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New River Crossing: Option Appraisal

Wisbech Access Study

August 2017

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New River Crossing: Option Appraisal

Cambridgeshire County Council / Fenland District Council

August 2017

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1. Executive Summary

This assessment forms part of the first phase of the Wisbech Access Study. The Wisbech Access Study consists of two distinct phases. The first phase is a series of individual scheme assessments, including the consideration of a new river crossing.

Fenland District Council have identified three significant growth sites around Wisbech within its Local Development Plan (LDP). One of these sites is situated to the west of the River Nene and an additional river crossing is required to enable this development to occur, and to help alleviate congestion on the existing two crossings within Wisbech town centre. A new river crossing would be directly linked to the provision of a Western Link Road.

The Western Link Road Assessment (also of the Wisbech Access Study) has identified three potential broad alignments for the route, and these have formed the basis of the locations considered for a river crossing within this appraisal. The three locations are to the south and west of the town centre, and are described below (from north to south):

- A Barton Road Crossing;
- A New Bridge Lane Crossing; and,
- A Southern Crossing located close to the A47 / Cromwell Road / Redmoor Lane Roundabout.

This report has considered the impact of the following restraints for each of the locations:

- Flood Risk and existing flood defences;
- Interaction with both North Brink and South Brink;
- Surrounding Development and land ownership, and the;
- Wisbech Conservation Area.

The report includes a structural assessment that has identified the different types and form of bridge that would be appropriate at each of the locations. This assessment has also identified three potential options for the structure to connect to the highway network at each of the three locations.

The requirement for the bridge to be positioned above the flood defences means that the depth of the structure itself becomes critical in determining the length of approach ramps and the impact the bridge has on the local environment.

The construction of a crossing at any of these locations will be a major project. The surrounding ground conditions are such that the bridge will require deep piled foundations. This in turn will require a large working area for the plant and equipment needed. The size of the required working areas, and the provision of suitable safety zones, would typically require major traffic restrictions in the vicinity of works.

A summary table scoring each of the options against the different variables considered within this assessment has been included in Appendix A.

The assessment has come to the following conclusions for each of the three locations:

Barton Road

The Barton Road location has the largest span required of the three locations. The fact that it is also within the Conservation Area would place the greatest level of design restrictions / expectations on this structure.

There is enough room on the South Brink to position a table junction to create a connection between the south brink and the bridge, however this would likely involve the loss of the access into the Nestle Purina Petcare site.

The resultant ramps on the North Brink are likely to be 80m long and 4m high adjacent to the river. The positions of the existing houses in this area means that the ramp connecting Barton Road to the bridge would prevent vehicular access to the properties closest to North Brink. If ramps were also required to connect North Brink to the bridge then additional houses north and south of the crossing would become inaccessible.

The demolition of approximately eight to ten houses closest to the crossing point would permit the construction of a junction which would allow the North Brink to connect to Barton Road. The nature of the buildings and the presence of the Wisbech Conservation Area would suggest that this approach would not be acceptable.

New Bridge Lane Crossing

The New Bridge Lane crossing is at a narrow location on the River Nene and is surrounded on the south side by a commercial properties and by rural land with residential properties on the north. As such it would be well serviced by a simple unobtrusive bridge design.

The required length of the ramps would make access to Tesco's yard and the residential properties on the south side of New Bridge Lane very difficult. The location of three properties on the North Brink and the Tesco store on the South Brink would mean that any connection between the brinks and the bridge would have to be positioned immediately adjacent to the bridge, making the bridge significantly wider than would otherwise be chosen.

In summary this location is hampered by its close proximity to a large and recent development. The structure would prove disruptive to the local properties both during construction, and throughout the life of the bridge.

Southern Crossing at Cromwell Road Roundabout

Unlike the Barton Road and New Bridge Lane locations there is no fixed element of the network to be connected to so the exact choice of the position can be selected to best suit buildability and to minimise impact. The difference in height between the brinks and the flood defences is the lowest of any of the crossing locations.

The span of the crossing at this location suits pre-cast concrete beams or a composite bridge. A utilitarian form of structure (rather than a more expensive iconic structure) is recommended at this location to match the industrial nature of the proposed development that will adjoin it. A utilitarian structure would have a similar appearance to the existing Freedom Bridge within Wisbech town centre.

In summary the Southern Crossing location presents a potential low cost location for a new bridge. To minimise negative impact on local stakeholders it would be beneficial to incorporate a set-back junction on the south side.

2. Introduction

Wisbech Access Study

This assessment forms part of the first phase of the Wisbech Access Study. The Wisbech Access Study consists of two distinct phases. The first phase is a series of individual scheme assessments, and the second phase of the study consists of a packaging assessment, as shown in figure 2.1 beneath. Note that this assessment is highlighted in green to demonstrate its relationship to the wider study.

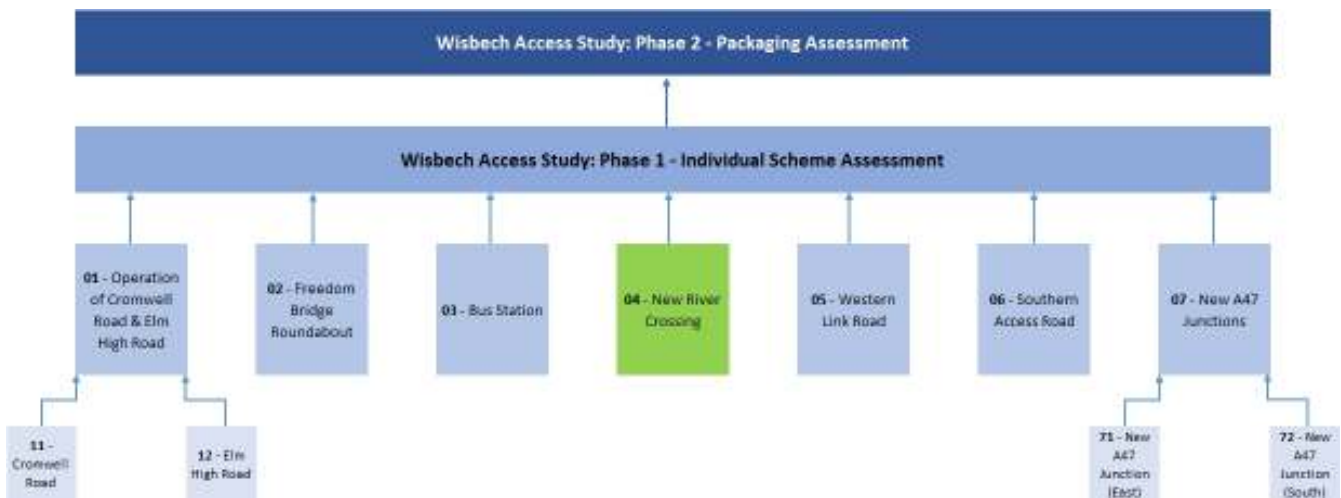


Figure 2.1 – Wisbech Access Study Components

New River Crossing

An additional river crossing is required to enable development to occur to the west of the River Nene, and to help alleviate congestion on the existing two crossings within Wisbech town centre.

The transport network in Wisbech is heavily constrained by the fact that the town is only served by two river crossings, both of which are in the centre of town. The wider transport assessment identified that little benefit could be gained from improving the local road network if the existing crossing provision was left untouched.

Of the two existing river crossings, Town Bridge (to the south of Freedom Bridge) is currently subject to a weight limit which prevents HGV's and other large vehicles from using it. In addition to this, there is also a 3 tonne structural weight limit applied to North Brink to protect the flood defences that run along this section of road.

Fenland District Council have identified three significant growth sites around Wisbech within its Local Plan. One of these sites is situated to the west of the River Nene and an additional river crossing is required to ensure that there is sufficient highway capacity over the river for this development to occur.

For the purpose of this assessment, three locations have been considered for the provision of a new crossing over the River Nene. All three locations were selected because they sit along a potential alignment for a new western link road which would also be required in conjunction with a new river crossing to connect any new development on the west of the river with the rest of Wisbech and the wider highway network.

The provision of a new Western Link Road is considered as a separate element of the Wisbech Access Study, and incorporates the work undertaken in this assessment of a new river crossing. Further detail on the Western Link Road can be found in the accompanying *Western Link Road Report*. This report focuses on considering the constraints (including topography, road network and development proposals), structural form, constructability and high level cost estimate of a new river crossing in each of the three locations.

Crossing Locations Considered

The Western Link Road Assessment (of the Wisbech Access Study) has identified three potential broad alignments for the route, and these have formed the basis of the locations considered for a river crossing within this appraisal. The three locations are to the south and west of the town centre, and are described below (from north to south):

- A Barton Road Crossing;
- A New Bridge Lane Crossing; and,
- A Southern Crossing located close to the A47 / Cromwell Road / Redmoor Lane Roundabout.

The three alignments and crossing locations were selected because they have the potential to fulfil the following essential requirements:

- Ability to serve the Wisbech West Development Site;
- Ability to connect through to the B198 Cromwell Road / B198 South Brink on the eastern bank; and,
- Availability of space on either bank to cater for the approach ramps and associated infrastructure.

Other locations that were initially considered but dismissed include (from north to south):

- Crossing between Coalwharf Road (east bank) and Chapel Road (west bank) – although this crossing location connects directly into the B198 South Brink, space is very constrained. In addition to this, the alignment would provide less access to the Wisbech West Development Site, and its proximity to the Wisbech Town Centre would reduce the benefit of diverting through trips onto the Western Link Road and away from the Town Centre.
- Crossing between South Brink and Magazine Lane (west bank) – this alignment would provide good access into the Wisbech West Development Site, however there is very limited space on the eastern bank for the structure to land and a direct connection through to the B198 Cromwell Road would be difficult in this location.
- Crossing on the alignment of Weasenham Lane (east bank) – this alignment would also have provided good access into the Wisbech West Development Site, however construction of a recent housing estate along the southern end of Weasenham Lane has constrained the space available for a structure to touch down on the eastern bank of the river, and particularly for a direct connection to be made through to the B198 Cromwell Road.

The location of the three crossings considered are shown in Figure 2.2 below, and are discussed in further detail beneath. The broad location of the Wisbech West development site is shown in yellow. Note that this is only approximate and has not been informed by any specific development proposals, this is merely to indicate the approximate area in relation to the crossing locations considered as part of this study.



Figure 2.2 – Crossing Locations Considered

Barton Road Crossing

This potential crossing location occurs at a bend in the river Nene where North Brink meets Barton Road.

The surrounding area on the north side of the river is residential and historic in nature. To the south side of the river the area is industrial, and is currently undergoing re-development. This crossing location lies within the Wisbech Conservation Area.

Because of the bend in the river this location would require the longest bridge. The north side of the river Nene is closely packed with housing and there is little free land that is not currently built on or occupied by an existing road. There is a wide verge available on the south side of the river. The river bank on both sides is topped by a brick faced flood defence wall.

This location has been considered as it is in close proximity to the proposed development site and would minimise the length of, and infrastructure required for the western link road. Although this site has many constraints and would do little to help divert wider through trips away from Wisbech town centre, it would serve the minimum requirement of providing access to the proposed development site.

New Bridge Road Crossing.

This potential crossing locations occurs where New Bridge Lane meets South Brink.

The surrounding area on the north side of the river is largely rural and undeveloped. The potential crossing location is close to Mile Tree Lane and there are several residential properties in the vicinity. On the south side of the river New Bridge Road is positioned between a recent mixed used commercial and retail development and several residential properties. In particular immediately adjacent to the junction of South Brink and New Bridge Road is the goods entrance of a new Tesco store.

The river in this location is relatively narrow and North and South Brink are positioned almost immediately adjacent to sheet pile flood defence walls that top the river banks. The adjacent fields on the north side of river and the development on the south side are lower than the two brinks.

This location has been considered as it naturally sits along the alignment of Mile Tree Lane and New Bridge Lane, the latter of which has the potential to provide direct access onto the lower end of Cromwell Road beyond much of the development closer to the town centre, and close to the A47.

Southern Crossing

This potential location is located west of the roundabout that forms the junction of the A47 / Cromwell Road / Redmoor Lane. This roundabout is subject to other recommendations as part of this study, and is fairly unconstrained, providing opportunity for it to be upgraded to accommodate an additional link from the western link road, and provide direct access onto the A47.

The surrounding area to the north and south of the river is largely farmland with several houses and farm buildings along South Brink to the south, and North Brink and Lords Lane to the north. Therefore the exact position of this crossing is less predetermined than the other sites, and has more flexibility when considering the alignment of the western link road

The river banks in this location are topped with sheet pile flood defence walls. These are positioned directly adjacent to the North and South Brink. The fields in these locations are significantly lower than the level of the brinks.

3. Existing Constraints

Flood Risk and Control

The River Nene is bounded by flood defence walls in all three potential locations, however the height of these walls above the adjacent road varies from location to location.

The Environment Agency have indicated that they would require any new bridge in this location to be positioned 600mm above the design flood height. This is to permit any floating debris, such as fallen trees, to be washed under the bridge without getting caught on the structure and creating a restriction to the flow of water. The design flood height is reviewed for any major works and the exact height at this location is unclear. However, it is understood that the existing flood walls are above the design flood height and the Environment Agency have stated that they would expect any bridge to be positioned above the height of these walls as a minimum. This will require any bridge to be accessed via a ramp and will influence how the road over the bridge interfaces with North and South Brink.

The approximate heights of the flood defence wall above the level of the adjacent road is shown below in Table 1.

Table 1: Relative level of brinks and flood walls

Location	Height above North Brink	Height above South Brink
Barton Road Crossing	1.7m	1.3m
New Bridge Lane Crossing	1.8m	1.4m
Southern Crossing	1.4m	1.1m

The Environment Agency's requirements would position the new bridge at a significantly higher level to the existing bridges. An alternative option would be to construct the bridge at the same height as the existing structures (and below the heights requested by the Environment Agency), but to avoid compromising local flood defences by constructing flood gates at either end of the bridge. These would be deployed in times of flood to close the road and allow flood water to flow over the top of the bridge without breaching the flood wall. However whilst this would allow a cheaper bridge to be constructed it would result in a bridge that would be closed at time of high flood risk. This option is subject to approval from the Environment Agency, and discussions upon the principle of this option should be had with the Agency should the cost of the other be considered prohibitively expensive.

The proposed bridge will have to be a single span structure with supports that will be positioned behind, or in line with, the existing flood defences. If the structure is built on the line of the flood defences this will place a restriction on the construction phasing as the flood defences must be maintained during the works.

The position of the flood defences will determine the minimum span that can be adopted. These are shown beneath in Table 2.

Table 2: Approximate spans in each location

Location	Minimum Span (approximate)
Barton Road Crossing	67 m
New Bridge Lane	38 m
Southern Crossing	42 m

Interface with North and South Brinks

In all three locations the River Nene is bounded by both the North and South Brink. These minor roads run alongside the river from the south west to the Nene Bridge in the centre of Wisbech.

The finished level of the road crossing the river will be at least 2.5m above the level of the existing Brinks. This will create a break in the brink unless a junction is created.

It would be possible to build a junction on either end of the bridge by building a ramp to raise the Brinks on the approach to match the crossing level. The ramps would typically be built at a 1 in 20 gradient, so if the final level of the bridge deck was 3m above the brink a 60m long ramp would be required. For purposes of driver visibility and safety it would be desirable to create a 'raised table' to mount the junction on which would be wider than the road itself.

It is undesirable to construct junctions in close proximity to each other for safety reasons. If the north and south brink were both connected to the bridge the distance between the junctions would be between 40m and 70m depending on the crossing location. This spacing would only be acceptable if a 30mph speed limit was in place and the vertical profile of the road was designed to ensure adequate visibility.

The close proximity of the brink to the flood defence wall and the 'launching' point of the bridge could have a significant impact on the width of the bridge. A junction requires a 'bell-mouth' of a certain size for visibility and manoeuvring and the bridge may need to be widened to accommodate this bell mouth, as there may be insufficient space on either side of the river given the proximity of both North Brink and South Brink to the flood defences.

Figure 3.1 beneath demonstrates the proximity of South Brink to the Nene's flood defences at the junction of South Brink and New Bridge Lane. In this instance, the bridge landing would need to be widened into a 'bell-mouth' to accommodate part of the junction with South Brink and New Bridge Lane.



Figure 3.1 – Proximity of South Brink to Flood Defences

At the Barton Road crossing the North Brink is lined by residential properties. Any ramp constructed to raise the level of the Brink to that of the crossing will prevent access to the front of these properties.

At the New Bridge Lane Crossing point there is a goods entrance to a new Tesco Extra located very close to the junction of New Bridge Lane and South Brink. The ramp required to raise New Bridge Lane to the level of the new crossing would require significant modification to the Tesco development access to allow access to the delivery yard to be maintained.

Surrounding Development and Land Ownership

The Barton River location is closely surrounded by residential properties on the north side. On the south side there is some clear land on the inside of the river bend which is currently dedicated as grass verges. Beyond the verges to the south there is part of the Nestle Purina pet food factory which appears to be undergoing re-development.

The New Bridge Lane location is confined by a Tesco store and residential properties on the south side. The north side of the river consists of fields and several residential properties which are offset from the New Bridge Lane alignment.

The Southern Crossing has several residential properties in its vicinity on either side of the bridge. However, there is adequate space between the houses to locate a bridge.

Wisbech Conservation Area

Construction of a bridge at Barton Road would involve careful consideration and will be subject to greater restrictions as the proposed crossing lies entirely within the Wisbech Conservation area. The presence of the conservation area has a direct impact on the planning process for the structure. It also has an implied impact on the level of monitoring and mitigation measures that may need to be in place before construction works, such as piling, can commence.

Another key factor to consider in relation to the conservation area is that the design would have to compliment, or at least not detract from, the aesthetic nature of the local area.

Typically this would suggest that the new bridge should adopt a similar design as the two existing bridges in the town centre. These are a pre-cast concrete bridge and a steel concrete composite bridge. Each has a curved soffit profile and presents a solid face to the river. A design of this nature is unlikely to be acceptable if it were to be raised by 2.5m to grant access over the flood defences, as required by the Environment Agency. Finding a design that would satisfy the aspirations of the planning process and local stakeholders whilst still meeting engineering and flood management requirements may be challenging.

4. Option Identification

Bridge Type Options

The requirement for the bridge to be positioned above the flood defences means the depth of the structure itself becomes critical in determining the length of approach ramps and the impact the bridge has on the local environment. The depth of the structure is the distance between the running surface and the underside, or soffit, of the bridge. The height of the flood defences plus the depth of the bridge will determine the length of any approach ramps required. As ramps are limited to a 1 in 20 gradient, to be accessible for cycle and pedestrian use, every 500mm of bridge thickness would increase the ramps by 10m.

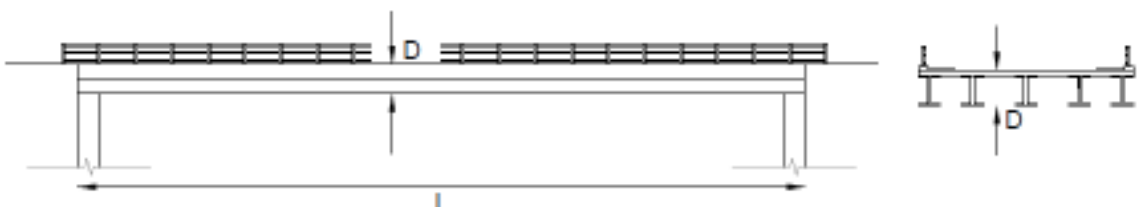
The depth of a bridge structure is determined by its structural form and its span. The majority of bridges consist of the main structural elements, such as beams, positioned below road surface. In these cases the span to depth ratio is largely determined by the material used for the structure. Typically a pre-stressed concrete bridge, such as Freedom Bridge in Wisbech town centre, will have a span to depth ratio of 21 to 1. A steel concrete composite bridge may have a span to depth ratio of between 25 / 30 to 1.

Bridges designed to have the main structural elements continuing above the level of the road, on either side of bridge, result in a thinner deck. This type of bridge include steel truss structures, and cable stayed structures. In these cases the thickness of the deck is governed by the width of the bridge as the deck effectively spans between the main structural elements on either face.

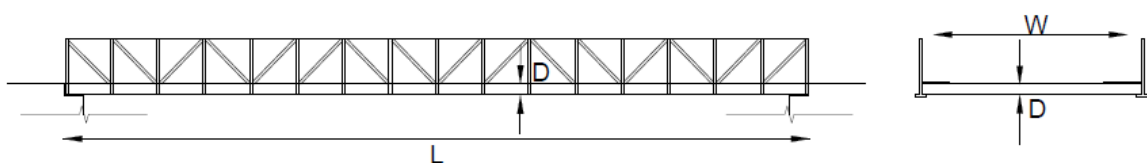
Figure 4.1 – Bridge Deck Options



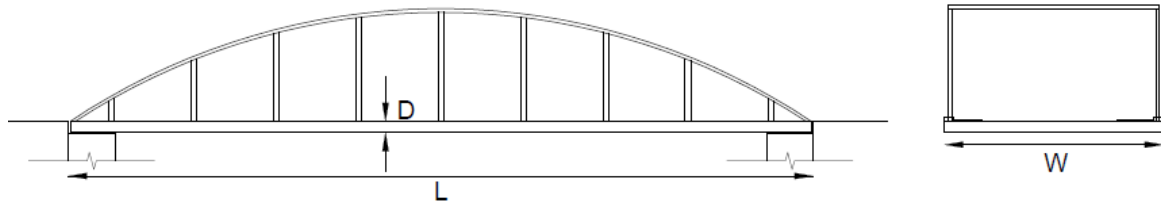
Precast concrete beams. Depth of deck, D , typically $L/21$



Steel composite bridge. Depth of deck, D , typically $L/25$.



Steel Truss. Depth of deck, D , typically $W/20$. Height of truss typically $L/15$.



Steel tied arch. Depth of deck, D , typically $W/20$. Height of arch typically $L/6$.

When the structural members reach significantly above road level the bridge will take on a more dramatic appearance. This would include structures such as tied arches, and cable stayed structures. They typically become a cost effective option at the longer spans of 100metres, or more. However, steel tied arch bridges can be a cost effective option at 70m+. These structures are often favoured in situations where they can make a dramatic statement and are often viewed as landmark bridges.



Figure 4.2 – Car Dyke Bridge, a steel tied arch bridge near Peterborough

The choice of material has an impact on span to depth ratio of the bridge and also to the level of maintenance required. Concrete structures are heavier in nature and therefore tend to have low span to depth ratio. At the same time concrete, when produced to a high standard, as is typical of precast beams, requires very little maintenance. Steel can achieve a slimmer deck but it requires more maintenance in terms of painting and cleaning. A low maintenance option for steel is weathering steel which is a specially formulated alloy which forms a stable layer of rust on the surface which prevents ongoing deterioration. Weathering steel ends up with a rusty red-brown colour which, whilst perfectly attractive in many environments, is not necessarily suitable for all settings, including residential areas.

A summary of the suitable bridge types considered across as three locations is provided beneath in Table 3.

Table 3: Bridge Type Summary

Bridge Type	Typical Span to Depth Ratio	Economic Span Range	Relative Cost / m ² of deck area
Precast Concrete Beam	21	10 - 50m	£
Concrete Box Beam	21	25 - 300m	££
Steel Truss Bridge	15	20 - 100m	££
Steel Composite Beams	25	15 - 100m	£
Cable Stayed	Determined by Transverse Span	100m+	£££

Options for Interaction with North / South Brink

Three options for the Brinks have been identified. These options could be adopted on both sides of the river, or a combination of options used to suit requirements.

The first option is to sever the brink in the location of the bridge. This will minimise the cost of the approach ramps to the bridge as they will only need to accommodate the road passing over the river.

The detrimental impact of this is that the brinks will become no through roads in these locations, and will only perform the function of providing local access to the properties directly adjacent to the road. This could create diversions for local residents. Where South Brink joins the A47 the junction is currently controlled with a No Entry sign, therefore if the brink was severed in this location then minor amendments to this junction may be required, or alternative access arrangements would need to be considered.

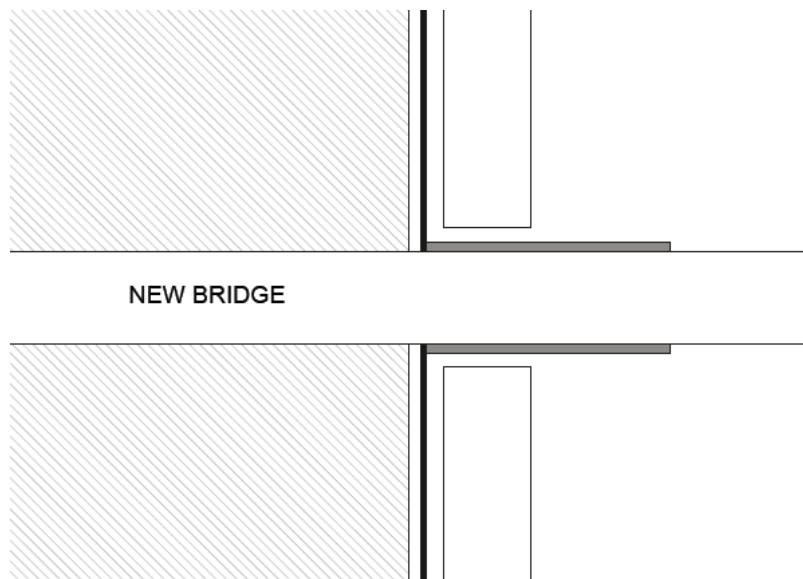


Figure 4.3 – New Bridge Severs North / South Brink

The second option is to install ramps to create a raised table at the intersection of the brink and the bridge. The negative aspect of this option is that it could triple the number of ramps required at each location. In most locations the ramps are located immediately adjacent to the flood defences and therefore to the end of the bridge. This close proximity would require the bridge to be widened to accommodate the junction bell mouth. In addition the bridge would have to be wide enough to ensure that the bridge parapets did not hamper driver visibility at the junction.

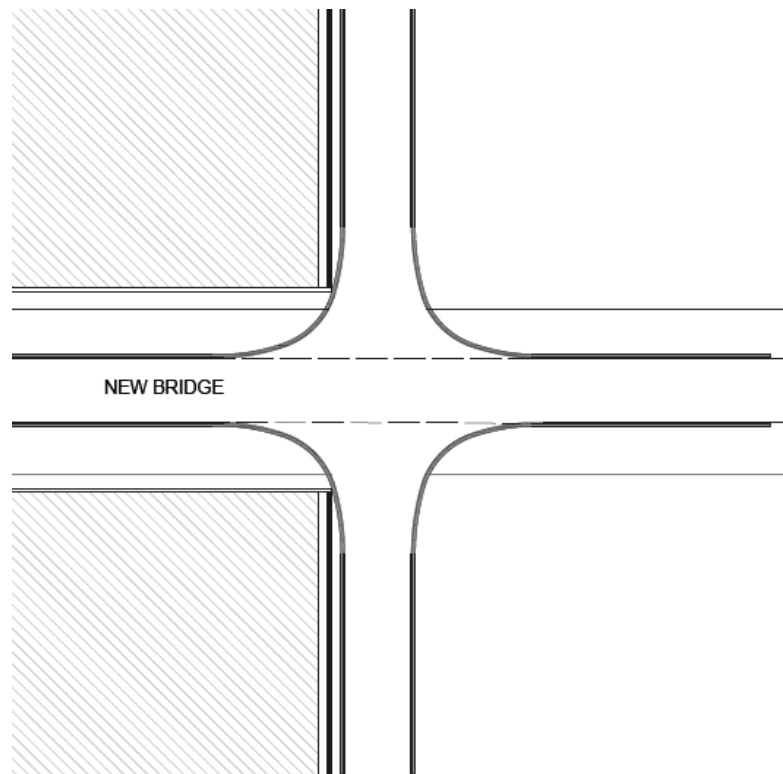


Figure 4.4 – Raised Table Junction between the Bridge and North / South Brink

The final option is to divert the brinks away from the river bank and to form new junctions remote from the bridge. This has the advantage that the new junction could be created on the level and have no need for ramps. In addition by moving the junctions away from the bridge it would create a larger gap between the two brink junctions and increase user safety. The disadvantage of this approach is that not every location has enough room to create this offset junction.

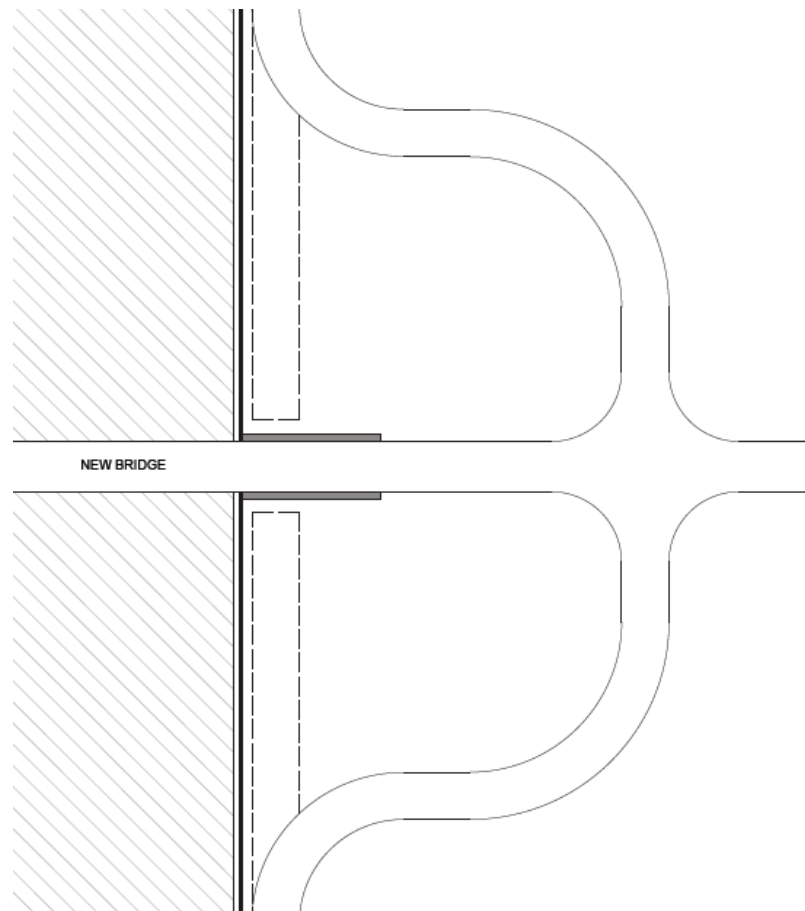


Figure 4.5 – Offset Junction between the Bridge and North / South Brink

It would be possible to lower the brink on the approaches to the bridge to allow them to pass under the new bridge. This would allow the brinks to remain intact but separate to the crossing. This approach would involve lowering the brink in the vicinity of the bridge by approximately 4m. This would require the excavation of approximately 11 thousand tons of earth adjacent to the flood defences and consequently was not considered desirable or practical, and has not been considered further.

The table below shows a summary of the options available at each location.

Table 4: Summary of Brink Options

Location	Brink	Sever Brink	Raised Table	Remote Junction
Barton Road	North	Undesirable	Would create conflict with residential building along North Brink and Barton Road.	Not Feasible
	South	Undesirable	Feasible	Potentially Feasible
New Bridge Lane	North	Feasible	Feasible	Feasible
	South	Feasible – but would create conflict with Tesco entrance	Would create conflict with Tesco entrance	Not Feasible
Southern Crossing	North	Feasible	Feasible	Feasible
	South	Feasible May require some alternative access arrangements on southern end.	Feasible	Feasible

Junction Positioning in Relation to Bridge

The safety of junctions is largely dependent on ensuring the visibility of the junction is greater than the sight stopping distance of the traffic approaching it. For a 30mph road it is desirable that someone positioned 9m back from the stop line has clear visibility to a point 90m ahead.

Visibility from adjacent junctions along the length of the bridge can only be ensured if the junctions are at a similar height to the bridge. If the junctions are set back from the river bank then the vertical profile of the road over the bridge will limit visibility. As a result an offset junction that is set back from the bridge must either be constructed on a raised section of road or be set back far enough to ensure adequate sight stopping distance. Ideally a junction should be set back so that it is at least 70m from the crest of the bridge.

Construction Issues

The construction of any of these crossings will be a major project. The surrounding ground conditions are such that the bridge will require deep piled foundations. This in turn will require a large working area for the plant and equipment required. Large piling operations can cause disruption to local buildings so close monitoring will be required if sensitive structures are close by.

The bridge itself will consist of large beams that will require transporting to site and the construction of large cranes to lift them into position. In addition such cranes will require temporary foundations (crane pads) for them to operate from.

The size of the required working areas, and the provision of suitable safety zones, would typically require major traffic restrictions in the vicinity of works.

The **Barton Road Crossing** comes with significant construction issues. On the south side of the river there may be enough room to keep the South Brink open during the construction of the abutments but the construction of the approach ramps and the erection of the bridge would still result in the south brink being closed for a considerable amount of time. On the North Brink the works site would be very congested and would probably involve the closure of the Brink and Barton Road for several months.

The **New Bridge Lane Crossing** has major construction issues on the south brink. The presence of the Tesco store and local properties leaves very limited room to access and build the abutment. Even if the crane pad were constructed on the more open north side, the piling and construction of the southern abutment would be very difficult in the confined area. South Brink and New Bridge Lane would be closed for the duration of the scheme.

The **Southern Crossing** location has relatively easy access and space to accommodate construction plant and working areas. It would likely be necessary to close both brinks during the works. The access to north brink properties can be achieved via diversion routes. Maintaining access to properties on the south brink may require the construction of a temporary route. Alternatively the phasing of the works could be arranged to allow local residents direct access to Cromwell Road Roundabout prior to closing the brink.

5. Option Assessment

Introduction

This chapter discusses how the different crossing locations, structural options and network connections combine.

Barton Road Crossing

The Barton Road location has the largest span required and therefore structurally it would suit a bridge type that has a large span to depth ratio. The fact that it is also within the Conservation Area would also place the greatest level of design restrictions / expectations on this structure. Any bridge at this location would have a major impact on the appearance of Wisbech town centre and, if desired, should be subject to a focused architect lead option study and a public consultation.

On the South Brink there is enough room to position a table junction to create a connection between the south brink and the bridge. The relative height of the brink and the flood defences means these ramps are likely to be 70m long. Because of the space available on this side of the road the only likely negative impact of these ramps would be the loss of the access that currently exists from South Brink into the Nestle Purina Petcare site. This access does not appear to currently be in use.

On the North Brink the difference in height between the flood defences and the road is greater. The resultant ramps from the bridge are likely to be 80m long and 4m high adjacent to the river. The positions of the existing houses in this area means that the ramp connecting Barton Road to the bridge would prevent vehicular access to the properties closest to North Brink. If ramps were also required to connect North Brink to the bridge then additional houses north and south of the crossing would become inaccessible.

The impact at North Brink could be reduced by either severing the brink at the crossing point. However, it is likely that stopping traffic using the north brink in this location would have a negative impact on the flow of traffic in the Town Centre, as more vehicles would be required to use the routes on the opposite side of the river to travel in a north-south direction.

The purchase and demolition of the houses closest to the crossing point would permit the construction of a junction which would allow the North Brink to connect to Barton Road. Approximately eight to ten houses would be required but this would depend on the final design of the bridge. The nature of the buildings and the presence of the Wisbech Conservation Area would suggest that this approach would not be acceptable.

In summary it would be extremely difficult to place a crossing at this location and connect it into the network on the north side of the river. The bridge would have a major impact on the appearance of the town centre and so would require a great deal of careful planning and negotiation to develop an acceptable solution.

New Bridge Lane Crossing

The New Bridge Lane crossing is at a narrow location on the River Nene and is surrounded on the south side by a commercial properties and by rural land with residential properties on the north. As such it would be well serviced by a simple unobtrusive bridge design.

The relative height of the flood defences on the south brink means that any approach ramps from the brink would be approximately 70m. However, the surrounding landscape in this area falls away from the brink and so it is likely that the final ramps along New Bridge Lane towards Cromwell Road would be at least 100m in length. This means that the ramps would make access to Tesco's yard and the residential properties on the south side of New Bridge Lane very difficult. This access would become more difficult if ramps were also created to connect the south brink to the crossing.

The level between the North Brink and the flood defences is such that any ramps connecting the brink to the crossing will be at least 80m in length. As with the south side the surrounding land falls away from the brink and the main approach ramps to the bridge will be 110m+.

The north and south brinks are located almost immediately adjacent to the flood defences. On the north side there are residential properties that would make it difficult to move a junction away from the brink. The location of the Tesco store would make such a move impossible on the south side. Therefore any connection between the brinks and the bridge would have to be positioned immediately adjacent to the bridge. This would require the bridge to be significantly wider than would otherwise be chosen.

In summary this location is hampered by its close proximity to a large and recent development. The bridge and the ramps to it would prove disruptive to the local properties both during construction, and throughout the life of the bridge. Forming connections to either brink would require the construction of a wider structure which would increase costs. Severing the South Brink and undertaking a major redesign of the goods entrance to the Tesco store would permit this location to work.

Southern Crossing at Cromwell Road Roundabout

The Southern Crossing location is surrounded by farmland and the occasional property. Unlike the Barton Road and New Bridge Lane locations there is no fixed element of the network to be connected to so the exact choice of the position can be selected to best suit buildability and to minimise impact.

The difference in height between the brinks and the flood defences is the lowest of any of the crossing locations. These will result in ramp lengths of approximately 60m on the south side and 65m on the north side. The surrounding land is lower than the brinks so an additional 20m on each ramp would be required if it was necessary to meet the level of the neighbouring fields. However, as this bridge would only exist if a new western bypass was being constructed, it is likely that any new approach road would be constructed at a higher level than the adjacent fields and therefore negate the need for these ramps.

The north and south brinks are immediately adjacent to the flood defences which would increase the required width of the bridge if an on line junction with either brink was required. As the exact location of the bridge can be selected it would be possible to create space for an offset junction on one side of the river. However, the presence of residential properties on each brink means that it is likely that this could only be achieved on a single side without compulsory purchasing these properties.

The span of the crossing at this location suits pre-cast concrete beams or composite bridge. However, the location will also be visible from the A47 and therefore a more high profile iconic structure could be justified as it would help form a gateway to Wisbech.

In summary the Southern Crossing location presents a potential low cost location for a new bridge. To minimise negative impact on local stakeholders it would be beneficial to incorporate a set-back junction on the south side. This could be brought into use prior to the bridge construction to permit uninterrupted access to local residences. If funding permits the option more iconic design should be considered. None of the typical iconic designs, such as cable stayed structures and tied arches, are particularly economic at the span concerned but could make a positive impact on the surrounding landscape and make a positive statement about Wisbech.

6. Cost Assessment

Introduction

The following estimates have been produced based on the 2015 Gross Replacement Cost figures for bridges published by CIPFA (Chartered Institute of Public Finance and Accounting). These figures are produced as part of a structures valuation toolkit that is used by every local authority in the country to produce a value for their bridge stock. The values are updated on an annual basis and whilst they are not suitable for actual construction estimates they are robust enough to produce comparative costs for high level scheme evaluation.

A more detailed construction estimate would require a greater level of detail than is currently held. A preliminary design, topographic survey, ground investigation, traffic management and access restrictions, and an understanding of the structure of the flood barriers would all be required to produce a representative construction estimate. It is recommended that this more detailed information is gathered once one or two preferred options have been shortlisted.

Cost Development

The costs are based on a unit price per metre square area of the bridge. In 2015 the basic cost price of 1 m² of single span bridge, which includes all of the options considered above, was £7,005. This base value is adjusted using factors to account for construction difficulty. The appropriate factors in the CFIPA guidance are; 1.25 for bridges in a conservation area, 1.6 for works adjacent to or incorporating river walls, 0.7 for works in a rural area. Not all factors are applicable in all cases.

The approach ramps are based on costs for reinforced earth embankments or ramps retained by reinforced concrete retaining walls.

The base costs are then used to calculate other costs related to the scheme. These include 12% costs for design fees, 10% costs for preliminaries and 10% for other costs. Traffic Management is not included at this stage.

Barton Road Crossing Cost Assessment

Two prices for a bridge at Barton Road have been calculated, these are:

1. A 67m single span structure that is 11.8m wide. The structure would be connected to the south brink with two ramps but severs the North Brink with a single ramp. The outline cost for the first option is **£17.6m**.
2. The second option is for the bridge is connected to the North Brink with a trio of ramps. The bridge would 18m wide to accommodate the junction at North Brink. The outline cost for this option is **£27.4m**.

New Bridge Lane Cost Assessment

Two prices for a bridge at New Bridge Lane have been calculated, these are:

1. A 38m span structure that is 11.8m wide. This structure would have no connections to North or South Brink, instead severing both roads and connecting via an approach ramp directly onto New Bridge Lane on the southern side and Mile Tree Lane (realigned) on the northern side. The outline cost for this option is **£7.5m**.
2. The second option would be a structure that is connected to the south brink only. This structure would be 38m span by 37.3m wide to accommodate the junction with South Brink. The junction with South Brink would consist of three approach ramps, whilst on the north side the brink would be severed and only a single ramp would be constructed towards Mile Tree Lane. Due to the extreme width of this structure a factor of 0.7 has been applied to the base cost per m². The outline cost of this option is **£14.6m**.

Southern Crossing Cost Assessment

As there are fewer constraints at this site, making it much more flexible, only one price has been calculated. The bridge would be:

1. A 42m span structure that is 11.8m wide. On the southern approach the junction would be offset from South Brink so that only a single ramp of 80m is required. On the northern approach the brink will be severed and so again only a single ramp of 85m will be required. In both cases the ramp has been extended to reach adjacent field level. The outline cost of this bridge is **£6.4m**.

If the Southern Crossing option was adopted and a more 'iconic' structure type was desired than it is likely that this would result in an uplift in cost of + 20-25%. The resultant cost would therefore be in the region of **£8m**.

Bridge Width

The work undertaken to assess the Western Link Road has considered whether this new road should be single carriageway, dual carriageway or a combination of both. The conclusion of this assessment is that a single carriageway road would provide adequate capacity for the traffic flows that are expected for the Western Link Road, but that passive provision should be made for the road to be dualled in future should local growth aspirations change or traffic flows generally increase beyond current expectations. This passive provision would include building the new river crossing to accommodate a dual carriageway to avoid creating a future pinch point on the network.

The junction improvements proposed at the roundabout of the A47 / Cromwell Road / Redmoor Lane as part of this study (Scheme CR7c – see *Cromwell Road Report*) consists of a two lane approach and exit from the new junction to serve the Western Link Road. Including provision for a dual carriageway over the new river crossing would provide the opportunity to extend the two lane approach and exit, further enhancing capacity at the A47 / Cromwell Road / Redmoor Lane Junction.

Preferred Option

The costs developed in this exercise are suitable for scheme comparison purposes and they clearly indicate that Barton Road Crossing represents a very significant increase in cost when compared to the other options. The southern crossing is clearly the best value option.

Due to the high profile location of the proposed structure, adjacent to the A47 and one of the main gateways into Wisbech from the South, consideration has been given to both an iconic and a utilitarian structure. Both appearances would have their advantages, an iconic structure would serve as a positive landmark for the area, whilst a utilitarian structure would cost less and be more appropriate to the nature of the development in the area.

Engagement with key stakeholders including Wisbech Town Councillors, Fenland District Councillors and Cambridgeshire County Councillors has identified that the utilitarian structure is preferred in this location for the reasons stated above.

A preliminary design has been produced for both structures for comparison, and to enable further design and outline costing of the utilitarian structure as part of the Western Link Road.

The design drawings are provided beneath. The iconic structure is similar to the Car Dyke Bridge located approximately 15 miles to west, which is considered to suit the local landscape very well. The utilitarian structure, which is the preferred option, is similar in appearance to the existing Freedom Bridge.

The cost estimate for an iconic structure is shown beneath in Table 5 beneath. Further detail on the cost estimates is provided in Appendix B.

Table 5: Iconic Structure Cost Estimate

Item	Cost
Land Acquisition	-
Demolition	-
Construction	£3,729,483.86
Design (12% of const. cost)	£372,948.39
Prelims and other costs	£745,896.77
Traffic Management	-
Sub Total	£4,848,329.02
Optimism Bias (@66%)	£3,199,897.15
Total	£8,048,226.17

The cost estimate for a simpler, more utilitarian structure, is shown beneath in Table 6. Again, further detail of this is provided in Appendix B.

Table 6: Utilitarian Structure Cost Estimate

Item	Cost
Land Acquisition	-
Demolition	-
Construction	£2,939,105.89
Design (12% of const. cost)	£293,910.59
Prelims and others costs	£587,821.18
Traffic Management	-
Sub Total	£3,820,837.66
Optimism Bias (@66%)	£2,521,752.86
Total	£6,342,590.52

The cost estimates includes an allowance for design and site supervision / site set up and maintenance. There is no traffic management cost associated with the structures as they would be built off-line. The cost estimate also includes a 66% Optimism Bias.

The Department for Transport (DfT) define Optimism Bias as “the demonstrated systematic tendency for appraisers to be overly optimistic about key parameters”, and require a contingency to be built into all scheme cost estimates to allow for it. The level of contingency to apply depends on the nature of the scheme, and the level of scheme development.

A new bridge is considered as a ‘fixed link’ scheme. The scheme has only been developed to a concept level which equates to ‘Stage1: Programme Entry’ against the DfT’s Optimism Bias criteria. As a result of these factors the Optimism Bias rate to be applied is 66%. The Optimism Bias rate reduces as schemes progress through the design process to reflect the greater cost certainty gained from more detailed levels of design.

7. Preferred Option

A summary table scoring each of the options against the different variables considered within this assessment has been included in Appendix A.

It is recommended that the option of constructing a new bridge at the southern crossing is adopted. This option presents the best value structure, the least disruptive construction process and has the minimum impact on existing properties and businesses along the river.

Once the ideal position has been selected it would be possible to advance other areas that may influence the design such as a detailed topographic survey and the agreement of the design flood level of this area.

A bridge in this location would have likely span of 42m which would suit numerous economic construction options. As the thickness of the deck will have a knock-on influence on the approach ramps it is recommended that a couple of options for the bridge are considered in more detail.

Engagement with Wisbech Town Councillors, Fenland District Councillors and Cambridgeshire County Councillors has identified that a utilitarian structure would be preferred over an iconic structure at this location to reduce costs and match the nature of the surrounding development. A utilitarian bridge would take the form of a precast concrete or steel composite bridge, creating a consistent appearance with the two existing structures in Wisbech town centre.

A precast concrete or steel composite bridge would present a simple solution which would result in a deck that was between 1.7 and 2.0m deep. In turn the approach ramps would be between 56 and 88m long depending on the nature of the road construction and the height of any highway embankment on the approaches. A simple bridge does not necessarily mean an inelegant one, and undertaking a preliminary design would allow the interaction between the landscape, flood defences and bridge form to be investigated in greater detail.

8. Appendix A – Option Scoring Matrix

New River Crossing Summary Comparison Table	Barton Road	New Bridge Road	Southern Crossing	Pre-cast concrete	Steel Composite	Steel Truss	Steel arch	Connect to brink	Sever Brink	Offset Connection
<u>Location Options</u>										
Ability to Connect to wider network	3	3	5							
Ability to reduce traffic in central Wisbech	1	3	5							
Land requirements	1	3	4							
Buildability	1	3	5							
Interface with River Flood Defence	2	1	5							
<i>Totals</i>	8	13	24							
<u>Structural Options</u>										
Construction Cost				5	4	3	2			
Maintenance Cost				5	4	3	2			
Approach Ramp				2	3	4	4			
Appearance				2	3	2	5			
<i>Totals</i>				14	14	12	13			
<u>Brink Junction Options</u>										
Cost								1	5	3
Impact								5	1	5
Network Connection								3	1	5
<i>Totals</i>								9	7	13
<u>Scoring</u>										
1= least benefit (including most expensive)										
to										
5 = greatest benefit (including least expensive)										

Final Combination

The structural options are relatively well balanced in the scoring so it was decided to complete a comparison of the location and the treatment of the brink only.

The results are shown below

<u>Location</u>	Connect to brink	Sever Brink	Offset Connection
Barton Lane	17	15	21
New Bridge Lane	22	20	26
Southern Crossing	33	31	37

This would suggest that a crossing built at the Cromwell Lane Roundabout location using an offset connection to the brink would be most beneficial.

9. Appendix B – Structure Cost Estimates

Iconic Bridge

Cost of single span Bridge	4,116.80	per m2	Based on CIPFA 2016 figures	5146	0.8	4116.8
Cost using reinforced earth	522.60	per m ²		871	0.6	522.6
Cost using retaining walls	1,096.20	per m length		1827	0.6	1096.2
Factors						
Factor	1.12					
span	42	m		0.7	Rural	
width	18.6	m		1.6	River Walls	
Bridge Deck Depth	0.75	m				
Span to Depth Ratio	21					
<i>width</i>						
Cost for main span =	3,216,044.16			Footway	1	m
				Footway	2	m
Height Difference North	1.45	m		Road	14.6	m
Number of ramps	1	No		Parapets	1	m
Ramp Width	13	m		Junction		
Ramp Length	44	m			18.6	m
Cost per ramp using embankment	71,073.60		based on ignoring the bottom 10m length of ramp (less than 0.5m height)			
Cost per ramp using ret walls	96,641.60		assuming 2 walls and a fill costing		50	per m ²
Height Difference South	1.1	m				
Number of ramps	1	No				
Ramp Width	11.8	m				
Ramp Length	37	m				
Cost per ramp using embankment	56,440.80					
Cost per ramp using ret walls	75,124.80					
Totals						
Main Span	£3,601,969.46					
North Ramps	£71,073.60					
South Ramp	£56,440.80					

Sub Total £3,729,483.86 **To West Link Road Connection**

Notes: CIPFA base Costs for 2 span rather than single span bridges have been adopted based on engineering judgement
CIPFA Base cost have then been reduced by Optimism Bias which will then include in final figure for consistency.
This is because CIPFA figures have been derived from actual scheme costs and so include some OB.

Design		12%	372,948.39
Staff, supervision, accommodation, temp fences		20%	745,896.77
Grand Total			4,848,329.02
Optimism Bias		66%	3,199,897.15
			8,048,226.17

Utilitarian Bridge

Cost of single span Bridge	3,087.60	per m2	Based on CIPFA 2016 figures	5146	0.6	3087.6
Cost using reinforced earth	535.20	per m ²		892	0.6	535.2
Cost using retaining walls	1,096.20	per m length		1827	0.6	1096.2
Factors						
Factor	1.12					
span	42	m	0.7	Rural		
width	18.6	m	1.6	River Walls		
Bridge Deck Depth	2	m				
Span to Depth Ratio	21					
<i>width</i>						
Cost for main span =	2,412,033.12			Footway	1	m
				Footway	2	m
Height Difference North	1.45	m		Road	14.6	m
Number of ramps	1	No		Parapets	1	m
Ramp Width	13	m		Junction		
Ramp Length	69	m			18.6	m
Cost per ramp using embankment	126,307.20		based on ignoring the bottom 10m length of ramp (less than 0.5m height)			
Cost per ramp using ret walls	167,701.60		assuming 2 walls and a fill costing 50 per m ²			
Height Difference South	1.1	m				
Number of ramps	1	No				
Ramp Width	11.8	m				
Ramp Length	62	m				
Cost per ramp using embankment	111,321.60					
Cost per ramp using ret walls	144,684.80					
Totals						
Main Span	£2,701,477.09					
North Ramps	£126,307.20					
South Ramp	£111,321.60					

Sub Total £2,939,105.89 To West Link Road Connection

Notes: CIPFA base Costs for 2 span rather than single span bridges have been adopted based on engineering judgement
 CIPFA Base cost have then been reduced by Optimism Bias which will then include in final figure for consistency.
 This is because CIPFA figures have been derived from actual scheme costs and so include some OB.

Design	10%	293,910.59
Staff, supervision, accommodation, temp fences	20%	587,821.18
Grand Total		<u>3,820,837.66</u>
Optimism Bias	66%	2,521,752.86
		<u>6,342,590.52</u>