Technical note

Project:	A428 Bus Enhancement Scheme	**To:**	Rid Hollands, Colin Young
Subject:	Flood Risk Desktop study	**From:**	Liz Hillcoat, Charlotte Nunns
Date:	26 Jan 2017	**cc:**	

Term	Definition
Awarded Watercourse	Ordinary watercourses that have been awarded to the respective Local District Authority by the Enclosure Acts. The Local District Authority is responsible for the maintenance of the public drain or watercourse.
Main River	Main Rivers are usually large stream and rivers, or watercourses of strategic drainage importance. Main Rivers are designated by the Department of Environment, Food and Rural affairs, and are the responsibility of the Environment Agency for maintenance purposes.
Ordinary Watercourse	An ordinary watercourse is every river, stream, ditch and passed through which water flows that does not form part of a Main River as defined by the Environment Agency. These are generally maintained by the riparian (landowner) or internal drainage boards.
Flood Zones	This is a national mapped data set held by the Environment Agency and show the predicted probability of flooding for any given area.
Floodplain compensation	Mitigation to prevent an increase in flood risk associated with development in the floodplain. Compensation must be on a level for level, volume for volume basis and hydraulically linked with the floodplain. It is preferential for compensation to be provided as close to the area of loss as possible.

Background

Cambridgeshire County Council are proposing a High Quality Public Transport scheme running between Cambridge and Cambourne. Atkins has been commissioned to complete this high level desktop study and site walkover to observe watercourses and potential associated flood risk issues. The purposed of this technical note is to provide a summary / bullet points of key flood risk findings that would feed into an EIA scoping report. This technical note assesses both Options 3a and Option 3.

This technical note focuses on the considerations required for the watercourses in the area, with a particular attention to the crossings and proximity to Bin Brook. The impact of existing surface water flood risk has also been considered.

Watercourse location

The following is a list of locations where watercourses are in close proximity to the route, starting at the most westerly end of the scheme.

Option 3a (cyan route)

- Through Cambourne there are no significant watercourses that would be impacted by the route, however there is a drainage system around a green open space to the east of the fitness and sports centre (Grid Ref. 532590, 259790).
- There are drainage channels in the vicinity of Wellington Way, over which the route would need to cross (Grid Ref. 535200, 259670). This watercourse is an ordinary watercourse and there is no known fluvial flood mapping (flood zones) for this area.

- In the area where the route is proposed in parallel between St Neots Road and the A428 at the Scotland Road Junction there are several drainage channels, balancing ponds and Callows Brook which require consideration (Grid Ref. 537140, 259690). These watercourses are 'awarded' watercourses, which means that they are awarded to the district council for maintenance purposes. There is no known fluvial flood mapping (flood zones) for this area.
- To the south of Madingley Wood the route will cross a drainage channel (Grid Ref. 540160, 259150). This watercourse is an ordinary watercourse and there is no known fluvial flood mapping (flood zones) for this area.
- At the eastern end of the scheme the route will cross Bin Brook (Grid Ref. 543600, 258310) and as shown on Figure 1. At this location Bin Brook is designated Main River and has associated Environment Agency flood zones which are approximately 30-40m wide at this location (1 in 100 (1%) annual probability event). The route crosses the watercourse where there appears to be a drain discharging into Bin Brook.

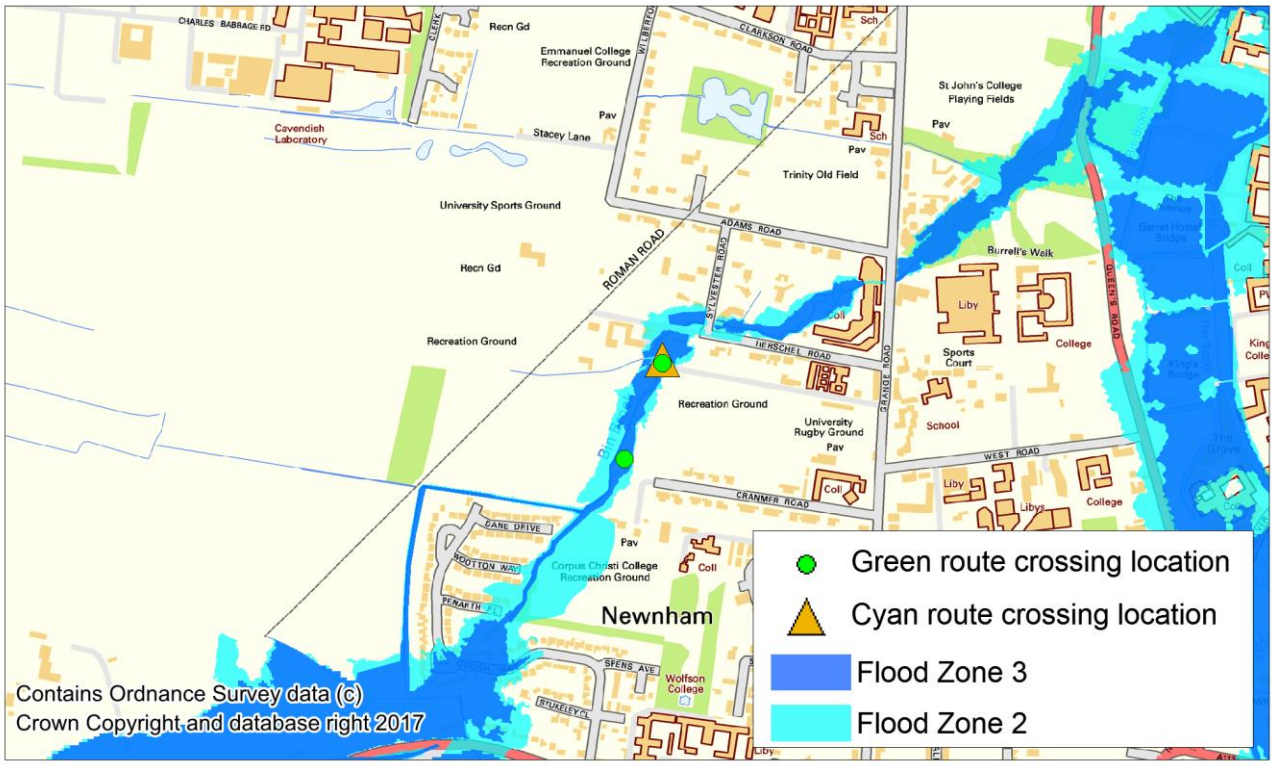


Figure 1 – Location of route crossing at the Main River designed reach of Bin Brook

Option 3 (green and red routes)

- The red route through Cambourne appears to be on existing roads and hence would not impact on watercourses. The green route involves development in the green open space associated with Lake Ewart and areas to the south of Cambourne where it will also cross a number of drainage channels (Grid Ref. 531520, 259000). The watercourses are ordinary watercourses and there is no known fluvial flood mapping (flood zones) for this area.
- There are no watercourses for consideration associated with the red route through the Bourne Airfield. There appears to be a small drainage route to the south of the airfield (Grid Ref. 534320, 259140) which would need consideration if the green route is proposed.
- There are drainage channels in the vicinity of Wellington Way, over which the route would need to cross (Grid Ref. 535200, 259670). This watercourse is an ordinary watercourse and there is no known fluvial flood mapping (flood zones) for this area.

- To the south of Madingley Wood the routes will both cross a drainage channel (Grid Ref. 540160, 259150). This watercourse is an ordinary watercourse and there is no known fluvial flood mapping (flood zones) for this area.
- To the south and south west of Hardwick both the red and green routes will cross several drainage channels. These watercourses are ordinary watercourses and there is no known fluvial flood mapping (flood zones) for this area.
- To the east of Hardwick both the red and green routes will cross Bin Brook (Grid Ref. 538470, 258580) and as shown on Figure 2. Although Bin Brook is an ordinary watercourse at this location, Environment Agency fluvial flood zones are present in this area and hence will require consideration.
- At the eastern end of the scheme the green route follows two paths and both cross Bin Brook designated as Main River. The solid green line route follows Herschel Road (Grid Ref. 543600, 258310). Should works be required to Herschel Road to accommodate the scheme then the associated design must take into consideration Bin Brook. The dashed green line to the south would require a new crossing of Bin Brook (Grid Ref. 543540, 258210) and at this location the floodplain (1 in 100 (1%) annual probability event) is approximately 30-40m wide at this location.
- At the eastern end of the scheme the red route is proposed to follow Adams Road and does not cross Bin Brook.

Figure 2 – Location of route crossing at the ordinary watercourse designed reach of Bin Brook

Summary

The above lists show that both options for the route cross or are in close proximity numerous watercourses, most of which are not designated as Main River or have associated flood zones. Watercourses classed as Main River, and those with mapping flood zones, normally have the greatest flows or are the most significant requiring flood risk considered during the design phases of the scheme. At these locations the scheme design must ensure that any changes to the drainage network, including culverting, do no cause an increase in flood risk in this area.

- Option 3a crosses Bin Brook once. At this location Bin Brook is designated as Main River, and has a floodplain approximately 30-40m wide and has a drainage channel discharging into it.

- Option 3 green route crosses Bin Brook in two locations. At one of these two locations Bin Brook is designated as Main River and has a floodplain approximately 30-40m wide. At the other location Bin Brook is an ordinary watercourse with a relatively narrow floodplain (<20m).
- Option 3 red routes crosses Bin Brook once. At this location Bin Brook is an ordinary watercourse with a relatively narrow floodplain (<20m).

Surface water

Along the lengths of both options 3 and 3a the surface water flood risk mapping indicates areas at risk from this source of flooding. However the areas at risk are primarily along existing watercourses and hence the risk/impact will be addressed as part of fluvial considerations. Elsewhere areas at risk are along the existing road network and therefore if there are no proposals to alter the road, the scheme would not impact surface water flooding, or if road improvements are required to accommodate the bus route then there may be potential to upgrade the road drainage to provide flood risk betterment. The other areas shown to be at surface water flood risk are associated with existing ponds and lakes, or localised ground depressions.

In areas where a new bus route is required, and hence some impermeable surfacing is proposed, surface waterrunoff will increase resulting in a potential increase in associated flood risk to downstream areas. At locationswhere impermeable surfacing is required, particularly in locations that would be susceptible to flooding as aresult of the scheme, surface water runoff attenuation must be provided. Surface water management shouldbe discussed and agreed with the Lead Local Flood Authority (LLFA), in this case Cambridgeshire County
Council at the earliest possible stage in the scheme design.

Other sources of flood risk

As part of a detailed flood risk assessment that would be required to support an associated planning application, all sources of flood risk must be considered. For this scheme, and based on the information currently available, it is considered that the most prevalent sources of flood risk are fluvial and surface water as discussed above.

The flood risk from groundwater should be considered, however at this stage the risk is considered low owing to the development being above the existing ground level. There is potential that below ground works such as excavations or sheet piling could interrupt groundwater movements which could result in localised raising of the water table, and hence this potential impact would need consideration during the design phases.

There is also a potential risk from underground water transmission infrastructure, however it is assumed that the location of these services will be determined during a services search and the scheme will be designed accordingly.

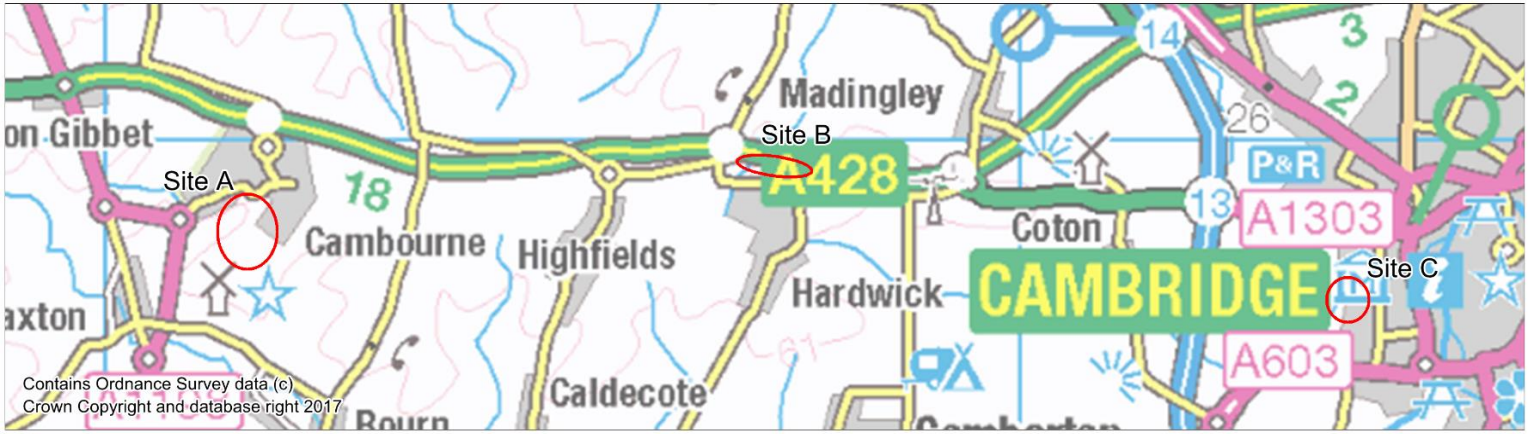
It is currently anticipated that there are no other sources of flood risk associated with the proposed development.

Site walkover

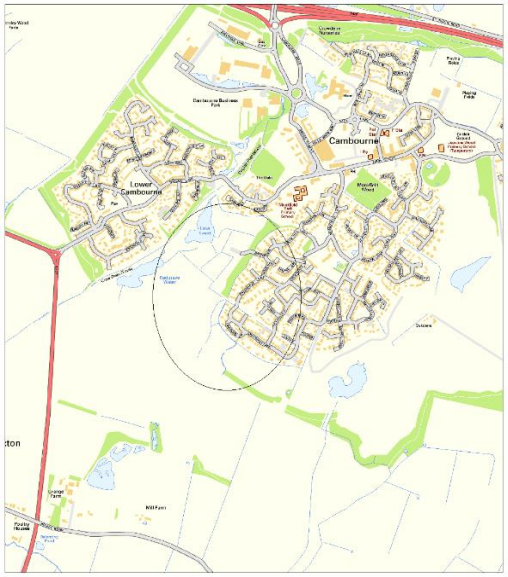
A site walkover was undertaken on the 12 January 2017 to view the watercourse crossings and determine any potential flood risk issues that may not be apparent from existing mapping and other readily available information. The weather conditions leading up to the site visit were dry with cold temperatures typical of winter months. There was light rain for a short period part way through the site visit, although not considered sufficient to increase flow within the watercourses or create areas of standing water.

The site visit was carried out in three locations, as shown on Figure 3:

- Site A – the green open space to the south of Cambourne through which Option 3 (green route) would pass;
- Site B – the area to the north of Hardwick, where Option 3a would be located in parallel to the A428; and
- Site C – the easterly end of the scheme where Option 3a and 3 (green route) would cross the Main River Bin Brook.



Site A



Site B

Site C

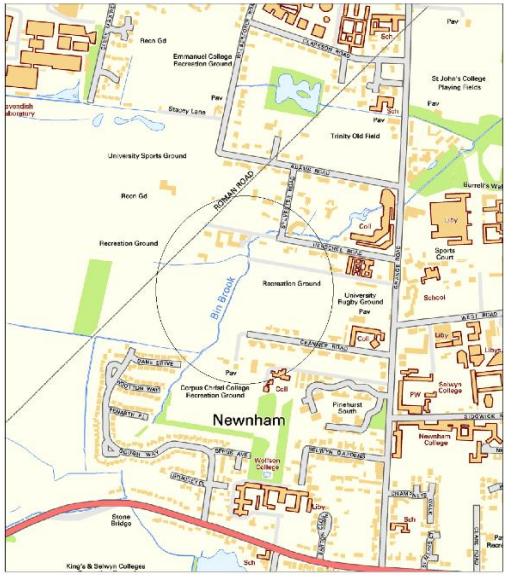


Figure 3 – Location of site visits

Site A

The site was easily accessible via the Public Right of Way (PRoW). At this site, and as previously identified on the mapping, the areas is crossed by numerous drainage channels which appear to feed the lakes from the new housing development located in Great Cambourne. The majority of the channels were dry and heavily vegetated. Figure A-1 shows the typical appearance of the drainage channels in green area to the west of Great Cambourne and Figure A-2 shows a typical culvert inlet under the numerous footpaths within this area of the green open space. Although the channels were dry the ground was relatively wet with some areas of standing water such as shown in Figure A-3 and within one of the observed channels as shown in Figure A-4. To the south of Great Cambourne, but still within the green open space the channels were larger and also appear predominately dry, although visibility was limited owing to the heavily vegetated nature of the channels such as shown in Figures A-5 and A-6.

If Option 3 (green route) is taken forward, then the assessment and design will need to determine the flow in these drainage channels to ensure the drainage system in this area is not significant adversely impacted as a result of the scheme. This area appears to also include a proportion of drainage from Great Cambourne and hence the drainage network for this new development would need to be obtained and used to inform the hydrology assessment for the area.

Site B

The site was easily accessible via PRoWs and was essentially along St Neots Road. Along this section were reaches of drain, both on the north and south side of the road, that appear to discharge into Callows Brook. The reaches of drain to the south of the road were clearly visible, with open sections and short culverted sections allowing for property access, as shown in Figures B-1 and B-2. Two storage reservoirs feed into this drain and during the site visit one of the reservoirs was dry whilst the other appear to contain a significant volume of water (Figure B-3). The drain connects to Callows Brook before being culverted under St Neots Road, flowing northward. The upstream end of Callows Brook before it enters a culvert under St Neots Road is shown in Figure B-4, the outfall from this culvert is shown in Figure B-5. The drains in parallel to the north side of St Neots Road were not visible owing to significant vegetation and fencing.

Option 3a appears to follow the current alignment of St Neots Road. If improvement works are required to the road to facilitate the proposed route then mindful consideration of these drains would be required as it appears to be a formalised drainage system, together with two storage reservoirs, to limit flooding either in this area or elsewhere. The scheme must ensure there is no negative impact on these drains.

Callows Brook, which flows in a northerly direction is shown in Figure B-6, which looks upstream towards the A428.

Site C

There were three locations at this site which were planned for a walk over, however it was not possible to visit two of these locations (were Option 3a and Option 3 one option for the green route cross Bin Brook) due to access arrangements and parking availability. However it was possible to visit the upstream location and an area downstream. This gives an overall appreciation of Bin Brook along this reach, albeit it was not possible to visit the exact crossing locations.

Figures C-1 to C-3 show Bin Brook (designated as Main River along this reach) at the location of Option 3 (green route) which follows Herschel Road. If road improvements are required in this area to accommodate the scheme then it must be ensured that any works do not negatively impact on Bin Brook.

Upstream of the above and upstream of the two other potential crossing locations is open watercourse which appears to be maintained to restrict excess vegetation growth. Figures C-4 to C-6 show Bin Brook and the associated alleviation channel from the Cranmer Road access.

Photographs for Site A

Figure A-1 – Typical appearance of drainage channels

Figure A-2 – Typical culvert inlet

Figure A-3 – Standing water

Figure A-4 – The only channel with standing water

Figure A-5 – Inlet south of Great Cambourne

Figure A-6 – South of Great Cambourne

Photographs for Site B

Figure B-1 – Typical appearance of drainage channels

Figure B-2 – Typical appearance of drainage channels

Figure B-3 – Part full storage reservoir

Figure B-4 – Callows Brook, upstream of St Neots Road

Figure B-5 – Outlet of St Neots Road culvert

Figure B-6 – Callows Brook, north of the A428

Photographs for Site C

Figure C-1 – Downstream of Sylvester Road bridge

Figure C-2 – Upstream of Sylvester Road bridge

Figure C-3 – Upstream of the culvert under Herschel Road

Figure C-4 – Bin Brook looking upstream from the Cranmer Road access

Figure C-5 – Bin Brook looking downstream from the Cranmer Road access

Figure C-6 – looking upstream along the alleviation channel around the Gough Way estate

Recommendations

The following recommendations have been made, dependant on which option/s are taken forward:

Option 3a (cyan route)

1. Determine the details for the proposed route at the location of the sports and fitness centre in Cambourne.

2. To the south of Wellington Way the route will cross a drain and hence the flow within this channel will need to be determined to inform culvert sizing.

3. Determine the detailed proposed for route along St Neots Roads to the north of Hardwick, specifically whether the scheme would involve widening the road. Further assessment would be required if road widening is proposed as this may impact on the drainage channels.

4. To the south of Madingley Wood, the route will cross a drain and hence the flow within this channel will need to be determined to inform culvert sizing.

5. At the eastern of the scheme, where the route would cross the Main River designated Bin Brook, it appears that the route would largely follow an existing track. However improvements would be required to accommodate the scheme, including a new crossing. A hydraulic model may exist for this reach of Bin Brook and hence it is recommended that this is obtained (if available) to inform the crossing design and road improvements at this location. If an existing model is not available then a one will need to be created. Furthermore development within the floodplain (which will reduce floodplain storage) would require associated floodplain compensation; and no drainage assets, such as balancing ponds, should be located within the floodplain.

Option 3 (green route)

6. A hydrology study would be required to determine the flow within the drainage network in the green open space to the south of Cambourne. This would need to be informed by the location of potential culverts under the route.

7. The surface water sewer network would need to be obtained for the new development of Great Cambourne and any other areas which may discharge surface water into the green open space discussed in the recommendation above.

8. Determine the details proposed for route to the south of Bourne Airfield. Further assessment would be required if the scheme is proposed in close proximity to the drains in this location.

9. At several locations the route will cross drains and other ordinary watercourses, such as to the south of Wellington Way, south of Madingley Wood and to the south and south west of Hardwick. At locations the route will cross a drain the flow within the channel will need to be determined to inform culvert sizing.

10. The route will cross Bin Brook at a location it is classed as ordinary watercourse. Flows would need to be determined at this location to inform culvert design, and the existing flood zones used to inform the general track design. The hydraulic information could potentially be informed by a hydraulic model if one existing for Bin Brook that extends to this reach.

11. At the eastern of the scheme, where the route would cross the Main River designated Bin Brook in potentially two locations. The northerly option appears to largely follow an existing track. However improvements would be required to accommodate the scheme, including a new crossing. The southerly options would require a new track prior to linking with Cranmer Road. A hydraulic model may exist for this reach of Bin Brook and hence it is recommended that this is obtained (if available) to inform the crossing design and road improvements at this location. If an existing model is not

available then a one will need to be created. Furthermore development within the floodplain (which will reduce floodplain storage) would require associated floodplain compensation; and no drainage assets, such as balancing ponds, should be located within the floodplain.

Option 3 (red route)

12. Determine the details for the proposed route through Cambourne. At present it is assumed that no road improvements are required to accommodate the scheme, however if road widening is proposed, then further assessment may be required.

13. At several locations the route will cross drains and other ordinary watercourses, such as to the south of Wellington Way, south of Madingley Wood and to the south and south west of Hardwick. At locations the route will cross a drain the flow within the channel will need to be determined to inform culvert sizing.

14. The route will cross Bin Brook at a location it is classed as Ordinary Watercourse. Flows would need to be determined at this location to inform culvert design, and the existing flood zones used to inform the general track design. The hydraulic information could potentially be informed by a hydraulic model if one existing for Bin Brook that extends to this reach.

Overall

15. Option 3a (cyan route) and Option 3 (green route) both cross the Main River designed reach of Bin Brook. Therefore works in these areas would need consent from the Environment Agency. Hence it would potentially be beneficial to engage in early discussions with the Environment Agency to determine any specific requirements / restrictions for this area.

16. All routes involve works that cross or are located in close proximity to ordinary watercourse, which would require consent from Cambridgeshire County Council. Therefore it would also be beneficial to engage in early discussion with the Cambridgeshire County Council drainage team to determine any specific requirements / restrictions for this area.

17. Surface water management should be discussed and agreed with the Lead Local Flood Authority (LLFA) at the earliest possible stage in the scheme design. This is of particular importance in areas where the scheme will impact on current drainage arrangement, whether this be to an existing drainage system or a reduction in infiltration rates (i.e. increase impermeable surfacing).

Flood risk preferred option

Based on the above assessment it is concluded that Option 3 (red route) is likely to be the least problematic in relation to flood risk considerations. This is primarily owing to this route not crossing the Main River designated reach of Bin Brook.

The second preferential option in relation to flood risk would be Option 3a (cyan route) as it is proposed to cross the Main River designated reach of Bin Brook at an existing crossing, albeit the crossing would need improvement works.

From a flood risk perspective the least favourable option would be Option 3 (green route) owing to its options for crossing the Main River designated reach of Bin Brook and its route through the green open space (and associated numerous drainage channels) to the south of Cambourne. This route would also cross an ordinary watercourse reach of Bin Brook.

Table 1 – Option summary table

Option	Location in Flood Zone 3	Impacts on Main River	Mitigation required	Regulatory authority	FRA required
3a (cyan route)	Yes, at Main River crossing of Bin Brook.	Yes, requires detailed consideration. Hydraulic modelling required.	Yes, may need floodplain compensation.	Cambridgeshire County Council and the Environment Agency.	Yes
3 (green route)	Yes, at ordinary watercourse and Main River crossings of Bin Brook.	Yes. One location likely to be minimal. The second location requires detailed consideration. Hydraulic modelling required.	Yes, one location likely to be easily accommodated. Second location may need floodplain compensation.	Cambridgeshire County Council and the Environment Agency.	Yes
3 (red route)	Yes, at ordinary watercourse crossing of Bin Brook.	Yes, although likely to be minimal.	Yes, although likely to be easily accommodated.	Cambridgeshire County Council.	Yes