
The Cambridge South East Transport Order

Transport And Works Act 1992

Transport And Works (Applications And Objections Procedure) (England And Wales) Rules 2006

Appendix 5.0 Pink Route Variant Alignment Technical Note

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Approved by:	E Mellor	Checked by:	M Payne
Subject:	Pink Route Variant Alignment Further Assessment		

1 Introduction

Mott MacDonald has been commissioned by the Greater Cambridge Partnership (GCP) to provide consultancy support for the Cambridge South East Transport (CSET) Phase 2 project. The project proposes a new dedicated Public Transport (PT) and active travel route between the Cambridge Biomedical Campus (CBC) and a new Travel Hub (known as the A11 Travel Hub) at the junction of the A11 and A1307.

In May 2020 the Brown Route presented in the 2019 public consultation was identified in the Outline Business Case (OBC) as the recommended preferred route alignment for the scheme. The OBC and this recommendation were approved by the GCP Executive Board in June 2020. The design for the preferred route alignment is currently being developed further alongside the Environmental Impact Assessment (EIA) of the scheme.

During a stakeholder meeting with Babraham residents on 30 November 2020 during the EIA Consultation on the preferred route, a query was raised by the residents regarding why a route alignment option running between the Brown and Pink Routes presented in the 2019 public consultation was not being considered.

Subsequently four responses to the EIA consultation which closed on 14 December 2021, were received that proposed and requested consideration of a variation to the Pink Route. This variation to the Pink Route is termed the Pink Route Variant in this note, and the alignment inferred from the residents' comments and the consultation responses is indicated below.

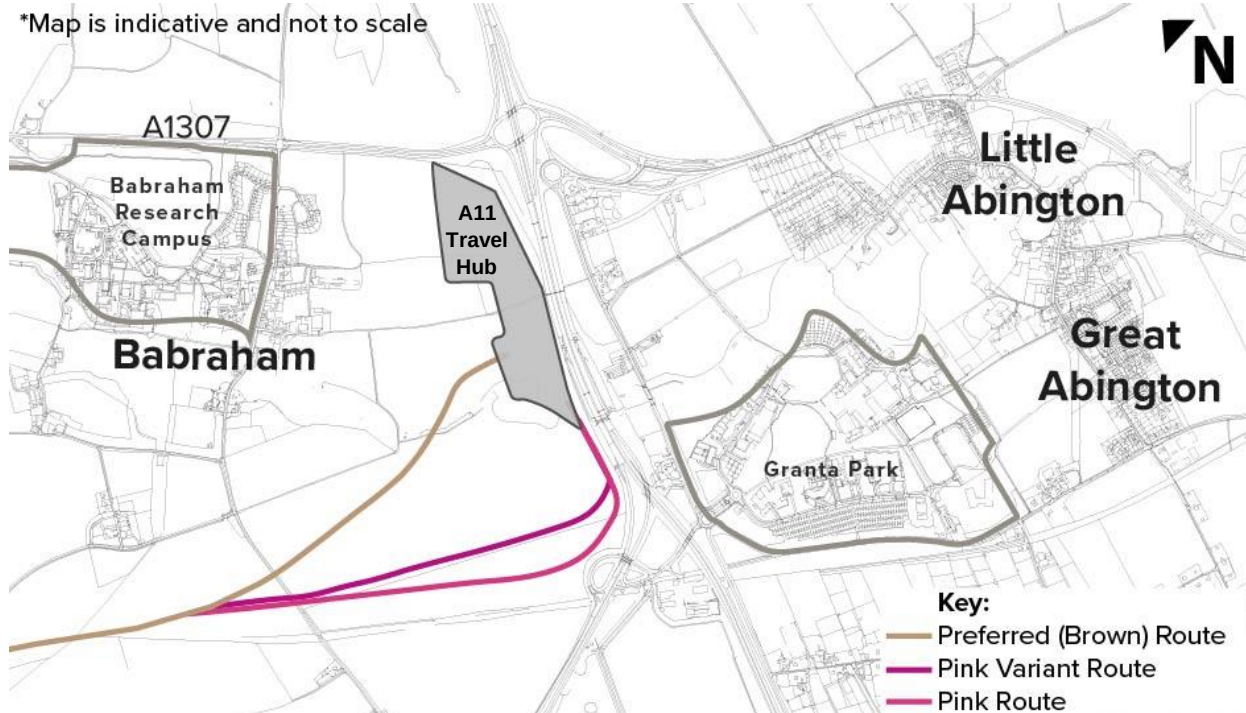
The key points of difference between the Pink Route Variant and the original (2019 consultation) Pink Route are:

- The variant takes a more direct route between the A11 Travel Hub and High Street, following an existing field boundary and avoiding land owned by Pampisford Estate.
- The variant alignment requires a tighter curve radius relative to the original Pink Route.¹

Figure 1.1 overleaf shows the three route alignments.

¹ Note – this curve radius for the Pink Route Variant, whilst tighter than the original Pink Route, is still an acceptable design solution

Figure 1.1: Proposed Pink Route Variant shown alongside Brown and Pink Route alignments



Source: Contains OS data © Crown copyright and database rights 2018 OS 100023205

Both the original Pink Route and the Pink Route Variant would cross the River Granta in the same location immediately to the west of the A11 trunk road river crossing.

1.1 Previous Assessment of Pink Route Variant

An initial assessment of the Pink Route Variant was undertaken in February 2021. Full details can be found in technical note document reference no. 403394-MMD-MAN-00-TN-PM-0724 but a summary of this assessment is provided below.

The assessment of the Pink Route Variant initially looked back at the comparison of the Brown and Pink Routes that was carried out during the options assessment phase of the project and development of the Outline Business Case (OBC). This was done in order to understand if this original assessment of the Pink Route versus the Brown Route would help in understanding how the proposed Pink Route Variant might compare.

The results of the original assessment were reported in the OBC and summarised in the report to the GCP Executive Board meeting held on 25 June 2020. The Pink Route Variant was not considered or assessed at this stage as it was not conceptually different from other longlisted route alignment options.

These shortlisted options were appraised from multiple perspectives utilising three mechanisms:

- A multi-criteria assessment framework
- Benefit Cost Ratio (BCR) calculation and Value for Money assessment
- Analysis of the results of the 2019 public consultation on the shortlisted options.

The outcomes of a Green Belt assessment of the shortlisted options were also considered in arriving at a recommended preferred route.

The assessment summarised that the main points of difference between the Pink and Brown Routes leading to the Brown Route being chosen as the preferred route alignment were that:

- The Brown Route is more direct, offering shorter journey times, generating higher patronage, and delivering additional passenger benefits relative to the Pink Route.
- From a deliverability perspective, the Brown Route requires less land and reduces the number of landowners affected by the scheme by keeping this section of the route within land owned by a single stakeholder.
- The Brown Route was more strongly supported than the Pink Route in the responses to the 2019 public consultation, albeit by a small margin.

The Pink Route Variant was then initially assessed qualitatively by comparison with the previous assessment of the Brown and original Pink routes. However, it should continue to be noted that the multi-criteria assessment framework used during the OBC stage of the project considers route alignment and travel hub options holistically and so is relatively insensitive to varying one section of an existing alignment option.

1.1.1 Multi-criteria Assessment

It was determined the Pink Route Variant would, in relative terms, perform better overall than the original Pink Route against the assessment criteria, but still worse than the Brown Route. The improved performance of the Pink Route Variant over the original Pink Route is due to the variant requiring less land and reducing the number of landowners affected by the scheme. However, the Brown Route requires less land than the Pink Route Variant, while affecting the same number of landowners.

1.1.2 Value for Money

Similar to the Pink Route, travel times for the Pink Route Variant would be longer than the Brown Route as the route is longer. Due to the longer route length and journey times relative to the Brown Route, but slightly shorter route length and journey times relative to the Pink Route, the Pink Route Variant would have lower benefits relative to the Brown Route, but slightly higher benefits relative to the Pink Route.

In terms of scheme costs, it was assumed that the Pink Route Variant would offer cost savings compared to the Pink Route but not of a magnitude sufficient to offset the lower benefits for the Pink Route Variant relative to the Brown Route.

Accordingly, in terms of relative Value for Money, the Pink Route Variant was expected to have a BCR comparable to or slightly better than the original Pink Route, but still worse than the Brown Route.

1.1.3 Environmental

A high-level review of the proposed Pink Route Variant was undertaken by environmental specialists to investigate if the proposed Pink Route Variant would be more acceptable from an environmental perspective than the Brown Route. This concluded that the Pink Route Variant would be unlikely to provide any environmental benefits of sufficient magnitude to make this a better route option than the Brown Route.

1.2 Purpose of this Technical Note

Following submission of the earlier assessment work Mott MacDonald were commissioned by GCP to undertake further analysis of the Pink Route Variant as follows:

- Develop a single Pink Route Variant alignment to the same level of design as undertaken at the OBC stage.
- Prepare a cost estimate for the Pink Route Variant on a comparable basis to the OBC cost estimate for the Brown Route.

- Calculate an initial benefit cost ratio for the Pink Route Variant on a comparable basis with the initial Benefit Cost Ratios presented in the OBC for the Brown and Pink Routes.
- Undertake a Value for Money comparison of the Pink Route Variant and Brown Route alignment options.

The remainder of this technical note presents the results and discussions of this further analysis exercise.

2 Concept Design of Pink Route Variant

A concept design exercise for the Pink Route Variant alignment has been undertaken and is presented in Appendix A (drawing reference number 403394-MMD-HWA-00-DR-HW-0834).

The route alignment follows the existing field boundary to mitigate the creation of severed parcels of land and mitigate impact on agricultural activities. A small strip of land (approximately 8m wide) would be provided between the Public Transport (PT) route and existing hedgerow to ensure minimal effect on the existing hedgerow and vegetation. Furthermore, in the south eastern corner of the field where the route alignment bends a parcel of land will be created of circa 18,000m². Both of these areas provide opportunities for environmental mitigation.

The PT route crosses the River Granta adjacent to and parallel with the A11. To minimise the impact of the new structure embankments are proposed outside the extents of the flood plain. This is consistent with the design of structures being progressed on the Brown Route alignment. As with the Brown Route alignment, flood plain mitigation will be required on the Pink Route Variant alignment due to the impact of bridge piers on flood plain capacity.

It should be noted that the flood plain where the Pink Route Variant crosses the River Granta is slightly wider than where the Brown Route crosses the river and therefore a longer bridge structure is required. The structure for the Pink Route Variant will be approximately 220m whereas the Brown Route alignment requires a structure 215m long. It should be noted that the length of the structure for the Brown Route has been updated to align with the Design Freeze 2 drawings for the preferred option being developed in parallel to this assessment. Previously the Brown Route structure length was 162m.

The design speed of the bend in the route alignment for the Pink Route Variant is the same as the Brown Route alignment.

A parallel active travel route will be provided for the length of the route with a signalised crossing (including a crossing designed for equestrian users) at the intersection with High Street.

As the PT route enters the southern extent of the A11 Travel Hub this will require a redesign of the travel hub layout to ensure PT vehicles are able to access the central interchange area. This design has not been undertaken at this stage of the assessment.

At the bend of the Pink Route Variant alignment an existing high-level power cable will need to be diverted. Most likely this will require burying to enable the PT route to cross the apparatus. It should be noted the same utility is affected by the Brown Route with similar diversion works proposed.

Following completion of the concept design exercise the length of the Pink Route Variant alignment is 2,090m. The length of the Brown Route alignment from the intersecting point with the Pink Route Variant to a common point in the A11 Travel Hub is 1,458m. The Pink Route Variant alignment is therefore approximately 630m longer than the Brown Route alignment.

3 Environmental Review of Pink Route Variant

The Babraham residents have advocated that there is an environmental case for the Pink Route Variant over the Brown Route. In response to this suggestion a review of the proposed Pink Route Variant has been undertaken by environmental specialists to investigate if the proposed Pink Route Variant would be more acceptable from an environmental perspective than the Brown Route.

The following factors were considered:

- Landscape and visual impact
- Air quality
- Noise
- Biodiversity
- Heritage
- Water resources and flood risk
- Greenhouse gases.

In this review no significant differences between the Brown Route, the original Pink Route and the Pink Route Variant were identified in respect of the following environmental factors:

- Air quality
- Noise
- Water resources and flood risk assuming the bridge crossings were on viaducts of similar scale in the flood plain.

3.1 Landscape and Visual Impact

The unique sections of the Brown Route and Pink Route Variant are within the River Granta Valley Landscape Character Area. This is an area of moderate landscape sensitivity.

The visual impact of the Pink Route Variant is likely to be slightly lower than the Brown Route, as it is further from receptors, follows an existing field boundary, minimises the severance of the fields to the south of the River Granta, and runs closer to the existing A505 / A11 corridor.

3.2 Biodiversity

The crossing of the River Granta for each option is similar in length and the riparian habitat is similar in value at the two crossing locations. The river itself has the same County Wildlife Site status at each crossing. The majority of each route crosses land that is largely arable in use and of limited biodiversity value as a result.

However, there are some potential impacts on biodiversity arising from the Pink Route Variant that are discussed below:

- There is evidence of increased otter activity at the crossing of the Pink Route Variant compared to the Brown Route crossing. There is no evidence of any holts in the area.
- As long as bats could fly below the Pink Route Variant bridge unimpeded then the impact on bat movement would be similar to the Brown Route option.
- The Pink Route Variant would be located close to the existing substantial hedge boundary running between the A11 and the High Street which probably provides nesting habitat for farmland bird species and breeding birds. Badgers could be using the hedgerow for setts as they frequently will dig sets in boundary hedgerows of this scale. Bats could be using the hedgerow as a commuting/feeding route so

there could be an increased collision risk for bats in this area. The Brown Route does not follow any such potential habitat. There is therefore an increased risk of an impact on birds, badgers and bats from the Pink Route Variant compared to the Brown Route.

- The Pink Route Variant will have a shadow effect on the River Granta adjacent to an area where the existing A11 bridge already has a large shadow footprint. The cumulative impact on the biodiversity in the river itself would probably be larger than the equivalent cumulative shadow effect of the Brown Route bridge and the A11 bridge due to the distance between the two crossings. Therefore, there would be a preference for the Brown Route crossing to reduce the potential for contributing impacts on a Water Framework Directive waterbody.

Overall, therefore, the Brown Route is likely to have a slightly lower impact on biodiversity than the Pink Route Variant.

3.3 Heritage

The Pink Route Variant would have a similar potential impact on heritage to the Brown Route. There are known heritage assets along the Brown Route, and it is highly likely there are heritage assets present along the Pink Route Variant. Both routes are therefore considered to have a similar potential impact on heritage assets. The location of the former water meadows has been considered in this assessment, but as these water meadows no longer exist, the impact is the risk to buried archaeological remains, which is of similar potential magnitude for both routes.

3.4 Greenhouse Gases

It is likely that the Pink Route Variant would have a slightly higher construction carbon footprint than the Brown Route as it is longer and so would consume more materials.

For PT vehicles propelled entirely by electricity or other renewable sources, there would be no material difference between the operational carbon footprints of the Brown Route and Pink Route Variant. However, such vehicles may not be available on the first day of operation.

In any interim period when PT vehicles might be powered by hybrid propulsion there would be a marginally higher carbon footprint of the Pink Route Variant due to the longer distance of each journey.

3.5 Summary

In summary the environmental review of the proposed Pink Route Variant identified the following points.

Environmental Issue	Assessment of Pink Route Variant compared to Brown Route
Landscape and visual impact	Pink Route Variant more distant from visual receptors than Brown Route with less severance of fields Slightly better than Brown Route
Air quality	No significant difference between Brown Route and Pink Route Variant
Noise	No significant difference between Brown Route and Pink Route Variant
Biodiversity	A slightly higher potential adverse impact from the Pink Route Variant compared to the Brown Route
Heritage	No significant difference in the potential impacts between the route options
Water resources and flood risk	No significant difference between Brown Route and Pink Route Variant
Green belt	No significant difference between Brown Route and Pink Route Variant
Greenhouse gases	Slightly higher embedded carbon due to increased length for the Pink Route Variant compared to the Brown Route

Environmental Issue	Assessment of Pink Route Variant compared to Brown Route
	Slightly higher operational footprint of Pink Route Variant until fully renewable powered PT vehicles in operation
Conclusion	The Pink Route Variant does not provide any environmental benefits of sufficient magnitude to make this a better route than the Brown Route as it has some potential adverse impacts compared to the Brown Route

4 Value for Money Exercise

4.1 Cost Estimates

A construction cost estimate for the Pink Route Variant has been prepared based on the alignment drawing shown in **Appendix A**. This exercise has been undertaken on the same basis as the cost estimate for the Brown Route and in accordance with GCP's standard cost estimation methodology and guidance.

This costing exercise follows the same principles and assumptions as that undertaken for the Brown Route alignment when preparing the OBC, with the exception of the costings for the Brown Route alignment now taking into account a larger structure over the River Granta. This has enabled a like-for-like comparison of the Brown Route and Pink Route Variant.

The costs provided in **Table 4.1** show the baseline construction estimates, excluding design, project management, environmental mitigation and risk for the Brown Route alignment and the Pink Route Variant alignment, and the overall estimated final cost, including design, project management, environmental mitigation and risk² is also shown. Land costs are excluded from construction cost estimates but are discussed below Table 4.1.

To clarify, the complete scheme is the route length between Francis Crick Avenue and the point of entry to the A11 Travel Hub, the A11 Travel Hub itself (as designed at OBC stage with 2,500 spaces) and the access junction on the A1307.

Table 4.1: Brown Route and Pink Route Variant scheme cost comparison (£,000 - base date of 2Q19)

Route	Estimated Baseline Construction Cost	Estimated Final Cost
Brown Route ³	£61,007	£137,601
Pink Route Variant	£61,912	£139,643
Difference	£905	£2,042

In addition to the construction costs, there are costs associated with the purchase of land. However, the associated land costs for each option are not available to publish at the time of this report being issued as they are currently being finalised. However, what is clear from the initial land cost estimates is that the difference between the two options with regards to land costs is very limited. Based on the emerging land cost estimates, there is a difference in the region of £400,000 in favour of the Pink Route Variant. Incorporating the land costs into the BCR assessment (see Section 4.2) would not change the Value for Money categories of the options, nor would it alter the difference between the two options in any significant manner that would help to differentiate the two options.

² Risk contingency has been applied using the P80 confidence level of 25%.

³ Provisional costs allowing for a larger structure over the River Granta and subject to confirmation

Overall, the costing exercise has indicated that there is very little difference between the baseline construction cost estimates for the two route options and overall final anticipated costs. However, the Pink Route Variant costs are still slightly greater when compared to the Brown Route alignment.

4.2 Economic Benefits

A proportionate approach has been applied to determine the potential economic Present Value Benefits (PVB) for the proposed Pink Route Variant. This approach makes best use of the available economic assessment results from the OBC for the Brown and the Pink routes as presented in **Table 4.2** below.

The Pink Route Variant is similar to the previously assessed Pink Route, but with an alignment that is 120m shorter. This shorter alignment would generate a marginal improvement in PT travel times relative to the assessed Pink Route. As such it is considered disproportionate to remodel the Pink Route Variant option based on a variance of 120m.

The alternative proportionate approach is based on the differential between the economic assessment results for the Brown and Pink Routes as shown below, with the average operating speed assumed to be the same for both alignments. The benefit calculation is as follows:

- Difference in length between the Brown and Pink Routes is 0.75km and this distance is the only variance
- PVB difference is £7.44M between the Brown and Pink Routes
- Pink Route Variant is 16% shorter than the Pink Route, therefore an additional 16% of the £7.44M PVB differential can be attributed to the Pink Route Variant (£1.19M).
- PVB for the Pink Variant is therefore estimated at £63.51M which is a 1.9% increase from the Pink Route.

This proportionate approach is based on the premise that the additional benefit between the modelled Brown and Pink Routes is directly attributed to the difference in the route distance. The PVB value calculated for the Pink Route Variant is considered representative of the proposal based on the OBC results.

Table 4.2: Pink Route Variant PVB Calculation (£M 2010 prices discounted)

Option	Distance (km)	PVB (£M) OBC
OBC Brown Route	1.46	£69.76
OBC Pink Route	2.21	£62.32
Difference	-0.75	£7.44
Pink Route Variant	2.09	£63.51
Difference Pink & Pink Route Variant	-0.63	£1.19
% Difference Pink & Pink Route Variant	-16%	1.9%

4.3 Benefit Cost Ratio

To understand the relative Value for Money of each route option, separate Benefit Cost Ratios (BCR) for each option have been calculated. **Table 4.3** presents a summary of the BCR calculations for the Pink Route Variant and an updated BCR for the Brown Route based on the revised cost estimate.

The additional cost for the Pink Route Variant equates to an increase in the Present Value Costs (PVC) of 1.5% (£1.46M) from the Brown Route, with the increase in route distance accounting for a reduction in the PVB of -9% (-£6.25M).

The BCR for the Pink Route Variant is calculated as 0.64 which represents a -9.9% reduction in the BCR from the Brown Route based on the combination of an increase in PVC and reduction in PVB.

Table 4.3: Brown Route and Pink Route Variant scheme benefits and costs comparison (P80 Risk Contingency 25% and Optimism Bias 15%, 2010 Prices Discounted, £M)

Route	PVB	PVC	BCR
Brown Route	£69.76	£98.17	0.71
Pink Route Variant	£63.51	£99.63	0.64
Difference	-£6.25	+£1.46	-0.07
% Difference	-9%	+1.5%	-9.9%

In summary, comparison of the different alignment costs, benefits and resulting BCRs, shows that the Brown Route has a BCR that is 9.9% higher than the Pink Route Variant.

5 Summary

The Pink Route Variant alignment and the Brown Route alignment have been compared on the basis of environmental impacts, costs and value for money, to determine if there is any merit in the Pink Route Variant being considered for adoption as the preferred route instead of the current Brown Route alignment.

Based on this assessment, the following conclusions can be drawn:

Environment

The Pink Route Variant does not provide any environmental benefits of sufficient magnitude to make this a better route than the Brown Route as it has some potential adverse impacts compared to the Brown Route. Whilst the Pink Route Variant performs slightly better on landscape and visual impacts, being more distant from visual receptors than the Brown Route, and with less severance of fields, the Pink Route Variant could have a slightly higher potential for impacting on biodiversity. The Pink Route Variant is also likely to have a slightly higher embedded carbon impact due to the slightly longer structure over the River Granta, although as there is only 5m difference in the length of the structures, this is likely to be a minimal difference.

Costs

Based on concept drawings for the Pink Route Variant, a costing exercise was carried out in order to compare against the OBC cost estimate for the Brown Route. This exercise has shown that overall scheme costs for the Brown Route alignment and Pink Route Variant alignment are similar, with a £905,000 difference in construction costs in favour of the Brown Route, and £2.042M difference in total cost. This is mainly due to the Pink Route Variant having a slightly longer alignment (approximately 630m) and structure across the River Granta (approximately 5m longer structure) (Note – the Pink Route Variant is 2,090m and the Brown Route is 1,458m).

Value for Money

Assessment of the relative benefits of the two route variants has shown there is a £6.25m (9%) difference in benefits in favour of the Brown Route. The primary reason for this is that the route length of the Pink Route Variant is 0.63km longer than the Brown Route, resulting in greater journey times. Using the benefits and costs, separate BCRs were then calculated for each route, with the Brown Route showing a BCR of 0.71, and the Pink Route Variant showing a BCR of 0.64. The difference in benefits is driven by the shorter distance of 0.63km for the Brown Route over the Pink Route Variant. There is also a £1.46m (1.5%) difference in PVC.

Conclusion

Overall, the Brown Route Variant still performs better than the Pink Route Variant when considered against a set of criteria (see Table 5.1), including environmental impacts, costs and Value for Money. Although the difference between the BCRs is marginal in absolute terms (0.07) it remains the same as the difference between the Brown and original Pink Routes reported in the OBC (0.07), on the basis of which the Brown Route was recommended as the preferred option. In percentage terms there are more material differences between the PVB (9%) and BCR (10%) for the two options.

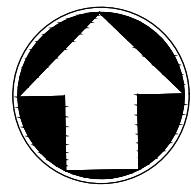
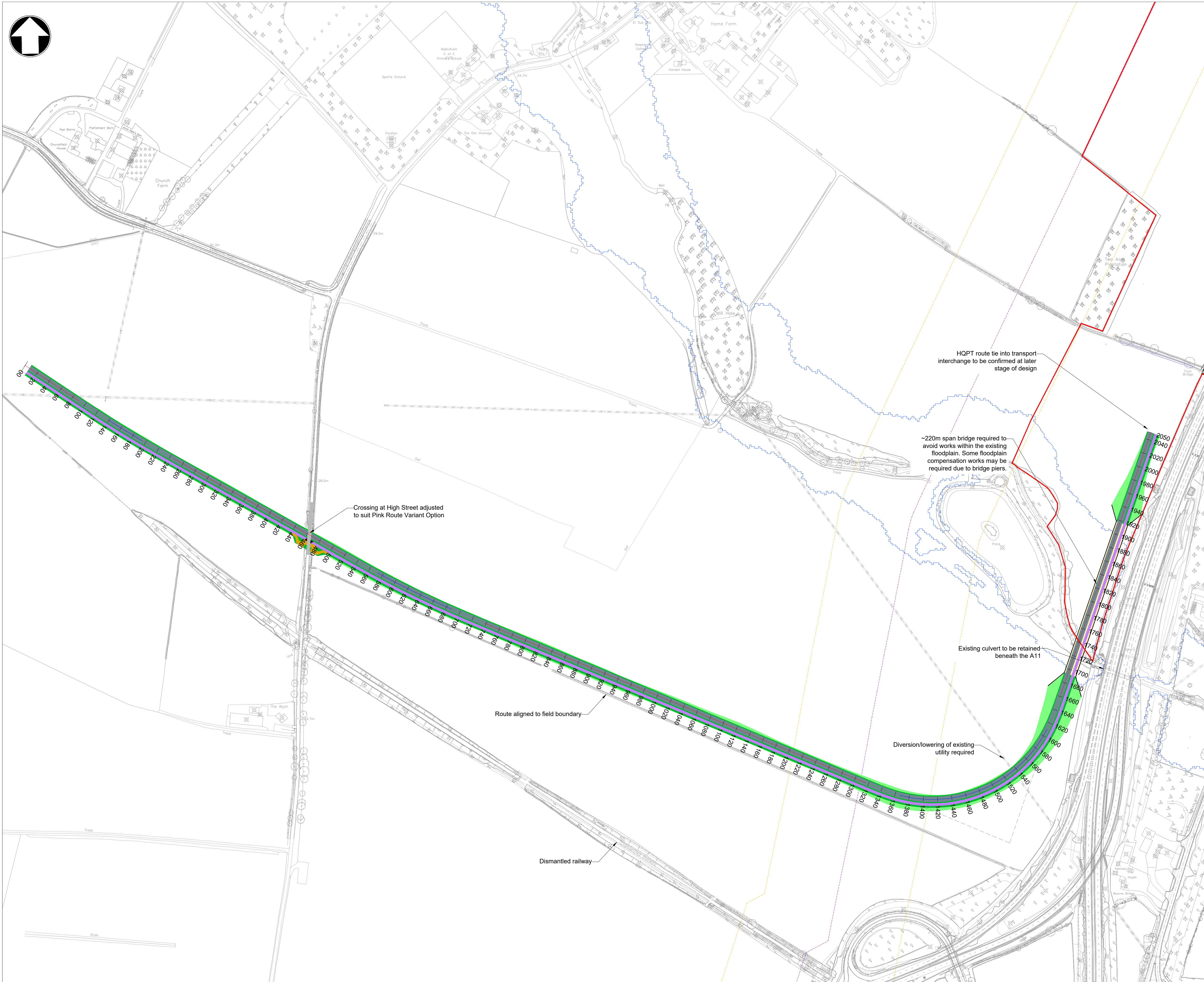
Table 5.1: Summary Comparison of Pink Route Variant versus Brown Route

Comparison Metric	Brown Route (metric result)	Pink Route Variant (metric result)
Multi Criteria Assessment (INSET)	✓ (1.08)	✗ (1.06 ⁴)
Environmental Impacts	✓	✗
Capital Costs	✓ (£137,601,000)	✗ (£139,643,000)
Value for Money	✓ (0.71 BCR)	✗ (0.64 BCR)

Whilst the results of this assessment support the Brown Route as the preferred route alignment, the technical assessment results for the Pink Route Variant are sufficiently close that GCP could also take into account public/stakeholder opinion in reaching a decision on whether to consider the Pink Route Variant for adoption as the preferred route instead of the current Brown Route alignment.

⁴ Based on the INSET score for the Pink Route – Pink Route Variant likely to score similar, if not slightly better, but no better than the Brown Route.

A. Concept Design of Pink Route Variant (drawing no. 403394-MMD-HWA-00-DR-HW-0834)



- Notes
1. Dimensions are in metres unless stated otherwise. Do not scale from the drawing.
 2. Drawing to be printed in colour.
 3. Route alignment shown is based on the highway design principles set out in the Design Manual for Roads and Bridges (DMRB). This drawing has been provided to show a preliminary route alignment only and should not be relied upon as a final solution.
 4. All works are subject to the approval of the local highway authority (Cambridgeshire County Council) and further stakeholder engagement including Highways England.
 5. The design speed is 100kph for the route with a reduction to 50kph on approach to A11 Travel Hub.
 6. Environmental constraints have been considered in the design such as the floodplain associated with the River Granta.
 7. OS mapping licence no. © Crown copyright and database rights 2020 OS 100023205 and topo survey reference 25373ea-01.dwg.
 8. The alignment north of the High Street will be as shown on drawings 403394-MMD-HWA-00-DR-HW-467 to 403394-MMD-HWA-00-DR-HW-0479.
 9. The chainages as shown on this layout are independent of the information shown on the layouts 403394-MMD-HWA-00-DR-HW-467 to 403394-MMD-HWA-00-DR-HW-0483 and relate only to this variant option.

- Key to Symbols
- Proposed Public Transport Route Alignment - Pink Route Variant
 - Proposed Verge
 - Proposed Hardstanding
 - Proposed Active Travel Path
 - Proposed Public Transport Route (PTR)
 - Proposed Equestrian Crossing
 - Proposed Controlled Crossing
 - Embankment / Cutting
 - Bridge Structure
 - Existing Gas Main
 - Existing Extent of Gas Main Easement
 - Extent of Existing Flood Plain

P1	15/03/2021	MA	First issue	EK	MR
Rev	Date	Drawn	Description	On'd	App'd

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GREATER CAMBRIDGE PARTNERSHIP

Title

Cambridge South East Transport
Phase 2
Public Transport and Active
Travel Route - Pink Route Variant
Sheet 1 of 1

Designed	M. Ambrose	MA	Eng check	E. Karim	EK
Drawn	M. Ambrose	MA	Coordination	E. Karim	EK
Dwg check	E. Karim	EK	Approved	M. Ring	MR
Scale at A1	1:2500	Status	PRE	Rev	P1
				Security	STD

Drawing Number

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