bedford, Oxford and Cambridge, and consideration of services from Aylesbury to Milton Keynes.
- 1.2. The Railway shall be explicitly designed and delivered to stimulate economic growth, housing and employment through the provision of new, reliable and attractive commuter and interurban passenger train services, providing city centre and wider network connectivity.
- 1.3. The Railway shall be designed, delivered and operated to achieve modal shift (both passengers and freight) and to reduce crowding on the wider rail network, most notably on services into and out of London.
- 1.4. Journey times shall as a minimum be significantly quicker than the current service provision.

- 1.5. The Railway shall aim to be competitive to journey times on other modes to encourage modal shift.
- 1.6. Consideration should be given to provision of or integration with services beyond the Oxford Cambridge sections (including recognising the aspirations for an Eastern Section east of Cambridge)

## **2. Overview**

- 2.1. The Railway is the rail transport system to be upgraded and/or delivered, including the Infrastructure, Operations, Maintenance, and Rolling Stock and Depots, required to meet this aspiration.
- 2.2. The Railway shall be designed and delivered to optimise benefits realisation, as set out in the underpinning Business Cases.
- 2.3. The Railway shall during development, design, construction and operation, as a minimum be cognisant of best practice, and shall aspire to set industry leading practice, in all aspects of railway operations and maintenance, demonstrating innovation where possible. This will include, but not be limited to, efficient delivery, local transport integration, the passenger environment and facilities provided at new stations. For example:
  - 2.3.1. reliable, safe and highly effective operational systems and practices, including all railway, organisational and contractual interfaces;
  - 2.3.2. assets that support efficient and effective operations and maintenance including the setting and delivery of reliability, availability, maintainability and safety (RAMS) targets;
  - 2.3.3. high workforce capability to deliver the operations and maintenance services; and
  - 2.3.4. job creation – including apprenticeships and workforce skills development and innovation.
- 2.4. The Railway shall be designed and structured to maintain flexibility for future private sector finance or investment and alternative models for the ownership and operation of infrastructure and rolling stock.

## **3. Customer Experience**

- 3.1. The Railway shall be developed, designed, constructed and operated to provide a good quality passenger experience appropriate to the modern world and type of rail service being provided and which meets the reasonable expectations of all groups of travellers for customer service, accessibility, comfort and passenger facilities and pays due regards to DfT's customer experience and wider transport policies.
- 3.2. The Railway shall be simple to use and accessible to all passengers, integrated with local and regional transport (including by cycling, walking and bus).
  - 3.2.1. The Railway shall be compliant with the PRSI and PRM-TSIs, which cover accessibility for Persons with Disabilities and Persons with Reduced Mobility, and the UK National Implementation Plan.
- 3.3. The Railway shall be designed to:
  - 3.3.1. be attractive, comfortable and pleasant to use for customers;
  - 3.3.2. provide reliable and helpful real-time passenger information in an appropriate range of formats.
  - 3.3.3. use modern, smart and convenient fulfilment mechanisms for authority to travel;
  - 3.3.4. enable passengers to have reliable access to communication networks in a way that meets their reasonable needs and expectations for entertainment, personal or business usage.

## **4. Capacity**

- 4.1. The Railway shall be designed and constructed to be capable of meeting forecast passenger demand particularly the growth anticipated as part of the transformation in the Oxford-Cambridge Arc.
  - 4.1.1. The forecast passenger demand will be agreed in consultation with DfT, and any other parties that the DfT deems appropriate (for example Network Rail). Any changes to the assumptions to forecast demand shall be agreed with DfT in advance.
- 4.2. The Railway shall be designed and constructed to be capable of maintaining current capacity for rail freight and where value for money and affordable make appropriate provision for anticipated future growth.
- 4.2. The Railway shall be designed and constructed to be capable of

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## **5. Train Service Performance**

- 5.1. maintaining current capacity for rail freight and where value for money and affordable make appropriate provision for anticipated future growth.
- 5.2. Performance targets for the Railway will be agreed with DfT, but as a minimum shall be in line with those of similar well performing services on the wider network. There shall be an ambition to improve on existing performance levels of similar services.
- 5.3. The Railway shall, insofar as practical, be resilient to any periods of poor performance on the wider network
- 5.4. The Railway shall isolate the wider network from any periods of poor performance on the Railway.
- 5.5. The Railway shall be capable of operating passenger and freight services from the existing network where it is permissible.
- 5.6. The project shall be designed and constructed to minimise any operational impact or risk in such interaction.

## **6. Rolling Stock**

- 6.1. Rolling stock and procurement strategies, and subsequent specification, shall take into consideration the DfT's objectives.
  - 6.1.1. Improving journeys for passengers
  - 6.1.2. Digitising the railway to reduce costs and increase capacity.
  - 6.1.3. Getting the most out of the assets we have
  - 6.1.4. Improving train connectivity and information for passengers
- 6.2. Rolling stock specifications shall also take into consideration the Rail Delivery Group (RDG)'s Key train requirements.

## **7. Electrification**

- 7.1. The Railway should seek opportunities to actively support decarbonisation and contribute to Net Zero Carbon Emissions, and bring forward proposals to the DfT in this regard.

Digital Signalling and Traffic Management

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## **8. Digital Signalling and Traffic Management**

- 8.1. The Railway should seek opportunities to actively support the DfT's strategy for digital railways and bring forward proposals to the DfT in this regard.

## **9. Safety and Security**

- 9.1. The project shall be designed and operated cognisant of best practice in physical, personnel and cyber security management and in compliance with DfT's security regulations. Advice will be sought from DfT, British Transport Police and other HMG security partners to achieve this outcome.
- 9.2. The project shall align with the DfT's 'Security in the design of stations' (SIDOS) best practice design guidance and meet the requirements on provision of physical protective counter terrorism measures set out in DfT's security regulations.
- 9.3. The Railway shall be designed, constructed and operated so that safety and cyber security risks are as low as reasonably practicable, in alignment with ORR's 'Health and Safety by Design' principles.

## **10. Delivery**

- 10.1 The project shall be developed, designed and constructed to the most efficient cost including up front construction costs, long term/whole-life asset maintenance/renewal and operational costs, as well as costs to the industry as a whole.
- 10.2. The Railway shall operate efficiently to earn revenue. Design should retain flexibility for developments in the commercial, customer and operational models.
- 10.3. The Railway shall be designed and developed to acknowledge, and apply, lessons learned from other major projects to improve outcomes.

## **11. Standards**

- 11.1. The Railway shall - unless a derogation applies - comply with all applicable UK and European railway standards and legislation including, but not limited to, the EU Technical Specifications for Interoperability ("TSIs") and notified National Technical Rules (NTRs), as managed by the Rail Safety and Standards Board (RSSB).

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- 11.2. In designing and developing the Railway, standards should be actively challenged where doing so offers improved affordability and/or operational improvement for the taxpayer while ensuring the safety, security and quality of the railway

## **12. Sustainability and the Environment**

- 12.1. The Railway shall be mindful of the RSSB's "Rail Sustainable Development Principles" in its design, construction and operation
- 12.2.1. The Railway shall, in liaison with stakeholders, be designed and delivered to avoid, reduce and, if possible, remedy adverse impacts, as far as reasonably possible (including during construction and future maintenance), and deliver enhancements where these are practical, value for money and affordable, including in the following areas
- 12.2.2. agriculture, forestry and soils
- 12.2.3. cultural heritage
- 12.2.4. disruption during construction and maintenance
- 12.2.5. rolling stock solutions
- 12.2.6. ecology
- 12.2.7. landscape and visual assessment
- 12.2.8. sound, noise and vibration
- 12.2.9. waste and material resources
- 12.2.10. water resources and flood risk assessment
- 12.2.11. whole life greenhouse gas emissions, including energy use (EC4T and wider usage) and embedded carbon
- 12.3. The design and development of the Railway shall have due regard to the Government's decarbonisation priorities, and all relevant environmental government policies. Where these are not expected to be met, this will be agreed in advance with the DfT.
- 12.4. The Railway and its stations shall be designed and developed to meet the legal requirement on Electric Vehicle Charging Points (EVCP) as a minimum and, where feasible, allow for future development/demand.

## **13. Integration**

- 13.1. The Railway shall be designed and developed in collaboration with other affected operators and service suppliers.

- 13.2. If the Railway proposes any operational, maintenance and ownership boundaries between existing and future railway entities, these shall be designed and agreed by the relevant parties or their representatives at appropriate levels through outline and detailed design.
- 13.3. In designing and developing The Railway, the capacity and journey time improvements that are planned at interfaces with other parts of the network, must be considered. The Railway should have no detrimental impact on the performance of these routes, including, where practical, not precluding future enhancements in these areas.

## **14. Engagement**

14. 1. In developing, designing and delivering the Railway, good collaborative engagement and communication channels should be developed and maintained with, but not limited to: the Department for Transport, Network Rail, the ORR, RSSB, RDG, HS2 Ltd, Train Operating Companies, Freight Operating Companies, British Transport Police and other Government departments and agencies.
- 14.2. EWR Co. should develop and maintain good collaborative engagement and communication with Local Authorities, the EWR Consortium, and Sub National Transport Bodies. By working with these stakeholders, and others, the Railway should be integrated with local and regional transport in order to promote ease of access and sustainable travel choices, including by cycling, walking and bus, where practical for first/last mile journeys.

B. Programme-Wide Output Specification

Notes

The Programme-Wide Output Specification (PWOS) presented here has been developed by EWR Co and agreed with the DfT. The PWOS adds detail to the Sponsor’s Requirements and incorporates and supersedes the Western Section Output Specification.

As the design is at an early stage, the PWOS does not contain formalised requirements that must be met, nor does it signify that decisions have already been taken. Indeed, the Technical Report considers options different from those in the PWOS because other approaches may be desirable and the DfT and EWR Co are evolving the solution to meet the Sponsor’s Requirements. As such there is scope for the PWOS to be amended.

Similarly, some of the objectives contained in this document may not be achievable, for example due to budgetary or programme constraints to be decided by the Government, and may need to be traded-off against each other. The requirements on the delivery of the Project will be confirmed as the design evolves and option decisions are made.

The PWOS makes reference to additional future options for the railway, referred to as Configuration Options 2.5 and 3.5. At this stage, no decision has been made to implement these options into the scope of the Project and, as such, they are not considered in the assessment of options presented in the Technical Report.

The use of the terms Programme, Railway, Scheme and Whole-System in the PWOS are equivalent to the Project.

Glossary

Term	Description
“The Railway”	East West Railway route
AVP	Aylesbury Vale Parkway Station
AYS	Aylesbury Station
BDM	Bedford Station
BIT	Bicester Station
BLY	Bletchley Station
CBG	Cambridge Station
CBN	Cambourne Station
CMS	Cambridge South Station
CO	Configuration Option
CO2.5	Configuration Option 2.5
CO3.5	Configuration Option 3.5
CS	Configuration State
CS1	Configuration State 1
CS2	Configuration State 2
CS3	Configuration State 3
DfT	Department for Transport
ECML	East Coast Mainline
ETCS	European Train Control System
EWR	East West Railway
EWR Co	East West Railway Company
GSM-R	Global System for Mobile Communications – Railway
HL	High Level
HS2	High Speed Two
INF TSI	Technical Specification for Interoperability of Infrastructure
MKC	Milton Keynes Central Station
NNTR	Notified National Technical Rule
ORR	Office of Rail and Road
OXF	Oxford Station
OXF	Oxford Parkway Station
PRM-TSI	Persons of Restricted Mobility Technical Specification for Interoperability
ptph	Passenger Train Per Hour
RA	Route Availability
RbM	Risk Based Maintenance (which includes RAMS)
RCM	Remote Condition Monitoring
RID	Ridgmont Station
ROC	Rail Operating Centre
RSSB	Rail Safety and Standards Board
SIDOS	Security in the design of Stations
TSI	Technical Specification for Interoperability
TSS	Train service specification
WCML	West Coast Mainline
WNO	Winslow Station

WOB	Woburn Station
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## 1. Introduction

- 1.1.1. This document seeks to define the key outputs that the East West Railway (EWR) (“The Railway”) programme will deliver between Oxford and Cambridge.
- 1.1.2. The document is intended to form the master reference document (with respect to scope) for all parties working on the delivery of the programme. More detailed specifications and requirements will be developed for the individual projects that make up the overall programme. These documents will expand upon the information that is provided within this document. In the case of a conflict between any such detailed specification and this document, this document will take precedence.

## 2. Purpose

- 2.1.1. The Output Specification has been designed to meet the high-level Sponsor requirements. The Output Specification also describes, at a high level, the key infrastructure items being developed to deliver these outputs in order that a clear baseline scope is established.

## 3. Scope and applicability

- 3.1.1. The programme is split into three core, and two optional, Configuration States (CS). The service capability enabled by these states are:
  - 3.1.1.1. Configuration State 1 (CS1): Oxford to Milton Keynes
  - 3.1.1.2. Configuration State 2 (CS2): Oxford to Bedford
  - 3.1.1.3. Configuration State 3 (CS3): Oxford to Cambridge, and Bletchley to Cambridge
- 3.1.2. As part of the scheme East West Railway Company (EWR Co) will consider Configuration Options 2.5 (CO2.5) Aylesbury to Milton Keynes and 3.5 (CO3.5) Bedford to Cambridge.
- 3.1.3. As part of the scheme EWR Co will ensure that decisions made will not preclude a future Eastern section passenger service.
- 3.1.4. When required the document will refer to any variation in output particular to any configuration state. Configuration options are not addressed within this document except where specifically identified. However, in the event of a decision to formally adopt these options into scope, this document would be updated to reflect their inclusion.
- 3.1.5. This document will address the required customer, operational, infrastructure, performance, sustainability and environmental and health and safety outputs for the programme.

- 3.1.6. The Railway will be focused on delivering and optimising the outcomes of the business case including focusing train service specifications to meet both commuter and interurban connectivity.
- 3.1.7. The design and construction of the whole Railway will take due consideration of the opportunities to provide digital services where appropriate.
- 3.1.8. The design and construction of the whole Railway will take due consideration of the need to be flexible in the delivery of commercial, operational and customer experience models.
  - 3.1.8.1. These considerations will be agreed at key design freeze points
- 3.1.9. The design of the Railway will ensure individual CS state decisions are considered against the wider route outputs and deliverables.

4. References

4.1. Applicable and relevant documents

- 4.1.1. The design of these output specifications have been informed by the documents outlined in Table 1.

Table 1 – Listing of documents which inform these specifications

ID	Document number	Document title	Revision
1	N/A	East West Rail Western Section Phase 2 Output Specification	4.0
2	N/A	East West Rail (Oxford to Cambridge) Sponsor’s Requirements	09/03/2020

4.2. Standards

- 4.2.1. The railway shall be compliant with the PRSI and Persons of Restricted Mobility Technical Specification for Interoperability (PRM-TSI) covering accessibility for persons with reduced mobility and the UK National Implementation plan.
- 4.2.2. The Railway and rolling stock shall comply with all applicable UK and EU railway standards and legislation including Technical Specifications for Interoperability (TSIs) and Notified National Technical Rules (NNTRs) unless a derogation to a standard or a change in law applies. In areas where no TSI or NNTR applies, cognisance of “best practice” and “security by design” principles will be considered.
- 4.2.3. In designing and developing the design, construction and operational model standards will be challenged where improved affordability and/or operational improvement can be defined, whilst still meeting safety, quality and security outputs defined within this specification.

- 4.2.4. Where interface or ownership of assets is or will be with a third party their company standards shall be complied with unless a derogation exists.

5. Whole-System output specification

5.1. Customer

- 5.1.1. EWR Co shall deliver the programme outputs in a way that meets its customer vision: “Trusted Travel for All: Simple, Intuitive, Fresh”.
- 5.1.2. EWR Co shall establish the information that customers need and
  - 5.1.2.1. develop channels to allow customers to access information based on their individual needs and expectations;
  - 5.1.2.2. include information prior to, during and post travel on services and
  - 5.1.2.3. include integrated travel options.
- 5.1.3. EWR Co shall provide an appropriate range of methods for the customer to secure and fulfil their authority to travel.
  - 5.1.3.1. These methods should consider means which are appropriate, modern, smart and convenient.
- 5.1.4. EWR Co shall develop EWR services that can integrate with other rail operators and between rail and other transport modes.
- 5.1.5. Station and rolling stock design and maintenance shall meet the customer vision, through setting customer experience requirements which as a minimum consider;
  - 5.1.5.1. comfort,
  - 5.1.5.2. ease of use,
  - 5.1.5.3. accessibility,
  - 5.1.5.4. facilities,
  - 5.1.5.5. customer information,
  - 5.1.5.6. wayfinding,
  - 5.1.5.7. authority to travel,
  - 5.1.5.8. customer assistance
  - 5.1.5.9. and transport integration.
- 5.1.6. The railway<sup>1</sup> shall be compliant with the PRSI and PRM-TSI covering accessibility for persons with reduced mobility and the UK National Implementation plan.
- 5.1.7. EWR Co shall build a culture and set of behaviours to ensure its staff and contractors meet the defined customer vision.

5.2. Operations

- 5.2.1. The Railway line shall be available for the operation of passenger services as defined within the train service specification (TSS) between the following hours as a minimum:

<sup>1</sup> New infrastructure and trains preclude existing assets unless specifically requested.  
Programme-Wide Output Specification EWR-EWR-SS-XX-SP-K-000001 V01 / R01  
East West Railway Company 7



Day	Times
Monday – Thursday	06.00 – 00.00#
Friday and Saturday	06.00 – 01.00#
Sunday	07.00 – 23.00

# until the following day

- 5.2.2. The Railway shall be available for the maintenance of infrastructure assets for a maximum of the following hours:

Night	Times
Tues to Thurs	00.01 – 05.59
Fri/Sat	01.01 – 05.59
Sat/Sun	01.01 – 06.59
Sun/Mon	23.01 – 05.59#

# until the following day

- 5.2.3. Maintenance activities shall be designed based on the Risk based Maintenance (RbM) methodology.
- 5.2.4. Opportunities will be explored and defined to provide continuous operation when maintenance is taking place.
- 5.2.5. The railway shall be operated efficiently to earn revenue.
- 5.2.6. Possessions and maintenance activities shall be undertaken in such a way that maximises use of technology to improve efficiency and reduce risk and
- 5.2.6.1. shall be controlled from the relevant control centre.

## 5.3. Train service specification

- 5.3.1. The December 2018 timetable forms the base for the existing trains in operation.

## 5.4. Service plan

- 5.4.1. The TSS for each configuration state shall build on the existing configuration state.
- 5.4.1.1. Configuration State 1:
- 5.4.1.1.1. 2 passenger trains per hour (ptph) Oxford to Milton Keynes (EWR services 1 & 2).
- 5.4.1.1.2. 1 freight path every 2 hours between Bletchley and Oxford.
- 5.4.1.2. Configuration State 2:
- 5.4.1.2.1. 2 ptp Oxford to Bedford (EWR services 3 & 4).
- 5.4.1.3. Configuration State 3:
- 5.4.1.3.1. 2 ptp Oxford to Bedford services extended to Cambridge (EWR services 3 & 4).
- 5.4.1.3.2. 2 ptp Cambridge to Bletchley Low Level (EWR services 5 & 6).
- 5.4.2. Optional states will be defined based on their individual business cases.
- 5.4.2.1. Configuration Option 2.5:
- 5.4.2.1.1. 1 ptp Aylesbury to Milton Keynes (EWR service 7).
- 5.4.2.2. Configuration Option: 3.5:

### 5.4.2.2.1. 2ptph Bedford to Cambridge (EWR service 8 & 9).

- 5.4.3. The Railway shall be designed to serve the following stations (calling patterns):

EWR service	OXD	OXF	BIT	AYS	AVL	WNO new	BLY +new	MKC	WOB	RID	BED	new	CBN new	CMS new	CBG
1	+	+	+			+	+	+							
2	+	+	+			+	+	+							
3	+	+	+			+	+		+	+	+	+~	+~	+~	+~
4	+	+	+			+	+		+	+	+	+~	+~	+~	+~
5							+#		+	+	+	+	+	+	+
6							+#		+	+	+	+	+	+	+
7				+	+	+	+	+							
8											+	+	+	+	+
9											+	+	+	+	+

~ Extension of service to Cambridge

# Assumption that services will use Bletchley Low level

+new – additional station component with connectivity to an existing station

new – new station

## 5.5. Journey times

- 5.5.1. The Railway shall be designed to deliver the following maximum point-to-point journey times:

Configuration State	From	To	Maximum journey time (minutes) <sup>2</sup>
CS1	Oxford	Milton Keynes	45
CS2	Oxford	Bedford	60
CO2.5	Aylesbury	Milton Keynes	40
CS3	Oxford	Cambridge	95

- 5.5.2. Services for CS1 between Oxford and Milton Keynes shall be clock face and at regular intervals.
- 5.5.3. Services for CS2 between Oxford and Bedford shall be clock face and at regular intervals that complement CS1 service frequencies to provide regular departures at stations along the route.
- 5.5.4. Services for CO2.5 between Aylesbury and Milton Keynes shall be hourly from departure points.
- 5.5.5. Services for CS3 between Oxford, Bletchley and Cambridge shall be a regular clock face pattern that compliments CS1 services to provide regular clock face departures at Oxford and Cambridge and provide a regular departure pattern and frequency along the route.

## 5.6. Operational model

<sup>2</sup> The maximum journey times are based on indicative route and infrastructure studies and will be validated as the schemes progress

- 5.6.1. A highly skilled and competent work force shall be provided by the Operator and Maintainer.

## 5.7. Capacity

- 5.7.1. Line capacity, calling patterns and rolling stock characteristics shall be designed to be sufficient to support passenger demand for the different phases of development of the scheme.
- 5.7.1.1. Active provision shall be provided for CS1, CS2, CO2.5 and CS3 across rolling stock, stations and platforms along the route in the 'Business As Usual' growth scenario as defined within the business case.
  - 5.7.1.2. Positive Passive capacity provision shall be provided for CS2 and CS3 across rolling stock, stations and platforms along the route in the 'High Growth' scenario as defined within the business case.
- 5.7.2. Train Planning headways between Bicester and (excluding Bletchley to Milton Keynes) the connection to Network Rail infrastructure as part of the approach to Cambridge shall be no greater than 3 minutes.
- 5.7.2.1. If EWR Co proceeds with Configuration Option 2.5, the headways between Aylesbury and Claydon shall be no greater than 8 minutes.
- 5.7.3. Route diversionary design and planning will primarily be on the basis of passenger diversion, not train diversion across the EWR route.
- 5.7.4. The railway will be designed and constructed to provide an agreed level of operational contingency for the projected level of growth within the business case.

## 5.8. Station capacity

- 5.8.1. An agreed impact assessment methodology shall be used at existing stations to identify the impact and changes required as a result of the introduction of EWR services, in line with the capacity provision levels outlined in Section 5.7.

## 5.9. Platform capacity

- 5.9.1. There shall be a provision for 106m operational length at all station platforms<sup>3</sup> within the TSS (at the point in which entry into service occurs for each configuration state) adequate to accommodate 4-car (4 x 24m) rolling stock.
- 5.9.2. All new station platforms shall provide positive passive provision for 202m operational length.
- 5.9.3. Platform lengths at Oxford, Milton Keynes, Bedford, (Cambridge South), Cambridge and on the East Coast Main Line (ECML) will be defined based on the future train service requirements as confirmed by the Department for Transport (DfT).

## 5.10. Depots and stabling

<sup>3</sup> Excludes Quainton

- 5.10.1. The programme shall provide one main rolling stock maintenance depot within proximity of the EWR<sup>4</sup> route.
- 5.10.2. The main rolling stock depot shall not be in excess of 15-minute journey time from the route.
- 5.10.3. Sufficient and suitable stabling shall be provided at suitable points on and near the route.
- 5.10.4. Stabling shall be located to optimise launch into service activities and overnight servicing.
- 5.10.5. The programme shall determine the requirement for any further stabling and servicing facilities necessary to support the operation of each configuration.

## 5.11. Freight capability

- 5.11.1. The programme shall assess and evaluate the cost / benefit associated with providing infrastructure capability for freight capacity over and above that identified in Section 5.4.
- 5.11.2. The maximum length of any freight train shall be 775 metres.
- 5.11.3. Any freight loops shall be 975metres in length to enable 'on the move' entry and exit onto the mainline.
- 5.11.4. Entry and exit speeds for any freight loops shall be at least 40mph.
- 5.11.5. The infrastructure shall be designed to technical parameters that do not preclude freight service operation along the EWR route.
- 5.11.6. No positive or neutral passive provision of infrastructure (e.g. passing loops) shall be made for additional freight capacity beyond those required for existing freight<sup>5</sup> services (those within Sections 5.3 and 5.4) and planned robust passenger operation, maintenance and stabling.

## 5.12. Rolling stock characteristics

- 5.12.1. Rolling stock provision shall be phased across the configuration states with CS1, CS2 & CO2.5 provided through an interim rolling stock solution with the rolling stock solution for CS3 to be decided at a later time.
- 5.12.2. Rolling stock shall be a maximum of 24 metres per vehicle.
- 5.12.3. The rolling stock for CS1, CS2 (and CO2.5) shall comprise of sufficient 3-car self-powered trains operating to the CS1, CS2 and CO2.5 train service specification.
- 5.12.4. The trains shall be fitted with ETCS, Automatic Selective Door Opening and in cab Driver Controlled Operation through body side cameras and in cab CCTV.

<sup>4</sup> Oxford to Cambridge, Bletchley to Milton Keynes and Aylesbury to Claydon

<sup>5</sup> In line with Section 10.3

- 5.12.5. The trains shall be supported by a full maintenance mechanism.
- 5.12.6. The rolling stock requirement for CS3 shall be designed to provide sufficient capacity for forecast passenger demand,
  - 5.12.6.1. be capable of meeting the TSS journey times and
  - 5.12.6.2. meet customer experience requirements.
- 5.12.7. The rolling stock procured for CS3 shall replace the interim rolling stock detailed in Section 1.
- 5.12.8. Rolling stock for CS3 shall have a suite of self-monitoring ‘intelligent’ sub systems and associated telemetry that is capable of real time updating to a central point.
- 5.12.9. Rolling stock shall allow level boarding into the vehicle from the platform.
- 5.12.10. Procurement of rolling stock shall take account of Rail Delivery Group (RDG) ‘Key Train Requirements’ KTR v5.1

5.13. Infrastructure

- 5.13.1. New infrastructure shall be designed and delivered to provide access for existing railway operators within the agreed gauge, weight and size parameters without unnecessary restrictions.
- 5.13.2. Infrastructure will comprise of a suite of self-monitoring ‘intelligent’ sub-systems and associated telemetry.

5.14. Track

- 5.14.1. Sufficient track capacity shall be provided to deliver the full TSS to the level of performance outlined within this output specification (Section 5.28).
- 5.14.2. Track design shall be optimised with signalling design to provide maximum operational flexibility and positive passive provision for future capacity.
- 5.14.3. Bi-directional functionality shall be the default position as standard on all new track installations on the EWR route including Bletchley High Level (HL) (Western direction only)<sup>6</sup>, but excluding Bletchley to Bicester.
- 5.14.4. Positive passive provision for double tracking shall be provided between Quainton<sup>7</sup> and Claydon Chord.
- 5.14.5. Turn back facilities shall be provided in the Bletchley High Level area to allow turn back towards Oxford and Bedford.
- 5.14.6. Turn back facilities shall be provided at Bedford to allow turn back towards Oxford and Cambridge.
- 5.14.7. The route between Oxford and Cambridge shall consist of a minimum of 2 tracks throughout.

<sup>6</sup> Excludes OXF to Gavray Junction  
<sup>7</sup> HS2 interface  
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5.15. Line speed

- 5.15.1. The line shall be designed to an operating speed that enables as a minimum, journey times for the different configuration states as defined in Section 5.5.
- 5.15.2. Opportunities to improve on the journey times in Section 5.5 shall be identified.
- 5.15.3. Any Line speed differentials shall not compromise the outputs of the scheme.
  - 5.15.3.1. For configuration state 1 the line speed is defined as 100 mph except for agreed existing retained track layouts.
  - 5.15.3.2. For configuration state 2 the line speed is defined as up to 100 mph except for agreed existing track layouts.
  - 5.15.3.3. For configuration option 2.5<sup>8</sup> the line speed is defined as up to 90 mph except for agreed existing track layouts.
  - 5.15.3.4. For configuration state 3 and option 3.5 the line speed is defined as up to 100 mph except for agreed existing track layouts.
- 5.15.4. Innovative and cost-effective options to raise the line speed shall be presented, to provide the redundancy detailed in Section 5.28.

5.16. Gradient

- 5.16.1. The rising and falling gradients of the new sections of the line shall have a normal limiting value of 1.25 % (1 in 80).
  - 5.16.1.1. The use of gradients shall be minimised along the route.
- 5.16.2. The location and length of sections of the route to utilise the proposed gradient shall be assessed as part of the assessment of freight capability as set out in Section 5.11.

5.17. Load bearing capacity

- 5.17.1. Structures on new sections of the route shall be designed for traffic loads in accordance with the TSI for Infrastructure (INF TSI), considering any built or constructed element of the route supporting the running of the trains.
- 5.17.2. For the purpose of designing new infrastructure elements of the route, a loading capacity for a train axle load of 25.5 tonnes shall be used for the expected design life of the structure.
- 5.17.3. The Railway shall have a minimum Route Availability (RA) grade of RA10 unless otherwise agreed.

5.18. Gauging

- 5.18.1. The Railway shall be designed and built to accommodate all freight gauges to W12<sup>9</sup> in both directions.

<sup>8</sup> AVP to Claydon Junction  
<sup>9</sup> Includes W6A, W7, W8, W9, W9+, W10 and W10+  
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- 5.18.2. The Railway shall allow operation of the defined rolling stock across the full configuration states including to and from and within the depot and stabling areas.
- 5.18.3. For new infrastructure, vertical clearances to structures shall provide positive passive provision for future electrification using the 25 kilovolts (kV) overhead system based on “normal clearance” as defined in Railway Group Standard GE/GN 8573 Issue 3.
- 5.18.4. For existing infrastructure (particularly pertinent to configuration state 1), vertical clearance to provide neutral passive provision for electrification shall only be provided to structures that have had civils construction and re-decking works take place as part of the scope of works.

## 5.19. Electrification

- 5.19.1. The Railway shall not at this point in time be electrified.
- 5.19.2. EWR Co shall develop proposals to place before DfT on the options for electrification.
- 5.19.3. All new or renewed infrastructure shall be made compatible with positive passive provision of future electrification at 25kV (overhead) unless specified otherwise.
- 5.19.4. As per the European Union 2004/30/EU all electrical apparatus within the vicinity of EWR route shall not emit electro-magnetic radiation that would prevent other equipment from functioning as intended.
- 5.19.5. Neutral Passive provision shall be provided for CS1 taking into account Section 5.18.3;
- 5.19.6. Pending a decision by DfT all configuration states except CS 1 will be designed for an electrified railway.

## 5.20. Command and signalling

- 5.20.1. The Railway shall support the DfT’s strategy for ‘Digital Railways’.
- 5.20.2. All new signalling infrastructure shall be at least European Train Control System (ETCS) Level 2 (“signals away”) to allow Level 3 – hybrid as an option for CS2, CS3 and CO3.5.
- 5.20.3. Any conventional signalling sections that are refreshed or renewed shall be ‘digital ready’
  - 5.20.3.1. and upgraded to ETCS Level 2 (signals away) where value for money can be demonstrated in CS1 and CO2.5
- 5.20.4. Signalling control for the route between Oxford Canal Junction and Bletchley HL shall initially be undertaken from Network Rail’s Rugby Rail Operating Centre (ROC).
- 5.20.5. Once the Bedford to Cambridge section is commissioned the complete EWR route between Oxford and Cambridge shall be controlled from a single control centre, apart from where routes at the fringes have their own control centres.
- 5.20.6. All signalling control shall be designed and developed to allow migration to an alternative EWR control centre in the future.

- 5.20.7. A backup signalling control method shall be provided.

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- 5.20.8. Signalling and traction power control shall be managed from the same location.
- 5.20.9. Bi-directional functionality shall be the default position as standard on all new signalling installations on the EWR route including Bletchley HL (Western direction only)<sup>10</sup>, but excluding Bletchley to Bicester.
- 5.20.10. A traffic management system shall be considered and evaluated to improve train performance.
- 5.20.11. The traffic management system shall be compatible with the train control system and interface with fringe areas.

## 5.21. HS2

- 5.21.1. Rail systems design shall be integrated with the major civils design and construction in the area being delivered by High Speed Two (HS2).

## 5.22. Safety

- 5.22.1. Safety for design, construction and operation/maintenance shall be considered in accordance with legislative requirements and industry standards and take account of the Office of Rail and Road’s (ORR’s) Health and Safety by Design principles.

## 5.23. Security

- 5.23.1. Suitable and sufficient cyber security and physical security shall be applied across the railway infrastructure, systems and data in line with legislative requirements and industry standards.

## 5.24. Communications

- 5.24.1. Operational Telecommunications shall be via Global System for Mobile Communications – Railway (GSM-R) (voice and data) or equivalent technology.
- 5.24.2. All operational areas of the EWR Co route shall be covered by a communications system.
- 5.24.3. Portable communication handsets shall be provided in line with operational needs.
- 5.24.4. Wayside signalling assets shall use a suitable telecoms network including appropriate provision for line side equipment and operational needs.
- 5.24.5. The communications system shall be designed to achieve specified performance, safety and availability targets.
- 5.24.6. Wi-fi or the latest alternative shall be provided on rolling stock and at EWR stations in line with meeting customer expectations.

## 5.25. Stations

<sup>10</sup> Excludes OXF to Gavray Junction

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- 5.25.1. The EWR scheme shall provide new stations
  - 5.25.1.1. at Winslow and Bletchley (with interchange for the West Coast Main Line (WCML)) and
  - 5.25.1.2. at Cambourne and between Sandy and St Neots (with interchange for the ECML).
- 5.25.2. New or renewed infrastructure at new EWR or existing stations along the route shall be designed based on the customer experience requirements;
  - 5.25.2.1. and where practical in line with security in the design of stations (SIDOS)
  - 5.25.2.2. and in line with agreed passenger forecasts with DfT
- 5.25.3. All new stations, and where practical existing stations, shall provide level access from the street to the platform.
- 5.25.4. Platform heights shall be set to facilitate level boarding.
  - 5.25.4.1. Where this is not possible then the height and offset (from the adjacent rail) of all platforms shall be such that the stepping distance to EWR rolling stock is minimised.
- 5.25.5. All new stations shall be equipped to meet customer needs, including those outlined in Section 5.1.5.
- 5.25.6. Passenger services ‘on a required basis’ shall continue to be able to call at Quainton Road.
  - 5.25.6.1. There is no requirement to address existing non compliances.

## 5.26. Level crossings

- 5.26.1. New level crossings shall not be proposed for any part of the EWR route.
- 5.26.2. All existing level crossings shall be considered for closure; where the only reasonably practicable closure options have disproportionate negative impacts, retention of the crossing may be considered provided an appropriate risk assessment shows the safety risk of retention (with enhanced control measures where necessary) to be tolerable.

## 5.27. Asset management

- 5.27.1. A digital asset information model shall be developed and populated throughout design which shall allow;
  - 5.27.1.1. digital asset information model to be used during construction to identify and locate all asset and components required to support all stages of the asset lifecycle and
  - 5.27.1.2. route-wide systematic failure analysis to be undertaken throughout the design, development and implementation stages to optimise the reliability of the infrastructure system and its ability to support the train service delivery targets.
- 5.27.2. Fixed Asset monitoring and maintenance shall be undertaken without disruption to the operational railway supported by:
  - 5.27.2.1. embedded sensors (Remote Condition Monitoring (RCM)),

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- 5.27.2.2. service train mounted sensors
- 5.27.2.3. and high-resolution imagery.

## 5.28. Performance

- 5.28.1. EWR Co shall support, contribute and work with the DfT and the rest of the UK rail industry to evolve and adopt the latest evolution of industry thinking for performance measurement<sup>11</sup>, to set appropriate targets ahead of entry into service for each configuration state.<sup>12</sup>
- 5.28.2. These ‘on-time’ and T3 performance<sup>13</sup> measures shall be used to report the reliability and punctuality of trains arriving at every recorded station stop on the EWR route.
- 5.28.3. The risk of poor performance being imported from or exported to the wider railway network shall be reduced through provision of latent redundancy and resilience within the design.
- 5.28.4. The Railway shall seek to minimise any detrimental effect on the performance of the routes where EWR interfaces and/or introduces new services through working collaboratively with industry partners.
  - 5.28.4.1. The base performance level will be agreed with the DfT to inform the design and planning for the Railway.

## 5.29. Interface management

- 5.29.1. An interface plan shall be developed for each configuration state that defines roles and responsibilities of the different parties, both internal and external.
- 5.29.2. The Interface plan shall define and consider interfaces to ensure efficiency and reduced impact on the existing network.

## 5.30. Environment and sustainability

- 5.30.1. EWR Co shall fully consider the importance of environmental sustainability in all its activities and the decisions it makes, including the consideration of the railway industry sustainability principles (Rail Safety and Standards Board (RSSB) “Rail Sustainable Development Principles”).
- 5.30.2. EWR Co shall realise opportunities for environmental improvement, so that the scheme is constructed, operated and maintained in an environmentally responsible manner that minimises negative environmental impacts.
- 5.30.3. EWR Co shall avoid direct impacts on the most significant nationally and internationally designated environmental and heritage assets during railway alignment development. These assets shall include as a minimum:
  - 5.30.3.1. Statutorily designated and other sites in relation to biodiversity,

<sup>11</sup> The rail industry has introduced a new ‘on-time’ performance measure for punctuality measurement: i.e. the percentage of recorded station stops arrived at ‘on time’ (early or less than one minute after the scheduled time).

<sup>12</sup> WS OS v4 requires PPM 92.5%, this shall be reviewed as part of the performance development measure.

<sup>13</sup> T3 refers to punctuality within three minutes of timetable.

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- 5.30.3.2. National Nature Reserves (NNRs),
- 5.30.3.3. Ramsar Sites,
- 5.30.3.4. Sites of Special Scientific Interest (SSSIs),
- 5.30.3.5. Special Areas of Conservation (SACs),
- 5.30.3.6. Candidate Special Areas of Conservation (cSACs),
- 5.30.3.7. Special Protection Areas (SPAs),
- 5.30.3.8. Candidate Special Protection Areas (cSPAs) and
- 5.30.3.9. Ancient Woodland.
- 5.30.4. Heritage assets:
  - 5.30.4.1. World Heritage Sites,
  - 5.30.4.2. Scheduled Monuments,
  - 5.30.4.3. Grade I and II\* Listed Buildings,
  - 5.30.4.4. Grade I and II\* Registered Parks and Gardens and
  - 5.30.4.5. Registered Battlefields.
- 5.30.5. Biodiversity. EWR Co shall enhance biodiversity, reducing impacts on species and creating and enhancing habitats, to deliver biodiversity net gain.
- 5.30.6. Waste and materials. EWR Co shall avoid or minimise life cycle impacts through specification, design, construction and operational management, and through promoting sustainable sourcing and use of resources.
- 5.30.7. Carbon. EWR Co shall minimise our carbon footprint, through advancing low carbon design, construction and operation, to be a net-zero carbon railway.
- 5.30.8. Water resources and flooding. EWR Co shall protect water resources and ensure no increase of flooding to communities.
- 5.30.9. Historic environment. EWR Co shall protect the historic environment through preserving and enhancing heritage assets.
- 5.30.10. Soil resources and agriculture. EWR Co shall protect soil resources and agriculturally important land.
- 5.30.11. Landscape. EWR Co shall protect and enhance the quality of landscapes, townscape and visual amenity.
- 5.30.12. Communities. EWR Co shall be a good neighbour to the communities in which we and our partners operate by effectively managing and controlling noise, vibration and pollutant emissions to air to avoid significant adverse impacts on health and quality of life.
- 5.30.13. EWR Co shall seek to avoid or minimise residential land acquisition.
- 5.30.14. EWR Co shall seek to avoid or minimise the demolition of properties.
- 5.30.15. EWR Co shall have due regard to all relevant environmental government policies.
- 5.30.16. Where these are not expected to be met shall be agreed in advance with our Sponsor.

## C. Assessment Factors: definitions and Considerations

Assessment Factors are a thread throughout the project development to ensure the Project meets its objectives. Each factor has a number of supporting Considerations. The origin of the Assessment Factors and the evolution and application of them is described in Chapter 5. Each option is assessed compared to a reference scenario for consistency, using a five-point scale: major worsening, minor worsening, neutral, minor improvement, major improvement.

	Factor	Definition
Business Case and Customers		
1	Transport user benefits	Benefits to transport users. This includes elements that drive 'generalised journey time': origin to destination journey times, access times to stations, number of interchanges. Also considers crowding and quality compared to current journey. Includes benefits of modal shift (i.e. decongestion and environmental benefits where people are attracted to rail rather than use of other modes due to shorter generalised journey times).
2	Contribution to enabling housing and economic growth including best serving areas benefitting from developable land	Potential for wider employment and productivity benefits of improved east-west connectivity and the opportunity for stations served by EWR to support housing growth within their catchment areas
3	Capital costs	Cost to bring the Project to full service, including land acquisition, construction and any adaptation and mitigation works, including risk.
4	Operating costs	Ongoing costs incurred in the delivery of the train service net of revenue
5	Overall affordability <sup>68</sup>	Consideration of the financial implications of the options in terms of costs and incomes for EWR and other parties, over the whole life of the railway. Whilst incomes are considered here, other non-financial benefits such as those considered in factors 1 & 2 are weighed against this factor of Overall Affordability and all other factors when determining which option represents best Value for Money.

<sup>68</sup> Assessment Factor 5 overlaps with Assessment Factors 3 and 4. Assessment Factors are therefore not additive.

Supporting Considerations	Description of how Factor is applied at this stage of design development
Business Case and Customers	
1. Time savings 2. Modal shift benefits	Qualitative, not monetised. Benefits to existing users rather than those attracted to developments which is captured in the housing and economic growth Assessment Factor.  High level consideration of estimated overall journey time.  At this stage modal shift assessments are based on a high-level qualitative assessment of the proximity to existing users to capture the ability of the station to attract new local patronage.
1. Wider economic impacts 2. Total potential houses enabled 3. Regeneration	Indicative qualitative assessment using available evidence in advance of modelling. Potential for wider employment and productivity benefits due to improved connectivity. Potential for stations served by EWR to support housing growth. Potential for stations served by EWR to support local regeneration.
1. Up front cost to implement Project 2. Cost risk 3. Programme risk	A quantitative estimate of the cost range appropriate to the design maturity of the options being assessed. A qualitative assessment of cost and programme risks at this stage.
1. Service operating costs e.g. staff, stations, signalling & electrical control centre, rolling stock lease, energy	A qualitative assessment of the scale is used where relevant at this stage of assessment.
1. Whole Life Cost: a) Capital costs b) Operating costs c) Maintenance costs d) Renewal costs e) End of life costs 2. Fare revenue 3. Non-fare revenue 4. Wider / non-EWR costs and incomes 5. Likelihood of obtaining third party funding contribution	Only capital costs are estimated quantitatively at this stage of assessment. The other considerations are considered qualitatively.

	Factor	Definition
Network Capability <sup>69</sup>		
6	Short distance connectivity to support commuting travel into key employment hubs (current and future)	Journey time between housing centres and employment hubs Using generalised journey times (i.e. 'door to door' and including interchanges)
7	Short distance passenger services	Journey time between EWR stations (station to station only)
8	Rail passenger connectivity to existing main lines	Ease of interchange e.g. platform-to-platform distance, level change/accessibility, stopping frequency, timetable alignment
9	Long distance passenger services	Strategic consideration of the extent to which EWR facilitates long distance passenger services beyond Oxford to Cambridge
10	Satisfying existing and future freight demand	Potential to meet freight demand, as anticipated by the freight industry, through active provision for freight paths

<sup>69</sup> Network Capability can overlap with journey time benefits and therefore these Assessment Factors overlap with the transport user benefits assessment factor. Assessment Factors are not additive.

Supporting Considerations	Description of how Factor is applied at this stage of design development
Network Capability <sup>71</sup>	
Trips appropriate to the infrastructure being considered are used e.g. where relevant, for the new railway between Bedford and Cambridge the following are considered:  Cambourne to Milton Keynes Cambourne to Cambridge St Neots South / Tempsford to Milton Keynes St Neots South / Tempsford to Cambridge	
Trips appropriate to the infrastructure being considered are used e.g. where relevant, for the new railway between Bedford and Cambridge the journey time between Bedford and Cambridge is considered	
Trips appropriate to the infrastructure being considered are used e.g. where relevant, for the new railway between Bedford and Cambridge the ease of interchange with ECML is considered	
Trips appropriate to the infrastructure being considered are used e.g. where relevant, for the new or modified railway on the approach to Cambridge the impact of options on the potential for future extension of services east of Cambridge is considered	
1. Travel time 2. No. of paths 3. Waiting time 4. Time of day	Generally this level of detail is not yet developed and modelled at this stage but the capability of the existing network i.e. number of paths is considered where relevant.



	Factor	Definition
Railway Operations		
11	Performance	The ability of the railway to provide a service that meets or exceeds customer expectations
12	Alignment with wider railway strategy / infrastructure	The extent to which the railway takes account of potential future change
13	Safety risk (construction and operation)	The risk (likelihood and consequence) of harm to workforce and public during construction, operations and maintenance

Supporting Considerations	Description of how Factor is applied at this stage of design development
Railway Operations	
1. Maintainability 2. Rolling Stock Reliability 3. Infrastructure Reliability 4. Operational Resilience of EWR service 5. Operational Resilience of Wider Rail Network	Qualitative assessments at this stage. Maintainability – the ease of undertaking routine inspections and maintenance of the infrastructure without affecting service to customers and the frequency of maintenance activities which are likely to affect service to customers Rolling stock reliability – likelihood of failure occurring Infrastructure reliability – likelihood of failure occurring Operational resilience of EWR to unplanned events Operational resilience of Wider Rail Network to unplanned events
1. Technology and customer expectations 2. Wider rail network strategy 3. Climate 4. Passenger demand 5. Freight demand	High level qualitative considerations at this stage. Extent to which the option enables latest and emerging technology, enables new and emerging strategic changes in the rail sector and provides flexibility to adapt to future changes in climate and demand if different to the scenarios used as the basis for design.
1. Safety risk (construction) 2. Safety risk (operations and maintenance)	No options being considered are unsafe. These considerations relate to levels of risk associated with build and operation.  Safety risk (construction) - risk (likelihood and consequence) of harm to workforce and public during construction, based on the expected residual risk in the final design. Safety risk (operations and maintenance) - risk (likelihood and consequence) arising from all in-service hazards, including the unplanned events considered when assessing operational resilience.

	Factor	Definition
Environment		
14	Environmental impacts and opportunities	Impacts on and opportunities to improve local, national and global environment, and local and regional socio-economic conditions not considered in other factors
Local Plans		
15	Consistency with Local Plans	Impacts on and opportunities to support the Local Plans prepared by the Local Planning Authority

Supporting Considerations	Description of how Factor is applied at this stage of design development
Environment	
Early stage assessments (next stages of work would lead to the detail for EIA and TAG business case) against each topic. Environmental Appraisal topics: 1. Agriculture, Forestry and Soils 2. Air Quality 3. Climate 4. Community (including consideration of properties, community and recreational facilities affected and clashes with public rights of way and open spaces) 5. Ecology and biodiversity 6. Electromagnetic interference 7. Equalities 8. Health 9. Historic Environment 10. Land quality 11. Landscape and visual 12. Major accidents and natural disasters 13. Noise and vibration 14. Planning 15. Socio-economics 16. Traffic and transport 17. Waste and materials 18. Water resources and flooding Social Impact topics: 19. Physical activity, health and well being 20. Accessibility 21. Severance 22. Option and Non-Use Values 23. Distributional Impacts 24. Community benefits from station facilities for non-rail passengers	
Local Plans	
Local Plans are considered at this stage of design development	

D. Project Section D Value Management Opportunities

The following value management opportunities have been identified for Project Section D (Clapham Green to The Eversdens). This list is not definitive, as further opportunities may be identified through the consultation process and ongoing design development.

Opportunity	Alignment	Description
A428 Scheme integration	A1, 2 and 9	<p>Alignments 1, 2 and 9 run roughly parallel to the A428 Scheme for approximately 12km. The designs as shown assumed that no integration would be possible due to the more advanced stage of the A428 Scheme.</p> <p>There is an opportunity, by working with Highways England, to modify the design of the A428 scheme to better accommodate the new railway. This opportunity could;</p> <ul style="list-style-type: none"><li>allow the railway to run closer to ground level, particularly in the areas around the A428 junctions, and reduce the volume of earthworks and number / length of structures required for EWR.</li><li>allow EWR to consider moving the railway closer (horizontally) to the road alignment where possible which may have benefits for both construction and reduce overall impacts of the Project.</li><li>allow integration of the construction programme for both schemes, to be more efficient and minimise the overall period of time for which residents are affected by construction.</li><li>create efficiencies arising from joint arrangements to divert underground and overhead utility services</li></ul>

Potential impact

Benefits could include:

- Reduced up front and maintenance costs (capital cost and overall affordability).
- Reduced construction programme due to reduced number and length of structures and volume of fill import.
- Improved construction safety if the A428 Improvement Scheme is not open during the construction of EWR features that interface with it (safety risk)
- Reduced disruption to local transport networks
- Reduction in the land required to construct the schemeProject due to a smaller footprint of earthworks and structures
- Reduction in some environmental impacts due to being closer to ground level and requiring fewer structures and less earthworks (visual impact, noise, embodied carbon)
- Opportunity to combine landscaping and other environmental mitigation measures.

Disbenefits might include:

- risks to the programme for development and construction of the A428 Improvement SchemeBlack Cat to Caxton Gibbet scheme
- risk of works being undertaken by Highways England which might subsequently need to be modified or replaced by EWR Co.
- Increased localised environmental impacts arising from the cumulative impact of the road and the railway.

From the work undertaken, it is considered likely that this opportunity would change the Assessment Factorassessment factor ratings on the affected alignments; however, this work is underway and has not been completed.

Opportunity	Alignment	Description
A428 crossing east of Cambourne	Cambourne North: A1, 3, 5, 7, 9	Alignments could cross under the existing A428 instead of over. This could reduce the earthworks fill import required for Cambourne North options, improve the highway diversion design of B1046 Comberton Road and reduce the length of 1.25% gradient for the railway which could affect train performance.
Barford Road Crossing	St Neots: A1, 2, 3, 4, 5, 6	<p>Realign Barford Road to allow the railway alignment to be lowered.</p> <p>This could potentially reduce the length of viaduct but could increase the volume of earthworks fill required.</p> <p>Lowering the alignment could also reduce the visual impact, although the road would need to be realigned which would disrupt local road networks to some extent during construction.</p>

Potential impact
<p>This could:</p> <ul style="list-style-type: none"><li>• Reduce up front and maintenance costs (capital cost and overall affordability).</li><li>• Reduce construction programme due to reduced fill import. However, the new crossing under the existing A428 could require closure of the A428, or traffic management, which may increase programme risk (Programme risk sub factor under capital cost)</li><li>• Improve construction safety (safety risk)</li></ul> <p>At this stage it is uncertain whether this opportunity would change the assessment factor ratings on any alignments.</p>
<p>This could:</p> <ul style="list-style-type: none"><li>• Reduce up-front costs (capital cost)</li><li>• Improve construction safety (safety risk)</li><li>• Reduce visual impacts and climate considerations. There may be negative traffic and transport/ severance impacts depending on the Barford Road realignment (Environment and Society)</li></ul> <p>At this stage it is uncertain whether this opportunity would change the assessment factor ratings on any alignments affected.</p>

Opportunity	Factor	Description
Tempsford horizontal	Tempsford (non A428):	Alignment 7 and 8 could follow Alignment 9 at the ECML crossing before curving to follow the Alignment 5/6 alignment.
	A7 and 8	This could reduce the fill import required, reduce utility impacts and reduce length in SSSI IRZ.
Tempsford horizontal	Tempsford: A7, 8 and 9	<p>Alignment 7, 8 and 9 could follow the St Neots alignments to the North of Ravensden before curving South, to the west of the ECML, to provide a station at Tempsford.</p> <p>This could reduce the fill import and length of viaduct, but the total alignment length could increase.</p> <p>The associated environmental impacts would need to be assessed to evaluate this opportunity.</p>
Tempsford vertical	Tempsford: A7, 8 and 9	<p>Barford Road and Birchfield Road could be realigned over EWR.</p> <p>This would enable the alignment to be lowered to shorten/ remove Birchfield Road viaduct. The alignment could also be lowered to increase the volume of cut material. The passing loop may need to be relocated to the east but this would be comparable to the location on St Neots options.</p>

Potential impact
<p>This could:</p> <ul style="list-style-type: none"><li>• Reduce up-front costs, but if curvature is increased it could increase maintenance costs (capital cost and overall affordability)</li><li>• Improve construction safety. However, the complexity of the ECML crossing on A8 and 7 would increase as it would be more skewed (safety risk)</li><li>• Reduce construction programme due to reduced fill import. (Programme risk sub factor under capital cost)</li><li>• Reduce ecology and biodiversity impacts and climate considerations (Environment and Society)</li></ul> <p>At this stage it is uncertain whether this opportunity would change the Assessment Factor ratings on any Alignments affected.</p>
<p>This could:</p> <ul style="list-style-type: none"><li>• Reduce up-front costs due to a reduction in fill import and viaduct length. There could be an increase in overall length however (capital cost)</li><li>• Improve construction safety (safety risk)</li><li>• Reduce construction programme due to reduced fill import and viaduct length. Any increase in length would be negative for this aspect (Programme risk sub factor under capital cost).</li><li>• There could be a journey time increase if the alignment length increases (transport user benefits)</li></ul> <p>At this stage it is uncertain whether this opportunity would change the Assessment Factor ratings on any alignments affected.</p>
<p>This could:</p> <ul style="list-style-type: none"><li>• Reduce up-front costs (capital cost)</li><li>• Improve construction safety (safety risk)</li><li>• Reduce construction programme due to reduced fill import and viaduct length. Any increase in length would be negative for this aspect (Programme risk sub factor under capital cost).</li><li>• Reduce visual impacts and climate considerations. There may be negative traffic and transport/ severance impacts depending on the road realignments (Environment and Society)</li></ul> <p>At this stage it is uncertain whether this opportunity would change the Assessment Factor ratings on any alignments affected.</p>

Opportunity	Factor	Description
Flood modelling	All	Flood modelling to identify opportunities to reduce viaduct extents in flood plain. This could reduce the length of viaducts but could increase the fill import requirement.
Track vertical approach at highways	All	The vertical alignment of EWR has been designed to have minimum impact on HE strategic routes with the rail generally going over highways. Opportunity to review whether changes to the roads alongside refinement of the rail vertical alignment could provide cost savings.
Highway crossings	All	Rationalising highway/PRoW network to provide perpendicular crossings and combine crossings where appropriate. This could reduce the number, and the length, of structures.

Potential impact
<p>This could:</p> <ul style="list-style-type: none"><li>• Reduce up-front costs (capital cost)</li><li>• Improve construction safety (safety risk)</li><li>• A decrease in structures such as viaducts would reduce carbon emissions.</li><li>• There may be negative impacts for water resources and flooding if engineering works encroach in to a floodplain (Environment and Society)</li></ul> <p>At this stage it is uncertain whether this opportunity would change the assessment factor ratings on any alignments.</p>
<p>This could:</p> <ul style="list-style-type: none"><li>• Reduce up-front costs (capital cost)</li><li>• Improve construction safety (safety risk)</li><li>• Reduce visual impacts and climate considerations. There may be negative traffic and transport/ severance impacts depending on the road realignment (Environment and Society)</li></ul> <p>At this stage it is uncertain whether this opportunity would change the Assessment Factorassessment factor ratings on any alignments.</p>
<p>This could:</p> <ul style="list-style-type: none"><li>• Reduce up-front costs (capital cost)</li><li>• Improve construction safety (safety risk)</li><li>• There may be negative traffic and transport/ severance impacts. However, fewer/ a shorter total length of structures would provide climate benefits. (Environment and Society)</li></ul> <p>At this stage it is uncertain whether this opportunity would change the assessment factor ratings on any alignments.</p>

## E. Project Section D Assessment Factor Tables

These tables can be accessed separately on the East West Rail website at <https://eastwestrail.co.uk/consultation/document-library>

## F. Assessment of Route to Approach Cambridge Station from the North

### 1. Introduction

#### 1.1. Executive summary

- 1.1.1. This appendix reviews the potential for EWR to approach Cambridge using a northern alignment between Cambourne and Cambridge via Milton. EWR Co has considered this route in order to verify the decision taken to prefer Route Option E, which approaches Cambridge from the south. This is necessary because route alignments in Section E might serve a station to the north of Cambourne. Such a station could be broadly equidistant by rail from Cambridge station, serving which is an objective for EWR. This appendix considers whether a northern route into Cambridge could satisfy the objectives for the EWR project and the extent to which a northern route compares with the southern alignments considered in Section E, F and G of the Technical Report.
- 1.1.2. The approach to considering this that EWR Co has taken is first to consider if a change in circumstances that could affect the decision not to prioritise northern routes into Cambridge has taken place. It has concluded that routeing via a Cambourne North station is such a change. It has then looked at other new and more detailed factual information available to it in order to establish if the decision would be different had that information been known at the time. To do this, EWR Co has considered a northern route from Cambourne North.
- 1.1.3. The selection of a preferred route option in 2020 following the previous public consultation was based on an assessment of how the various options performed against a combination of fifteen Assessment Factors, which included transport user benefits as well as capital and operating costs, and against the overall programme objectives for EWR. The decision to enter Cambridge from the south was based on engineering, operational, economic, and environmental reasons. This appendix considers how a route approaching Cambridge from the north would perform in relation to the same topics.
- 1.1.4. In engineering terms, a northern route from Cambourne to Cambridge is feasible, although it would be complex and expensive to consent, construct and operate. A northern route would cross the newly upgraded A14 trunk

road to the west of Girton, which at this location is an eight-lane dual carriageway. This would therefore require a substantial bridge structure. The prevailing low-lying land levels mean that this structure would be a prominent feature in the surrounding landscape.

- 1.1.5. An additional station could be provided to the near Oakington, south-east of Northstowe, but this area is low-lying and forms part of a floodplain so the station and its approaches would necessarily be elevated. A junction with the existing West Anglia Main Line (WAML) would be located north of Milton and this too sits in a floodplain. This location was also granted outline planning permission for the proposed Cambridge Sports lake.
- 1.1.6. The route into Cambridge would be via the WAML, a two-track line which would need to be upgraded to a four-track line to accommodate the additional EWR services. The WAML corridor between Milton and Cambridge is much more constrained than a southern approach with properties against the railway boundary and multiple highway crossings with adjacent properties. This would necessarily require demolition of residential and commercial property and the widening or replacement of several substantial structures, including the A14 bridge at Milton, and a new bridge over the River Cam. Cambridge North station would also need to be modified to accommodate the additional lines. In addition, the road bridges carrying the A1303 Newmarket Road, Coldhams Lane and Mill Road in Cambridge would all need to be replaced and widened to accommodate the extra tracks.
- 1.1.7. Economically and operationally, a northern approach to Cambridge does not provide the same level of benefits as a southern approach and is less able to satisfy the overall objectives of EWR. In comparison with services entering Cambridge from the south, which in all our assessments are assumed to call at the new Cambridge South station that is being developed to serve the heart of Cambridge's internationally significant Life Sciences cluster in the south of the city en route, the Northern approach would be slower and more complicated. This is because, using assumptions common to both scenarios, if the EWR services entered Cambridge from the north they would need to pass through Cambridge station in order to then turn back at the new Cambridge South station, which would need to be modified.
- 1.1.8. Furthermore, services on a northern approach utilising the EWR lines to travel further east to Norwich and Ipswich could not do so without reversing manoeuvres at Cambridge station and without the construction of further infrastructure to enable these onward journeys. This would add time to journeys and increase operational complexity. To travel eastwards from the north, without calling at Cambridge station and therefore avoiding the reversing move, a new railway chord would need to be constructed at Coldham's Common or Ely. This would not meet the Project Objectives as Cambridge station would not be called at. However, future freight on the Newmarket Line could use the chord to avoid Cambridge station. Furthermore, although the length of railway for a northern route and



southern alignments is similar (the northern route is approximately 600m longer) journeys approaching Cambridge station from the north would take longer due to any extra time spent at a stop the new Oakington station. for Northstowe station. If this intermediate station is omitted, then journey times would be approximately the same as for services approaching from the south.

- 1.1.9. In terms of service provision and the benefits of unlocking housing development, the additional benefits of a station at Oakington are small given the guided busway already serves this area, including the new settlement at Northstowe, with a frequent service to Cambridge (every 10 minutes to the city centre). The growth of housing in this area is not dependent upon EWR as planning permission has already been granted and there is limited potential for additional housing land to come forward for development.
- 1.1.10. Although stopping at Cambridge North would connect existing and planned employment sites and housing to the route, a northern approach forgoes the opportunity to directly connect the new Cambridge South station, and planned growth around it, to the route with fast, reliable east-west public transport. A southern approach is better aligned with the local and national economic and strategic ambition to support Cambridge's internationally significant Life Sciences cluster. In addition, it would be possible for services approaching Cambridge from the south to continue beyond Cambridge station and serve Cambridge North if required.
- 1.1.11. A qualitative assessment of capital costs for a northern route has been completed and the extent and complexity of the structures, poor/wet ground conditions between Oakington and Milton, loss of residential and business properties, and modifications to the railway and existing stations are expected to make this solution more expensive than the southern alignments proposed by EWR Co given that the alignment lengths are similar for each approach.
- 1.1.12. The considerations above relate primarily to engineering, operations and economics.
- 1.1.13. The route that EWR Co has considered is not designed to the same level of detail as the southern alignments. However, the design level is sufficient to enable a comparison to be made. That design is also sufficient for high level environmental comparisons to be made.
- 1.1.14. This appendix demonstrates that an alignment approaching Cambridge from the north remains less attractive than a southern approach into the city, reinforcing the previous conclusion that a southern approach to Cambridge should be preferred and the case for the proposals described in Chapters 9, 10 and 11 of this Technical Report.

## 1.2. Overview

- 1.2.1. In developing designs for the new length of railway between Bedford and Cambridge, EWR Co has been following an iterative development process. This has entailed the progressive selection of a Preferred Route Corridor followed by the selection of a more detailed Preferred Route Option within that Corridor. The next stage of design development will be to identify a Preferred Route Alignment, which will then be used to take forward detailed design work on EWR Co's final proposals for the Project. This process is described in Chapter 5 of this Technical Report and next steps are described in Chapter 12.
- 1.2.2. The Preferred Route Corridor, running via the broad area around Sandy, was selected by Network Rail in 2016 and is shown on Figure 1.

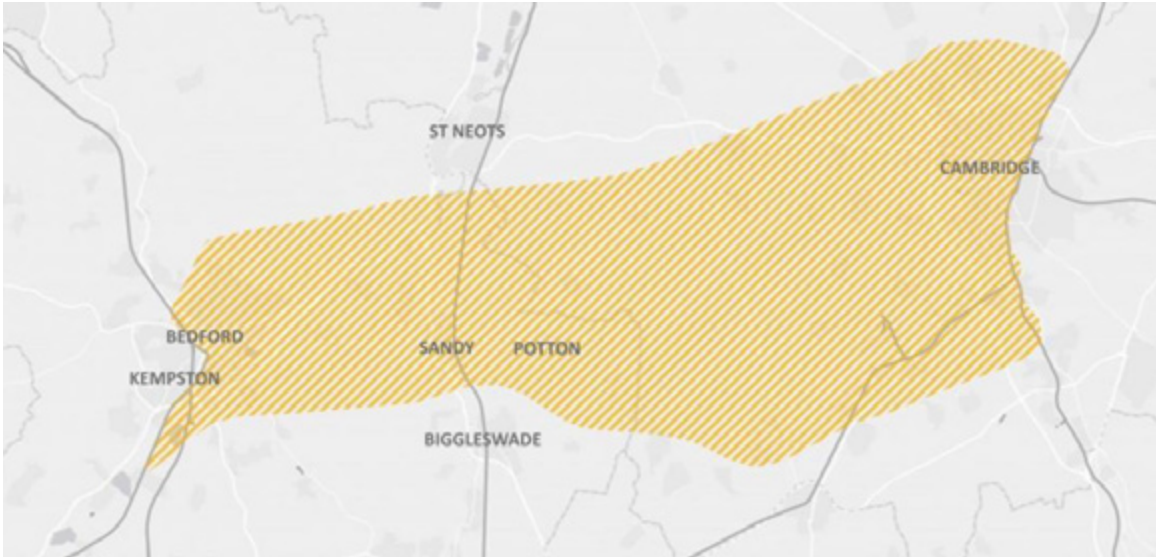


Figure 1:  
Preferred  
Route Corridor

- 1.2.3. 'Route Options' were then developed within the Preferred Route Corridor. As part of this process, Network Rail and EWR Co considered how the three different potential approaches to Cambridge – from the north, west and south – compared and how they performed when considered against the Strategic Objectives for the Project. It was concluded that an approach into Cambridge from the south should be preferred and a final shortlist of Route Options was prepared on this basis. This is what was reported in the consultation document and technical report that supported the 2019 consultation.
- 1.2.4. Using the Strategic Objectives for EWR and the set of route selection Assessment Factors agreed with the Department for Transport (DfT), five potential Route Options were shortlisted in EWR Co's initial non-statutory consultation between January and March 2019. Two of these – Route Options B and E – would have served Cambourne and an indicative station location was provided on the south side of the town near Caxton.



- 1.2.5. The Technical Report supporting the 2019 consultation also set out the reasons why approaches to Cambridge from the north and west had been previously ruled out by Network Rail and respondents were invited to give their views on whether they agreed that EWR Co was right to prioritise Route Options that approached Cambridge from the south. options that approached Cambridge from the south.
- 1.2.6. After taking this feedback into account, EWR Co concluded that the decision to prefer an approach to Cambridge from the south remained sound. The reasons for this were:
- Adverse impacts on existing local transport connectivity if EWR were to use the route of the guided busway to reach Cambridge;
  - Additional tracks being required for a longer section of the West Anglia Main Line (WAML) if EWR were to approach Cambridge from the north, whereas some of the additional tracks south of Cambridge are likely to be required anyway to provide capacity for the proposed new Cambridge South station;
  - Additional route length if EWR were to approach Cambridge from the north would lead to higher costs and lower passenger benefits with longer journey times;
  - Requiring a reversing move at Cambridge station for any onward journeys to/from Ipswich and to/from Norwich if services to and from locations further east were to serve Cambridge rather than bypass the city; and
  - Whilst there would be potentially better connectivity to economic and employment opportunities near Cambridge North station, this would be at the cost of not being able to directly support the planned biomedical campus and wider economic growth opportunities around the proposed Cambridge South station.
- 1.2.7. Environmental considerations also affected this conclusion:
- It was concluded that there are a considerable number of significant environmental features in the area along the route, with potential impacts on the village of Oakington, loss of open green space, flood risk, and the Air Quality Management Area associated with the A14; and
  - At least a similar level of effort was therefore likely to be required to mitigate the effects of the presence of multiple environmental features compared to route options that approach Cambridge from the south.
- 1.2.8. As set out above, this analysis was undertaken on the basis of an indicative station location south of Cambourne as this would have reduced the need to cross the A428 to the west of Cambourne to reach a station location to the north of Cambourne.
- 1.2.9. Since the Preferred Route Option – Route Option E – was announced in January 2020 – following EWR Co’s recommendation that was based on additional work it had undertaken in response to consultees’ comments – EWR Co has developed and analysed a number of potential Route Alignments. Details of this process and the options considered are set out in the main part of this Technical Report.
- 1.2.10. As part of the Route Alignment Option development process, EWR Co has examined the potential performance of alignments following the route of the A428 Improvement Scheme being promoted by Highways England between Black Cat and Caxton Gibbet. The preferred alignment for the A428



Figure 2: Preferred Route Option

- Improvement Scheme had not been announced when the Preferred Route Corridor was selected, or the Route Options were being developed.
- 1.2.11. The preferred alignment for the A428 Improvement Scheme was confirmed by Highways England in February 2019 – part way through EWR Co’s 2019 consultation on the Route Options – and differed from the options that Highways England had previously published. The preferred alignment selected for the A428 Improvement Scheme is largely located on land just to the north of the Preferred Route Corridor for EWR, which was the most northerly option consulted upon. As a result, this land also lies outside all five of the short-listed Route Option areas included in EWR Co’s 2019 consultation.
- 1.2.12. In light of the new information from Highways England and following comments received from respondents during the 2019 consultation regarding the A428 Improvement Scheme, EWR Co has considered how potential alignments in this area might perform compared to alignments wholly within the Preferred Route Option area.
- 1.2.13. Moreover, if an alignment that runs to the north of the A428 Improvement Scheme is selected, this would remove the need for at least one of the potential crossings of the A428 Improvement Scheme required in order to serve a station located north of Cambourne. As a result – and following stakeholder feedback – EWR Co has considered potential station locations to the north and to the south of the town, both of which would remain proximate to the Preferred Route Option area.
- 1.2.14. This also had the potential to reduce the additional route length required in order to approach Cambridge from the north, which might lead a reduction in costs and higher assessed passenger benefits due to reduction in journey times.
- 1.2.15. Consequently, EWR Co has continued to consider whether this new information represents a change of circumstances that might require the previous decision to prefer a southern approach to Cambridge to be reconsidered. This Appendix sets out updated information for that analysis and whether there is any resultant change to EWR Co’s previous conclusions.

2. Options considered

2.1. Overview

The potential route approaching Cambridge from the north can be considered as two main sections:

- A new section of railway between a station north of Cambourne and the new junction with the WAML near Milton – Section NA1; and
- A section of the existing WAML from the new junction to Cambridge station, the terminus station for Connection Stage 3 – Section NA2.

- 2.1.1. Section NA1 would diverge from the Route Alignments 1 and 9 at Cambourne North Station (described in Chapter 9 of the Technical Report). It would then swing onto a north-easterly route, crossing the A14 on a bridge between Bar Hill and Girton Junction (where the A14 connects to the M11). Some 2.75km further to the northeast, a new station could be provided close to the existing village of Oakington. A station in that location would be about 3.6km from the existing settlement of Northstowe and could theoretically serve that location and other existing settlements nearby. The route would then swing to the east, crossing over the Cambridgeshire guided busway on a viaduct structure and diverting Cottenham Road on a bridge to go over the railway. It would then cross the A10 on a bridge before swinging south to join the WAML.
- 2.1.2. For Section NA2, if the new railway was to approach Cambridge from the north, the best performing of these approaches would be a route that joins the WAML between Milton and Waterbeach.
- 2.1.3. Owing to constraints imposed by existing communities and properties, it is difficult to provide different – or differently performing – routes that serve the same locations. Other routes would be longer, which would be more likely to increase cost and journey time, or approach through built up areas, meaning greater impacts would result.
- 2.1.4. The northern route that has been assessed is broadly similar to the proposals put forward by a local interest group, CamBedRailRoad (CBRR), before and during EWR Co’s 2019 Consultation. CBRR’s proposal also identified the possibility of a station at Oakington for Northstowe.

2.1.5. The CBRR proposal also includes:

- A connecting line (referred to as a ‘chord’) at the new Milton Junction which would allow trains from the Cambourne direction to head north along the WAML without servicing Cambridge North or Cambridge stations (and vice versa)
- A chord across Coldham’s Common to allow trains from Cambridge North to join the existing line to Ipswich without servicing Cambridge station.
- More recently, a chord near Ely to allow trains to pass between the WAML and the Ely to Bury line – these trains would not serve Cambridge, Cambridge North or Ely en route.

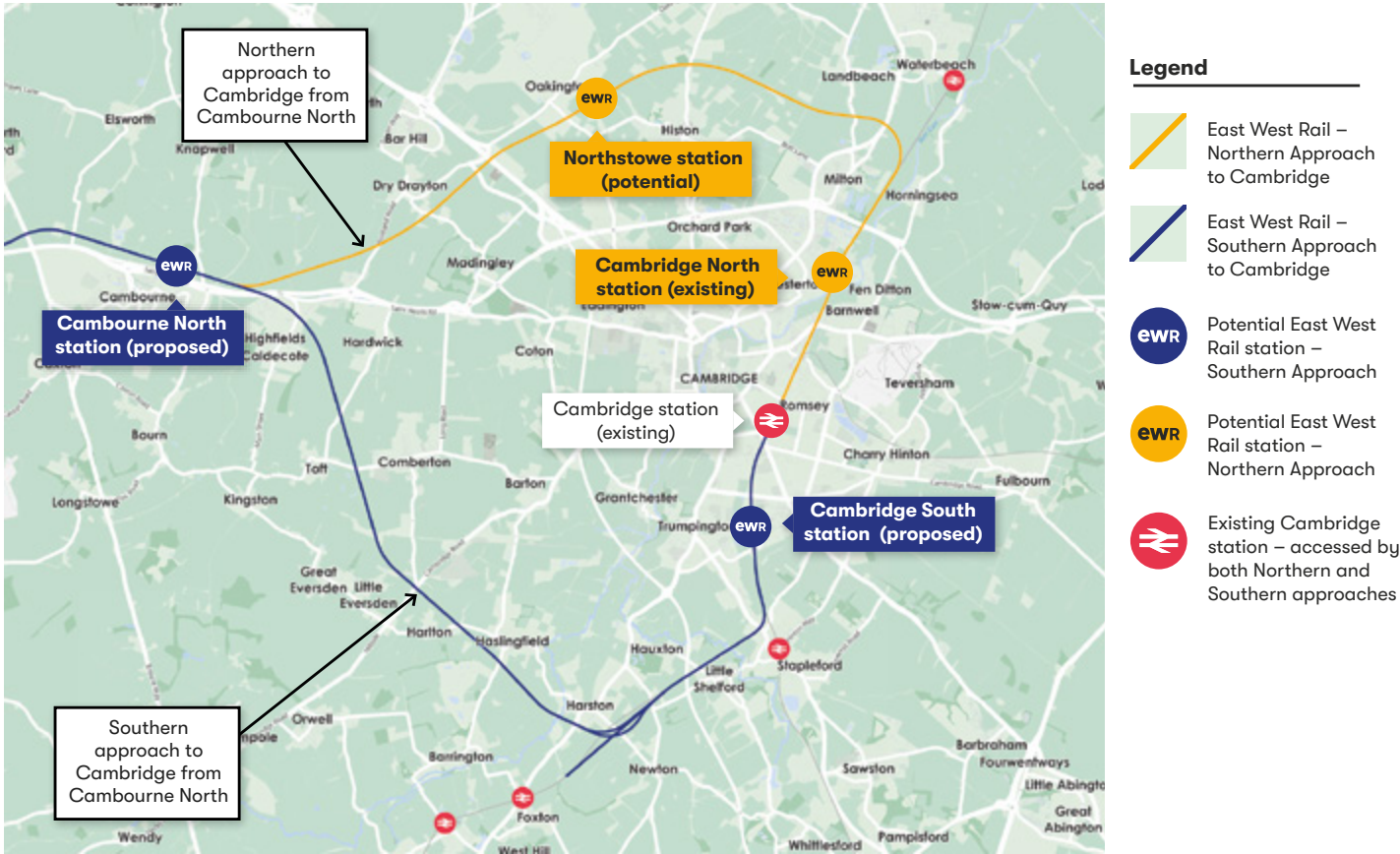


Figure 3: Map of northern and southern approaches to Cambridge

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## **2.2. Railway operations**

### **Introduction**

2.2.1. Section NA1 does not currently exist and would be a completely new-build railway. As such, it would not have any interfaces with the existing railway, similar to the Sections D and E alignments described in Chapters 9 and 10 of this Report. Consequently, the operational performance of Section NA2 is assessed below in order to enable comparisons to be drawn with Section F described in Chapter 11 of the Report.

### **Section NA2 - capacity on the existing railway network**

2.2.2. An operational assessment has been completed in order to understand the current utilisation of the WAML and to identify whether there is sufficient spare capacity to accommodate the additional EWR services on Section NA2. This also includes acceptable spare capacity for resilience of the service and future services. The purpose of this assessment is to determine whether the new EWR services can run on the existing twin-track WAML line from the new Milton Junction, through Cambridge North station, and reach Cambridge station using the infrastructure as it is laid out today, or whether additional tracks are required in order to meet the Project Objectives.

2.2.3. The first stage of the analysis was to understand the existing timetable and check if the EWR services could be added. This check was conducted using the December 2019 off-peak timetable because this pattern of services is broadly consistent for most of the day.

2.2.4. The results of this analysis showed that there would be several conflicting movements between EWR and other services. These would include:

- Trains toward Ely and eastbound EWR services conflicting where EWR services join the WAML; and
- Conflicts on various platforms at Cambridge station.

2.2.5. The analysis demonstrated that the existing twin-track railway does not have sufficient capacity to accommodate the additional EWR services specified in the Project Objectives. This is because the new EWR services would conflict with the services already provided by the existing train operators. In addition, as described above, this analysis was carried out on the basis of the off-peak timetable. At peak hours, a greater number of existing services operate, which means that capacity would be constrained even further.

2.2.6. Therefore, in order to run the extra EWR services it would be necessary to alter the existing infrastructure on the WAML by building new tracks. This would then provide the additional capacity needed to allow the new EWR services to operate without conflicting with the existing services.

2.2.7. There are two potential options:

- Adding one extra track to the WAML to provide a three-track railway; and
- Adding two extra tracks to provide a four-track railway.

2.2.8. In order to determine which of these options are feasible, EWR Co has carried out a second stage assessment in order to confirm whether sufficient capacity would be created in each case in order to run the additional EWR services specified in the Project Objectives. This involves testing a possible timetable solution and assumes that an additional two platforms will be provided at both Cambridge North and Cambridge stations.

2.2.9. The analysis demonstrated that the three-track option would not provide sufficient additional capacity to accommodate the additional EWR service specified in the Project Objectives.

2.2.10. The only remaining option that would deliver the Project Objectives if trains approach Cambridge from the north would be:

- To add two extra tracks to the WAML, making it a four-track railway between the new Milton Junction and Cambridge station; and
- To build two additional platforms at both Cambridge North and Cambridge stations.

2.2.11. An approach to Cambridge from the North would not necessarily preclude the extension of EWR through services to the north and east of Cambridge in the future, however because services heading in these directions depart from the north end of the station, this operation could only be enabled by imposing a reversing move on the trains. This would see EWR services approach the Cambridge platforms from the north and then “change ends” to depart towards the north.

2.2.12. This reversing move would, effectively, double the number of EWR services on tracks north of Cambridge. To avoid conflicts with existing services, this would also require the EWR services to approach and depart from Cambridge on the eastern side. This would mean that a grade-separated junction is required where the EWR route joins the WAML in order that the EWR lines could sit to the east of the existing route. Two chords would also be required on Coldham’s Common and at Ely to create additional capacity and avoid conflicts with existing services.

2.2.13. Operationally, reversing moves at Cambridge could generate the need for additional drivers and trains due to the additional time required to carry out the activity. This would increase journey times for passengers passing through Cambridge en-route. Furthermore, the infrastructure works to approach Cambridge from the north would also generate additional cost in comparison to the southern approach to Cambridge.

- 2.2.14. The reversing move could be avoided if the EWR services from the north turned east before reaching Cambridge, however this approach would not satisfy the Project Objective of providing a service into Cambridge station on such services.

### **2.3. Economic impact**

- 2.3.1. Our approach to analysing future benefits of EWR suggests that additional transport user benefits from a northern approach option would be small when considering the added overall journey time that an additional stop at Oakington for Northstowe would entail, and the fact that the Northstowe area is already well-served by the Cambridgeshire guided busway.
- 2.3.2. Although stopping at Cambridge North would connect existing and planned employment sites and housing to the route; a northern approach forgoes the opportunity to directly connect the new Cambridge South station, and planned growth around it, to the route with fast, reliable east-west public transport unless extensive additional infrastructure is provided. A southern approach is better aligned with the local and national economic and strategic ambition to support Cambridge's internationally significant Life Sciences cluster.

#### **Transport user benefits**

- 2.3.3. East West Rail will aim to generate fast, frequent and more reliable journeys for travel at stations along the route with either of the southern and northern approach options notwithstanding the differences between the options – deliverability terms mentioned elsewhere in this document.
- 2.3.4. The southern approach option is assumed to call at the planned Cambridge South station on the WAML after leaving Cambourne, before terminating at Cambridge, ready for the return leg. The northern option would call at a new station at Oakington for Northstowe, then Cambridge North, before terminating at Cambridge. It's expected that calling at Oakington would generate some additional demand for the service but would also add between two and three minutes in journey times for other passengers already using the route.
- 2.3.5. While improving the transport connectivity between Northstowe and Cambridge North to Bedford, Bletchley and further afield, the service offer in a northern approach scenario is not a substantial improvement on the existing connectivity – as Cambridge North is already served by Greater Anglia services on the Fen Line, and Northstowe by guided busway services providing connections every twenty minutes to Cambridge North station and every ten minutes into the centre of Cambridge. Taking a northern approach also worsens the connectivity of towns like Bedford, Tempsford/St. Neots and Cambourne to new employment opportunities in the developing region of Cambridge surrounding Cambridge South station (see sub-section below on wider economic benefits).

- 2.3.6. While taking a northern approach offers the opportunity to pass through Cambridge and terminate at Cambridge South station, this option adds a significant increase in journey times to Cambridge South compared to approaching Cambridge from the south, and would trigger additional infrastructure spend on turn-backs at Cambridge South. Moreover, the northern approach would also severely limit the viability of an East West Rail extension eastwards to Norwich and Ipswich as time consuming reversing manoeuvres would then be required, passing through Cambridge station again and Cambridge North station for Norwich services.
- 2.3.7. Previous analysis indicates that approaching Cambridge from the north offered no substantial improvement in journey time benefits over the southern approach and removes the opportunity to cater to the expanding employment opportunities at Cambridge South. The option is likely to be more expensive, harder to deliver and present more operational risks.

#### **Wider economic benefits and housing**

- 2.3.8. A key strategic objective of EWR is to enable economic growth and housing growth across the OxCam Arc.
- 2.3.9. Cambridge's role as a major regional centre and international hub for skilled employment, high growth companies and world-class research makes the decision of how EWR provides connectivity to the Cambridge area a critical one. Our analysis indicates the additional wider economic benefits could be greater by serving the south of Cambridge than the north. This is mainly because of its ability to connect more people with areas of job growth – enhancing connectivity between the growing Life Sciences cluster centred around the Biomedical campus and Addenbrooke hospital and Cambourne, the ECML station on EWR, Bedford and beyond which all have potential for significant housing growth in future.
- 2.3.10. Whilst still at an early stage of development, evidence from the Greater Cambridge Local Plan suggests that potential housing and employment growth is possible in multiple areas including the city's north eastern and southern fringes among other areas. There is no clear preference at this stage for concentrated growth in a single area and the potential of the southern fringe of the city, already an international centre of excellence for patient care, biomedical research and healthcare education, has long been recognised as having potential to expand. Greater Cambridge is home to an internationally significant Life Sciences cluster, competitive among other world-leading regional clusters in North America and Europe. Cambridge South lies at the heart of this cluster and East West Rail's role in supporting the cluster's future growth was recognised by central Government in its Life Sciences Sector Deal in 2018.

- 2.3.11. A northern approach to Cambridge forgoes the opportunity to provide this employment hub at the south with fast, reliable east-west public transport. Instead it would serve current and planned employment sites at Cambridge's north eastern fringe, and the housing growth area at Northstowe. As mentioned already, Cambridge's north eastern fringe and Northstowe are relatively well served by the existing road network and the guided busway. In a northern approach, onward connectivity to Cambridge South would be slower, and also less reliable without additional infrastructure investment, making the south a less attractive destination by public transport, thereby potentially increasing pressure on the road network.
- 2.3.12. England's Economic Heartland (EEH) Regional Transport Strategy, published in February 2021, states its support for EWR to develop proposals at several locations including Cambridge and Cambridge South.
- 2.3.13. EEH's Regional Transport Strategy identifies several key Economic Asset sites to the south of Cambridge including Cambridge South and Babraham. Babraham is a site that the proposed Cambridge South East Transport project would serve as well as Cambridge South station. This is a good example of multimodal transport where the railway can support longer distance journeys whilst busways can deliver people directly to their final destination.
- 2.3.14. EEH highlights places of economic growth and that it is key that homes are linked to jobs through sustainable transport solutions.



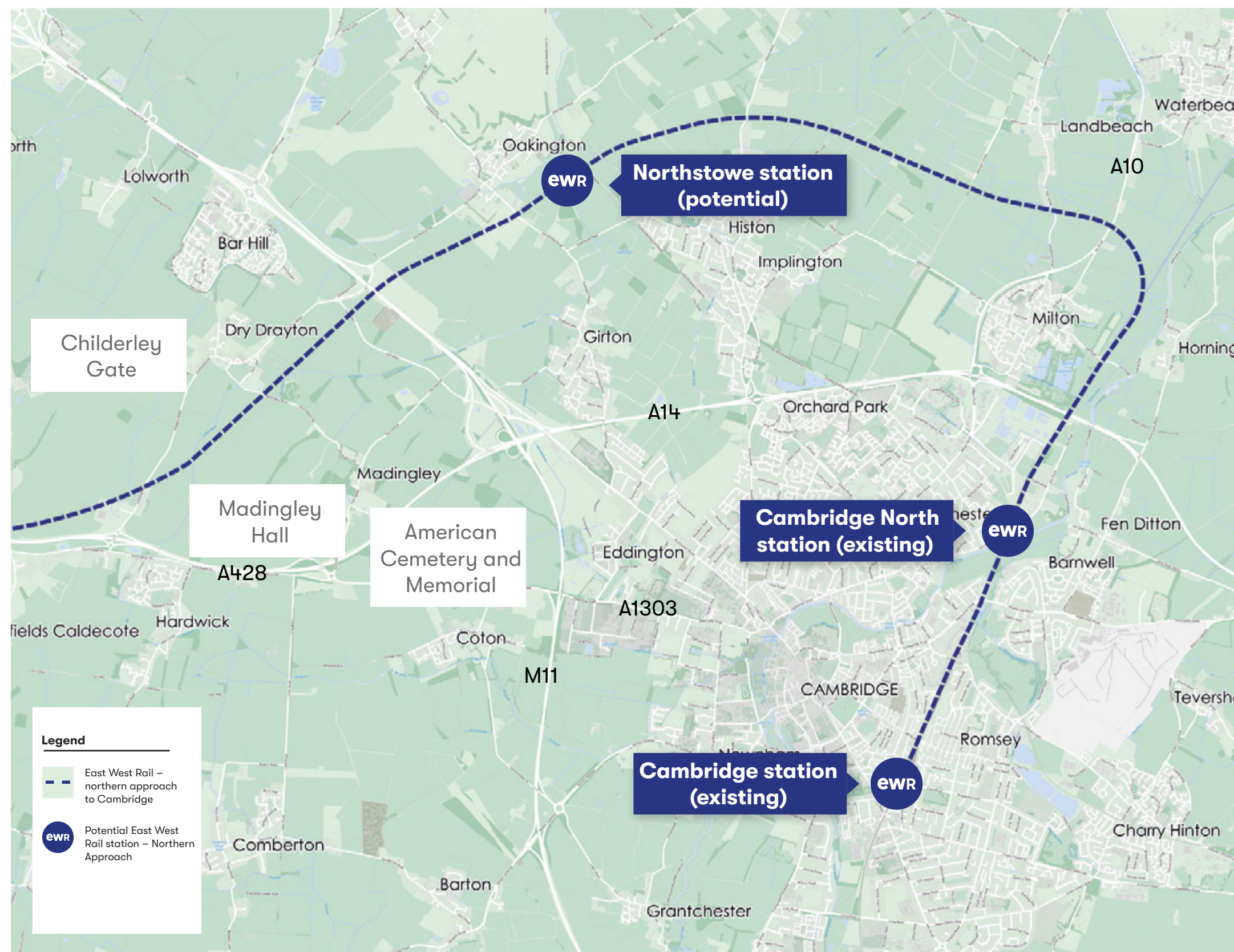


Figure 4: Map of Northern Approach to Cambridge

## 2.4. Environment

### Overview

- 2.4.1. EWR Co has carried out a high level appraisal of the environmental impacts and opportunities associated with a northern approach to Cambridge.
- 2.4.2. Consideration has been given to the potential for interactions with important designated sites. In common with the southern approaches to Cambridge, there is a relatively remote potential for interactions with the Fenland SAC, Portholme SAC and the Ouse Washes SAC, SPA and Ramsar site. Therefore, consideration of these interactions is not likely to assist in distinguishing between northern and southern approaches to Cambridge.
- 2.4.3. However, a northern approach to Cambridge is less likely to interact with bat populations associated with the Wimpole and Eversden Woods SAC. Nevertheless, EWR Co considers that such interactions as may occur are likely to be capable of being mitigated. Therefore, it is expected that the interaction with the northern approach would not be likely to perform materially better than the southern approach. EWR Co currently expects the southern approach to require an assessment under the Conservation of Habitats and Species Regulations 2017 prior to any decision to grant a DCO and/or to proceed with the scheme.
- 2.4.4. The appraisal of other environmental topics continues to indicate that the southern approach is preferable from an environmental perspective and this is predominantly due to the predicted number of demolitions that would be required. There are approximately 40 residential and commercial properties that would be likely to require demolition for the northern approach as opposed to 5 for the southern approach. It is not expected that a more detailed environmental appraisal would alter this view. However, EWR Co has carried out a high level qualitative comparison, sufficient for checking the previous decision to favour a southern approach. This includes consideration of potential for impacts to priority habitats, the historic environment and

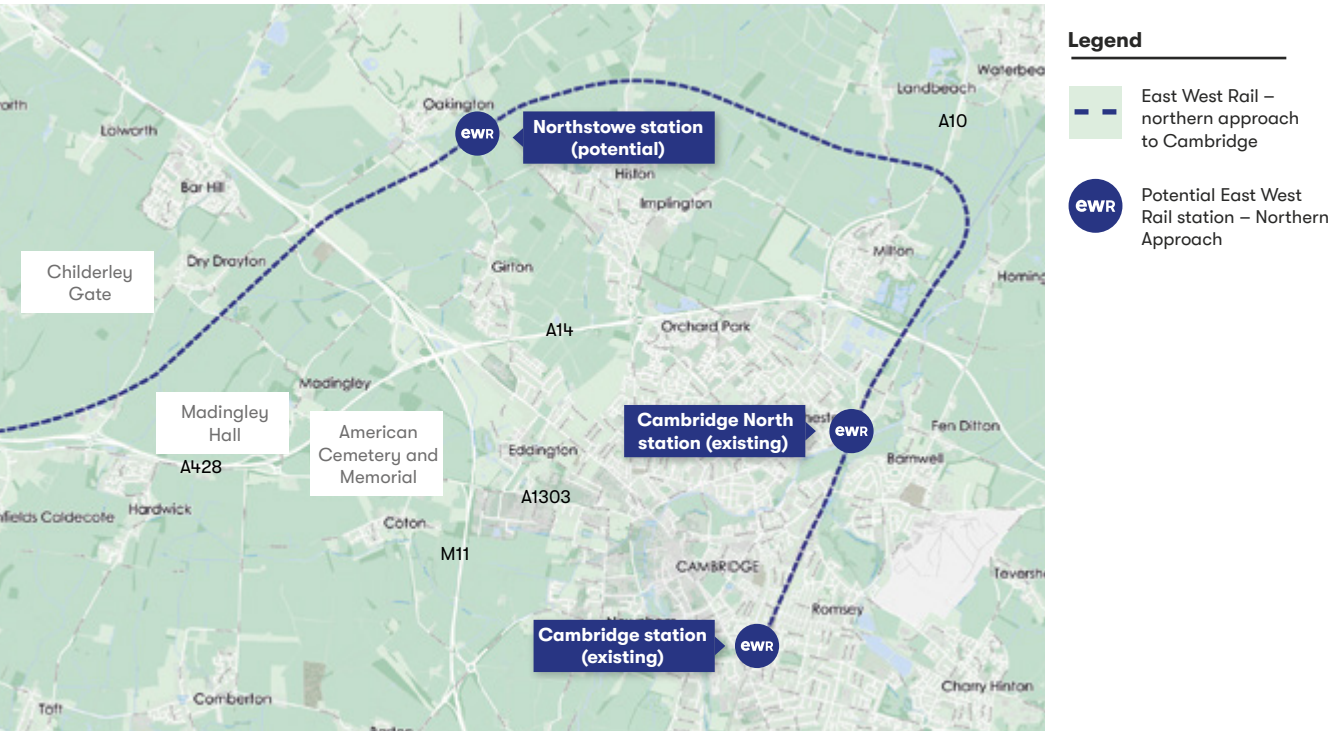


water resources. Also, due to the general topography of the area and the need to cross both roads and flood zones in this area, the railway is expected to be elevated in locations, for example on viaducts or embankments, which would be likely to result in visual impacts.

**Section NA1 – Cambourne North to the WAML between Milton and Waterbeach**

2.4.5. This section is approximately 18km long.

2.4.6. Figure 4 shows the key environmental assets in the area between Cambourne North station and the connection to the WAML. The key features are the flood zones and built up areas. There are also a number of highways and Public Rights of Way (PRoW) and drainage ditches north of Cambridge.



2.4.7. The route crosses several major roads including the A1307, A14, A10 and the guided busway. The built up areas of Caldecote, Dry Drayton, Hardwick and Horningsea are within 500m of the centreline of Section NA1. Oakington is also adjacent to the northern alignment.

2.4.8. The route would have the potential to impact on the settings of a number of heritage assets, but in particular the American Cemetery and Memorial, Madingley Hall and Childerley Gate as well as a number of highly graded churches.

2.4.9. The American Cemetery and Memorial is a Grade I Registered Park and Garden with a Grade II\* listed memorial chapel. The cemetery is one of twenty four permanent Second World War cemeteries erected on foreign soil

by the American Battle Monuments Commission and is the only permanent United States of America Second World War military cemetery in the British Isles. It is built on land gifted by Cambridge University and is subject to a 1954 international agreement between the United Kingdom and the United States which restricts development of the land in the vicinity of the cemetery. Historic England has highlighted that the cemetery is a designated heritage asset of the highest significance, not only for its inherent heritage and landscape value, but also reflecting an important international and historic relationship between the United Kingdom and the United States. The setting may be affected by a northern approach.

2.4.10. In addition, a northerly route would potentially impact upon Madingley Hall, listed at grade I, and several grade II\* listed buildings including the church of Mary Magdalene, the gateway to Stable Courtyard, which lie within the grade II listed Madingley Hall Registered Park and Garden. The park affords views to the north and north west, including along the prominent north allée, meaning that this important heritage group and its setting may be adversely affected by any part of a northern route lying to the south of the A14.2.4.11. The potential station at Oakington for Northstowe sits within a significant flood zone, as does the connection to the WAML. These will both require mitigation. The area in general is known to be flat and wet and previous projects in the area have required substantial foundations and stabilisation works. This would be likely to have an impact on the engineering solution

and lifecycle maintenance on the assets.

2.4.12. Due to the general topography of the area and the need to cross both roads and flood zones in this area, the railway is expected to be elevated in locations, for example on viaducts or embankments, which would be likely to result in visual impacts.

2.4.13. Therefore, there are potential environmental impacts from Section NA1 in relation to flood zones and flooding; built up areas; the highway network and the settings of heritage assets. It can be concluded that there may well be significant impacts as a result of a northern approach in section NA1. Whilst a full appraisal or assessment of impacts on these receptors has not been undertaken, it is sufficient for comparison purposes to have established that section NA1 of the northern approach can be predicted to have adverse environmental impacts subject to mitigation. EWR Co does not consider that the performance of section NA1 materially out-performs a southern approach to Cambridge.

**Section NA2 – existing WAML from Milton/ Waterbeach to Cambridge station**

2.4.14. The length of this section is approximately 6.25km. This excludes any chord to the north of Milton Junction, which would be approximately 1km in length and any chord on Coldham’s Common which would be an additional 1.25km in length.

2.4.15. From the point of connection to the WAML to the A14 overbridge, the WAML sits in a flood zone from

the River Cam. Just north of the A14, the railway is flanked by areas of Priority Habitat.

- 2.4.16. Immediately south of the A14, the railway is flanked by further Priority Habitat sites and Milton substation on the east and a Cambridge sewage works on the west. There is a Priority Habitat site on the east side of the railway, just north of Cambridge North station. There is a potential for a northern route of the railway to interact with these habitats as described further in this appendix below from paragraph 2.5.8 onwards.
- 2.4.17. The railway then crosses the River Cam on a 2 track bridge and then passes between Stourbridge Common on the west, which is Priority Habitat and Open Green Space – Public Park or Garden, Access Land – Combined Open Country, Registered Common Land and Section 16 Dedicated Land and a flood zone from the River Cam, and Ditton Meadows on the east, which is a City Wildlife Site, Priority Habitat and a flood zone from the River Cam. Again, there is the potential for a northern alignment of the railway to interact with these habitats – see paragraph 2.5.34 onwards.
- 2.4.18. Just north of the A1134, on the east side, is the Grade 1 listed Cambridge Leper Chapel, to the south of the A1134 is Coldham’s Common which is a Local Nature Reserve, Open Green Space – Public Park or Garden and Other Sports Facility, Access Land – Combined Open Country, Registered Common Land and Section 16 Dedicated Land, Country Wildlife Site, flood zone and Green Belt. This is considered at paragraph 2.5.39 onwards.

## **2.5. Engineering solution**

- 2.5.1. This section addresses in greater detail the impacts and interfaces likely to result from the implementation of each of Section NA1 and Section NA2 and how these would need to be addressed.

### **Section NA1 – Cambourne North to the WAML between Milton and Waterbeach**

- 2.5.2. From Cambourne North station to the A1307, the line will be on a continuous curve. The A1307 and A14 are close together and may require a viaduct in order to cross both. A full assessment of PRoW and water courses would be required in order to understand the vertical alignment of the railway and the volume of earthworks.

- 2.5.3. East of the A14, the railway will be approaching the large flood zone area and is therefore likely to have to be on a viaduct. The proposed station at Oakington for Northstowe is at the very southern end of the new town, south of Oakington village, nearly 5km away from the northern edge of Northstowe (roughly a one hour walk). The station will be in a flood zone and so is likely to be an elevated structure. There could be an opportunity to place the station next to the guided busway and create a multimodal transport interchange point. Soon after the station, the railway passes over the guided busway which could also drive the need for the station to be elevated.
- 2.5.4. East of the guided busway, the railway would be going over flat land with multiple drainage ditches. As such, it is likely to have to be on an embankment throughout. Due to the prevailing low-lying land level, it is highly likely that there will be no cuttings in this area and as such, all fill materials will need to be imported. This would increase construction related traffic, road congestion and create additional costs. In addition, due to the poor ground conditions, it is most likely that more substantial earthworks and foundation solutions will be required, as has been found by other projects in the area. A full geotechnical analysis is required to understand the full solution, but the engineering solution can be expected to be more complicated and expensive than if the railway were running on more stable ground such as to the south of Cambridge.
- 2.5.5. The railway will cross over Longbeach Road and the A10 before joining the WAML. The distance between the A10 and the WAML is only approximately 750m. In addition, the west side (and the east side) of the WAML are in floodplain. This, combined with the flood zone in the area, will make the connection details complex.
- 2.5.6. If similar functionality to an access to Cambridge from the south was to be achieved, a chord to the north would be needed where the alignment of NA1 joins NA2, to allow trains from Norwich and Ely to access the EWR line without having to go to Cambridge and reverse. This would be likely to require grade separation so that services could head south and then west across the WAML without interfering with the services on the WAML down line (to Ely). Again, this chord is in a flood zone and it may also encroach on a SSSI Impact Risk Zone. This would only be required when services would be heading further east in the future, not for the current Project Objectives, and so is not considered in assessments.
- 2.5.7. It should also be noted that a proposal to build the Cambridge Sports Lake in the area on the west side of the railway between Milton and Waterbeach was previously granted outline planning permission. The Trust promoting this scheme has recently confirmed that it still wishes to pursue the proposals. An interaction with such a facility would add to the complexity of joining the WAML just north of Milton.



## Section NA2 – Existing WAML from Milton/Waterbeach to Cambridge station

2.5.8. On the WAML, the operational timetable assessment has shown that the twin-track section of the existing railway requires an additional two tracks to accommodate the extra EWR services. This section of the WAML has not been a four-track railway in the past, it has always been a twin track railway. As such, additional land will be required as the two new tracks will not be able to be totally built within the existing railway land boundary.

2.5.9. The route into Cambridge along the WAML from the north has been split into three geographical areas based on relatively discrete constraints and considerations, namely:

- Milton to Cambridge North station;
- The crossing of the River Cam; and
- The approach to Cambridge station.

### Milton to Cambridge North station

2.5.10. There are three key components to be considered with four tracking from Milton:

- Widening/renewal of the A14 overbridge so that it can take four tracks (it currently only accommodates two); and
- Modifications to Cambridge North station.

2.5.11. The A14 overbridge will need an additional span. This will be complex to build with temporary closures required during construction, which will need to be carefully planned due to the strategic importance of the road as a major east-west connection. A temporary diversion would be required which would require further design. The site is constrained due to the proximity of Milton Country Park, an electrical substation, Cambridge Sewerage Works and the River Cam, including its flood zone. As such, there are considerable time and cost risks associated with these works.

2.5.12. The Cambridge North station area, bounded by the A14 Cambridge By-Pass to the north and the River Cam to the south, includes the following key considerations, shown on Figure 5:

- Lafarge and Freightliner sidings;
- Future development of the Cambridge Sewage Works site;
- The recently opened Cambridge North station;
- Cambridge North proposed development;
- Chesterton level crossing; and
- The narrow railway corridor sandwiched by residential properties to both sides north of the River Cam.



Figure 5 Cambridge North site considerations

2.5.13. The Cambridge North proposed development is planned to be delivered in four phases of which phase 1 comprising of a hotel and offices is already advanced. The remaining phases are planning to develop the land along the west side of the railway corridor including the area currently occupied by the Lafarge and Freightliner sidings. It has not been confirmed whether proposed removal of the sidings by this development can be achieved. As such, options have been developed that retain the sidings and remove them.

2.5.14. Anglian Water has announced plans to relocate the Cambridge Sewage Works and in turn offering the site up to future development. However, the timings of this would need to be managed and provision made in case Anglian Water decided upon a different strategy.

2.5.15. Fen Road crosses the existing two track railway at Chesterton level crossing and provides access to residential and commercial properties to the east side of the railway. It is assumed an increase in the number of tracks will require the closure of the level crossing potentially cutting off access to the properties between the railway and the River Cam. Grade separation of the level crossing is not considered practicable whilst retaining access to Moss Bank and the properties closest to the crossing along Fen Road. Therefore, an alternative access would be required such as a new road bridge over the River Cam.

Figure 6: Fen Road and Chesterton level crossing



#### Cross section

2.5.16. A typical cross section for lineside features and equipment has been developed based on the same principles used for the analysis of the works in central Bedford set out in Chapter 8 of this Report. This cross section has been applied to the areas of the route that use the existing Network Rail corridor. A 6.35 m offset from track centreline to outside edge of a low retaining wall has been assumed and equates to a 'fence line to fence line' dimension of 24.133 m for a four track section using standard Network Rail six-foot and ten-foot dimensions. It may be possible to reduce the space provided to minimise encroachment on neighbouring properties and land in constrained areas by reducing the dimension between track and OLE mast and / or adjusting the position of cable troughing.

2.5.17. A nominal construction boundary 4 m outside of the cross section (10.35 m from track centreline) has been assumed.

2.5.18. A schematic of the existing track layout is shown in Figure 7.

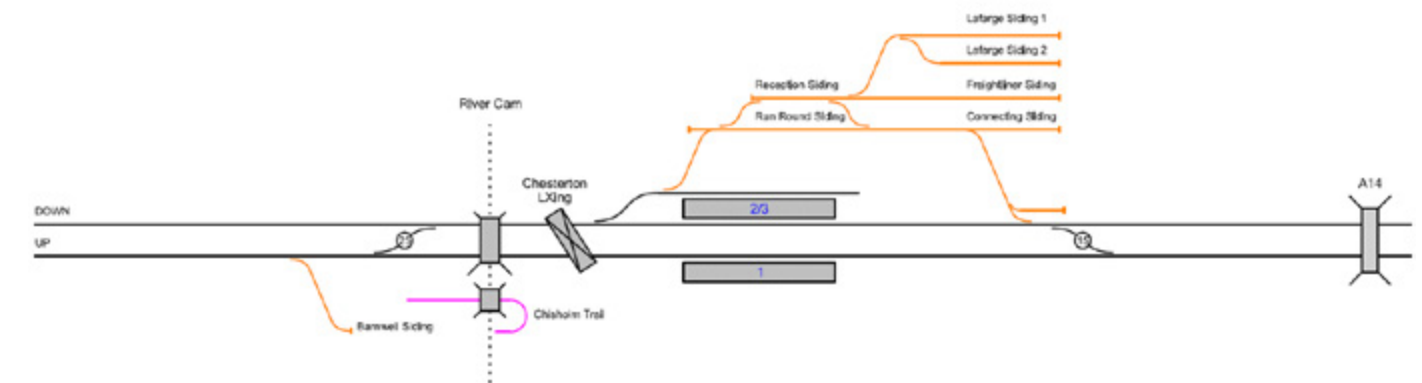


Figure 7: Cambridge North existing layout

2.5.19. Five alignment options have been developed for this area considering two new EWR tracks on the west side of the existing Fen Line tracks:

- Option 1a – new platform and track to the east of Cambridge North station, freight sidings removed;
- Option 1b – new platform and track on the east of Cambridge North station, with freight sidings in same location;
- Option 2a – new platform and track on the west of Cambridge North station, freight sidings removed;
- Option 2b – new platform and track on the west of Cambridge North station, with freight sidings in same location; and
- Option 2c – new platform and track on the west of Cambridge North station, with freight sidings moved north.



## Option 1a

2.5.20. The existing side platform 1 is widened to become an island platform 0/1 with the existing Up track realigned to the east. A turnback siding is included to enable the continuation of the off-peak service that runs between Cambridge and Cambridge North. It may be possible to locate the turnback siding between tracks and closer to the platforms but would require further analysis. New works is indicated in red in Figure 8. Figure 9 indicates track centrelines in red, the edge of the new permanent railway boundary in green (shown as “edge of cess”) and assumed construction boundary in light blue.

Figure 8: Cambridge North Option 1a layout

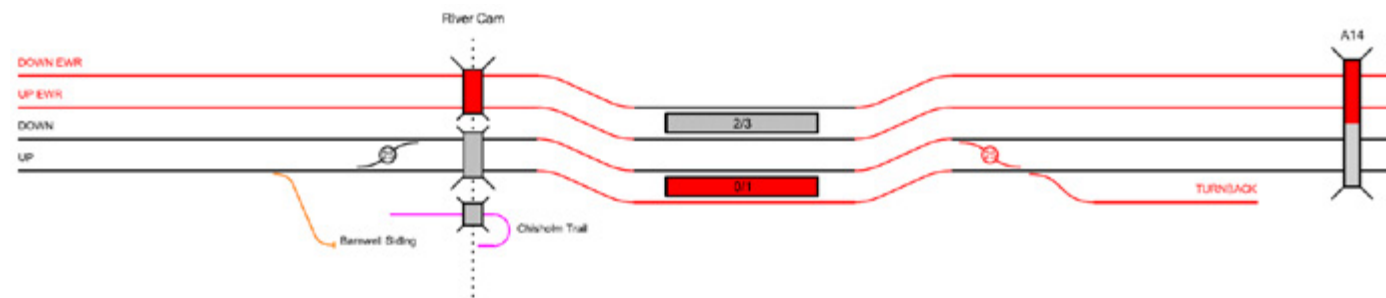
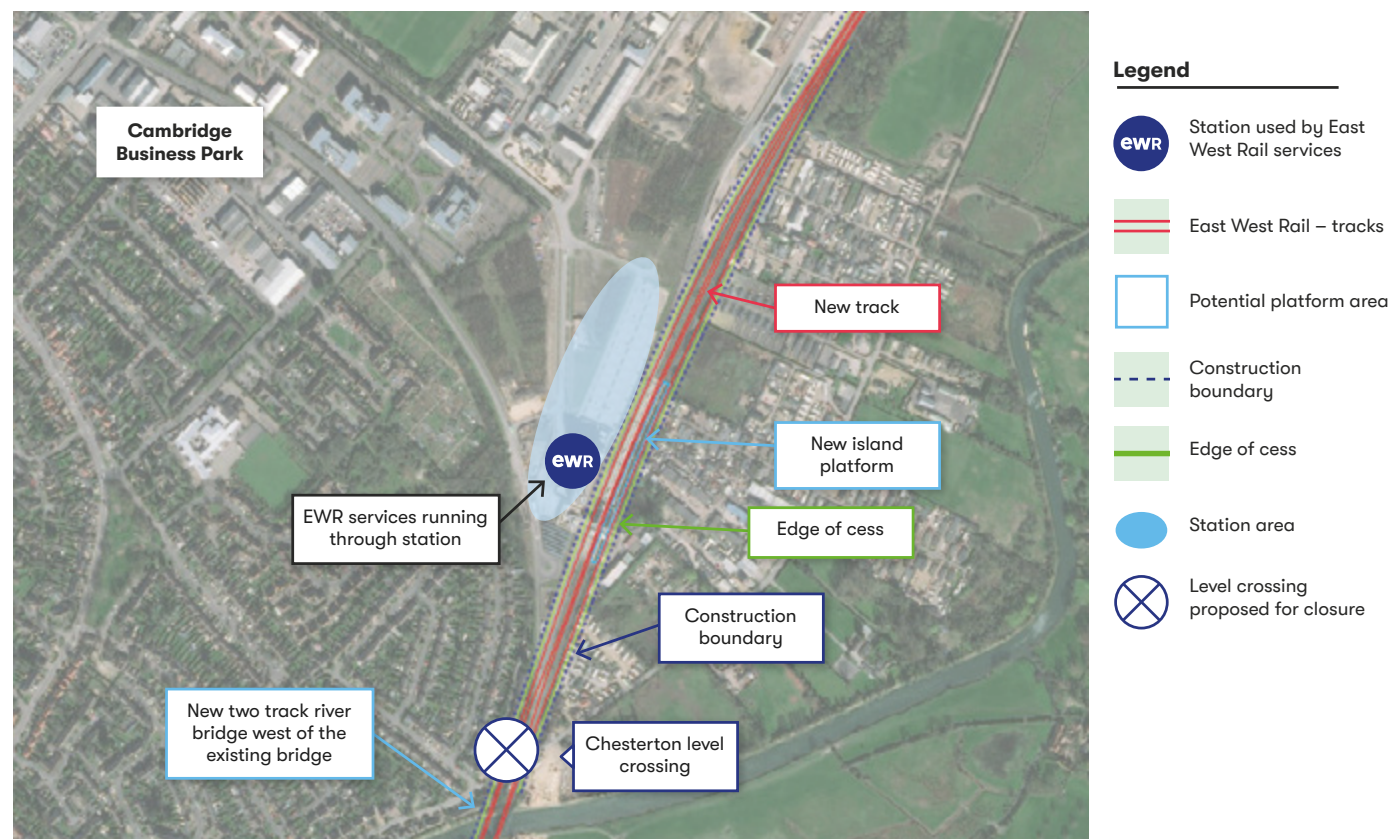


Figure 9: Cambridge North Option 1a site overview



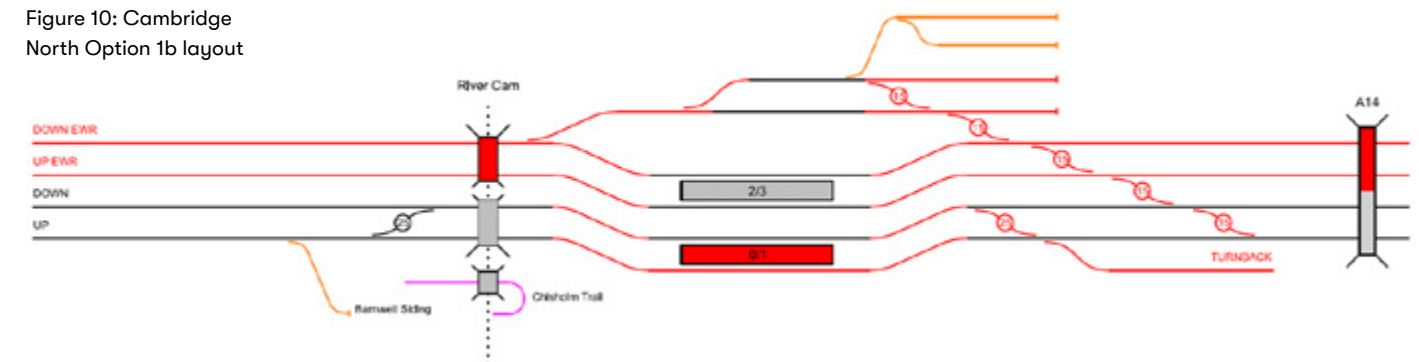
## 2.5.21. Main characteristics specific of this option are:

- Existing platform 1 is widened to become an island platform 0/1;
- The freight sidings are not retained;
- Chesterton level crossing is closed;
- Residential and commercial properties along the east side of the railway are impacted;
- New two track river bridge west of the existing bridge;
- Property demolitions are required on both sides of the railway in the narrow corridor north of the River Cam; and
- The Cambridge North and Cambridge Sewage Works sites are not encroached.

## Option 1b

2.5.22. Option 1b is a variation of Option 1a. It uses the same station layout and retains the freight sidings and their connection to the mainline south of station. New works are indicated in red in Figure 10. Figure 11 indicates track centrelines in red, retained tracks in purple, the new permanent railway boundary in green (shown as “edge of cess”) and assumed construction boundary in light blue.

Figure 10: Cambridge North Option 1b layout





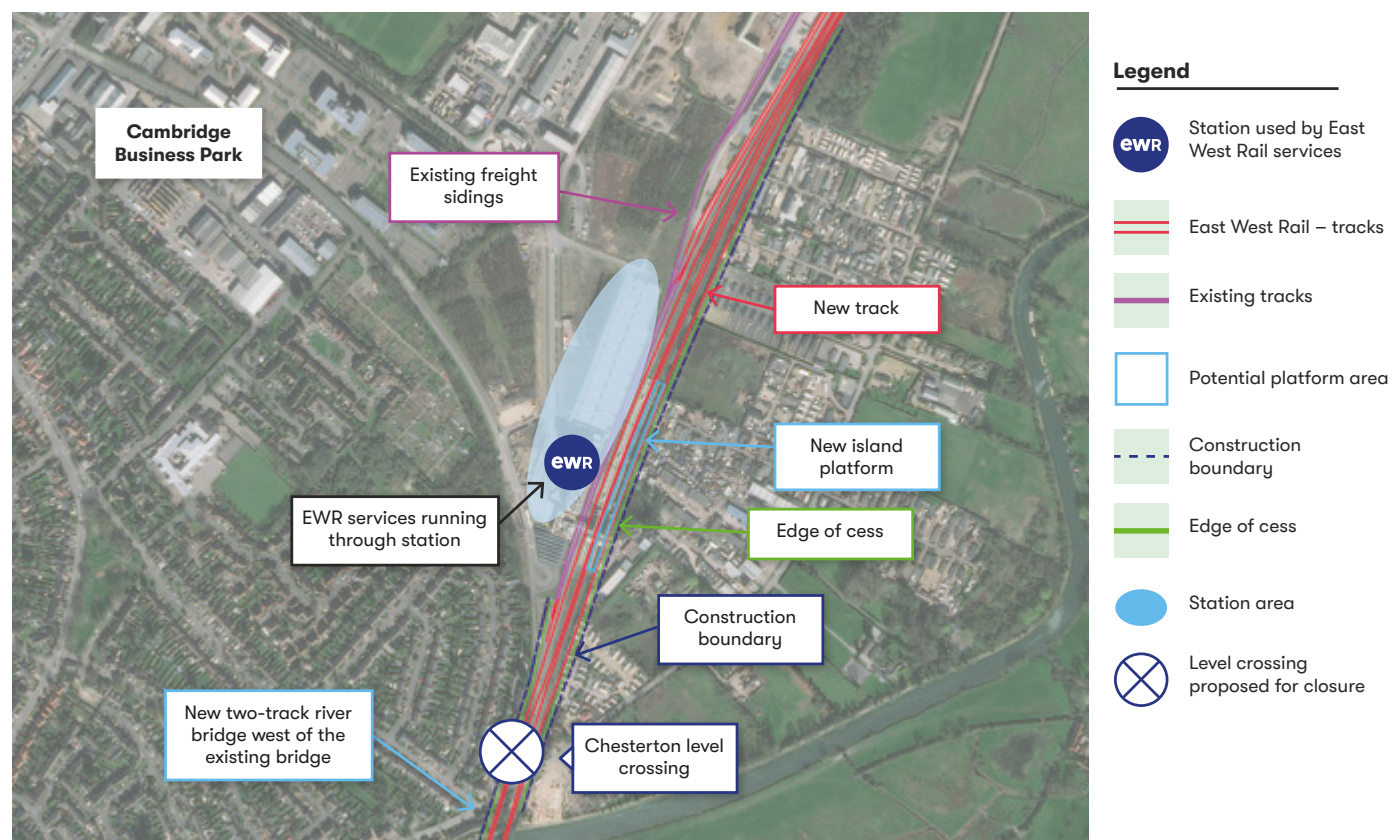


Figure 11: Cambridge North Option 1b site overview

#### 2.5.23. Main characteristics that differ from Option 1a are:

- The freight sidings are retained in their existing location; and
- The freight reception siding and run round loop are reconfigured.

#### Option 2a

2.5.24. A new side platform 4 is constructed on the west side of the station and the new EWR tracks occupy the space given up by the freight run round siding and existing bay platform 3 line. The existing Up and Down tracks are retained in their current location. Therefore, there are no impacts on properties to the east side of the railway. New works are indicated in red in Figure 12. Figure 13 indicates track centrelines in red, retained tracks in purple, the new permanent railway boundary in green (shown as “edge of cess”) and assumed construction boundary in light blue.

Figure 12: Cambridge North Option 2a layout

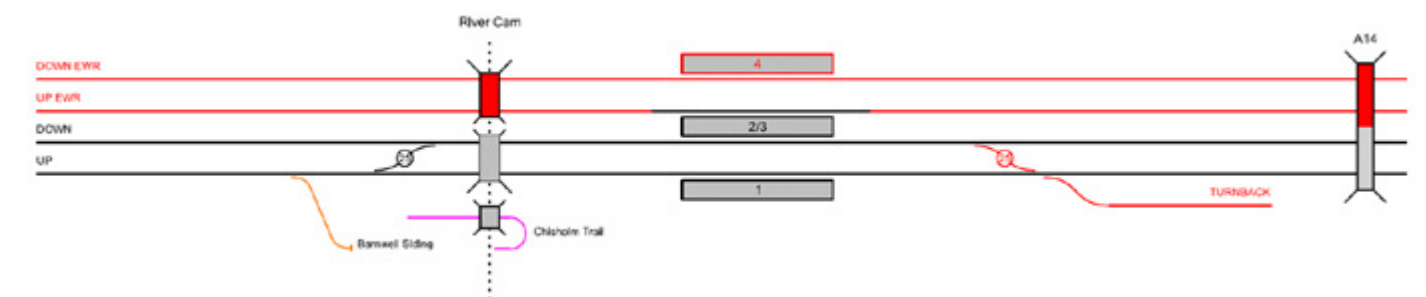
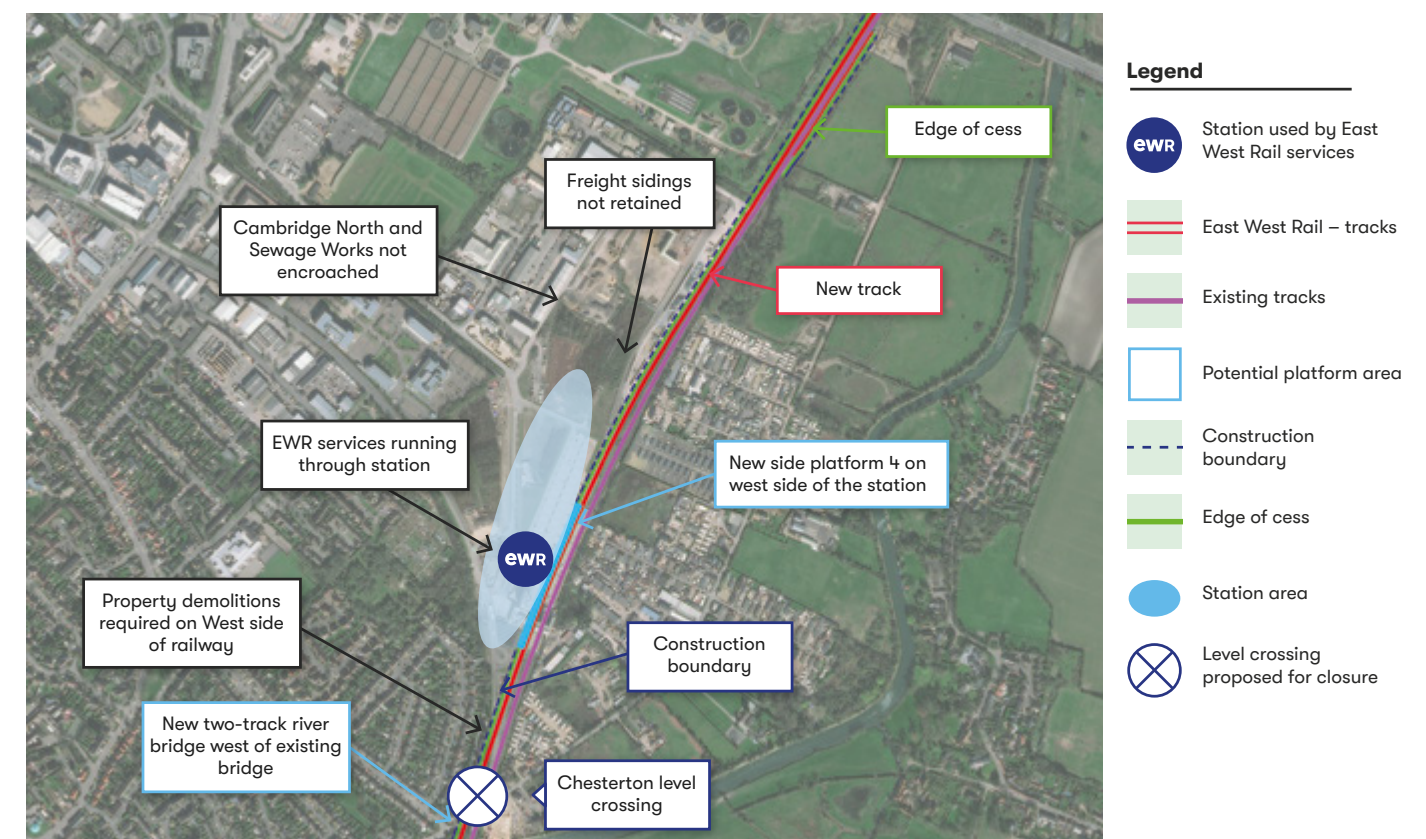


Figure 13: Cambridge North Option 2a site overview





2.5.25. Main characteristics of this option are:

- A new side platform 4 is constructed on the west side of the station;
- The freight sidings are not retained;
- Chesterton level crossing is closed;
- Existing Up and Down tracks retained;
- New two track river bridge west of the existing bridge (alternative bridge options are discussed in paragraph 2.5.34 onward);
- Property demolitions are required on the west side of the railway in the narrow corridor north of the River Cam; and
- The Cambridge North and Cambridge sewage works sites are not encroached.

#### Option 2b

2.5.26. Option 2a is a variant of Option 2b. It uses the same station layout and retains the freight sidings and their connection to the mainline south of station. By retaining the freight connection to the south, the run round siding and reception siding are moved west and encroach on the exiting station buildings and the Cambridge North development site. It is also worthy to note this configuration is not compatible with the alternative river bridge options, due to the nature of the track geometry and placement of switches and crossings. New works are indicated in red in Figure 14. Figure 15 indicates track centrelines in red, retained tracks in purple, the new permanent railway boundary in green (shown as “edge of cess”) and assumed construction boundary in light blue.

Figure 14: Cambridge North Option 2b layout

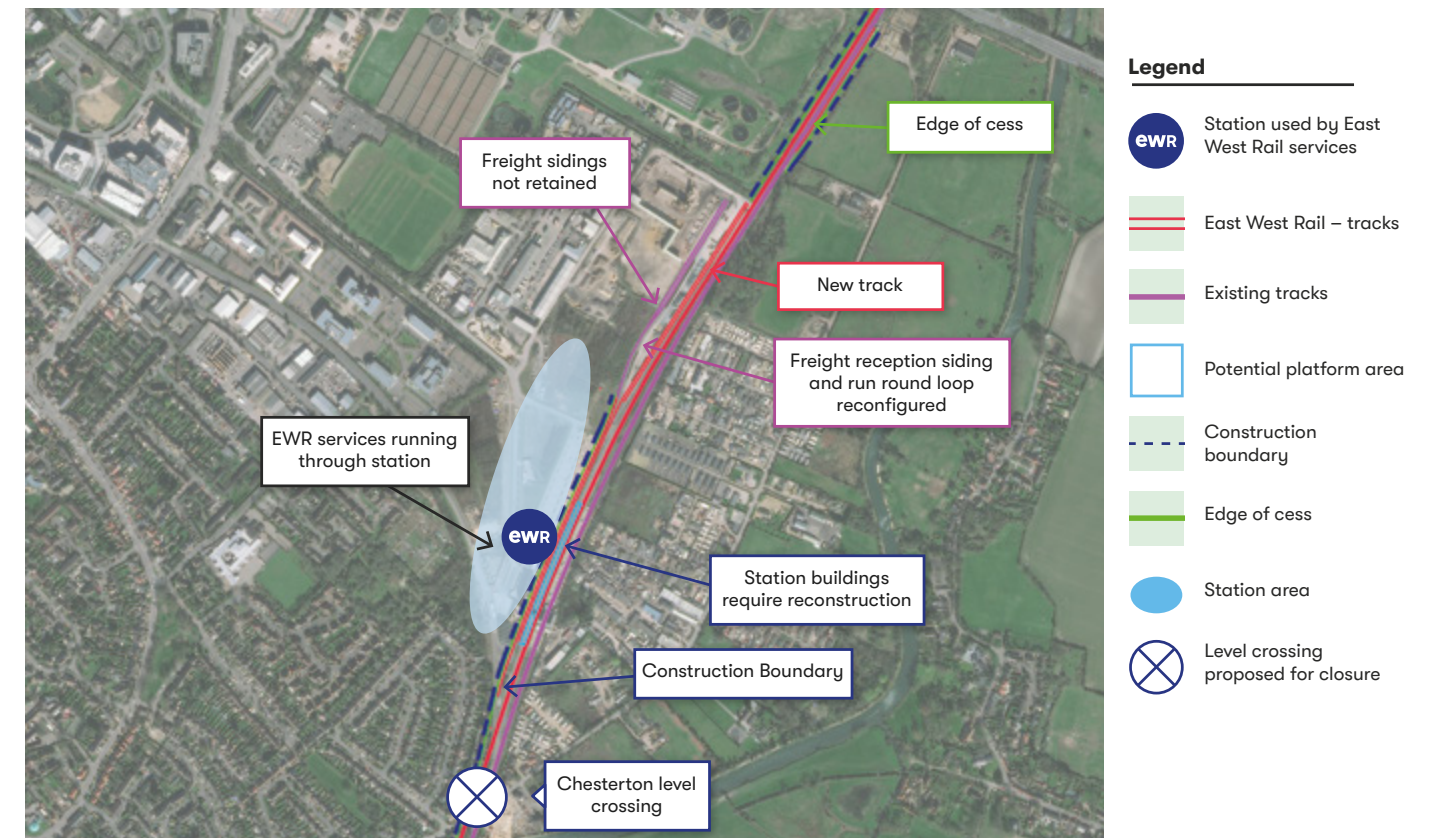
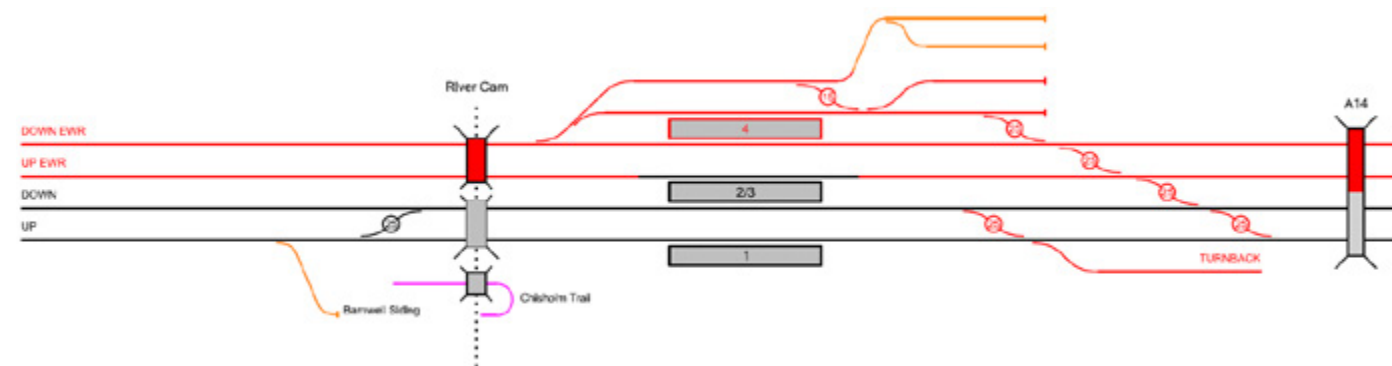


Figure 15: Cambridge North Option 2b site overview

2.5.27. Main characteristics that differ from Option 2a are:

- The freight sidings are retained in their existing location;
- The freight reception siding and run round loop are reconfigured;
- The station buildings will require reconstruction; and
- The Cambridge North develop site is encroached.

#### Option 2c

2.5.28. Option 2c is a variation of Option 2b. It uses the same station layout and relocates the freight sidings north to the Cambridge Sewage Works site. The freight sidings connect to the mainline north of the station avoiding encroachment onto the station buildings and the Cambridge North development site. New works are indicated in red in Figure 16. Figure 17 indicates track centrelines in red, retained tracks in purple, the new permanent railway boundary in green (shown as “edge of cess”) and assumed construction boundary in light blue.



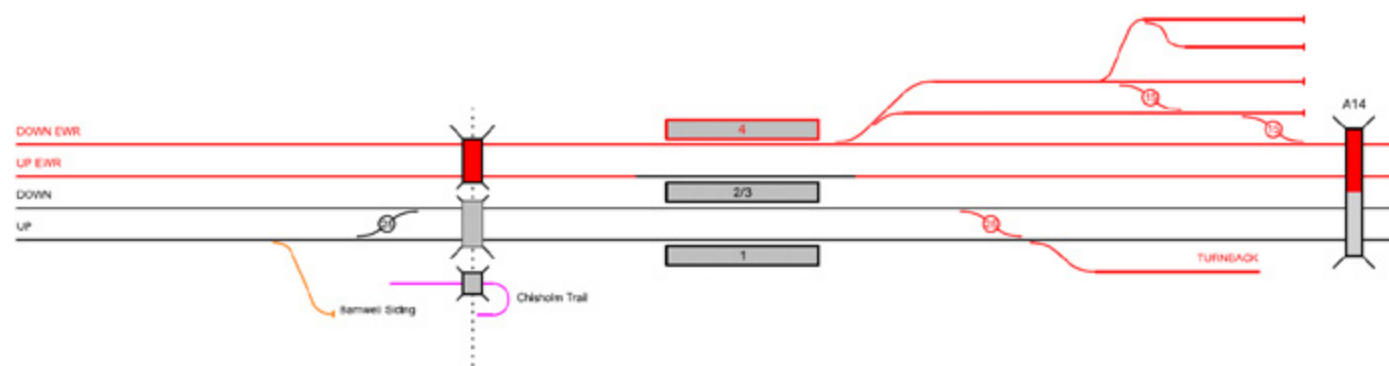


Figure 16: Cambridge North Option 2c layout

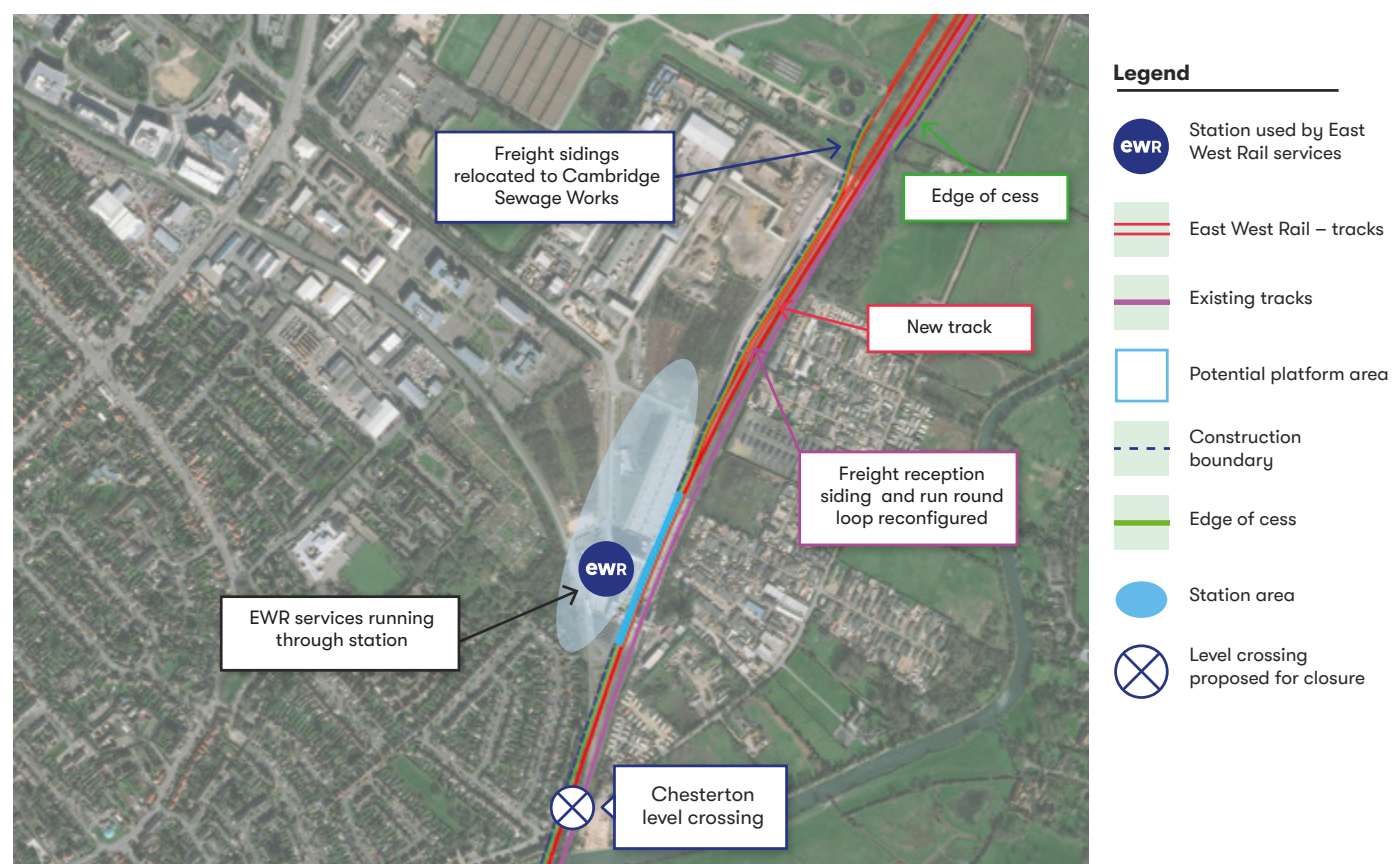


Figure 17: Cambridge North Option 2c site overview

#### 2.5.29. Main characteristics that differ from Option 2a:

- The freight sidings are relocated to the Cambridge sewage works site; and
- The freight reception siding and run round loop are reconfigured to provide a connection to the mainline north of the station.

#### Section conclusion

2.5.30. Option 2 would be preferred, as it has similar impacts to Option 1 on the properties on Moss Bank whilst not impacting the properties on the east side of the railway. Option 2 directly impacts 26 properties whilst Option 1 directly impacts 39.

2.5.31. Of the three sub-options for 2 (a, b and c), 2b or c are preferred as the sidings could be retained. Option 2b would have to be used if the sidings must remain in their current location and could not be moved slightly north into the sewerage works.

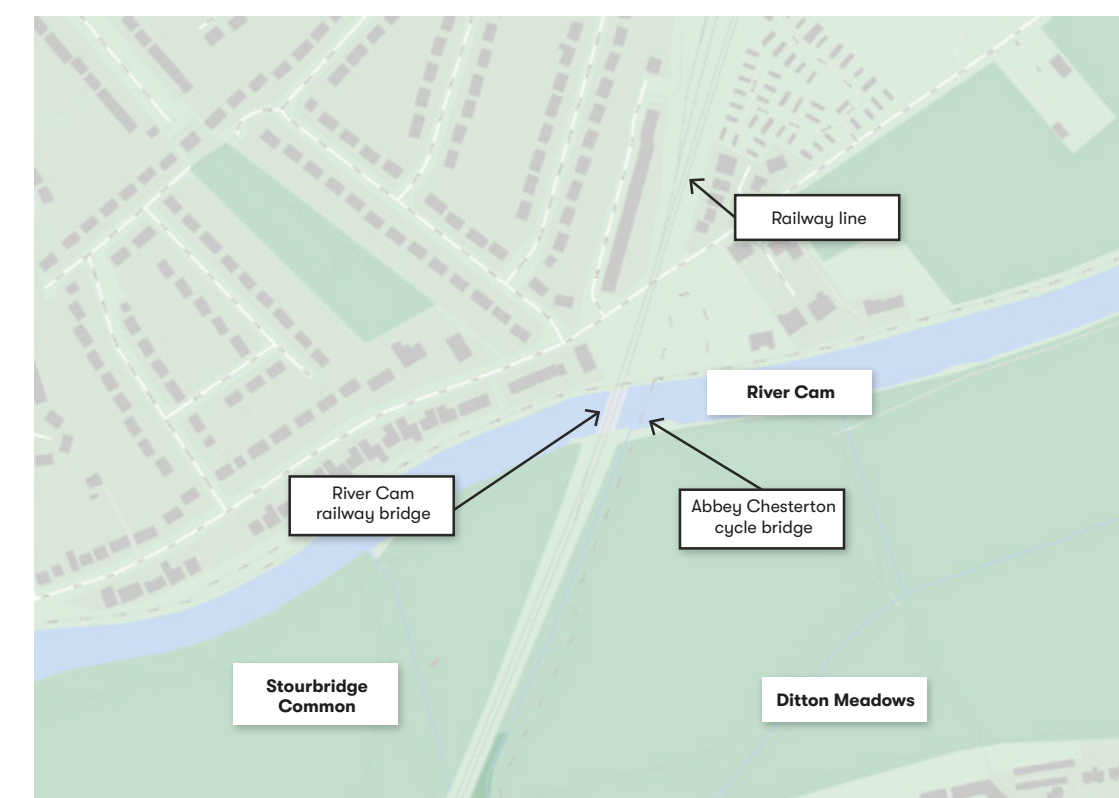
2.5.32. This would also require alterations to the Cambridge North concourse building as the current bay platform facility will need to be retained.

2.5.33. For all options, a new access point would be required to Fen Road east of the railway as the dead-end road will be severed once Chesterton level crossing is closed. The solution to restoring the connection to the Fen Road community would require further work.

#### River Cam Crossing

2.5.34. The Fen Line crosses the River Cam south of Cambridge North station via a two-track truss bridge. Immediately to the east of the railway bridge is the recently opened Abbey Chesterton Bridge that links the Chisholm Trail from the south to the Cam Towpath on the northern side of the river.

Figure 18: River Cam crossing



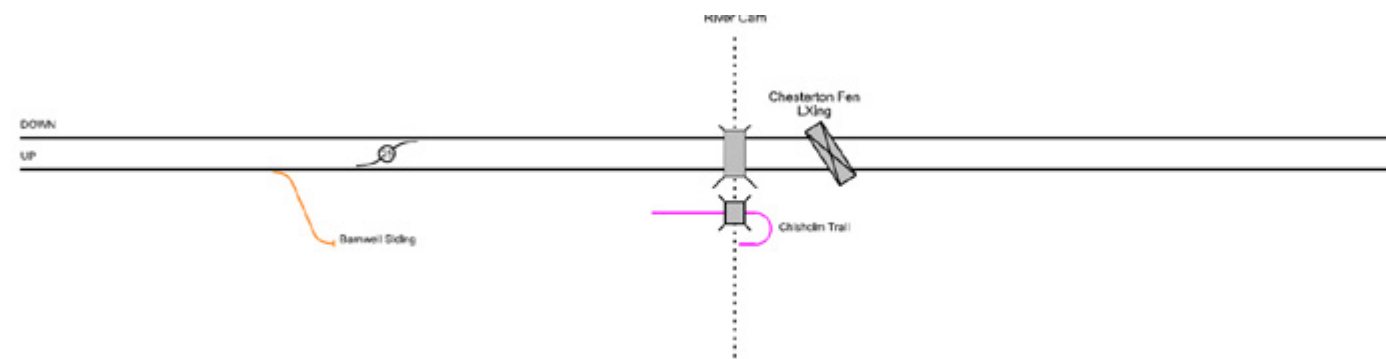


Figure 19: River Cam Crossing layout

2.5.35. Four alignment options to cross the river have been considered:

- Option 1 – a new twin-track bridge on the west side of the existing, existing remains for existing twin-tracks;
- Option 2 – a new four track bridge to take the new tracks on the west side and existing tracks on the east;
- Option 3 – a new four track bridge to take the new tracks on the east side and existing tracks on the west; and
- Option 4 – a new four track bridge to take the new tracks, one on the east side and one on the west side, and existing tracks in the middle.

Option 1

2.5.36. Option 1 retains the existing two-track bridge with a new and separate two-track bridge constructed to the west. A minimum separation of 5 m between the railway bridges has been assumed resulting in 15 m track centres. This approach is considered to be the least disruptive to the existing operational railway.

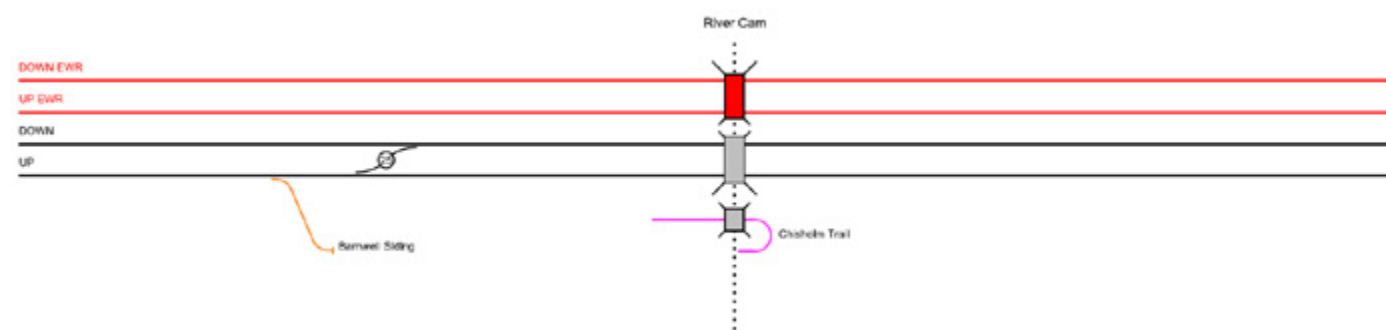


Figure 20: River Cam Crossing Option 1 layout

2.5.37. Properties to the west of the railway are impacted and multiple demolitions anticipated. The Abbey Chesterton Bridge is unaffected. Figure 21 indicates proposed track centrelines in red, retained tracks in purple, the new permanent railway boundary in green (shown as “edge of cess”) and assumed construction boundary in light blue.

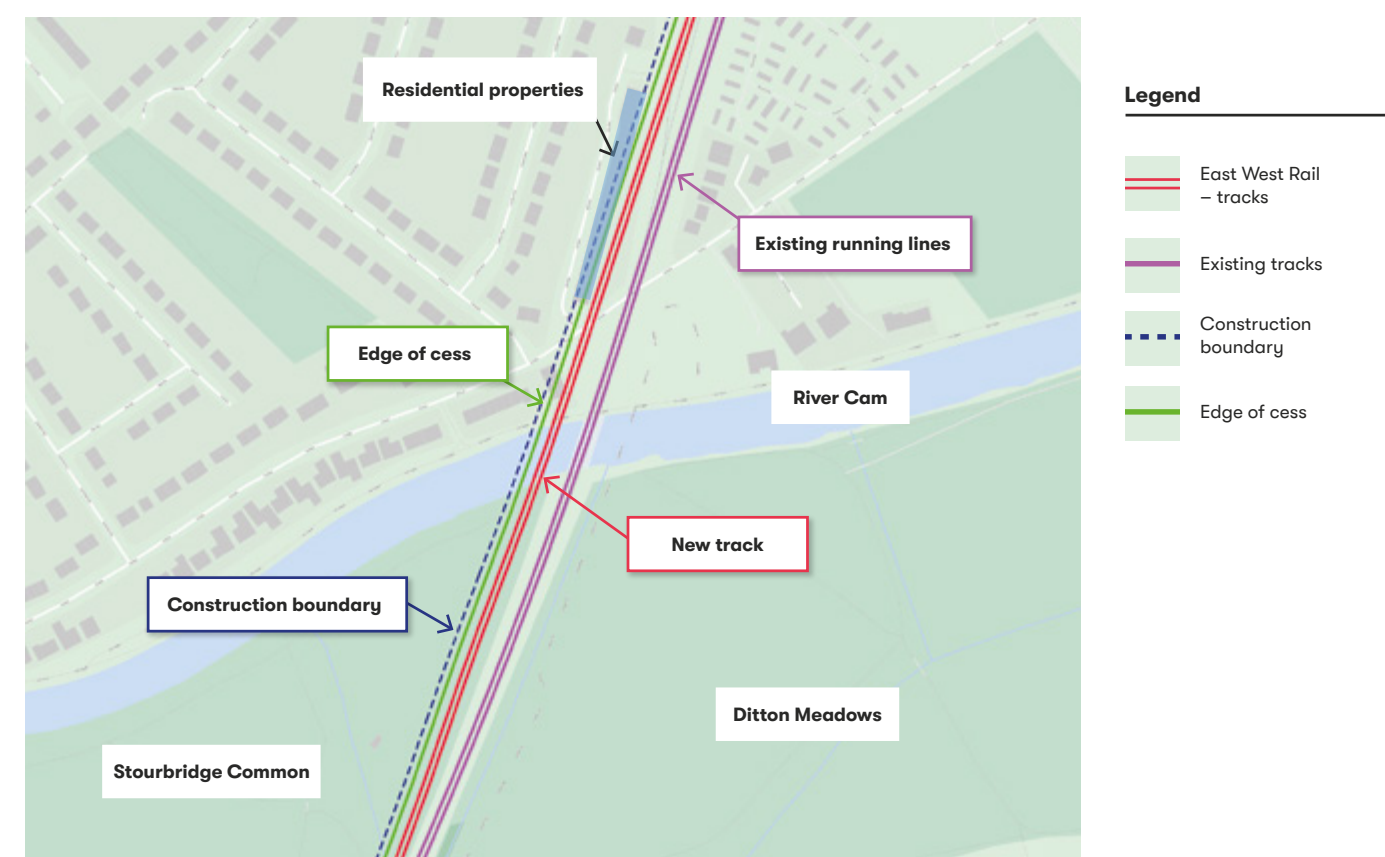


Figure 21: River Cam Crossing Option 1

Option 2

2.5.38. Similar to Option 1, the two new tracks are constructed to the west of the existing tracks albeit this time on a single four-track bridge. A single bridge enables the separation between tracks to be minimised resulting in fewer demolitions on the west of the railway corridor.

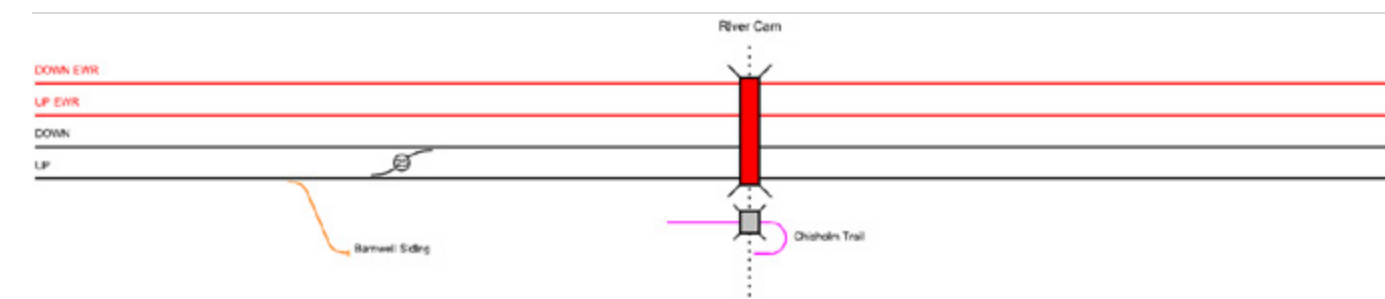


Figure 22: River Cam Crossing Option 2 layout

2.5.39. Whilst a four-track bridge may be more disruptive to the existing railway, it may be possible to minimise this disruption by constructing the new four-track bridge offline, modifying existing and construction of new abutments allowing the bridge to be moved into position during a blockade. Newark Dyke Bridge [on the ECML] was constructed in this way although this was a like for like replacement of a two-track bridge.



2.5.40. A substantial lay down area would be required to be able to build the new four track bridge next to the existing bridge and this would likely be needed on the south bank of the River Cam due to space availability. It should be noted that there is now a new cycle bridge next to the rail bridge on the east side and the space available on the south side is either part of Ditton Meadows or Stourbridge Common.



Figure 23: Newark Dyke Bridge



Figure 24: River Cam crossing Option 2

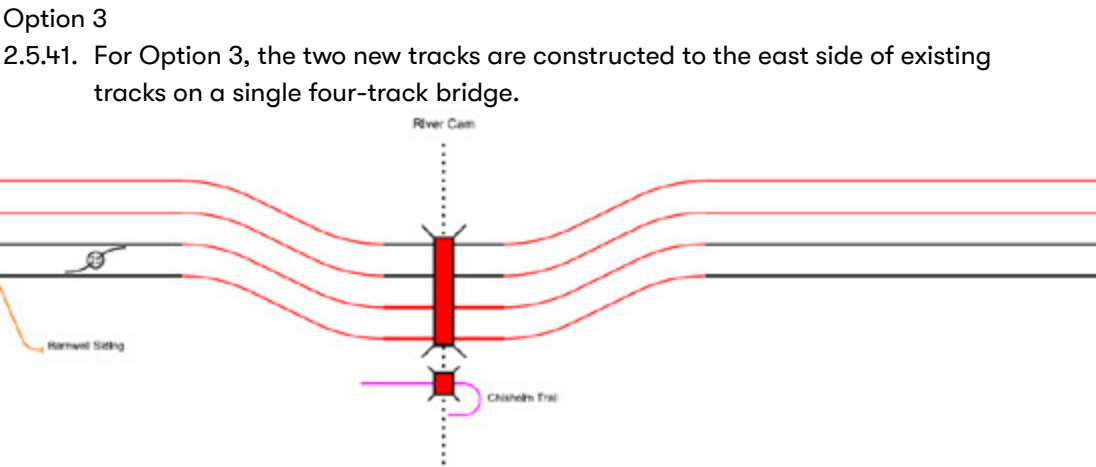


Figure 25: River Cam Crossing Option 3 layout

2.5.42. Demolitions to properties on the west side of the railway are avoided, but some properties remain impacted to some degree. However, with the tracks moving to the east properties on that side will also be impacted. These impacts could be minimised with careful construction planning and localised narrowing of the cross section. Option 3 results in the least number of impacted properties.

2.5.43. The Abbey Chesterton Bridge will need relocating to make way for the new railway bridge.



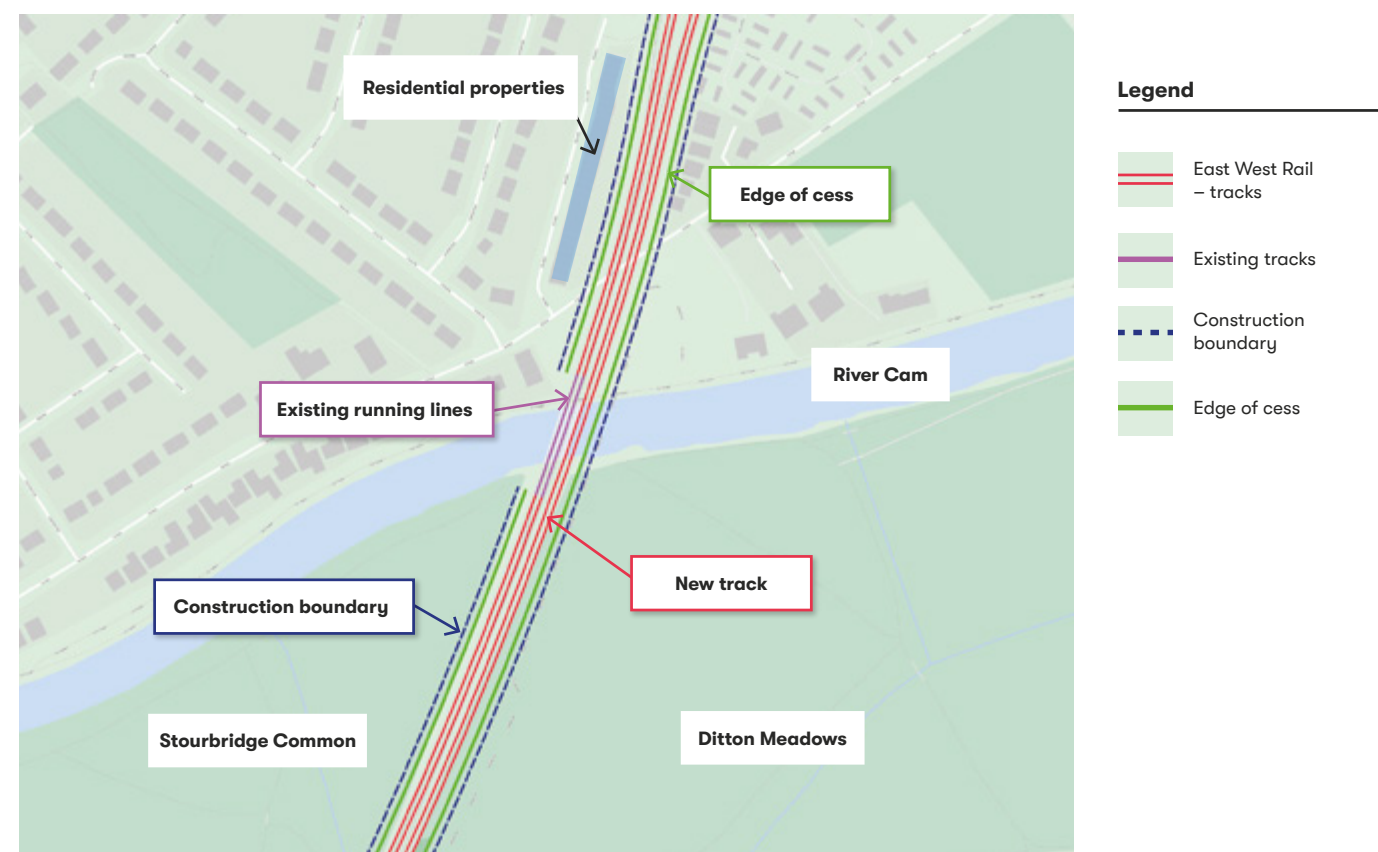


Figure 26: River Cam crossing Option 3

#### Option 4

2.5.44. Option 4 retains the existing alignment of the Fen Line tracks over the river with a new track constructed either side on a single four-track bridge.

2.5.45. Impacts on properties is similar to Option 3 but trading a higher likelihood of impacting the properties on the west side of the railway to those on the east.

2.5.46. The Abbey Chesterton Bridge will need relocating to make way for the new railway bridge.

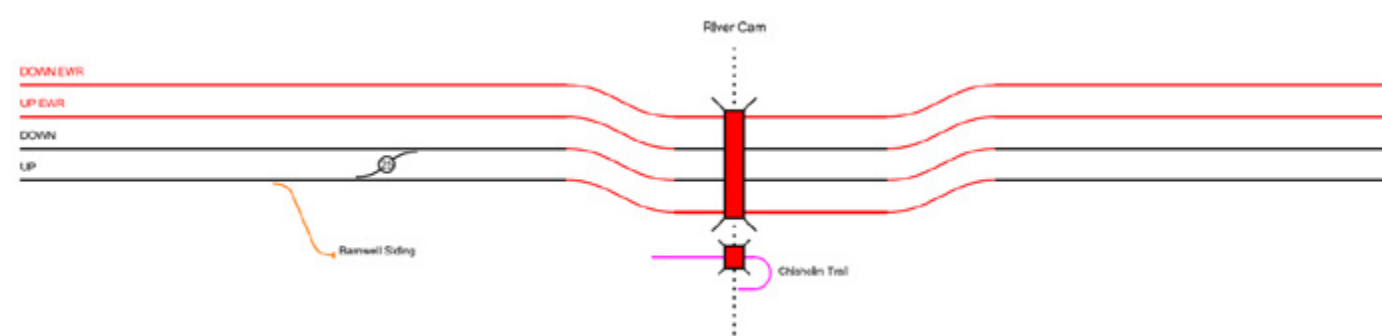


Figure 27: River Cam Crossing Option 4 layout

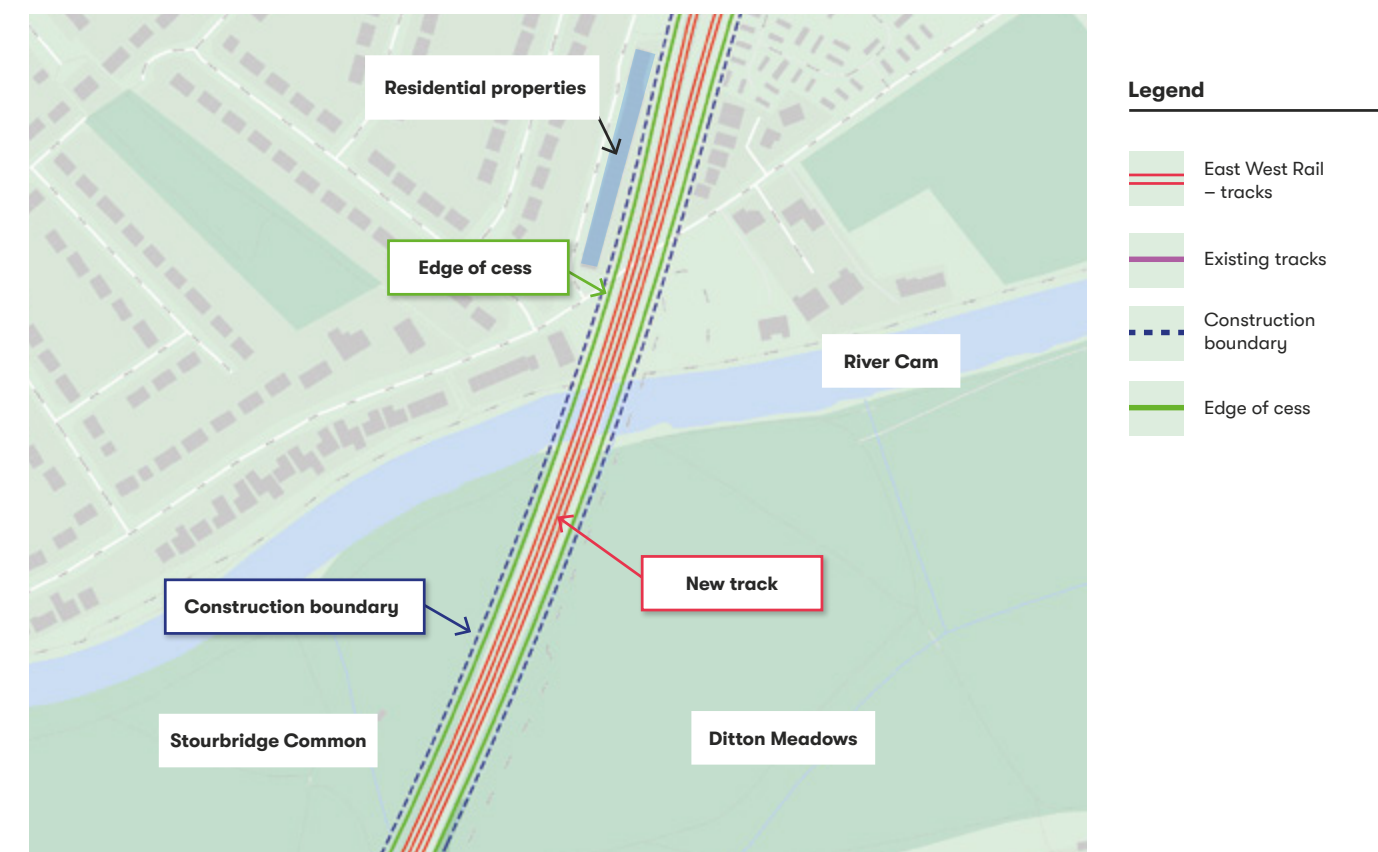


Figure 28: River Cam crossing Option 4

#### Section conclusion

2.5.47. Option 1 is the preferred solution as:

- It minimises impact on the existing railway crossing and therefore disruptions to existing services;
- is the simplest of the options to install; and
- Would cost less than the 4 track bridge options.

2.5.48. Options 2, 3 and 4 are discounted as it is significantly more complex to build, due to the size of the structure, would require more land to build, would have greater disruption on existing rail services during installation, would be more expensive and still have impacts on the same properties as Option 1 or worse.

#### Cambridge station approach

2.5.49. This area is defined as between the River Cam crossing to the north and Mill Road overbridge to the south. Mill Road overbridge is approximately 300 m north of the end of the platforms at Cambridge station. The Cambridge approach area includes the following key considerations, shown on Figure 29:

- Predominately a narrow railway corridor with industrial, commercial and residential properties close to the railway boundary;
- Bridges over the railway for the A1134 Newmarket Road, Coldham's Lane, and Mill Road;
- Coldham's Common; and
- Coldham's depot and the carriage sidings on the east side of the corridor.



Figure 29: Cambridge approach site overview

2.5.50. The station track layout will require reconfiguring to accommodate the new tracks approaching from the north or the south. Reconfiguring the station layout has been excluded from consideration at this stage, because it is unlikely to influence a decision between a northern or southern approach.

2.5.51. The existing track layout is indicated in Figure 30. This is a simplified schematic focussing on the mainlines and connections to the carriage sidings, depot, and the junction with the Newmarket Line.

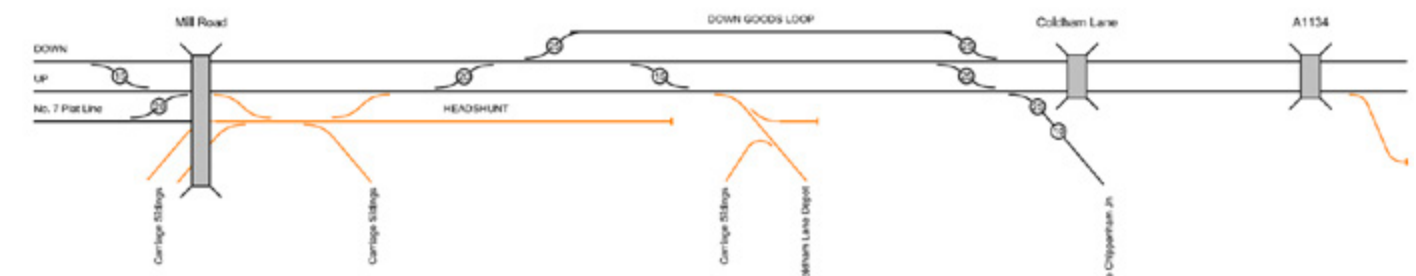


Figure 30: Cambridge approach existing layout

2.5.52. Two options have been identified:

- Option 1 – two new tracks on the west side; and
- Option 2 – combination of two new tracks on the east side and then one on the east and one on the west.

#### Option 1

2.5.53. Option 1 locates a pair of new tracks on the west of the corridor adjacent to the existing infrastructure except for a 600 m section where the proposed Up EWR track utilises the existing Down Goods Loop. The A1134 overbridge (two span bridge), Coldham's Lane overbridge and Mill Road overbridge will need reconstructing to accommodate the additional tracks. New works are indicated in red in Figure 31.

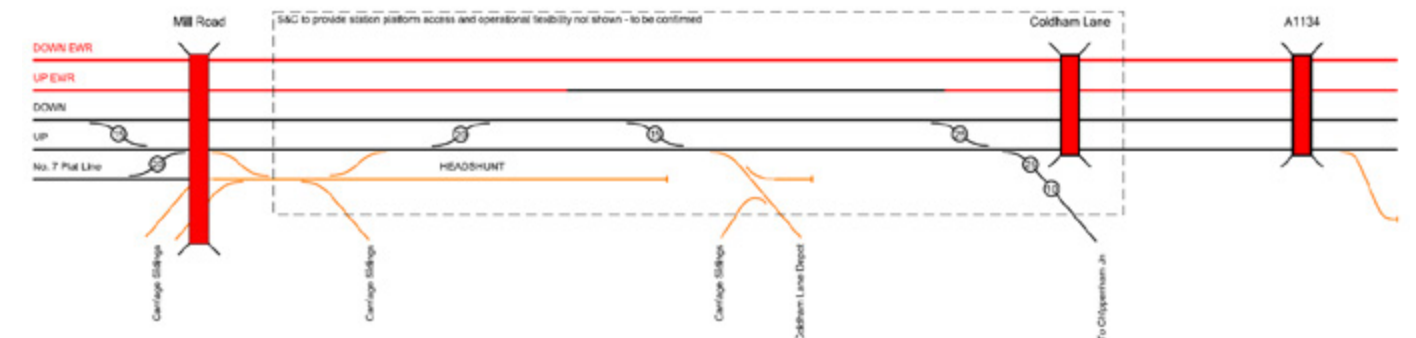


Figure 31: Cambridge approach Option 1 layout



2.5.54. Main characteristics specific of this option are:

- Two new tracks on the west side of the corridor (to create a new four-track railway);
- The A1134, Coldham's Lane and Mill Road overbridges are reconstructed;
- A mixture of industrial, commercial and residential properties along the west side of the corridor are impacted, including demolitions, because of the corridor widening; and
- Coldham's Junction, connections to the carriage sidings and Coldham's Depot are not impacted.

2.5.55. The length of the route through this area is captured in the following figures (Figure 32 to Figure 36) , which indicate track centrelines in red, retained tracks in purple, the new permanent railway boundary in green (shown as "edge of cess") and assumed construction boundary in light blue.

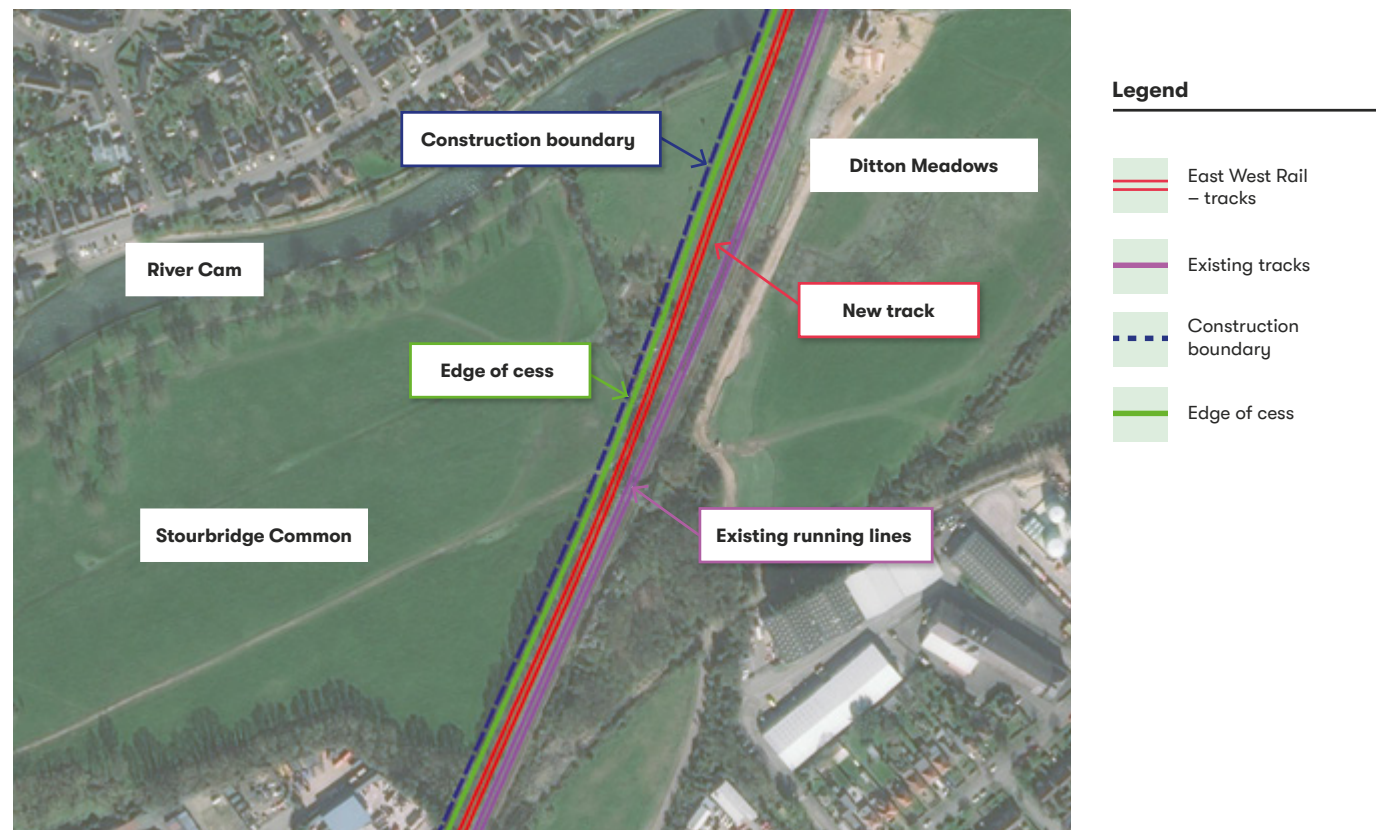


Figure 32: Cambridge approach option 1 - image 1

2.5.56. From right to left is the River Cam crossing, Stourbridge Common to the west of the railway, and Ditton Meadows to the east. Stourbridge Common holds the status of Access Land – Combined Open Country, Registered Common Land and Section 16 Dedicated Land and is likely to require a Special Parliamentary Procedure in order to secure permission to build on this land. This is a lengthy process with no guarantee of success, which significantly increases the risk of a delay to the project. In particular, the fact that an

approach into Cambridge from the south would not require this land to be developed at all would be relevant to any decision taken under the Special Parliamentary Procedure.



Figure 33: Cambridge approach Option 1 - image 2

2.5.57. Commercial properties are impacted on the west side of the corridor with some demolitions required. The A1134 overbridges would need to be closed, demolished and rebuilt causing significant disruption in Cambridge. It is possible that one of the bridges will need to be raised, due to electrification clearances, which could have an additional significant impact on the land needed. The Grade 1 Leper Chapel is very close and the setting could be impacted by the works. Space for construction is also a consideration.



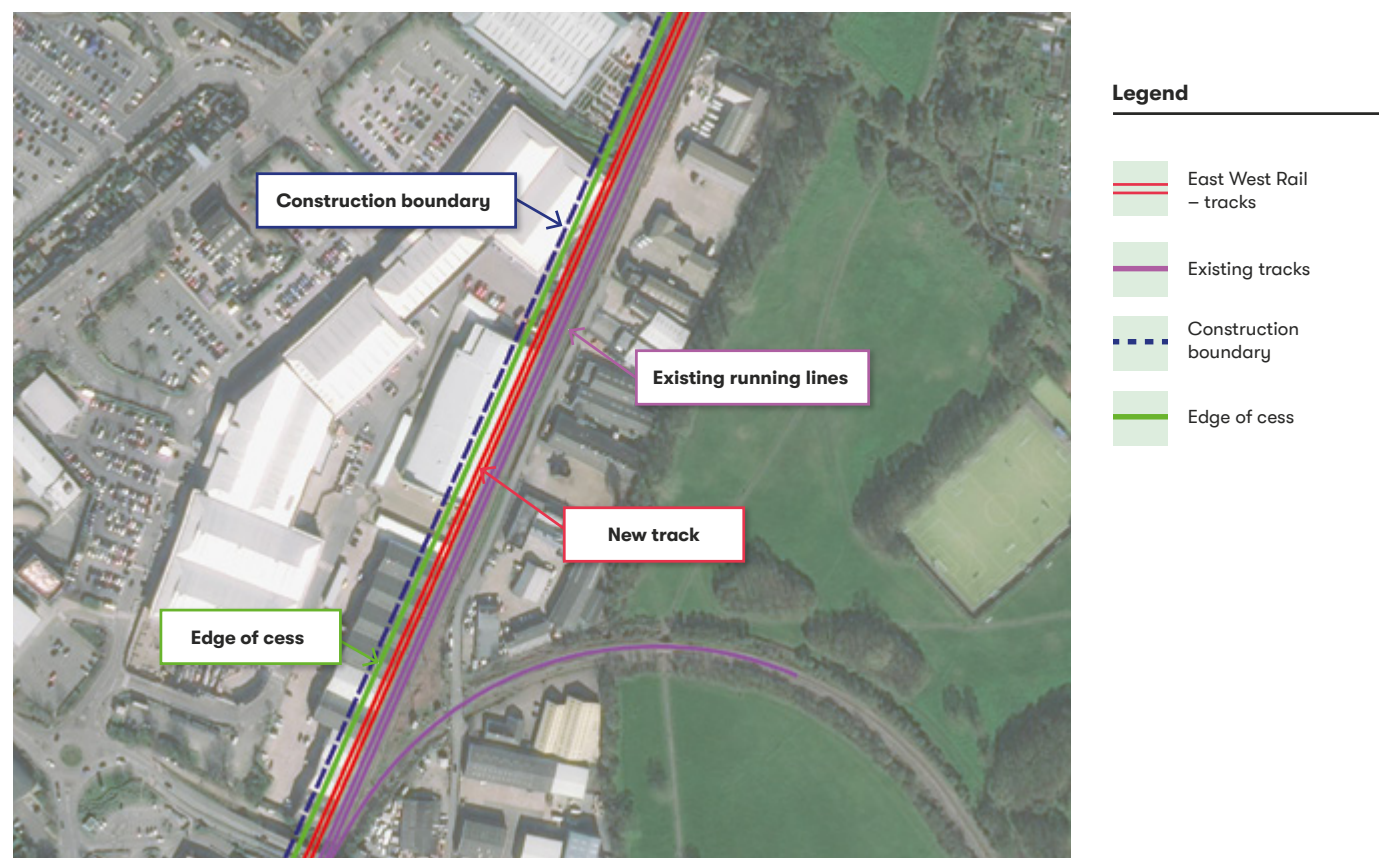


Figure 34: Cambridge approach Option 1 - image 3

2.5.58. Commercial properties are impacted on the west side of the corridor with some demolitions required.

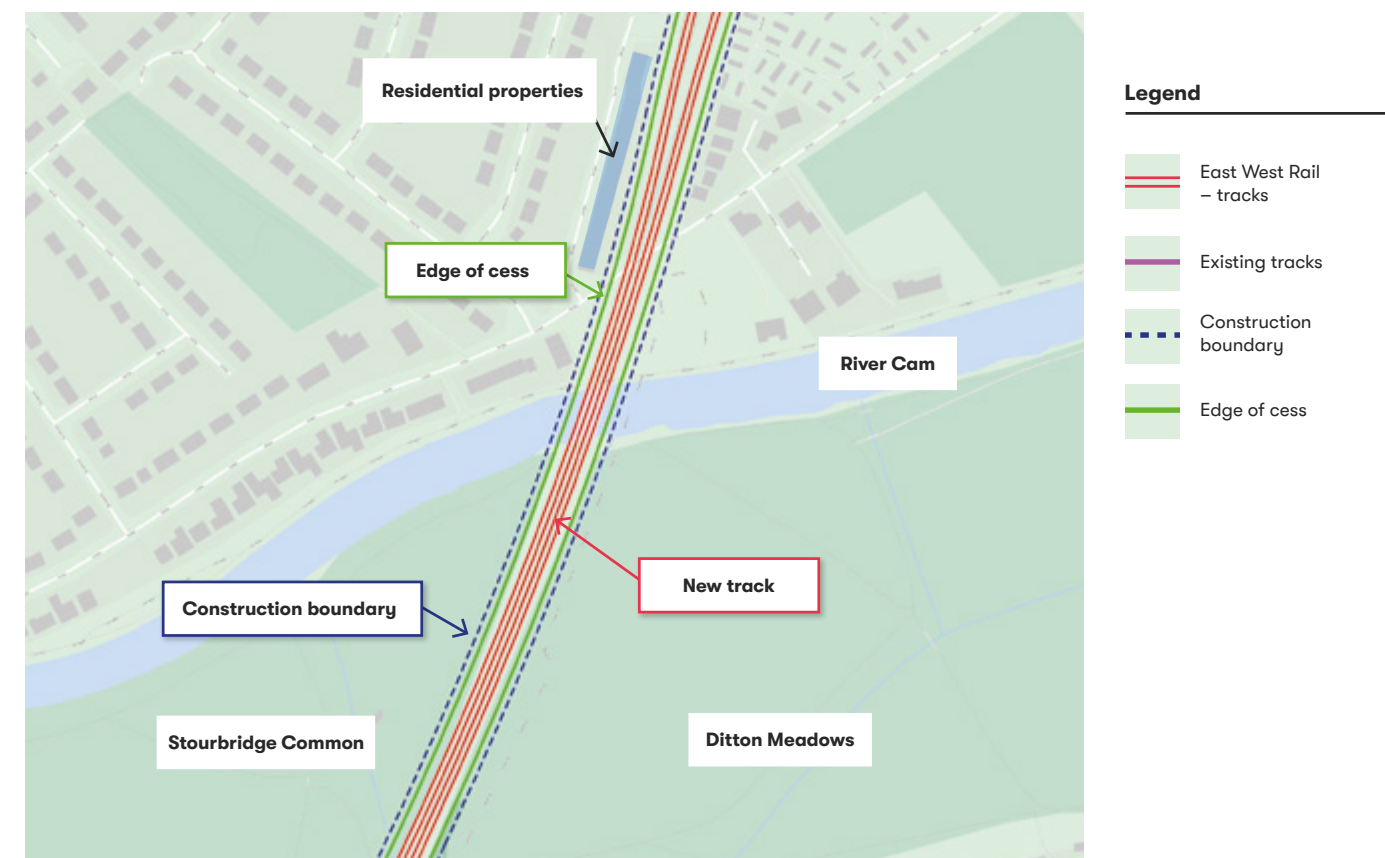


Figure 35: Cambridge approach Option 1 - image 4

2.5.59. Although it is anticipated the large commercial building in this area itself will remain untouched by the widening of the corridor, the goods access to the rear of the property will be occupied by the widened railway corridor. This will change the function of the building. Demolitions of residential properties will be required to the south of the commercial properties.



Figure 36: Cambridge approach Option 1 - image 5

2.5.60. The area shaded yellow in Figure 36 represents a new development area on which construction of residential apartments has commenced; the new tracks would need land from this site.

- Option 2
- 2.5.61. Option 2 locates two new tracks on the east side of the corridor between the River Cam crossing and Coldham's Lane. From there a new track is constructed on both sides of the railway except for a 600 m section where the proposed Down EWR track utilises the existing Down Goods Loop. The new track on the east side of the corridor utilises the space given up by the carriage siding headshunt tracks. Therefore, reconfiguration of the sidings will be required to maintain an appropriate level of functionality and connections to the mainlines. Further investigation into the operation of the sidings is required to determine the extent of works required.
- 2.5.62. Coldham's Junction will require reconfiguration to allow the new line on the east side to be installed; it would remain as a single-track junction for CS3 works. Double tracking of this junction would only be required for future services heading east and this would be a requirement for either approaching Cambridge from the north or the south.
- 2.5.63. The A1134 Newmarket Road overbridge, Coldham's Lane overbridge and Mill Road overbridge will need reconstructing to accommodate the additional tracks. New works are indicated in red in Figure 37.

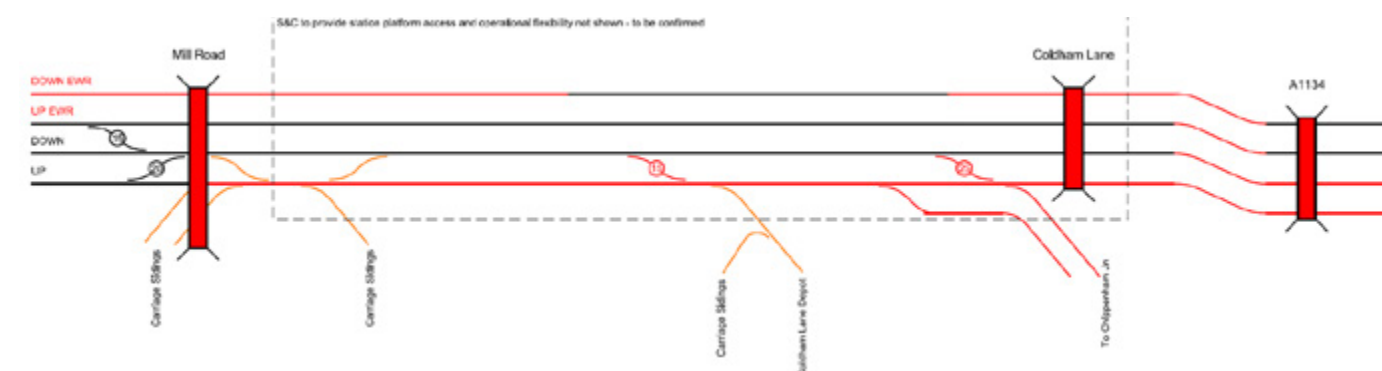


Figure 37: Cambridge approach Option 2 layout

2.5.64. Main characteristics specific of this option are:

- Two new tracks are constructed on the east side of the corridor between the River Cam crossing and Coldham's Lane;
- A new track on the west side and east side of the corridor (four track railway) between Coldham's Lane and Mill Road;
- The A1134, Coldham's Lane and Mill Road overbridges are reconstructed;
- A mixture of industrial, commercial and residential properties along the west side of the corridor are impacted, including demolitions, because of the corridor widening;
- Commercial properties on the east side of the corridor are impacted;
- Coldham's Junction, connections to the carriage sidings and Coldham's Depot will require reconfiguring;



- Significant number of possessions required to be able to complete this work due number of changes to the existing railway; and
- Works would be in very close proximity to the Grade 1 Listed Leper Chapel and may affect both its setting and curtilage.

2.5.65. The length of the route through this area is captured in the following figures (Figure 38 to Figure 42) , which indicate track centrelines in red, retained tracks in purple, the new permanent railway boundary in green (shown as “edge of cess”) and assumed construction boundary in light blue.

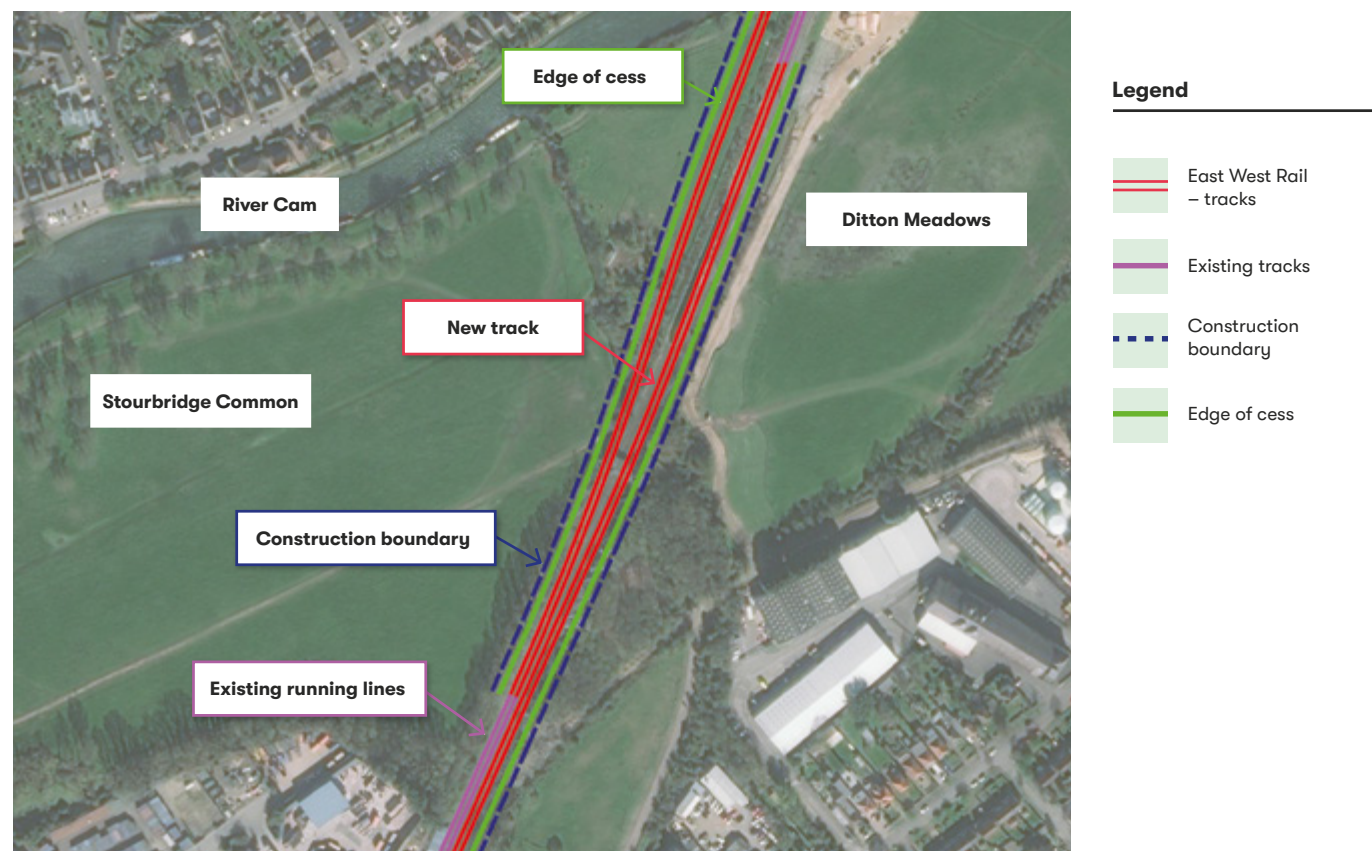


Figure 38: Cambridge approach option 2 - image 1

2.5.66. From right to left is the River Cam crossing, Stourbridge Common to the north of the railway, and Ditton Meadows to the south.

2.5.67. Stourbridge Common holds the status of Access Land – Combined Open Country, Registered Common Land and Section 16 Dedicated Land and is likely to require a Special Parliamentary Procedure in order to get permission to build on this land. This is a lengthy process with no guarantee of success, which significantly increases the risk of a delay to the project. In addition, as set out above, the fact that an approach into Cambridge from the south would not require this land to be developed at all adversely affects the possibility of the necessary consent being granted.



Figure 39: Cambridge approach option 2 - image 2

2.5.68. With the railway corridor widening to the east, the Barnwell Siding (currently out of use) will be removed and the boundary line of the railway moved to the edge of the road named Barnwell Junction. The A1134 overbridges would need to be closed, demolished and rebuilt causing significant disruption in Cambridge. It is possible that one of the bridges will need to be raised, due to electrification clearances, which could have an additional significant impact on the land needed. The Grade 1 Leper Chapel is very close and the new track on the east side will bring the railway closer to it. The extension of the railway boundary would affect the setting of this chapel as well as other properties along the road.



2.5.69.



Figure 40: Cambridge approach option 2 - image 3

2.5.70. Commercial properties along the east side of the corridor between the A1134 Newmarket Road and Coldham's Lane are impacted as the new railway boundary will encroach on Coldham's Road, which serves as the only point of access. Commercial properties to the west are also impacted and demolitions required to accommodate the proposed track on that side of the corridor between the Big Yellow Storage company and Coldham's Lane.



Figure 41: Cambridge approach option 2 - image 4

2.5.71. The new track to the west will utilise the existing Down Goods Loop. Therefore, there is minimal widening of the corridor and commercial properties to the west side of the corridor between Coldham's Lane and southern end of the Down Goods Loop are not anticipated to be directly impacted by the works





Figure 42: Cambridge approach option 2 - image 5

2.5.72. The area shaded yellow in Figure 42 represents a new development area on which construction of residential apartments has commenced; the new track would need land from this site.

#### Section conclusion

2.5.73. Option 1 is simpler to construct from a railway perspective as the construction area could be fenced off from the existing running lines. However, significantly more building demolition would be required, both residential and commercial with approximately 45 buildings directly impacted. It would not have an impact on the Grade 1 Leper Chapel and it would have less impact on the operational railway during construction.

2.5.74. Option 2 would not require as much demolition of buildings as Option 1 with approximately 13 buildings directly impacted, but would require alterations to Coldham's Junction, impacts to existing sidings and more work to be completed in possessions as it involves working within the existing operating lines. This option would also encroach further into the setting of the Grade 1 listed chapel. This option is likely therefore to take longer to construct than Option 1 and cause more disruption to existing rail services.

2.5.75. Options 1 and 2 would both cause significant road disruptions to Cambridge due to the road bridge closures and rebuilds. Traffic diversions would likely need to be in place for a significant time until all works were complete. Accessibility to the bridge sites and construction area are very tight. The replacement of the A1134 Newmarket Road bridge carries significant risks and complexity, particularly due to its proximity to a Grade 1 Listed Chapel. This has an impact on both options.

2.5.76. It is not possible to conclude which of the two options would be preferred as both options are complicated, expensive and disruptive to Cambridge. As such, both options have been used to conduct a factual comparison against the southern alignment.

Ability to head further east, to Ipswich and Norwich, in the future

#### Newmarket Line chord

2.5.77. The Newmarket Line is made of a single track connecting to the WAML at Coldham Lane Junction. Access to the northern end of Coldham's Road is via Laundry Lane level crossing. Line speed of the junction is 25mph.

2.5.78. The CBRR proposal includes a northern chord connecting the WAML to the Newmarket Line) through Coldham's Common to enable services to continue east if not stopping at Cambridge. The CBRR proposal starts the chord north of the A1134 Newmarket Road, encroaches even further into the setting of the Leper Chapel and passes through Barnwell Lake.

2.5.79. However, it is feasible to provide a 25mph chord that starts south of the A1134 and avoids the lake and the setting of the Leper Chapel. This results in the demolition of some commercial properties at the northern end of Coldham's Road. It is assumed the Newmarket Line would be double tracked, but a single-track northern chord is likely to be sufficient. A two-track northern chord would result in a lower line speed and further land take at Coldham's Common. Figure 43 shows the single-track northern chord.

2.5.80. Further operational analysis would be required to understand if the new chord would need to be grade separated so as to not have an impact on the mainline services when trains move onto the EWR down line.

2.5.81. Coldham's Common holds the status of Access Land – Combined Open Country, Registered Common Land and Section 16 Dedicated Land amongst and as such, would require a Special Parliamentary Procedure to get permission to build on this land. This is a lengthy process and one that is difficult to get permission, which greatly increases the risk of delay to the project. It is unlikely that permission would be granted to be able to build this chord, especially because these works are not required if services approach Cambridge from the south.

Figure 43: Newmarket Northern chord



2.5.82. The southern approach would not need a new chord at Coldham's Common for services via Newmarket making the number of infrastructure interventions, and disruptions to existing rail and possible road services, fewer than approaching from the north. The existing chord at Coldham's Common would most likely need to be twin tracked from its existing single track arrangement, but this would entail the reinstatement of the previous twin track railway and the corridor is still available without encroaching further on the Common. This would allow trains to head to Cambridge station and onwards towards Oxford.

2.5.83. An alternative to a new chord on the Newmarket Line would be to include a northern chord where EWR joins the WAML at Milton and a southern chord at Ely. A chord at Milton would not be required if trains approach Cambridge from the south rather than along a northern route. Figure 44 indicatively shows where the Ely chord would be located. These chords would allow freight services to use EWR infrastructure north of Cambridge where freight paths are via Newmarket, to Ely and south to Cambridge rather than directly from Newmarket to Cambridge. Journey times for both passenger services and freight from Ipswich/Felixstowe would be longer when going via Ely due to the longer route length. The additional land take required for a chord at Ely would have to be justified given that an alternative, of approaching Cambridge from the south, exists that would not need this extra land.

Figure 44: Ely chord



2.6. Test against Project Objectives

- 2.6.1. Selecting a route that approaches Cambridge from the north is capable of meeting all Project Objectives except:
- Turning back out of Cambridge station, may need to be accepted as a way in which trains can head east to Norwich, Ipswich and other destinations in the future which is not a preferred operational move due to significant restrictions – it would be highly imprudent to design a brand-new, high-frequency service with a reversing move included, as this would be designing risk and fragility into the service.

3. Comparison to approaching Cambridge from the south, via the Shepreth Branch

3.1. Comparison of factual data

- 3.1.1. The two northern approach options have been treated as one option to compare with a southern approach to Cambridge for a number of factual fields.

General

All quantities taken from Cambourne station to Cambridge station using Geospatial Information Systems	Southern approach	Northern approach
Operational alignment length	23.7 km	24.6 km
Built length in flood zone	830 m	4735 m
Total length of viaduct	1.1 km	3.4 km
Number of built up areas intersecting 500m buffer of alignment (ONS Census 2011 data)	9	4
Length of railway in Cambridge wards	2.8 km	4 km
Number of properties within 200m of alignment (Address Base Premium – Ordnance Survey Data)	3,800	4,600
A road crossings (new infrastructure required)	4	5
B road crossings (new infrastructure required)	2	1
Minor road crossings (new infrastructure required)	11	9
Guided busway crossings (new infrastructure required)	0	1



Environment and Heritage

All quantities taken from Cambourne station to Cambridge station using Geospatial Information Systems	Southern approach Alignment + 10m buffer	Northern approach Alignment + 10m buffer
SSSI	0	0
SAC	0	0
Scheduled monument	2	0
Listed buildings – grade 1 and 2*	0	0
Listed buildings – grade 2	0	0
Priority Habitat	14	8
Wildlife Trust	0	0
Local Nature Reserve	0	0
Properties	5	40 - 85

- 3.1.2. The relative performance of the two approaches to Cambridge can be compared in relation to these parameters. EWR Co continues to consider that a southern approach performs better than a northern approach even though in linear terms they are comparable in length (southern approach 23.7km, northern approach 24.6km).
- 3.1.3. However, the southern approach would comprise far less infrastructure in flood zones (830m) than the northern approach (4735m). This is important as additional embankment and viaduct would be needed for the northern route (3400m) in comparison with the southern route (1100m). The northern route would have greater embedded carbon and require far more imported materials as a result. It would be higher level and so have a greater visual impact.
- 3.1.4. The southern route is closer to more settlements (nine), whilst the northern route is close to five settlements. However, more of the northern route would be within the built up area of Cambridge itself – by 1.2km. With 1200 more properties within 200m of the alignment there is a greater likelihood of amenity impacts resulting from a northern route as well.
- 3.1.5. The two approaches interact with more-or-less the same number of road crossings. However, the northern approach would require more works in the Cambridge urban area and cause greater disruption than the southern approach and the complex and visually prominent new crossing of the A14

Southern approach Alignment + 2km buffer	Northern approach Alignment + 2km buffer
4	1
0	0
13	9
92	106
43	44
984	1090
3	1
10	12
60,200	73,500

- near Bar Hill – which is an eight-lane dual carriageway in this location – is required only for a northern approach, not a southern one.
- 3.1.6. In terms of natural environment impacts, noting the comments at paragraphs 2.4.2-3 in relation to European Sites, the southern approach is closer to more designated SSSI sites and the Wimpole and Eversden Woods SAC (discussed above). A northern approach is close to more priority habitats and Local Nature Reserve sites. Since the northern approach is less likely to interact with the SAC, but mitigation is assumed to be available for the southern approach, at this stage for comparison purposes it is assumed that mitigation is also available for impacts on designated sites from the northern approach.
- 3.1.7. In heritage terms, the southern approach is also closer to more scheduled monuments, although the northern route is closer to more listed buildings. Heritage does not assist in distinguishing between the northern and southern approaches.
- 3.1.8. It is in relation to impacts on properties that a strong distinction can be drawn. The northern approach affects dramatically more residential and commercial properties (40-85) than a southern approach (5). This difference is afforded particular weight in the back-check undertaken and strongly favours a southern approach.is afforded particular weight in the back-check undertaken and strongly favours a southern approach.

## 4. Conclusion

- 4.1.1. Since the decision to prioritise a southern approach to Cambridge, new information about the potential alignments for EWR north of the proposed A428 Scheme and serving a Cambourne North station mean that it is necessary and appropriate to check that the decision remains sound.
- 4.1.2. Based upon other information available, including the factual comparisons described above, a high level qualitative comparison, sufficient for considering whether the previous decision to favour a southern approach remains sound, shows that the northern approach:
- Is very slightly longer than the southern approach by approximately 1 km and, with an additional station stop at Oakington for Northstowe, it will have a longer journey time. If the station at Oakington were to be removed, the journey times would be approximately the same.
  - In comparison with serving Cambridge South, the northern approach is less likely to be able to recognise many benefits from an Oakington station because much of the planned housing at that location has already been granted permission or, for those phases that are still awaiting permission, there is no requirement for the railway to be built in order to get permission.
  - Northstowe is already served by public transport in the form of the guided busway. There is a stop at Oakington, very close to where the new railway station would be located. The guided bus goes from Oakington every 20 mins during the week and is timetabled to take 12 mins to get to Cambridge North station and more frequent services to the city centre. EWR services calling at Oakington for Northstowe and then Cambridge North and Cambridge would be duplicating existing public transport, not complimenting.
  - The track will need to be on viaduct for some sections between Cambourne and the WAML due to the number of roads and flood zones to cross. The ground is also known to be wet and difficult to build on (platform extensions at Waterbeach required substantial foundations to deal with the poor ground conditions). This is likely to lead to a requirement to have more substantial foundations and increased earthwork stabilisation. This would affect construction costs, maintenance costs, safety, and environmental considerations.
  - The WAML sections are potentially significantly extremely complex with 39 – 84 property acquisition and demolitions (depending upon which option), a complex level crossing closure, a new bridge over the River Cam and several key road bridges to replace. The property acquisitions are of a nature that are not required for the southern approach.
  - Every road bridge in the city that crosses the railway north of Cambridge

station would require modification or demolition and rebuilding causing significantly more disruption to Cambridge and increasing the cost. The bridges affected are the A14, A1134, Coldham's Lane and Mill Road. This is in comparison to approaching from the south where only one bridge would need replacing (Long Road). These bridge works will be complex due to diversions and construction areas being more complex in built up areas.

- A Grade 1 listed chapel may be impacted by the works to replace the A1134 road bridge and there is a risk that the setting will be impacted in a way that permission to build will be delayed or not approved. A small strip of land on Stourbridge Common will also be required. Stourbridge Common holds the status of Access Land – Combined Open Country, Registered Common Land and Section 16 Dedicated Land and is likely to require a Special Parliamentary Procedure in order to get permission to build on this land.
  - Cambridge North station will require significant infrastructure and systems modifications, including new platforms, whereas Cambridge South station will only need minimal updates in order to enable EWR services to operate. This will result in greater service disruptions at Cambridge North and compensation costs.
  - Passenger trains would need to reverse out of Cambridge station in order to be able to head further east in the future – this is not an optimal operational solution due to longer dwell times at Cambridge and increased chance of delay possibilities.
- 4.1.3. It should be noted that the northern approach does avoid the Mullard Radio Astronomy Observatory and is further away from the Wimpole SAC. However, the impacts on both of these assets are predicted to be capable of mitigation, subject to detailed design and – in the case of the SAC – assessment.
- 4.1.4. As such, the northern approach does not perform as well operationally, is not as easy to construct, will take longer to build, will therefore be more expensive to build, has lower transport user benefits and impacts more people, directly and indirectly, when compared to the southern approach. Therefore, in the view of EWR Co, the decision to prioritise a southern approach into Cambridge remains correct.

