

Oxford to Cambridge Expressway
Corridor Assessment Report
***Appendix H: Construction Detailed
Corridor Assessment***

PCF Stage 1

May 2018

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1. Introduction

1.1 Overview

The Oxford to Cambridge Expressway is a major highways project with the strategic aim of addressing poor east-west connectivity between towns and cities in the 'Brain Belt' region, inclusive of Oxford, Cambridge and Milton Keynes, through the provision of a new highway that connects the three cities.

The Oxford to Cambridge Expressway strategic study: stage 3 was undertaken to investigate the case for linking existing roads between Oxford and Cambridge, and to a strategic east-west road link to improve connectivity between the regions. This report proposed that the existing dual carriageways of the A34 from the M4 to Oxford and the A421 and A428 from the M1 to M11 are utilised for the expressway. For the remaining length of the project, three shortlisted expressway corridor options from Oxford to Milton Keynes were identified, this section of the expressway is referred to as the 'Missing Link'. Refer to Figure 1.1 below for overview of the proposed corridor options from the strategic study. All options would require both on-line upgrading of existing carriageway and the provision of new off-line carriageway.

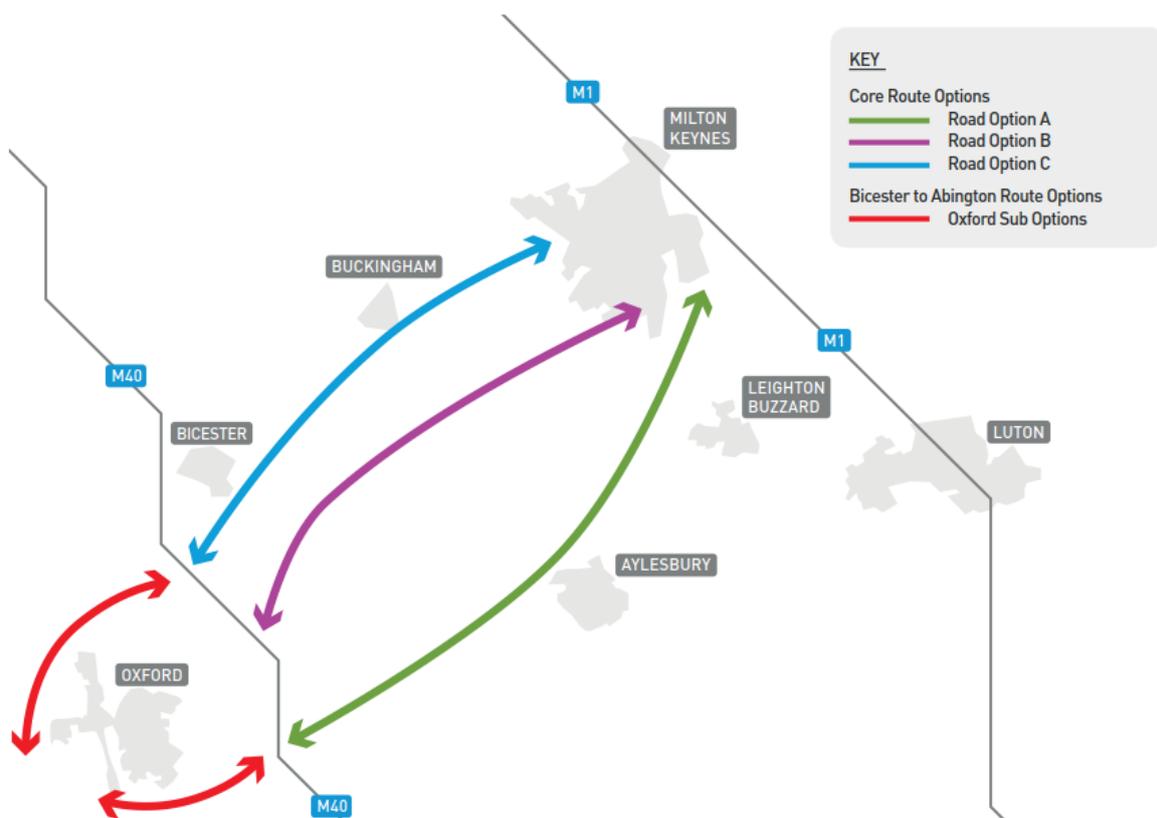


Figure 1.1 : Proposed Corridor Options from the Oxford to Cambridge Expressway strategic study: stage 3

1.2 Purpose of this document

The principal aim of the project is to develop a range of interventions for a new expressway linking Oxford, Milton Keynes and Cambridge that are likely to achieve or contribute to achieving the objectives, detailed in section 2 of the Corridor Assessment Report (CAR). The specific constructability objectives of the project are:

- To identify any significant *obstacles or constraints* that could affect project delivery, with the intention of reducing the constraint through the assessment of *construction processes* to ultimately achieve better buildability; or prevent errors, delays, and cost overruns; and
- to identify through assessment, the *safety performance of the project delivery*.

We are undertaking this study as Project Control Framework (PCF) Stage 1, which has been broken into 2 elements;

- PCF Stage 1A as the recommendation of a preferred corridor
- PCF Stage 1B as the identification of route options within the preferred corridor

PCF Stage 1A focuses on analysing the Oxford to Cambridge Expressway strategic study: Stage 3 Report to produce the CAR such that we can make an informed decision on the preferred corridor to be taken forward to PCF Stage 1B.

PCF Stage 1B will then develop refined route options within the chosen corridor to take forward to the next stage PCF Stage 2: Option Selection.

The aim of this Construction Corridor Assessment is to identify the key construction constraints for each of the corridor options, as well as the potential mitigation measures and opportunities at high level. The outcome of this Construction Corridor Assessment will identify the relative performance of each corridor based on assessment of constraints and potential mitigation options against construction processes. Refer to Appendix A for further detail around constraints and construction processes.

2. Methodology

2.1 Assessment process

The following describes the methodology behind the assessment of constructability for each corridor and the approach to the ranking of the relative performance. The obstacles and constraints considered in the assessment include:

- Airfields
- Rail Crossings
- Current and future known housing developments
- Utilities to include gas and electric transmission networks
- Communities
- Hydrology
- All road crossing points
- The density of constraints
- On-line vs off-line construction. 'On-line' means works that sit within the areas of existing highway, for example an existing section of road that needs to be excavated for realignment purposes. 'Off-line' means works that sit outside the existing highway, typically in adjacent or non-built-up land.

The construction processes considered are:

- Health, Safety & Welfare during construction, including the safety performance of the project delivery.
- Site logistics management – to ensure that required construction activities are carried out without delays caused by materials being delivered to site.
- Space to construct including site mobilisation
- Level of interface and coordination (with stakeholders)
- Potential design and construction alternatives

Information was gathered through a desktop study to establish the significant constraints present throughout the corridors. Other sources utilised in this assessment have included data both of environmental and geographical features in the landscape and also existing and planned future infrastructure. Key data sources include;

- Oxford to Cambridge Expressway strategic study: stage 3
- Design Manual for Roads and Bridges (DMRB)

The study areas are described in section 3 of the CAR. A dedicated approximate quarter-mile-wide strip study area was also used along the centre of the corridors to help evaluate the direct impact on construction activity to a theoretical carriageway.

Mapped reference segments along the corridors were evaluated to identify specific constraints. The reasons for approaching the evaluation on a segmented basis was to:

- approach the assessment on a manageable scale
- ensure the appraisal has definition
- identify key problem areas along the corridors and whether those problems could be mitigated

The assessment based findings on technical constraints which focused on the practicality of building methods and standards. Social and environmental constraints were also considered to include the potential nuisances caused through construction activity such as: noise, vibration, dust and the likely impacts on traffic and transport mainly through “on-line” works activities.

The assessment was broken down into two steps. Step one identified the constraints and their significance through the relationship between proximity and magnitude. Step two identified threats and opportunities through evaluation of construction processes.

Proximity represented:

- the position of a constraint in relation to the centre of the study area and the theoretical position of a proposed carriageway construction. A constraint positioned closer to the centre was likely to represent a greater threat opposed to a position located at a distance.

Magnitude represented:

- the scale and effect of the proximity in relationship to the technical, social and or environmental constraints.

Construction processes represented:

- key procedures required to carry out the build of a project.

The findings to this assessment to both step one and two used a 7-point scoring scale as shown in the tables below. The purpose of this approach was to allow differentiation of the varying constraints across the areas being appraised.

Table 2-1 : The step one 7-point scale used to determine the levels of both proximity and magnitude

Score colour code	7-point effect scale
7	Significant adverse effect
6	Potential significant adverse effect
5	Slight adverse effect
4	Neutral
3	Slight beneficial effect
2	Potential significant beneficial effect
1	Significant beneficial effect

The scores to both magnitude and proximity were multiplied together to produce an overall score, the achievable score range was between 1 and 49.

We were only concerned with areas of 'significant constraint' and therefore only took forward onto step 2 an overall score between 21 and 49.

The overall score and findings from step one were evaluated against construction processes to see whether or not we could mitigate against the significant constraints. The evaluation implied that the constraint in the study area could not be removed all together, but reduced.

Table 2-2 Step two 7-point scale arrangement was used to determine the levels of possible mitigation against the constraints identified in step one.

Score Colour Code	Level of reduction through mitigation	7-point effect scale
7	1	Unlikely to be able to mitigate
6	0.9	Mitigation may be possible
5	0.8	Effect not significant with typical mitigation
4	0.7	No effect or a neutral effect due to the balancing of positive and negative effects
3	0.6	Slight beneficial effect
2	0.5	Potential beneficial effect (opportunity)
1	0.4	Significant beneficial effect (likely)

A number of 1 to 0.4 was applied dependent on the level of mitigation available. If there was no option to mitigate a factor of 1 was applied as opposed to a factor of 0.4 in which a significant beneficial effect was likely.

The two assessment steps were multiplied together to produce an overall score for each corridor.

For the qualitative scoring and descriptions made to the assessment, please refer to the Construction Corridor Assessment.

3. Construction assessment of corridors

3.1 Common Corridors

For all corridors, there are two areas commonly represented, east and west of the 'Missing Link' respectively. The western common corridor is located between the M4 and Abingdon, loosely following the existing A34. The eastern common corridor is from the M1 junction 13, loosely following the existing A421, A1 and A428 to the M11 junction 14. These common corridors are likely to represent primarily on-line works including the widening and development of existing roads.

The Common Corridors construction assessment has been conducted on the assumption that the existing road network will be utilised for the Oxford to Cambridge Expressway. As such, this presents challenges around the requirement for on-line works due to the proximity of neighbouring constraining infrastructure.

The following significant constraining factors are present in the common corridor areas; airfields, rail, towns, roads, on-line / off-line construction and utilities.

- Two airfields are present less than 2 miles from the centre of the common corridors; Dalton Barracks (<1000 ft.) and Cambourne Airfield (directly adjacent). It should be noted that in March 2013, the Ministry of Defence announced that 12 Logistic Support Regiment stationed at Dalton Barracks would be disbanded, with the site closing completely in 2029. Certain construction activities may be affected from height restrictions placed by the airfields, including cranes.
- There are a number of rail crossing points along the proposed common corridors of the expressway. Firstly, at the existing overbridge at the Great Western Rail crossing point where the proposed corridor follows the A34, east of Didcot. Secondly, there are 2 rail crossing points, one under and one over the existing road, south of Bedford. In addition, there is a proposed new central East West Rail (EWR) crossing point. Finally, there is a rail crossing point south of St Neots, where the railway currently supports Great Northern, Southern, and Thameslink services.
- The town of St Neots is located within 2 miles of the proposed corridor.
- A large number of road users may be affected by the construction of the common corridors, potentially resulting in a level of traffic disruption. Full road closure may be required for some stages of works. There are a number of over and under bridges likely to require demolition and reconstruction or in situ widening where feasible. Some sections of widening of the existing carriageway may present challenges associated with the close proximity of properties.
- The common corridors are likely to be predominantly constructed on-line, with widening of existing roads, and upgrading of existing structures occurring. The on-line aspect of the construction of these common section is likely to involve high levels of traffic management and phasing work due to the interface between construction operations and live traffic.
- A large number of utilities are likely to be impacted by the construction along the common corridors. Two known power lines cross the proposed corridor at the

A34, as well as a substation located at St Neots. Pylons are present in the common corridors, and in addition, a number of gas assets cross the common corridors. Utility diversions are likely to be required around the area prior to construction works commencing.

It is important to note the mitigation measures against the key constraints noted above for the common corridors. These include but are not limited to;

- Early involvement with Network Rail to mitigate to against any construction delays.
- Phasing of on-line works to minimise congestion to road user and communities.
- Early engagement with utility providers to ensure the design and safe working methods are in place in advance of the main construction works and procurement of critical, specialist materials.
- Potential to move the corridor further south in Section 9a, away from St Neots residential areas, to allow for further off-line construction.

3.2 Corridor A

This corridor begins west of Abingdon and passes south of Oxford junction 8A of the M40, where it then loosely follows the existing A418 past Aylesbury towards the M1.

Corridor A performs well but not quite as well as one of the other corridor options. There are moderate levels of significant constraints identified within the corridor, with a neutral level of mitigation. The score for Corridor A is therefore Green.

The following significant constraining factors are present in the area of Corridor A; rail, access to villages, access to cities, schools, roads, potential on-line construction, and utilities.

- There are 5 rail crossing points along Corridor A. There is an existing East-West Rail line which cross the corridor north of Radley, and near Apsley Guise Station, the Chiltern Main rail line crosses near Haddenham and north west of both Aylesbury and Leighton Buzzard. In addition to the 5 existing rail line crossings, the HS2 route is proposed to intersect Corridor A near Aylesbury.
- There are a number of villages that may have access impeded by the proposed construction of Corridor A, with those closer to interchanges more likely to be affected. A number of villages are also directly along Corridor A, which are likely to be affected by construction.
- Traffic access and egress to the city of Oxford is likely to be affected throughout the construction works.
- There are 4 schools within half a mile of the centre of Corridor A – Manor preparatory, Larkmead, St Helens, and Chilworth.
- There is potential for a moderate level of on-line construction for Corridor A. A large number of main roads are likely to be affected throughout the construction as a result of crossing of existing major roads and partial on-line works. Full road

closure may be required for some stages of works. Several bridges along the corridor are likely to require removal or replacement.

- A large number of utilities are likely to be impacted by construction along proposed Corridor A. There is a substation approximately 0.4 miles north of proposed corridor, and a number of power lines that run in close proximity to the corridor. Of note, Cowley Substation which is located in close proximity. In addition, 4 gas pipelines cross the proposed corridor.

It is important to note the mitigation measures against the key constraints noted above for Corridor A. These include but are not limited to;

- Early involvement with Network Rail to mitigate to against any construction delays.
- Phasing of on-line works to minimise congestion to road user and communities.
- Early engagement with utility providers to ensure the design and safe working methods are in place in advance of the main construction works and procurement of critical, specialist materials.
- Early measures in place to manage potential construction impacts in school locations.

Within Corridor A, there are also opportunities to improve the construction process;

- Potential opportunity to tunnel under heritage sites (circa 400 - 800m).
- Potential to utilise land adjacent existing roads to reduce amount of any potential on-line construction works.
- Potential to locally raise the vertical alignment of the carriageway over gas pipelines to ensure sufficient cover.

3.3 Corridor B1

Corridor B1 begins west of Abingdon and heads north past the east of Oxford, loosely following the A34 to the south of Bicester. From the south of Bicester, the corridor passes east towards Milton Keynes, joining the M1 at junction 13.

Corridor B1 is the best performing from a constructability aspect. There are moderate levels of significant constraints identified within the corridor, but fewer than Corridor A, with a neutral level of mitigation. As such, this corridor has been scored as Green.

The following significant constraining factors are present in the area of Corridor B1; airfields, rail, access to cities, current and future developments, roads, potential on-line construction, utilities and hydrology.

- Corridor B1 passes through 1 airfield - the existing Dalton Barracks Airfield. Certain construction may be affected from height restrictions placed by the airfields, including cranes. It should be noted that in March 2013, the Ministry of

Defence announced that 12 Logistic Support Regiment station at these barracks would be disbanded, with the site closing completely in 2029.

- There are 8 existing rail crossing points along Corridor B1. There is an existing Greater-Western Rail line crossing the corridor south of Peartree Interchange, 2 minor freight rail lines south of Bicester, 2 rail line crossings east of Bicester, 2 rail crossing points in close proximity to the A4146 near Bletchley, and finally the existing East-West Rail (EWR) crossing point near Woburn Sands. In addition to these existing rail crossings, the proposed EWR line runs parallel to the centre of Corridor B1 for 12 miles. In addition to the 8 existing rail line crossings, the HS2 route is proposed to intersect Corridor B1 between Bicester and Winslow.
- Traffic access and egress to the cities of Oxford and Milton Keynes is likely to be affected throughout the construction works.
- The proposed Corridor B1 passes in an area of Current and Future Development which is classified as a "Site Under Construction and in Planning Application". At the time of this assessment, the type of the development is "Residential" and the status is "Under Construction".
- There is potential for a moderate level of on-line construction for Corridor B1. A large number of main roads are likely to be affected throughout the construction as a result of crossing of existing major roads and partial on-line works. Full road closure may be required for some stages of works. Several bridges along the corridor are likely to require removal or replacement.
- A number of utilities are likely to be impacted by construction along proposed Corridor B1. There is a substation within the corridor area, approximately 1.2 miles south west of Winslow, with likely multiple pylons and cables in the vicinity. In addition, within the Corridor B1 area, there are existing high voltage overhead distribution lines which would require consideration throughout construction.
- There are three hydrological constraints on Corridor B1 - the River Thames (approx. 82ft wide), River Cherwell (approx. 46 ft. wide), and Wolvercote Mill Stream and Seacourt streams (approx. 16 ft. wide).

It is important to note the mitigation measures against the key constraints noted above for Corridor B1. These include but are not limited to;

- Potential to utilise land adjacent existing roads to reduce the amount of potential on-line construction.
- Early involvement with Network Rail to mitigate to against any construction delays.
- Phasing of on-line works to minimise congestion to road users and communities.
- Early engagement with utility providers to ensure the design and safe working methods are in place in advance of the main construction works and procurement of critical, specialist materials.

Within Corridor B1, there are also opportunities to improve the construction process;

- Potential use of existing Dalton Barracks for site compound and project offices.
- Potential use of railway for deliveries.
- Potential to relocate the large number of high voltage overhead lines to underground.

3.4 Corridor B2

The corridor begins to the west of Abingdon, and passes south of Oxford towards Bicester. From the south of Bicester, the corridor passes east towards Milton Keynes, joining the M1 at junction 13.

Corridor B2 is lesser performing and returns a lower score against the constructability objectives. There are high levels of significant constraints identified within the corridor, with a neutral level of mitigation. The score for Corridor B2 is Amber.

The following significant constraining factors are present in the area of Corridor B2; rail, access to villages, access to cities, access to schools, current and future developments, roads, potential on-line construction, and utilities.

- There are 6 rail crossing points along Corridor B2. There is an existing East-West Rail (EWR) line which will cross the corridor north of Radley, the St George Barracks rail line for military storage and distribution near Bicester, 2 rail crossing points in close proximity to the A4146 dual carriageway near Bletchley, and finally the existing EWR crossing point near Woburn Sands. In addition to these existing rail crossings, the proposed EWR line runs parallel to the centre of Corridor B2 for 12 miles. In addition to the 6 existing rail line crossings, the HS2 route is proposed to intersect Corridor B2 between Bicester and Winslow.
- A number of villages, including Arnot, where the St Georges Barracks are located, is likely to be impacted by construction of Corridor B2.
- Traffic access and egress to the cities of Oxford and Milton Keynes is likely to be affected throughout the construction works.
- There are 4 schools within half a mile of the centre of Corridor B2 – Manor preparatory, Larkmead, St Helens, and Chilworth.
- The proposed Corridor B2 passes in one area of Current and Future Development which is classified as a "Site Under Construction and in Planning Application". As of the time of this assessment, the type of the development is "Residential" and the status is "Under Construction".
- There is potential for a low level of on-line construction of Corridor B2. A number of main roads are likely to be temporarily affected for construction of crossings. Full road closure may be required for some stages of works. Some bridges along the corridor are likely to require removal or replacement.
- A number of utilities are likely to be impacted by construction along proposed Corridor B2. There is a substation approximately 900 ft. north of corridor centre,

another 1.2 miles south of the corridor centre and a number of existing overhead power lines (high and low voltage) that run in close proximity to the corridor centre. Within the Corridor B2 area, there are existing high voltage overhead distribution lines which would require consideration throughout construction.

It is important to note the mitigation measures against the key constraints noted above for Corridor B2. These include but are not limited to;

- Potential to utilise land adjacent existing roads to reduce the amount of potential on-line construction.
- Early involvement with Network Rail to mitigate to against any construction delays.
- Phasing of on-line and crossing point works to minimise congestion to road users and communities.
- Early engagement with utility providers to ensure the design and safe working methods are in place in advance of the main construction works and procurement of critical, specialist materials.

Within Corridor B2 there are also opportunities to improve the construction process;

- Potential use of existing barracks for site compound and project offices.
- Potential use of railway for deliveries.
- Potential to relocate the large number of high voltage overhead lines to underground.
- Potential to use the Cowley freight loop rail link for deliveries.

3.5 Corridor B3

The corridor begins to the west of Abingdon, and passes south of Oxford towards Junction 8A of the M40, then towards Bicester. From the south of Bicester, the corridor passes east towards Milton Keynes, joining the M1 at junction 13.

Corridor B3 is expected to perform similarly to Corridor B2. As such the score for Corridor B3 is also Amber.

The following significant constraining factors are present in the area of Corridor B3; rail, access to villages, access to cities, access to schools, and current and future developments, roads and utilities.

- There are 6 rail crossing points along Corridor B3. There is an existing East-West Rail (EWR) line which will cross the corridor north of at Radley, the St George Barracks rail line for military storage and distribution near Bicester, 2 rail crossing points in close proximity to the A4146 dual carriageway near Bletchley, and finally the existing EWR crossing point near Woburn Sands. In addition to these existing rail crossings, the proposed EWR line runs parallel to the centre of Corridor B3 for

12 miles. In addition to the 6 existing rail line crossings, the HS2 route is proposed to intersect Corridor B3 between Bicester and Winslow.

- A number of villages, including Arnot where the St Georges Barracks are located, are likely to be impacted by construction of Corridor B3.
- Traffic access and egress to the cities of Oxford and Milton Keynes is likely to be affected throughout the construction works.
- There are 4 schools within half a mile of the centre of Corridor B3 – Manor preparatory, Larkmead, St Helens, and Chilworth.
- The proposed Corridor B3 passes in one area of Current and Future Development which is classified as a "Site Under Construction and in Planning Application". As of the time of this assessment, the type of the development is "Residential" and the status is "Under Construction".
- There is potential for a low-moderate level of on-line construction of Corridor B3. In addition to the potential on-line construction, a number of main roads are likely to be temporarily affected for construction of crossings. It is likely a series of bridges will be removed and re-built on the on-line sections of construction. Full road closure may be required for some stages of works.
- A number of utilities are likely to be impacted by construction along proposed Corridor B3. There is a substation approximately 0.4 miles north of proposed corridor, another 1.2 miles south of the proposed corridor. Within the Corridor B3 area, there is an existing high voltage overhead distribution line which would potentially require consideration throughout construction.

It is important to note the mitigation measures against the key constraints noted above for Corridor B3. These include but are not limited to;

- Potential to utilise land adjacent existing roads to reduce the amount of potential on-line construction.
- Early involvement with Network Rail to mitigate to against any construction delays.
- Phasing of on-line and crossing point works to minimise congestion to road users and communities.
- Early engagement with utility providers to ensure the design and safe working methods are in place in advance of the main construction works and procurement of critical, specialist materials.

Within Corridor B3, there are also opportunities to improve the construction process;

- Potential use of existing barracks for site compound and project offices.
- Potential use of railway for deliveries.
- Potential to relocate the large number of high voltage overhead lines to underground.

3.6 Corridor C1

Corridor C1 follows a similar path to Corridor B1, however at Bicester heads north-east towards Buckingham, then back towards Bletchley, joining the M1 at junction 13.

Corridor C1 has a similar level of performance to corridors B2 and B3 and returns a lower score against the constructability objectives. There are high levels of significant constraints identified within the corridor, with a neutral level of mitigation. The score for corridor C1 is therefore Amber.

The following significant constraining factors are present in the area of Corridor C1; airfields, rail, access to villages, access to cities, and current and future developments, roads, potential on-line construction, and hydrology.

This is driven by the following significant constraining factors being present;

- The C1 Corridor passes through 1 airfield - the existing Dalton Barracks Airfield. Certain construction may be affected from height restrictions placed by the airfields, including cranes. It should be noted that in March 2013, the Ministry of Defence announced that 12 Logistic Support Regiment station at these barracks would be disbanded, with the site closing completely in 2029.
- There are 6 existing rail crossing points along Corridor C1. There is an existing Greater-Western Rail line crossing the corridor south of Peartree Interchange, 2 minor freight lines south of Bicester, 2 rail line crossings east of Bicester, 2 rail crossing points in close proximity to the A4146 dual carriageway near Bletchley, and finally the existing East-West Rail (EWR) crossing point near Woburn Sands. In addition, the proposed EWR line will cross Corridor C1 twice. In addition to the 6 existing rail line crossings, the HS2 route is proposed to intersect the corridor between Bicester and Buckingham.
- A number of villages are likely to be impacted by construction of Corridor C1.
- Traffic access and egress to the cities of Oxford and Milton Keynes is likely to be affected throughout the construction works.
- The proposed Corridor C1 passes in one area of Current and Future Development which is classified as a "Site Under Construction and in Planning Application". As of the time of this assessment, the type of the development is "Residential" and the status is "Under Construction".
- There is potential for a high level of on-line construction for Corridor C1. As such, a large number of roads are likely to be affected by the construction as a result of on-line works, and the crossing of existing major roads. Several bridges along the corridor are likely to require removal or replacement.
- There are three hydrological constraints on Corridor C1 - the River Thames (approx. 82ft wide), River Cherwell (approx. 46 ft. wide), and Wolvercote Mill Stream and Seacourt streams (approx. 16 ft. wide).

It is important to note the mitigation measures against the key constraints noted above for Corridor C1. These include but are not limited to;

- Potential to utilise land adjacent existing roads to reduce the amount of potential on-line construction.
- Early involvement with Network Rail to mitigate to against any construction delays.
- Phasing of on-line works to minimise congestion to road users and communities.
- Early engagement with utility providers to ensure the design and safe working methods are in place in advance of the main construction works and procurement of critical, specialist materials.

Within Corridor C1, there are also opportunities to improve the construction process;

- Potential use of existing barracks for site compound and project offices.
- Potential to relocate the large number of high voltage overhead lines to underground.

3.7 Corridor C2

Corridor C2 follows a similar path to Corridor B2, however at Bicester heads north-east towards Buckingham, then back towards Bletchley, joining the M1 at junction 13.

Corridor C2 jointly performs the least well against the constructability objectives, and the score reflects this. There are high levels of significant constraints identified within the corridor, with a neutral level of opportunity to improve safety performance. As such, the score for this corridor is also Amber.

The following significant constraining factors are present in the area of Corridor C2; rail, access to villages, access to cities, access to schools, and current and future developments roads, potential on-line construction, and utilities.

This is driven by the following constraining factors being present;

- There are 7 rail crossing points along Corridor C2. There is an existing East-West Rail (EWR) line which will cross the corridor north of Radley, the St George Barracks rail line for military storage and distribution near Bicester, 2 rail crossing points in close proximity to the A4146 dual carriageway near Bletchley, and finally the existing EWR crossing point near Woburn Sands. In addition, the proposed EWR line will cross Corridor C2 twice. In addition to the 7 existing rail line crossings, the HS2 route is proposed to intersect the corridor between Bicester and Buckingham.
- A number of villages are likely to be impacted by construction of Corridor C2.
- Traffic access and egress to the cities of Oxford and Milton Keynes is likely to be affected throughout the construction works.

- There are 3 schools within half a mile of the centre of Corridor C2 – Manor preparatory, Larkmead, and St Helens.
- The proposed Corridor C2 passes in one area of Current and Future Development which is classified as a "Site Under Construction and in Planning Application". As of the time of this assessment, the type of the development is "Residential" and the status is "Under Construction".
- There is potential for a moderate level of on-line construction for Corridor C2. A large number of main roads are likely to be affected throughout the construction as a result of crossing of existing major roads and partial on-line works. Full road closure may be required for some stages of works. Several bridges along the corridor are likely to require removal or replacement.
- A number of utilities are likely to be impacted by construction along proposed Corridor C2. There is a substation south-east of Oxford and existing high voltage overhead distribution lines which would require consideration throughout construction.

It is important to note the mitigation measures against the key constraints noted above for Corridor C2. These include but are not limited to;

- Potential to utilise land adjacent existing roads to reduce the amount of potential on-line construction.
- Early involvement with Network Rail to mitigate to against any construction delays.
- Phasing of on-line and crossing point works to minimise congestion to road users and communities.
- Early engagement with utility providers to ensure the design and safe working methods are in place in advance of the main construction works and procurement of critical, specialist materials.

Within Corridor C2, there are also opportunities to improve the construction process;

- Potential use of existing barracks for site compound and project offices.
- Potential use of railway for deliveries.
- Potential to relocate the large number of high voltage overhead lines to underground.
- Potential to use the Cowley freight loop rail link for deliveries.

3.8 Corridor C3

Corridor C3 follows a similar path to Corridor B3, however at Bicester heads north-east towards Buckingham, then back towards Bletchley, joining the M1 at junction 13.

Corridor C3 is expected to perform similar to Corridor C2. As such, the score is also Amber.

The following significant constraining factors are present in the area of Corridor C3; rail, access to villages, access to cities, access to schools, and current and future developments roads, potential on-line construction, and utilities.

- There are 7 existing rail crossing points along Corridor C3. There is an existing East-West Rail (EWR) line which will cross the proposed centre of the corridor north of at Radley, the St George Barracks rail line for military storage and distribution near Bicester, 2 rail crossing points in close proximity to Blackthorn Road, the existing EWR crossing point near Station Road, the rail crossing point in close proximity to the A4146 dual carriageway, and another EWR crossing point near Woburn Sands. In addition, the proposed EWR line will cross Corridor C3 twice. In addition to the 7 existing rail line crossings, the HS2 route is proposed to intersect the corridor between Bicester and Buckingham.
- A number of villages are likely to be impacted by construction of Corridor C3.
- Traffic access and egress to the cities of Oxford and Milton Keynes is likely to be affected throughout the construction works.
- There are 3 schools within half a mile of the centre of Corridor C3– Manor preparatory, Larkmead, and St Helens.
- The proposed Corridor C3 passes in one area of Current and Future Development which is classified as a "Site Under Construction and in Planning Application". As of the time of this assessment, the type of the development is "Residential" and the status is "Under Construction".
- There is potential for a high level of on-line construction for Corridor C3. As such, a large number of roads are likely to be affected by the construction as a result of on-line works, and the crossing of existing major roads. Several bridges along the corridor are likely to require removal or replacement.
- A number of utilities are likely to be impacted by construction along proposed Corridor C3. There is a substation south-east of Oxford and existing high voltage overhead distribution lines which would require consideration throughout construction.

It is important to note the mitigation measures against the key constraints noted above for Corridor C3. These include but are not limited to;

- Potential to utilise land adjacent existing roads to reduce the amount of potential on-line construction.
- Early involvement with Network Rail to mitigate to against any construction delays.
- Phasing of on-line and crossing point works to minimise congestion to road users and communities.

- Early engagement with utility providers to ensure the design and safe working methods are in place in advance of the main construction works and procurement of critical, specialist materials.

Within Corridor C3, there are also opportunities to improve the construction process;

- Potential use of existing barracks for site compound and project offices.
- Potential use of railway for deliveries.
- Potential to relocate the large number of high voltage overhead lines to underground.

4. Conclusion

From this assessment, Corridor B1 is the best performing corridor, with a moderate level of significant constraints identified, and a neutral level of mitigation. It should be noted that this is based on the ease of construction, taking into account the constraints, and also the potential mitigation and opportunities available for each corridor at this PCF Stage 1A assessment.

Table 4-1 : Construction Corridor Assessment

Corridor	Final Corridor Score	Level of performance
B1	Green	Corridor B1 is the best performing. There are moderate levels of significant constraints identified within the corridor, but fewer than Corridor A, with a neutral level of mitigation
A	Green	Corridor A performs well but not quite as well as one of the other corridor options. There are moderate levels of significant constraints identified within the corridor, with a neutral level of mitigation
B2	Amber	Corridor B2 is lesser performing and returns a lower score against this objective. There are high levels of significant constraints identified within the corridor, with a neutral level of mitigation
B3	Amber	B3 is expected to perform similar to B2
C1	Amber	Corridor C1 has a similar level of performance to corridors B2 and B3 and returns a lower score against this objective. There are high levels of significant constraints identified within the corridor, with a neutral level of mitigation
C2	Amber	Corridor C2 jointly performs the least well and the score reflects this. There are high levels of significant constraints identified within the corridor, with a neutral level of mitigation
C3	Amber	Corridor C3 is expected to perform similar to Corridor C2

While Corridor B1 has been identified as the best performing corridor, there are a number of constraints to note within the area. Specifically, north west of Oxford to the area around Peartree interchange includes several rail and road junctions which may present challenges for the on-line works, power transmission lines running alongside existing transport infrastructure and two rivers running parallel to the corridor. Construction to this area is likely to have a negative impact on traffic and the local communities.

The second best performing option, Corridor A, also has a number of constraints present within the area. Of note, the corridor is highly constrained in the area of the A34 north east of Abingdon. This is a result of schools, a hospital, the neighbouring Dalton Barracks and Oxford within the corridor area. On-line widening along the corridor is likely to have a negative impact on traffic. In addition, power transmission

lines running in close proximity to existing transport infrastructure are likely to provide a constraint to construction of Corridor A.

The third and fourth best performing corridors are Corridor B2 and B3 respectively. Both of these corridors contain the highly constrained area around the A34 north east of Abingdon which includes schools, hospital, neighbouring Dalton Barracks and Oxford. On-line widening along this area is likely to have a negative impact on traffic as will the main road crossings east of Oxford. In addition, a power transmission network runs in close proximity to existing transport infrastructure around Oxford.

After Corridors B2 and B3, Corridor C1 is the next best performing corridor. Key constraints include the region north west of Oxford to the area around Peartree interchange, and the large potential for on-line work between Bicester and Bletchley.

Finally, Corridors C2 and C3 jointly perform least well against the constructability objectives. The corridors include the key constraints north east of Abingdon and south of Oxford, the high potential for on-line work between Bicester and Bletchley, and the main road crossings.

Throughout the construction corridor assessment, the mitigations measures were generally neutral. A number of key mitigation measures and opportunities exist across the corridor, include;

- Early engagement with utility providers to ensure the design and safe working methods are in place in advance of the main construction works and procurement of critical, specialist materials.
- Early involvement with Network Rail to mitigate to against any construction delays.
- Phasing of on-line and crossing point works to minimise congestion to road users and communities.
- Potential to utilise land adjacent existing roads to reduce the amount of potential on-line construction.
- Locally raise the vertical alignment of the carriageway over gas mains to ensure sufficient cover.
- Tunnel under sensitive sites.
- Relocate high voltage overhead lines to underground.
- Use of existing barracks for site compound and project offices.
- Use of railway for deliveries.

This PCF Stage 1A Construction Corridor assessment provides a high level evaluation of the Corridor options. These will be taken forward into PCF Stage 1B and further developed.

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Appendix A. Assumptions and decisions

Constraints

Constraints can be identified in advance. The constraints are defined as “a constraining condition, agency, or force that limits the systems’ performance in a given context/environment.” (Mayer et al, 1995) & (Whelton et al, 2004).

There are five categories of constraint are:

- economic
- legal
- environmental
- technical
- social

For the assessment, in order of weighting, the technical, social and environmental are applied. There is also consideration for legal and economic factors such as time, cost, and quality. If the economic constraints for example, are not managed properly, the product/performance/function/quality may be affected.

The constraints are also measured against a theoretical assessment throughout the build phase with an application of the Expressway and the Design Manual for Roads and Bridges (DMRB) standards.

Technical constraints - The technical constraints generally refer to the processes involved in completing construction activities, and are often based on the practicality of building methods and standards rather than technical design issues. For example, in constructing a foundation, the specific site location must be level before excavation can take place; then formwork and reinforcement can be placed before concrete is poured. Each task must be completed before the next can begin; therefore, each task acts as a constraint on the next task.

Other technical constraints may relate to construction tolerances, space required for builder’s work, available storage or handling areas, site access routes, co-ordination of services and so on.

Environmental Constraints - To include the potential nuisances caused through construction activity such as noise, vibration, and dust. Also the impacts on traffic and transport mainly through the impact of “on-line” works activities.

Social constraints - To include factors that may arise as a result of wider interest in or opposition to a project.

Guidance in defining constraining factors has been sourced from:

Constraints on construction projects (2018). Designing Buildings Wiki Official Website. [on-line] Available at: [http:// designingbuildings.co.uk/](http://designingbuildings.co.uk/) [Accessed 20 02 Mar. 2018].

Construction Processes

A construction process represents a key procedure or process to enable the design and build of a structure or series of linked structures. If the processes are not managed correctly against any key constraining factors, it is expected this has an impact on the project performance.

Construction Logistics

Construction logistics or logistics management “is the process of planning, implementing and controlling supply chain resources, generally from the point of origin, such as raw material accumulation, to the point of destination, i.e. delivering goods to the correct location on the construction site.” Logistics management in construction (2018). Designing Buildings Wiki Official Website. [on-line] Available at: <http://designingbuildings.co.uk/> [Accessed 20 02 Mar. 2018].

Effective logistics management is important and can enhance efficiency and productivity, having a positive overall impact on cost and time. For example, good logistics management ensures the workforce are able to carry out required activities without delays caused by materials being delivered to site.

Space to construct and site mobilisation (set-up)

There must, so far as is reasonably practicable, be suitable and sufficient safe access to and egress from; every construction site to every other place provided for the use of any person whilst at work; and every place construction work is being carried out to every other place to which workers have access within a construction site.

The Construction (Design and Management) Regulations 2015 Part 4: Safe places of construction work, Chapter 17

Health Safety & welfare during construction (to include safety performance of the project delivery)

The Construction (Design and Management) Regulations 2015 (CDM) are intended to ensure that health and safety issues are properly considered during a project's development so that the risk of harm to those who have to build, use and maintain structures is reduced.

A constraining condition limits the organisations performance in a given environment. If the significant constraint is not therefore managed effectively in the context of a health and safety hazard, we can expect a greater potential to cause harm.

The assessment identifies significant constraint(s) and implies that relevant current legislative measures are required to manage and control any potential harm caused.

No direct consideration is made on the funding and budgeting for the management and control of health and safety.

Design or construction alternatives

To look at the practical elements of construction based on the DMRB and Expressway Standard and if necessary suggest alternative construction methods or design departures to improve performance, reduce cost, or overcomes a specific site problem.