Our Reference: CLA.D4.WQ2.AS1
Your Reference: TR010044

Response to ExA's Second Written Questions (WQ2) – Q2.11.2.1

This document sets out the response to the Examining Authority (ExA)'s Second Written Questions (WQ2) Q2.11.2.1 by Cambridgeshire County Council (CCC), Huntingdonshire District Council (HDC) and South Cambridgeshire District Council (SCDC) (together, the Councils).

Cambridgeshire County Council is the Local Highway Authority for Cambridgeshire.

Q2.11.2.1: Road design and layout

CCC [REP1-048] have requested that new highways infrastructure be provided in accordance with DMRB.

- ***d) With particular regard to route continuity and road safety considerations, how is this justified where the existing roads leading to those points do not currently appear to conform with DMRB? Please provide justification for each location referred to.***
- ***e) Do other Local Highway Authorities share the view that new highways infrastructure, for which they will be responsible for in future, should conform with DMRB?***

1. Introduction

1.1. This response reiterates and expands upon points made in Cambridgeshire's Written Representation [**REP1-048**, section 4].

2. Use of the DMRB

2.1. There are only two recognised standards in the UK for highway design – DMRB and Manual for Streets.

2.2. It is the responsibility of the Local Highway Authority, Cambridgeshire County Council (CCC) and not National Highways to determine what standard is appropriate for Cambridgeshire roads. CCC have reasonably determined DMRB is to be used as DMRB is far more appropriate for rural roads subject to national speed limit.

2.3. It is also up to CCC to determine to what extent the requirements of that standard are enforced or relaxed. DMRB adopts a process for Departure applications whereby non-compliant elements can be proposed by the applicant, considered by CCC and potentially accepted when they can be justified on grounds such as environmental, value for money, and safety. To date it is CCCs consideration that no departures have been justified by the applicant or therefore accepted by CCC.

2.4. For more detail on this point refer to Appendix A.

3. Route Continuity

3.1. It is of primary importance to understand that route continuity is about much more than the physical carriageway width. The experience of the highway by users is influenced by many factors including: alignment ('bendiness') and forward visibility (known as the

alignment constraint); and carriageway and verge width, junction form, junction frequency, frontage activities such as domestic and commercial accesses, laybys, parking and bus stops (collectively known as the **layout constraint**). Together, all these factors influence road users by sending a message as to what speed it is appropriate to drive at.

3.2. DMRB covers this by requiring each road improvement to be designed to a selected design speed. CD109 states:

For new rural roads, design speed shall be derived from Figure 2.1 using alignment constraint (Ac) and layout constraint (Lc).
Layout constraint (Lc) measures the degree of constraint provided by the road cross-section, verge width, and frequency of junctions, lay-bys and commercial accesses.
*For road improvements of up to 2km in length on existing rural roads, the design speed shall be derived using Figure 2.1 with the value of **Ac calculated for a minimum road length of 2 km incorporating the section of road improvement.***

3.3. Consequently, the selection of an appropriate design speed for the new section of road should be a process that measures the above constraints over a length not only incorporating the new section but also the adjacent length of road into which it joins.

3.4. Prudent selection and consistent application of an appropriate design speed to the new section of road will help to ensure 'route continuity' with the existing road.

3.5. CD109 states:

Connection to existing roads
Where an improved section of road rejoins an unimproved section of existing road, providing a similar standard of curvature and stopping sight distance as provided for the improvement will create a consistent standard at the interface.

At no point does it say that the cross section should be exactly the same.

4. Consistent Application of an Appropriate design speed

4.1. It should be noted that selection of a high design speed (eg 100km/h) results in a flatter straighter alignment, greater forward visibility and generally wider verges, greater carriageway width and less junctions/accesses. All of which will indicate to drivers it is safe to drive at speeds up to 100km/h.

4.2. Conversely selection of a lower design speed (eg 50 or 60km/h) results in far more curved alignments (increased 'bendiness'), less forward visibility, and narrower verges and carriageway may be appropriate with more junctions/accesses. This will result in drivers acting more cautiously as the road layout indicates only lower speeds are safer.

4.3. Importantly, changing just one of the alignment or layout constraint factors so that it is inconsistent with the others is likely to lead to a **less safe situation**. Narrowing the highway cross section from 7.3 to 6.0m alone, while maintaining high speed alignments and high-speed visibility is unlikely to be effective in reducing speeds. It only makes a small difference to the layout constraint (Lc Increases 25 to 28) and thus is most unlikely to affect the choice of design speed.

4.4. It is CCC's view that the Applicant's approach in reducing the cross section is flawed; speeds are likely to remain high, but there would be a less appropriate road width consistent with that speed. If the Applicant was concerned that there was a road safety problem associated with speed and or overtaking, then their approach should have been to introduce greater alignment constraint by increasing the change in direction along the proposed roads (increased 'bendiness') and reducing the harmonic mean visibility accordingly. It is only as part of a package of measures, such as introducing horizontal curvature and reducing forward visibility, that narrowing the highway could safely reduce vehicle speeds.

4.5. Refer to Appendix B for additional detail on location specific assessments; the conclusions are summarised below.

4.6. Toseland Road:

- A compliant design requires only one change in carriageway width at each tie-in, 1km apart, so there will not be numerous changes in cross section.
- From the northern tie-in point on Toseland Road the existing road continues in a straight line for approximately 1.4km to the junction with High Street. In terms of route continuity, the requirements of CD 109 "…..providing a similar standard of curvature and stopping sight distance…" are met.
- Collision data provides no evidence to suggest that the National Speed Limit is unsafe.

4.7. B1046 and Potton Road:

- The total length of proposed road is approximately 2km, with a compliant design requiring only one change in carriageway width at each tie-in, so there will not be numerous changes in cross section.
- From the western tie-in point on the B1046 travelling North, the existing road is straight for a distance of approximately 600m. There is then a curve in the road at the ECML bridge, after which the B1046 again continues in a straight line for a distance of approximately 600m into St. Neots
- From the eastern tie-in point on the B1046 travelling East the existing road is straight for a distance of approximately 300m. There are then two bends within 300m after which the B1046 continues East in an essentially straight line for a distance of approximately 2km to Abbotsley.
- In terms of the connection from the improved section to the existing the requirements of CD 109 "…..providing a similar standard of curvature and stopping sight distance…" are met.
- Collision data provides no evidence to suggest that the National Speed Limit of 60mph is unsafe.

5. The Road Safety Auditor's recommendation

5.1. The Applicant asserts in their response to the Councils' Written Represtation (Page 50 of REP3-008) that providing a carriageway width of 6m with no hard strips will be safer than providing a DMRB compliant cross section of 7.3m: *"The Applicant is committed to keeping the nature of the existing road to remove unnecessary safety risks. Having localised areas of wider road has been shown to increase driver speeds and increase the temptation for drivers to attempt overtaking which may lead to accidents. The Applicant has undertaken a Road Safety Audit **[APP-241]** and no safety concerns were raised as to the 6m minimum width of non-trunk roads."*

5.2. In fact the only comment made by the Applicant's Road Safety Audit team that indicates they have considered this issue is in a document titled "A428 Black Cat to Caxton Gibbet Improvement Pre-Stage 1 Road Safety Review (Black Cat Junction options a, b

& c and route Options 1, 5 & 6) Report No: 60541541-AECOM-SR-RP-0D Dated 17th May 2017", and a relevant extract reproduced below.

5.3. It can be seen very clearly that this recommendation makes no reference to providing new carriageway width to match the existing, the recommendation is simply to provide adequate transitions between new and existing sections of carriageway. Cambridgeshire County Council supports this recommendation.

*"**D21 Problem***

Drawing No.: Various.

Location: New bridge structures accommodating single carriageway rural roads.

Summary: Frequent changes in carriageway widths leading to collisions.

The Audit Team have noted that on similar schemes the introduction of bridge structures, either carrying the side road over the mainline, or vice versa, often results in the minor side road being increased in standard/width through/over the new structure. This can result in frequent and sudden changes in both the standard and width of the side road carriageway and particular problems at the interface with the existing road (at the limits of the scheme). These frequent changes in road standard can encourage drivers to increase their speed over the 'improved' section but result in an increased risk of graze or loss of control type collisions as vehicles make the transition from the new road to the existing road.

Recommendation

It is recommended that adequate transitions are provided between new sections of carriageway, associated with structures, and sections of existing single carriageway rural roads."

6. The A14 Experience

6.1. The local roads associated with the Applicant's recent A14 Cambridge to Huntingdon (A14 C2H) Improvement scheme, contained wholly within Cambridgeshire, also used DMRB standards. This scheme included many locations where the local road was altered or diverted by the new A14. All the pre-existing local roads were 'legacy roads' existing a long time prior to the introduction of DMRB in 1992 and not conforming to the modern day DMRB. However this did not preclude its use for the design of the altered/diverted local roads.

6.2. For each local road a suitable design speed was agreed and adopted, and consequently designed with appropriate and consistent alignments, cross sections visibility etc.

6.3. It should be noted that in all cases where a 100 km/h or 85km/h design speed was agreed for the county road, a road width of 7.3m was selected. Where 50, 60 km/h and some 70km/h design speeds were agreed, a 6m width was generally selected.

A14 Cambridge to Huntingdon Improvement scheme

SoCG Report Update – Deadline 13

Road Cross Section Details Carriageway Section	Road Type (TD27)	Design Speed (kph)	Carriageway Width (m)	C/R Width (m) *1	Hard-strip Width (m)	Min Verge Width (m) *2	NMU route *3
Silver Street Bridge	S2	50	3.5 (6.0 over bridge to provide passing place)	N/A	None	2.5 (W) 2.5 (E) (0.6 min on bridge)	None - NMUs to use carriageway as very minor road
A1198 Ermine Street Bridge	S2	100	7.3	N/A	None (as NMU route provided)	2.5 (W) 6.3 (E)	3.0 (E)
Mere Way Bridge	S2	50	3.5 (6.0 over bridge to provide passing place)	N/A	None	2.5 (0.6 min on bridge)	NMUs to use carriageway as access track/ bridleway
B1040 Potton Road Bridge	S2	85	7.3	N/A	None (as NMU route provided)	6.3 (W) 2.5 (E)	Yes – West side
Hilton Road Bridge	S2	70	6.0	N/A	None (as NMU route provided)	2.5 (W) 6.3 (E)	Yes – East side
Conington Road Bridge	S2	70	6.0	N/A	None (as NMU route provided)	2.5 (W) 6.3 (E)	Yes – East side
New Barns Lane Bridge	S2	50	3.5 (6.0 over bridge to provide passing place)	N/A	None (as NMU route provided)	5.0 (W) 2.5 (E)	Yes – West side

Figure 1 – Extract of A14 Cambridge to Huntingdon SoCG Between Highways England and Cambridgeshire County Council HE/A14/EX/190/LA01, Appendix A: Highway Specifications

6.4. These cross sections were agreed in the A14C2H SoCG between NH and CCC, as shown in the extract above, Figure 1. It is unclear to CCC why a similar hierarchy of provision is not considered to be a reasonable approach by NH, and cannot be agreed for A428.

6.5. On A14C2H, where changes of cross section were needed at tie ins these were designed to taper into the existing road, at rates consistent with DMRB. Where appropriate, 'road narrows' warning signs erected.

6.6. It is also necessary to correct two incorrect assertions made by the Apllicant at page 50 of REP3-008. Upon the recommendation of the road safety auditor at opening to traffic, two of the A14 side roads (B1040 Potton Road and B1043 Offord Road), for which CCC are Highway Authority, had road markings changed to 'no overtaking'. This had little or nothing to do with the cross-sectional width of the road. It was due to the dubious forward visibility created by the crest vertical alignment on the bridge over the A14 leading to inappropriate overtaking decisions being made on a relatively straight road alignment.

6.7. 'Road narrows ahead' warning signs were included at isolated locations (eg Grafham Road) where 6m wide new sections tied into 3.5m single track roads. This is therefore not relevant for this discussion as there are no tie ins to single track roads on A428 scheme. They were not installed or required where 7.3m wide new sections tied into 6.0m roads.

7. The need for Hard Strips

7.1. Regarding hard strips, DMRB standard CD127 Clause 2.6 NOTE 2 states the following:

"A hard strip provides a surfaced strip that abuts the carriageway. The key reasons for the provision of hard strips include:

1) pavement integrity/stability;
2) partial provision for stopped vehicles;
3) snow and water collection;
4) overrun facility for driver error or evasive action;
5) improved level of service and driver comfort;
6) supports edge lines;
7) reduces the risk of vegetation encroachment over edge lines; and
8) allows for the placement of road studs outside vehicle wheel paths, where appropriate."

7.2. Without the necessary hard strips the local roads will be lacking provision of the above operational safety and maintenance measures.

7.3. Items 1), 3), 6) and 7) are key issues for CCC and these are expanded upon in the next section.

8. Operational and Maintenance considerations

8.1. This section considers some further consequences of only providing a narrow 6m carriageway.

Edge of Pavement Integrity

8.2. The photographs in Appendix D taken at Toseland Road, B1046 and Potton Road clearly show the problems created by narrow cross section (generally around 5.5 to 6.0m in the photos) and the lack of hard strip provision.

8.3. Even just light trafficking close to the edge of the carriageway causes damage over time to the edge of the carriageway. It can be seen how the edge of pavement and any edge lines deteriorate. This is turn leads to the need for costly repetitive interventions to repair damage. This is a highly undesirable outcome for CCC, but one which is likely if existing widths are merely reproduced in the new works.

8.4. One photograph in particular, Figure 10, demonstrates how close any HGV is to both the edge of the carriageway and the central road marking on a 6m carriageway, and how increased provision is required on any new road properly designed for 100km/h.

Constraints on Maintenance Activity

8.5. When interventions are needed, at 6.0m, the road is too narrow to operate one way under traffic lights and allow for workspace and clearance to the moving traffic, which would be possible with 7.3m carriageway. Consequently, complete closures are needed far more often on narrow roads.

Potentially unsafe drainage provision

8.6. Where kerb and gully drainage will be provided, which is Cambridgeshire's preferred solution, the gully spacing is calculated by allowing the flow against the kerb to build up to a given width (eg 1.0m) before discharge. Ideally on a high-speed road this flow of water against the kerb would not encroach within the nearside wheeltrack of vehicles.

This is not possible on a 6m road, and in wet weather vehicles will necessarily drive through water collecting and flowing against the kerb. There is therefore an increased risk of aquaplaning in wet conditions on a narrow carriageway compared with a 7.3m carriageway.

HGVs cause most road pavement damage, particularly when turning

8.7. It is noted that HGVs operate from the Eaton Transport site on Toseland Road, and Eynesbury warehousing/ plant hire site on Potton Road. This is in addition to the general heavy/agricultural uses one might expect on rural roads. As well as pavement issues, there is evidence of tyre marks in grass verges and damaged kerbs and gully units. CCC believe that a newly desgined road should properly provide for the expected users.

9. Conclusion

9.1. It is reasonable for Cambridgeshire County Council to require a 7.3m wide carriageway on a road for which it is the Highway Authority and for which a design speed of 100km/h has been agreed as appropriate. This will improve safety and reduce operation maintenance liabilities compared with a 6.0m provision.

9.2. This approach is entirely consistent with that taken on the recent A14 project.

Appendix A: The Use of DMRB as an Appropriate Design Standard

1. Available standards

1.1. There are two Nationally recognised standards for highway design as follows:

a) Manual for Streets (MfS), the National standard for residential and other streets, which applies a "*..user hierarchy to the design process with pedestrians at the top. This means considering the needs of pedestrians first when designing, building, retrofitting, maintaining and improving streets.*"
b) Design Manual for Roads and Bridges (DMRB), first introduced in 1992, the National standard for Trunk Roads and Motorways, which is also widely used for local roads. GG 101 Introduction to the Design Manual for Roads and Bridges Clause 1.1 NOTE states "*DMRB requirements can be applied to other roads with the approval of the specific highway or local authority acting as the Overseeing Organisation.*"

1.2. There are no other suitable National or local standards.

2. Why the Manual for Streets (MfS) is not suitable

2.1. MfS is a National standard for residential streets that places pedestrians at the top of the road user hierarchy; Clause 1.3.4 recommends "The application of MfS advice to all 30mph speed limits as a starting point.." Clause 1.3.5 states "*Much of the research behind MfS1 for stopping sight distance (SSD) is limited to locations with traffic speeds of less than 40mph and there is some concern that driver behaviour may change above this level as the character of the highway changes.*" Clause 1.3.6 states "*it is only where actual speeds are above 40mph for significant periods of the day that DMRB parameters for SSD are recommended. Where speeds are lower, MfS parameters are recommended.*"

2.2. For the affected rural local road network within Cambridgeshire where the National speed limit is 60mph it is evident that this is incompatible with pedestrians being at the top of the road user hierarchy. That is not to say that the needs of all Non-Motorised Users are not important, but clearly motorised vehicles are at the top of the road user hierarchy on Cambridgeshire's roads affected by the scheme, so the chosen design standards need to take account of this fact.

2.3. MfS defers to DMRB in matters relating to design speed and geometric design parameters such as SSD, horizontal alignment and vertical curvature, for roads with design speeds in excess of 60kph.

3. Cambridgeshire, as Local Highway Authority, has determined DMRB is to be used

3.1. The use of DMRB is not restricted to Trunk Roads and Motorways. Clause 1.1.1 states "*Where DMRB requirements are applied to other roads, the specific highway or local road authority acting as the Overseeing Organisation should decide on the extent to which the requirements are appropriate in any given situation.*" Cambridgeshire County Council is the specific highway authority within Cambridgeshire and is best placed to decide on the extent to which DMRB should be applied locally.

3.2. For the reasons given above, Cambridgeshire County Council, as Local highway Authority, has determined that the consistent application of DMRB provides the most appropriate set of standards for Cambridgeshire's roads and that the use of MfS is not appropriate.

4. Principles for the Consistent Application of Design Manual for Roads and Bridges (DMRB)

4.1. The Applicant appears to agree with the use of DMRB and their design generally uses DMRB; unfortunately, however the Applicant has been inconsistent in its application.

4.2. The principles the Council has advised the Applicant shall be applied to the design and construction of the Scheme's local roads within Cambridgeshire are as follows:

- Consistent application of National Highways' Standards for Highways standards and specifications as follows:
  - Design Manual for Roads and Bridges (DMRB)
  - Manual of Contract Documents for Highway Works (MCHW)
  - Interim Advice Notes (IAN)
- Full compliance with standards wherever possible; full details of any Departures from Standard need to be submitted to CCC with appropriate justification (eg taking into account environmental, safety, or whole life value for money considerations), and will only be accepted in exceptional circumstances where a compliant design is not realistically achievable.

Appendix B: Design Speeds: Location Specific Assessments

1. Design Speed

1.1. The current Highway Link Design standard is CD 109. To comply with this standard the designer is required to derive the design speed, which is based on Alignment Constraint (Ac) and Layout Constraint (Lc) . The Applicant has not provided the required derivation and has simply selected the design speed based on the existing speed limit.

1.2. The value of Lc is determined from Table 2.3, see Appendix C. The road type is S2.

1.3. The Applicant's proposed non-compliant design of 6m wide carriageway with verges typically 1.5m wide with a Medium number of 6 to 8 per km of commercial accesses, lay-bys and junctions gives an Lc value of 28.

1.4. The Council's requested compliant design of 7.3m wide carriageway with standard verge width, with a Medium number of 6 to 8 per km of commercial accesses, lay-bys and junctions gives an Lc value of 23.

1.5. The value of Ac for a single carriageway is determined from Equation 2.2b, see Appendix C. The Council is not proposing any changes to the alignment so there is no change to the value of Ac determined for each local road.

2. Location Specific Assessments

<u>Toseland Road</u>

2.1. The Applicant's preliminary design states the following alignment design parameters:

- Design speed 100kph
- Total length of improvements 970m
- The minimum horizontal radius is 720m, but only for a length of 45m approximately; the minimum horizontal radius otherwise is 2880m
- The required Stopping Sight Distance (SSD) of 215m is achieved

2.2. Toseland Road has a smooth/straight alignment, see Figure 1 below; a low value of Bendiness degrees/km (approximated at 10 degrees/km) and a corresponding high value of Harmonic mean visibility means that the value of Ac will not exceed 8.

2.3. The design speed is selected from Figure 2.1, of CD109, see Appendix C.

2.4. For an Ac value of 8 and either an Lc value of 23 (non-compliant layout) or 28 (fully compliant layout) the design speed is 100pkh.

2.5. This means that it is not the cross-section element of layout constraint that places the greatest constraint on speed, but the alignment. Simply reducing the carriageway width to 6m does not necessarily reduce speed, a driver's perception of a safe speed is primarily determined by the alignment and the Applicant has designed the alignment to fully comply with standards. In fact, the predominant horizontal curvature of 2880m would be suitable for a design speed of 120kph. In other words, drivers will believe that at least 100kph is a safe speed based on the smooth alignment that provides more than the necessary visibility, so providing a narrow carriageway would be confusing.

Providing a non-compliant layout with a fully compliant alignment will actually make it less operationally safe not more. It is CCC's view that the Applicant's approach is flawed. If the Applicant was concerned that there was a road safety problem, then their approach should have been to introduce greater alignment constraint by increasing the change in direction along the proposed roads (increased 'bendiness') and reducing the harmonic mean visibility accordingly.

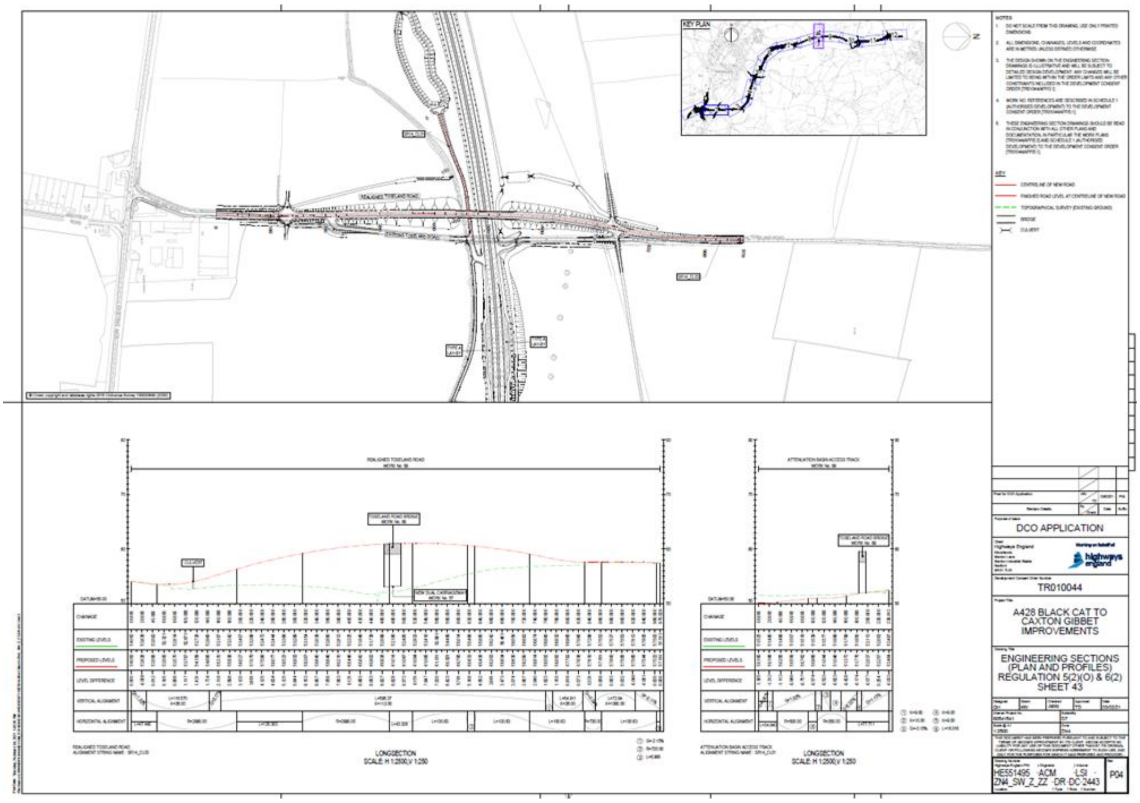


Figure 1: Applicant's General Arrangement and Longitudinal Section of Toseland Road [Extracted from APP-022].

2.6. The total length of proposed road is approximately 1km, with a compliant design requiring only one change in carriageway width at each tie-in, so there will not be numerous changes in cross section.

2.7. From the northern tie-in point on Toseland Road the existing road continues in a straight line for approximately 1.4km to the junction with High Street. In terms of the connection from the improved section to the existing the requirements of CD 109 *"…providing a similar standard of curvature and stopping sight distance…"* are met.

2.8. Collision data was obtained from crashmap.co.uk website[1] dating from 1st January 2013 to 31st December 2017 (data from Department for Transport's Road Safety Data[2]). Just one collision on Toseland Road was recorded as slight with 2 vehicles and 1 casualty involved. There was a total of 3 collisions recorded at the junction of Toseland Road and the existing A428. This data provides no evidence to suggest that the National Speed Limit of 60mph is unsafe.

1 [redacted]

[redacted]

B1046 and Potton Road

2.9. The Applicant's preliminary design states the following alignment design parameters:

- Design speed 100kph
- Total length of improvements 1417m and 495m at the B1046 and Potton Road respectively
- The minimum horizontal radius is 720m for the B1046. For Potton Road it is 360m, but only for a length of 5m approximately; the minimum horizontal radius otherwise is 720m
- The required Stopping Sight Distance (SSD) of 215m is achieved

2.10. Potton Road has a smooth/straight alignment, see Figure 2 below; a low value of Bendiness degrees/km (approximated at 10 degrees/km) and a corresponding high value of Harmonic mean visibility means that the value of Ac will not exceed 8. The net result is the same as at Toseland Road; a design speed of 100kph irrespective of the layout constraint.

2.11. The B1046 provides greater horizontal curvature with radii of 720m, but this is the desirable minimum for a design speed of 100kph. The Bendiness degrees/km (approximated at 22.5 degrees/km) and a corresponding high value of Harmonic mean visibility means that the value of Ac will not exceed 10.5. The net result is the same as at Toseland Road and Potton Road; a design speed of 100kph irrespective of the layout constraint.

2.12. As at Toseland Road, providing a non-compliant layout with a fully compliant alignment will actually make it less operationally safe not more, the Applicant's approach is flawed. If the Applicant was concerned that there was a road safety problem, then their approach should have been to introduce greater alignment constraint by increasing the change in direction along the proposed roads and reducing the harmonic mean visibility accordingly. However, this would require additional land take and increase the cost of the project.

2.13. The total length of proposed road is approximately 2km, with a compliant design requiring only one change in carriageway width at each tie-in, so there will not be numerous changes in cross section.

2.14. From the western tie-in point on the B1046 travelling North-West across the existing A428 to the bridge over the East Coast Main Line (ECML) the existing road is straight for a distance of approximately 600m. There is then a very slight curve in the road at the ECML bridge, after which the B1046 again continues in a straight line for a distance of approximately 600m into St. Neots and the junction with Cromwell Road.

2.15. From the eastern tie-in point on the B1046 travelling East the existing road is straight for a distance of approximately 300m. There are then two bends within 300m after which the B1046 continues East in an essentially straight line for a distance of approximately 2km to Abbotsley.

2.16. In terms of the connection from the improved section to the existing the requirements of CD 109 "*…providing a similar standard of curvature and stopping sight distance…*" are met.

2.17. Collision data for B1046 and Potton Road was obtained from crashmap.co.uk website[3] dating from 1st January 2014 to 31st December 2018 (data from Department for Transport's Road Safety Data[4]). There were five collisions recorded in this period, of which none were fatal, 1 serious and 4 slight. These five collisions resulted in 6 casualties and involved 9 vehicles. Most collisions occurred at the junction between the two roads. This data provides no evidence to suggest that the National Speed Limit of 60mph is unsafe.

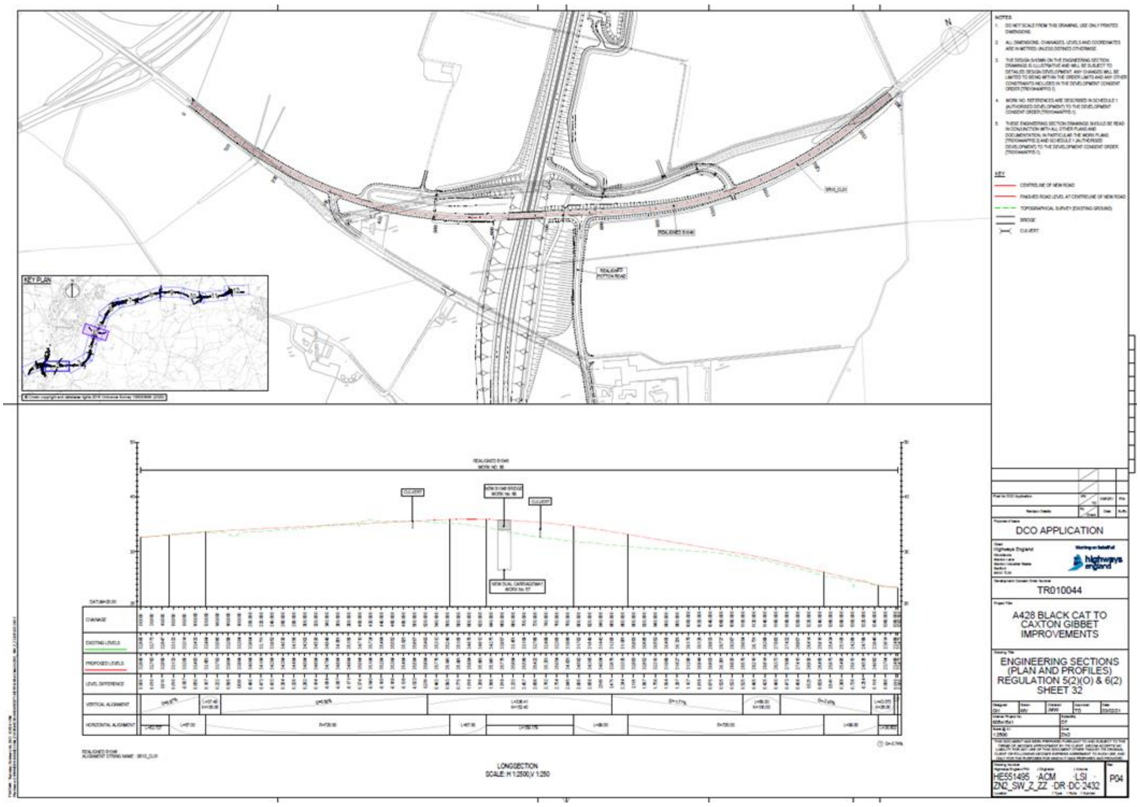


Figure 2: Applicant's General Arrangement and Longitudinal Section of B1046 and Potton Road Realignment [Extracted from APP-021]

3 [redacted]

[redacted]

Cambridgeshire County Council | Huntingdonshire District Council | South Cambridgeshire District Council

Appendix C: Extracts of DMRB CD 109

The following pages are taken from DMRB CD 109, available at:

[redacted]

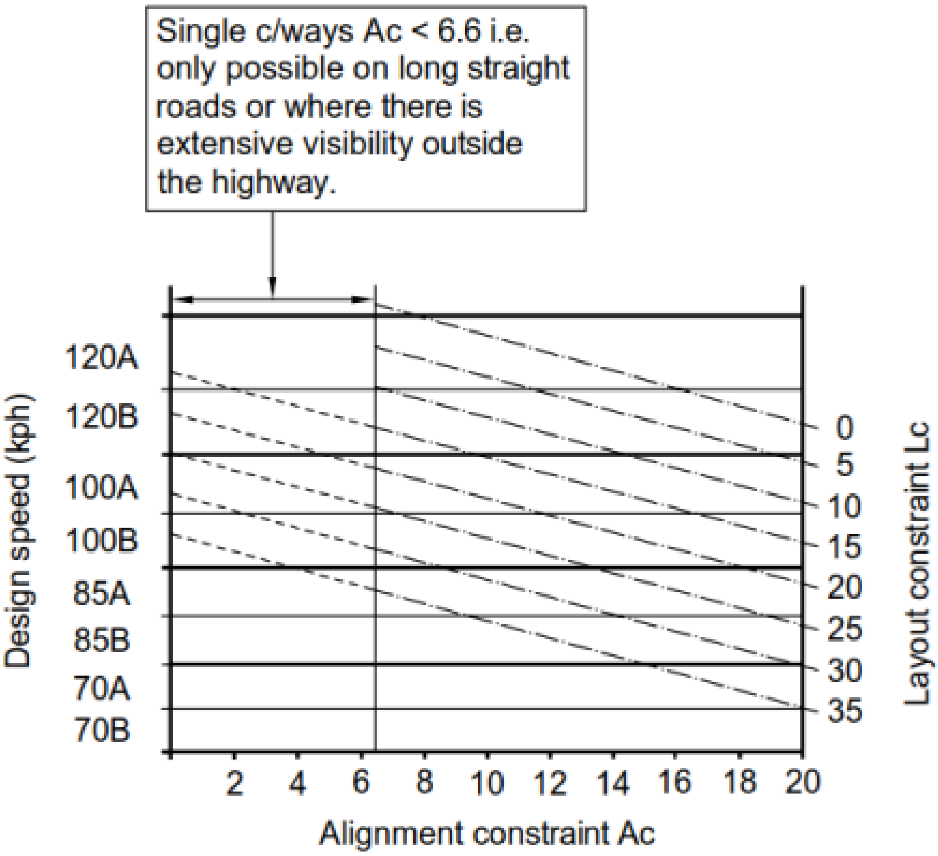
2. Design speed

Selection of design speed

Rural roads

2.1 For new rural roads, design speed shall be derived from Figure 2.1 using alignment constraint (Ac) and layout constraint (Lc).

Figure 2.1 Selection of design speed (rural roads)



NOTE 1 *In Figure 2.1 the design speeds are arranged in bands (i.e. 120kph, 100kph, 85kph, etc). Suffixes A and B indicate the higher and lower categories of each band.*

NOTE 2 *As an example using Figure 2.1 to derive a design speed, an Ac value of 12 and and Lc value of 15 would give a design speed of 100A.*

2.2 Alignment constraint (Ac) shall be calculated using Equation 2.2a and Equation 2.2b for dual carriageways and single carriageways respectively:

Equation 2.2a Dual carriageways

$$Ac = 6.6 + \frac{B}{10}$$

Equation 2.2b Single carriageways

$$Ac = 12 - \frac{\text{VISI}}{60} + \frac{2B}{45}$$

where:

B = Bendiness degrees / km.

VISI = Harmonic mean visibility (metres) (see harmonic mean visibility section below).

NOTE Bendiness is calculated by dividing the sum of the change in direction (in degrees) of a road by the length (in km) over which it occurs. For example, a 3km length of road with a total change in direction of 180 degrees would have a bendiness of 60 degrees / km.

2.3 Layout constraint (Lc) shall be derived using Table 2.3.

Table 2.3 Layout constraint (Lc)

Road type	S2				WS2		WS2+1		D2AP		D3AP	D2M	D3M	D4M
Carriageway width (excluding hard strips and hard shoulder)	6 metres		7.3 metres		10 metres		11.5 metres		Dual 7.3 metres		Dual 11 m-etres	Dual 7.3 metres & hard shoulder	Dual 11 metres & hard shoulder	Dual 14.7 metres & hard shoulder
Frequency of commercial accesses, lay-bys and junctions	H	M	M	L	M	L	M	L	M	L	L	L	L	L
Standard verge width	29	26	23	21	19	17	19	17	10	9	6	4	0	0
1.5 metre verge	31	28	25	23	-	-	-	-	-	-	-	-	-	-
0.5 metre verge	33	30	-	-	-	-	-	-	-	-	-	-	-	-

L = Low number of commercial accesses, lay-bys and junctions, less than or equal to 5 per km

M = Medium number of commercial accesses, lay-bys and junctions, between 6 to 8 per km

H = High number of commercial accesses, lay-bys and junctions, greater than or equal to 9 per km

NOTE 1 *Layout constraint (Lc) measures the degree of constraint provided by the road cross-section, verge width, and frequency of junctions, lay-bys and commercial accesses.*

NOTE 2 *Values of Lc are obtained from Table 2.3 by reading along the appropriate verge width rows and down the road type columns corresponding to the appropriate frequency of commercial accesses, lay-bys and junctions. The appropriate value of Lc is denoted by the number read at the intersection of the verge width row and the road type column.*

2.4 For road improvements of up to 2km in length on existing rural roads, the design speed shall be derived using Figure 2.1 with the value of Ac calculated for a minimum road length of 2 km incorporating the section of road improvement.

Urban roads

2.5 On urban roads, design speeds shall be selected with reference to the speed limits for the road, as shown in Table 2.5.

Table 2.5 Urban roads speed limit/design speed relationship

Speed limit		Design speed
Mph	**Kph**	**Kph**
30	48	60B
40	64	70A
50	80	85A
60	96	100A

NOTE *Design speeds are higher than the speed limit and therefore permit a small margin for vehicle speeds in excess of the speed limit.*

Harmonic mean visibility (VISI)

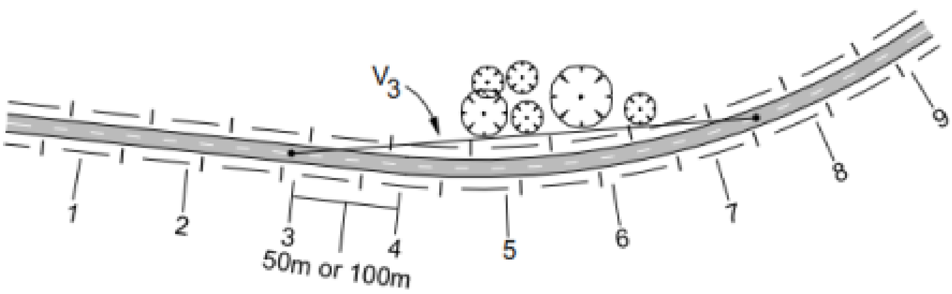
2.6 The harmonic mean visibility (VISI) shall be measured over a minimum length of 2km.

2.6.1 Measurements of sight distance should be taken in both directions at regular intervals (50 metres for sites of restricted visibility, 100 metres for sites with unrestricted visibility).

2.7 Sight distance shall be measured from an eye height of 1.05 metres to an object height of 1.05 metres, with both measurements taken above the centre line of the road surface.

2.8 Sight distance shall be the true sight distance available at any location, including any sight distance available across verges and outside of the highway boundary or across embankment slopes or adjoining land, as shown in Figure 2.8.

Figure 2.8 Measurement of harmonic mean visibility



2.8.1 The harmonic mean visibility for new roads should be calculated using Equation 2.8.1.

Equation 2.8.1 Formula for calculating harmonic mean visibility

$$VISI = \frac{n}{\frac{1}{V_1} + \frac{1}{V_2} + \frac{1}{V_3} \cdots + \frac{1}{V_n}}$$

where:

n =	Number of observations.
V_1 =	Sight distance at point 1, etc.

2.8.2 The harmonic mean visibility for existing roads should be calculated using an empirical relationship given in Equation 2.8.2.

Equation 2.8.2 Empirical relationship

$$\mathrm{Log}_{10} VISI = 2.46 + \frac{VW}{25} - \frac{B}{400}$$

where:

VW =	Average verge width (averaged for both sides of the road)
B=	Bendiness (degree per km - minimum length of 2 km)

NOTE 1 Equation 2.8.2 is applicable up to VISI = 720 metres.

NOTE 2 On long straight roads, or where sight distance is available outside of the highway boundary, the relationship between the average verge width and bendiness can result in values of harmonic visibility calculated using Equation 2.8.1 being significantly underestimated.

2.8.3 For preliminary route analysis, where detailed measurements of sight distance are not available, the following typical values should be used:

1) VISI = 700 metres for long virtually straight roads, or where the road is predominantly on embankment affording high visibility across embankment slopes or adjoining level land;
2) VISI = 500 metres where a new road is designed with continuous overtaking visibility, with large crest K values and wide verges for visibility;
3) VISI = 300 metres where a new road is designed with frequent overtaking sections, but with stopping sight distance provision at all sharp curves;
4) VISI = 100 - 200 metres where an existing single carriageway contains sharp bends, frequent double white line sections and narrow verges.

NOTE The empirical relationship provided by Equation 2.8.2 can be used for the preliminary analysis of existing routes if values of bendiness (B) are available.

Design speed related parameters and relaxations

2.9 Designs shall provide at least the desirable minimum values for stopping sight distance, horizontal curvature, vertical crest curvature and sag curvature as shown in Table 2.10, except for the following situations:

1) where a relaxation is permitted by sections 2, 3, 4 or 5 of this document;
2) the design of a vertical crest curve on a 2 lane single carriageway road (see Section 9).

2.9.1 Design parameters should meet or exceed desirable minimum values except where particular circumstances relating to 2 lane single carriageways roads exist (see Section 9).

NOTE Requirements and advice on the application of relaxations below desirable minimum is provided in GG 101 [Ref 5.N].

2.9.2 Interfaces between sections of road with different design speeds should be designed so as not to suddenly present the driver with low radius horizontal curves, sharp crests or shorter sight distances.

2.10 Minimum geometric parameters for full overtaking sight distance (FOSD) and overtaking crest K values that shall be used for the corresponding design speed are shown in Table 2.10.

Appendix D: Site Photographs

1. Toseland Road

1.1. The existing road varies between 5.0m to 6.0m in width depending at which points it is measured.

1.2. There is evidence throughout the length to be upgraded of edge failure of the pavement surface, and repeated repairs having to be carried out. These repairs are generally wider than the existing road pavement, in an attempt to improve stability.

Figure 3: Typical edge repair, Toseland Road

Figure 4: General View of Toseland Road showing repeated edge repairs

1.3. The condition adjacent to unkerbed edges is poor and in places it is clear vehicles have run on the verge.

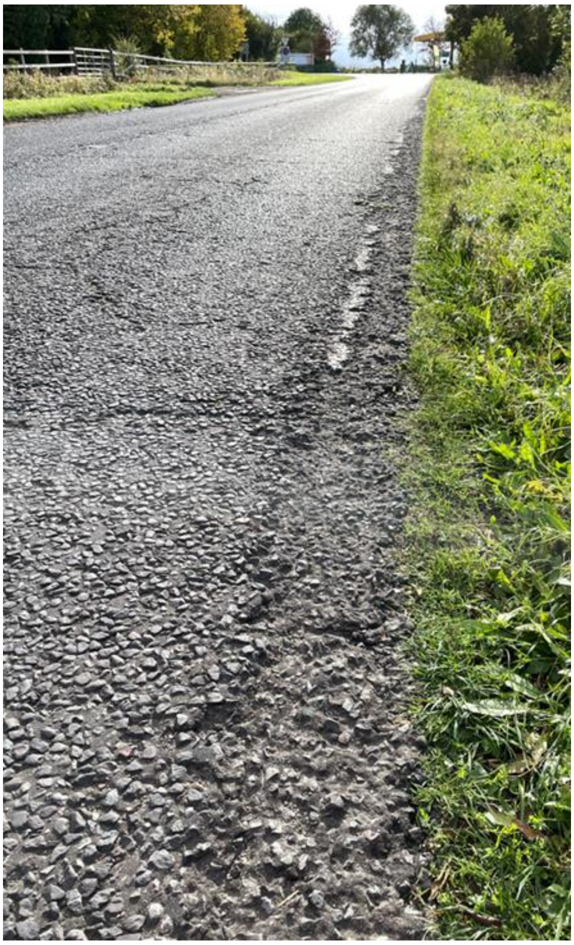


Figure 5: Toseland Road: typical edge condition

Figure 6: Toseland Road – vehicles running on verge

Figure 7: Toseland Road – existing access to Eaton Transport site

Figure 8: Toseland Road- Previous edge repairs failing again

B1046

1.4. NW of rail bridge the existing road is 6.8m wide kerbed, with adjacent footways and housing. Side inlet gullies mean that gully pots are not in wheel track.

Figure 9: Photo of B1046, NW of railway bridge. 6.8m carriageway, kerbed

1.5. South east of railway bridge, the road narrows to 6.0m to 6.2m and condition deteriorates. It is very noticeable that HGVs drive close to edge of pavement and centre of road, see Figure 10.

Figure 10: Photo of HGV on B1046 6m width

1.6. Figures 11 and 12 show local widening of the B1046 to 7.0m at A428 bridge and back to 6.0m either side – this is the sort of repeated cross section change here and at the railway bridge that is referred to in the standards and is not desirable.

Figure 11: Photo of B1046 at bridge over existing A428

Figure 12: *B1046 at bridge over existing A428*

1.7. South of A428 bridge, the B1046 is approx 6.0m wide. Figures 13,14 and 15 show evidence of edge damage and repairs.

Figure 13: Photo of B1046, length to be diverted, edge repairs on 6m section

Figure 14: Photo of B1046, edge damage on 6m section

Figure 15: Photo of B1046, edge damage

Potton Road

1.8. The road is only 5.0m wide at tie in point. There is very noticeable edge damage to pavement, and dislodged/damaged kerbs where present as shown in the following figures.

Figure 16: Photo of Potton Road, Edge failures and repairs

Figure 17: Photo of Potton Road- dislodged kerbs

Figure 18: Photo of Potton Road – Dislodged Gully outlet

Figure 19: Photo of Potton Road – edge failures and repairs

Figure 20: Photo of Eynesbury Plant Hire/ Warehousing site on Potton Road – wide HGV access