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Feasibility Study:

Options Narrative

Erewash Borough Council

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1. Introduction

Erewash Borough Council (EBC) wish to improve connectivity across the town of Long Eaton, particularly in reference to the provision of crossing points for pedestrians and cyclists across the Long Eaton Canal, which runs in a generally north-south direction to the west of the town centre. The upgrading / replacement of one existing crossing point on Broad Street, and the provision of an additional crossing on Britannia Street, is proposed. Refer to Figure 1 for a location plan.

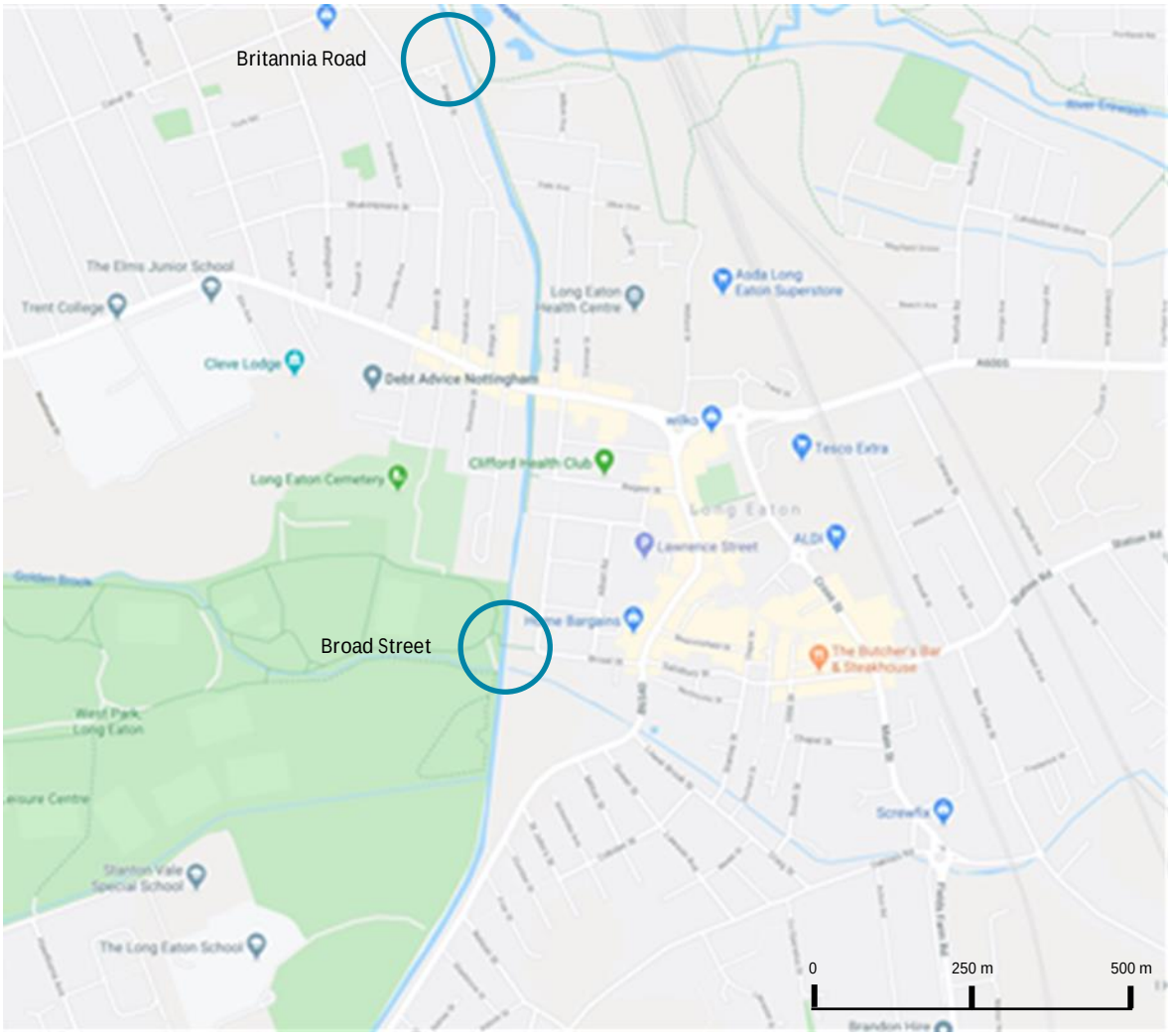

Figure 1. Map of Long Eaton

Both structures are likely to be of a similar size and span. The canal itself is navigable, and used by small craft and longboats, and this facility must be maintained. Based on information gleaned from a site visit, and approximate dimensions taken, the current provision for headroom is approximately 3.0 m to the canal water level. This is roughly compatible with the guidance given by the Inland Waterways Association, which suggests for a “broad channel” which can accept craft with beam upto 4.35 m as in this case, a 3.0 m minimum headroom is desirable for new structures.

AECOM have been contracted by Derbyshire County Council under the Midlands Highway Alliance framework to develop footbridge options for EBC. The purpose of this document is to provide a narrative around the development of the indicative design which is to be used as the basis of a layout for a future design competition.

2. Broad Street site

Table 2.1 – RAG-categorised Options Table for Broad Street Footbridge

Design Option (refer to Appendix A for layouts)	Connects Towpath to either side	Improves Gradient of Approach from Broad St	Headrooms / clearances	Improves width of bridge	Controls cycle speed	Cost (capital and maintenance)
Option 1: Direct replacement (i.e. as existing)	No change – as existing arrangement.	No change – as existing arrangement.	No change – as existing arrangement (likely marginal improvement)	No change – as existing arrangement.	No change – as existing arrangement.	May be able to re-use elements of existing substructure to minimise costs. Cheapest overall option.
Option 2: Movable bridge (any of swing / lift / bascule type structure)	Provides cross-connectivity between towpath and cycle route, however this is severed when the bridge is in the "open" position	Existing ramp alongside John Sankey will be removed, with approach at grade.	Provides an "at-grade" crossing, and unlimited headroom, however will also sever either canal or footpath depending on bridge position (i.e. either open or closed).	Width of swing bridge limited by width of towpath, as this will govern "parking space" unless installed to pivot on West Park side of canal	Only controls cycle speed for people wishing to cross the canal if the bridge is in the "open" position, otherwise an "at-grade" route across.	Extremely high capital costs (circa 10x a static bridge). Ditto maintenance costs. Ongoing maintenance requirements and monitoring very high.
Option 3: Layout configuration as per workshop (canal narrowing – refer 4.2.3)	Provides connectivity between towpath and route from Long Eaton to West Park, but access is via ramps / stairs and utilises bridge structure	No change – existing ramp would be retained and integrated into new design	Headroom to towpath can be marginally improved by reduction in construction depth, but level of pathway fixed by Broad St. ramp	Bridge can be widened, but access path alongside John Sankey will remain as current	Requires cyclists to "turn off" the towpath through a right-angle turn to access ramp.	Requires canal to be narrowed, but no land acquisition. Modest structural costs, retains existing ramp.
Option 4: Post-workshop layout configuration (canal narrowed; with additional land acquired – refer 4.2.3)	Direct connectivity provided via stairs / ramps from bridge, and includes at-grade linkage between Broad St. and towpath without utilising bridge	Existing ramp replaced with stairs, and ramp replaced with switchback ramp with improved gradient (although still below-desirable of 1-in-20, at 1-in-12 with landings)	Headroom to both canal and towpath can be achieved through raising of entire structural system.	Bridge can be widened to minimum of 3.5m recommended by CD 353 for combined cycleways, but requires land acquisition	Switchback ramps provide the best option for controlling cycle speed but requires land acquisition	Canal narrowing may not be required if sufficient land acquired, however land will need to be purchased. Cost increase over Option 3 due to extra structure and land.

3. Britannia Road site

Table 3.1 – RAG-categorised Options Table for Broad Street Footbridge

Design Option (refer to Appendix A for layouts)	Direct interaction with existing routes	Provides Equalities Act compliant access	Headrooms / clearances	Controls cycle speed	Flows with access desire lines	Manageable cost and maintenance
Option 1: Movable bridge (any of swing / lift / bascule type structure)	If installed to interact directly with cycle route would block towpath. If installed at towpath level, would not interact with cycle route.	Provides an "at-grade" crossing with no ramps / stairs.	Provides an "at-grade" crossing, and unlimited headroom, however will also sever either canal or footpath depending on bridge position (i.e. open or closed).	Only controls cycle speed for people wishing to cross the canal if the bridge is in the "open" position, otherwise an "at-grade" route across.	Arguably best option for direct access to cycle route, due to "at-grade" installation. However potential delays with bridge cycle times etc.	Extremely high capital costs (circa 10x a static bridge). Ditto maintenance costs. Ongoing maintenance requirements and monitoring very high.
Option 2: Layout configuration as per workshop (Straight, north-facing ramp on both banks; west-facing stairs on west bank; south-facing stairs on east bank)	Provide interaction with cycle route, but "blocks" existing route, forcing all users onto, and over, the bridge ramps.	Yes, as Options 3 and 4, however the layout of ramps is less desirable as limits routes and imposes potential diversions further than required.	Provides headroom to canal and canal towpath. Headroom to cycle route not applicable due to diversion over ramps.	Controlled by steps for cyclists heading from west bank to east in north-south directions by stairs. Straight ramps leading directly onto ground-level routes.	Provides direct access for pedestrians, however not optimal for disabled users or cyclists wanting to cross and head south on east-bank.	Likely less expensive than Option 2 in terms of materials due to less length of ramps etc, however this is considered marginal expense.
Option 3: Post-workshop layout configuration (AECOM) (increased span length. East bank ramps as Option 2 but beyond bund into floodplain; switchback ramp on west bank)	Provides interaction with cycle route and continues existing cycle route beneath bridge without interruption.	Yes, although ramps will have below-desirable gradient of 1-in-20, instead utilising maximum permissible 1-in-12 with landings every 650 mm of vertical rise. Shortest diversions for disable users.	Provides headroom to canal, canal towpath and to existing cycle route, although requires longer span and taller columns than Option 4.	Likely best option, as cycle users only need to be on ramp if crossing canal. Switchback ramp on west side. East side ramps could also be switchback.	Provides shortest route / least diversion for disabled users on west bank. East bank as Option 4.	Marginally more expensive than Options 2 and 4 due to increased span / additional ramps / slight increase in support lengths etc.), however this is considered marginal expense
Option 4: Post-workshop layout configuration (EBC) (as Option 2, but with slightly shortened span, "up and over" ramps on east side from cycle route)	Provide interaction with cycle route, but "blocks" existing route, forcing all users onto, and over, the bridge ramps.	As Option 3, however longer diversion on west bank, and introduces unnecessary interface between cycle route users and all other users of the crossing.	Provides headroom to canal and canal towpath. Headroom to cycle route not applicable due to diversion over ramps.	Not on east side – straight ramps onto cycle route. Provides some control on west side as ramp access through right-angle turn, but then a straight ramp onto bridge.	Longer diversion route for disabled users on west bank. Provides access to both north and south on east bank for all users (no staircases)	Likely less expensive than Option 3 in terms of materials due to slightly shorter span and slightly shorter supports, however this is considered marginal expense.

4. Discussion

4.1 "Moving" bridges

There are many common disadvantages to the adoption of movable bridges of all types, and these are given below, broadly grouped where possible:

- Cost – the cost for construction of a moveable bridge significantly exceeds the cost of an equivalent static bridge of the same size and span, by a factor up to x10. This is due to the additional design work which is required, the additional moving components which need to be fabricated, the likely larger foundations required, and a more delicate installation process;
- Whole-life cost – there are significant additional maintenance costs which can reach up to x10 the cost of an equivalent static structure. It is unlikely these will be hand-powered, hence there will be electrical machinery which will need to be maintained, in addition to possible hydraulics and electronics, worn moving parts, requirements to lubricate etc. on top of the normal bridge maintenance requirements;
- Failure points – there are numerous additional points of failure on a moving structure, any one of which could prevent the proper functioning of the structure and could lead to severance of either the footway or the waterway as a route depending on if the structure fails in the 'open' or 'closed' position. There are then additional, non-structural points of failure, such as a power cut, flooding, control system failures etc.;
- Power requirements – the size of span would likely result in a structure that was too massive to be "unpowered". It is not clear how a moving structure powered by hand would comply the Equalities Act. Further, it is not clear how a hand-operated structure could be closed to allow passage if you approach the open structure from the 'wrong' side. All these considerations lead to the structure being powered, and with suitable controls being placed on both sides;
- Supervision – as the watercourse is navigable, there would need to be a facility for supervision or contact provided in case of a failure of the structure which prevents opening, thus blocking the waterway, leading to craft becoming "trapped". It is likely a 24/7/365 call-out facility would be required;
- Opening times – movable bridges to not generally open or close quickly, to avoid issues associated with momentum and impact damage. It is estimated that a full open-closed-open cycle time could range from 1 minute and 30 seconds to 6 minutes delay in journey times, plus the time required for passage of traffic on the canal;
- Water level – as the canal water level is only approximately 150 mm below the bank / towpath level, this means that for certain types of movable bridge, the bulk of the supports, machinery and equipment would be installed below the water level and thus susceptible to flooding. There would also be potential cleaning issues as the "pit" would be classified as a confined space;
- Construction depth – similarly to the above, the 150 mm of available freeboard is insufficient for the likely required deck thickness. This would therefore require ramps to both sides of the structure to enable the structure to be lifted clear of the water, or the structure would have to remain partially submerged when closed, which would restrict the flow on the canal and trap debris in addition to being detrimental to the structure itself.

4.2 General design points

4.2.1 Compliance with standards

Although this is a Local Authority scheme, and thus the Local Authority is not bound to adopt the Design Manual for Roads and Bridges (DMRB) requirements, it is considered that the general design of the bridge should be fully-compliant, insofar as is reasonably practicable, with CD 353 – 'Design Criteria for Footbridges'. This would be adopted generally as a "best practice" guidance document, with deviations from such being assessed and approved by the Local Authority and Technical Approval Authority on a case-by-case basis.

Further, additional design considerations – such as the provisions of the Equalities Act, and guidance from other stakeholders such as the Canal and Rivers Trust – should be complied with.

4.2.2 Span dimensions

It has been assumed, for the sake of cost saving, that where similar spans are required, that an identical design will be adopted at both sites. This is the case for Options 3 and 4 at Broad Street, and Options 2 and 4 at Britannia Road – where a similar span of approx. 19 m is shown. The "moving bridge" options at both sites would be entirely bespoke. Option 3 at Britannia Road would require a longer span and would thus obviously differ.

The existing structure at Broad Street is approximately 1.8 m (6 feet) wide. It is currently unclear if the intent is for cyclists to be able to use this structure as a cycle route – i.e. to be able to remain mounted across the structure – or not. The deck width has been detailed to the minimum width for unsegregated usage in accordance with CD 353 Cl. 11 regardless, as a desire has been expressed to "open up" the route compared to the existing structure.

A similar approach has been adopted at Britannia Road.

4.2.3 Canal narrowing

At the Broad Street site, several of the options involve a local narrowing of the canal. This is shown indicatively on the drawings, as there is no particular guidance on requirements or how this is geometrically set out. AECOM have been informally advised that local narrowing of the canal may be permissible, in consultation with the Canal and Rivers Trust requirements and consents. Due to the proximity to the lock, it will not be permissible to narrow the canal over the full length of canal, as space must remain to allow mooring of boats local to the lock, and this may govern the location of the narrowing relative to both the lock and the bridge.

The minimum canal cross-section – and thus the permissible widening – must be agreed via consultation with the Canal and Rivers Trust as part of the detailed design process. It should be noted that a greater reduction in width of the canal should lessen the amount of land to be acquired from third-parties. Conversely, greater use of acquired land may remove the need to narrow the canal. Each option should be investigated by EBC and a decision reached on the preferred approach.

4.2.4 Ramp gradients and widths

CD 353 Cl. 5.8 recommends that the ramp gradient should not be greater than 1-in-20 unless 'special circumstances apply'. Notes to this same clause define 'special circumstances' as below:

> *"… special circumstance include locations where a maximum slope of 1 in 20 cannot be achieved for the desired bridge and ramp alignment without either creating a long diversion, causing unacceptable environmental impact or requiring excessive use of space."*

The ramps on the indicative layouts proposed are detailed for a gradient at 1-in-12, which is the absolute maximum in CD 353 which it suggests should only be used in cases of 'extreme difficulty'. Local Transport Note 1/20 'Cycle Infrastructure Design'. Cl. 10.8.21, and Table 5.8 gives similar gradients.

Gradients steeper than 1-in-20 may be accepted by the TAA, however it is considered that where land is available that the gradient of the ramps be reduced as far as possible towards the recommended 1-in-20 gradient. It should be noted that this will increase the length of the ramps by approximately 45%, including the removal of the necessary landings. EBC, the Designer and the TAA should discuss the implications of this additional land requirement, material usage and overall cost increase against the accessibility of the route and determine the optimum solution. The "red line" shown on the drawings has been derived to leave sufficient space for this decrease in the gradient.

The ramps have been detailed to a minimum width of 2.0 m in accordance with CD 353 Cl. 5.4. For shared use by cyclists, these ramps would be further governed by Cl. 11 and Table 11.7, unless cyclists are forced to dismount.

Where gradients steeper than 1-in-12 are adopted, handrails are required in accordance with Cl. 6.1, which will necessitate a widening of the ramps, as the clear width provided will be measured between the handrails.

4.2.5 Ramp layouts

When considering Options 2 and 4 in Table 3.1 above, with the proposed stairs / ramps on the east bank on the same alignment as the existing route, the inconvenience of having to ascend and descent a ramp - of any gradient and any length – should be considered.

As this is an existing cycle route (National Cycle Route 67, section between Long Eaton and Heanor), it is likely there will be significant cyclist usage of the structure. As these ramps will become the "through route", there will be a requirement for the ramps to be widened for "shared use" in accordance with CD 353 Cl. 11 unless measures are taken to force cyclists to dismount. The provisions of Cl. 11.10 would otherwise come into effect, requiring measures to be taken to limit the hazards associated with fast-moving cyclists, especially considering the possible 1-in-12 gradient of the ramps, without hindering the passage of pedestrians; prams; wheelchair and other mobility-impaired or visually-impaired users. This would be particularly prevalent for Option 4, where ramps would be provided to both the north and south approaches.

If at all possible, it is suggested that the geometry be revised to allow the existing track to be retained at-grade alongside the ramps. If this is not possible then the ramps could be extended to give a shallower grade which would marginally improve the situation. Switchback ramps may also be considered as a means of controlling cyclist-induced hazards.

4.2.6 Maintenance

All the options considered assume a lightweight steel truss footbridge structure, and are further assumed to be painted steel. This may introduce issues in areas close to the ground where soil and vegetation result in damp conditions leading to accelerated corrosion. Concrete plinths are provided to all supports to a height of 250 mm above ground level. Ramps are shown to be continuous to ground level for simplicity, however consideration should be given to replacing the lower sections of the ramps with either earthworks or reinforced concrete to lift the steelwork off the ground.

It may be possible to adopt a lower-maintenance FRP/GRP solution for both the span and ramp structures, reducing the overall maintenance burden.

4.2.7 Construction access

Both sites have issues relating to construction access, and these should be carefully considered in relation to the selected design.

5. Estimated costs

The overall estimated capital costs of the Broad Street and Britannia Road structures are presented in Table 5.1 and 5.2 respectively below.

Table 5.1 – Estimated capital costs for Broad Street Footbridge (based on Table 2.1 Option 4)

	Quantity	Rate	Cost
Steelwork (deck span) [1), 4)]	16.5 tonnes	£3 000 / tonne	£49,500
Steelwork (ramps / staircases) [1)]	54.0 tonnes	£3 000 / tonne	£162,000
Steelwork (substructures) [1)]	6.2 tonnes	£3 000 / tonne	£18,600
Concrete (substructures)	12.0 m³	£400 / m³	£4,800
Concrete (piled foundations) [2)]	37 No. 600Ø at 10 m length	£550 / m³	£57,750
Concrete (staircase footings)	11.0 m³	£400 / m³	£4,400
Reinforcement [3)]	34.9 tonnes	£1 350 / tonne	£47,115
Parapets	302.0 m	£200 / m	£60,400
Combined deck surfacing	456.3 m²	£100 / m²	£45,630
TOTAL			£450,195

Table 5.2 – Estimated capital costs for Britannia Road Footbridge (based on Table 3.1 Option 4)

	Quantity	Rate	Cost
Steelwork (deck span) [1), 4)]	16.5 tonnes	£3 000 / tonne	£49,500
Steelwork (ramps / staircases) [1)]	63.8 tonnes	£3 000 / tonne	£191,400
Steelwork (substructures) [1)]	5.8 tonnes	£3 000 / tonne	£17,400
Concrete (substructures)	22.0 m³	£400 / m³	£8,800
Concrete (piled foundations) [2)]	44 No. 600Ø at 10 m length	£550 / m³	£68,500
Concrete (staircase footings)	12.4 m³	£400 / m³	£4,960
Reinforcement [3)]	43.7 tonnes	£1 350 / tonne	£58,995
Parapets	367.3 m	£200 / m	£73,460
Combined deck surfacing	522.1 m²	£100 / m²	£42,210
Associated canal side works (west bank)	1.0 m retaining wall and pathway, 7.0 m long		£20 000
Associated canal side works (steps)	New steps in bank between cycle route and towpath		£2 000
TOTAL			£537,225

Notes:

1) excludes transport costs, cranage, etc.
2) no allowance for rig hire, establishment of rig and associated works, or repositioning.
3) assumes 275 kg/m³ in all superstructure and substructure concrete.
4) Both Broad Street and Britannia assume a 19.0 m span.

However, note should be made of the following exclusions or assumptions:

- unit rates are derived from available information, extrapolated from 2016 prices with a compound 3% annual RPI rate
- no allowance for any preliminary works, such as site clearance, over-coming difficult access, site setup etc. These costs will vary significantly depending on the local conditions and restrictions as well as the complexity of the final structural design. It is recommended that a minimum allowance of 25% capital costs quoted above for each site be made, however these should be verified with the Client's selected Contractor;
- no allowance for supervision, profit or risks etc.;
- no allowance for temporary works, except where otherwise stated;

- normal hours of working have been assumed – i.e. no Bank Holidays, weekends or overnight shifts;
- piled foundations have been assumed due to ground conditions determined from preliminary ground investigation works and results. The selected final design may be able to adopt different foundations, but these will be confirmed through the final design process;
- no allowance is made for any canal narrowing works, which are to be agreed with the Canal and Rivers Trust as part of the consultation and approvals process – at the request of EBC, an estimate of the cost of narrowing has been made despite AECOM not having access to the required dimensions and details which will be arrived at by consultation with C&RT during detailed design. A range of between £1500 and £2500 per linear metre of narrowing is estimated, however this should be confirmed by the Client's selected Contractor once the requirements and final details have been agreed;
- costs associated with land acquisition and other commitments made throughout the consultation process are excluded;
- costs associated with "minor works" such as re-fencing boundaries, re-align paths etc. are excluded.

These costs have been benchmarked against other footbridge schemes – and against larger schemes where installation of a new footbridge(s) is part of wider works – and found to be comparable. Further details of the costs of these other schemes cannot be provided on the grounds of commercial sensitivity. These are indicative estimates only and need to be verified for the final design.

Of particular note is that the lengthened span for Britannia Road Option 3 vs the 'standard' span for Broad Street Option 4 (25.5 m vs 19.0 m, approximately) increase the overall steelwork cost by very little (circa £21 000). This represents approximately 2% of the overall estimated capital expenditure in Tables 5.1 and 5.2.

6. Recommendations

AECOM recommendations for selected options are below. It should be noted that these recommendations are made without consultation with stakeholders other than Erewash Borough Council. AECOM cannot therefore confirm the likely acceptance, or otherwise, of any of these proposals by other stakeholders. These stakeholders include (but are not limited to):

- Canal and Rivers Trust – will need to assent to the use of airspace above the existing canal; the use of canal banksides for ramps / supports etc.; potential narrowing of the canal at the Broad Street site.
- Environment Agency – will need assent for all options at Britannia Road as the eastern supports and access ramps will require supports either on the existing flooding bund, or in the floodplain beyond. At both sites there is a requirement for environmental surveys to verify there are no protected species etc. who would be affected by the proposals either in service or during construction especially given the likely vegetation clearance required. There are also issues of route drainage and outfall.
- Sustrans – consultation will be required due to the interface with the existing National Cycle Route 67 on the east bank of the Britannia Road site;
- Disability groups – to confirm the acceptability of the proposed ramp layouts and arrangements.
- Cycling groups - to confirm the acceptability of the proposed ramp layouts and arrangements, and in some cases the disruption to the routes.
- Statutory Undertakers – to confirm services requirements.
- Canal user groups – to highlight the potential limitations on usage of the canal infrastructure.
- Local residents and developers – to highlight potential changes to the landscape and surroundings which were not present at the time of purchase.

In addition, there will be the required statutory public consultations, which could result in objections.

6.1 Broad Street Footbridge

Subject to the points highlighted in Section 4 above, and pending confirmation of required accessibility and measures to require cyclists to dismount, the option from Table 2.1 recommended by AECOM is Option 4. This requires the acquisition of land which is currently part of the John Sankey car park, and also the narrowing of the canal – although narrowing of the canal may be omitted if sufficient land can be obtained from the car park.

It is considered that this option provides the best balance between accessibility, route improvements, access and cost.

6.2 Britannia Footbridge

Subject to the points highlighted in Section 4 above, and pending confirmation of required accessibility and measures to require cyclists to dismount, the option from Table 3.1 recommended by AECOM is Option 3. The marginal increase in span length and height of structure is considered to be a small cost increase (approximately 5% of the cost of this structure alone), but to provide the best value for money as it leads to the least route severance and the best experience for users of the proposed new structure, as interface with users of the existing cycle route will be limited to those crossing the canal.

Notwithstanding the above the 3D visualisations and 2D plans which have been produced by AECOM for this site, for use by the EBC in submissions for funding and which are understood to be the basis for the proposed design competition, are based on Option 4 on instruction from EBC.

Appendix A:

Options Layout Sketches