



Place Scrutiny Commission

24/07/2017

Report of: Peter Mann - Service Director Transport

Title: Prince Street Swing Bridge

Officer Presenting Report: Adam Crowther – Head of Strategic City Transport

Contact Telephone Number: 0117 903 6854

1.0 Purpose of Paper/Decision Required

Based on original TMT Report (submitted 19th May 2015), and subsequently further requested Risk Matrix Assessment Report (submitted 8th June 2015), the decision was made to proceed with Option 1, i.e. Not to undertake any further additional in depth detailed Structural Assessments of the bridge and to commence immediately (with the extent of condition information available), with the structural repair works based on the recommendations of CH2M Consultant's 2014 Principal Inspection Report. The scope of the proposed refurbishment works was to put the bridge back to a "competent structural condition" to enable current existing traffic usage and maritime traffic "operational" usage.

Early specialist Contactor procurement (using existing BCC Contracts), and early commencement of work with suitable "judged" allowances to cover the "potential unknowns" contingencies in terms of increased cost and potential programme prolongation had already been considered and were risk assessed to enable a reduction to the original risk assessment (RAM), from High to Medium. A brief summary of the history of site refurbishment works is listed as follows below:

- Road closed to vehicular traffic on Prince Street on 17th August 2015.
- Temporary Scaffolding Footbridge construction commenced on 18th August 2015.
- Temporary Footbridge opened to the public on 2nd October – 7 weeks construction period.
- Bridge "Swung off" and Landed on quayside on 5th October. – Commence programme of Work.
- Proposed 6 months Construction Programme – Estimated completion end of March 2016.
- Cabinet Report – March 2016, tabled a revised a revised completion date of September 2016 with a subsequent revised outturn cost of 1.20million, due to the increase in the extent and scope of work.
- Works Programme revised further in April 2016 with a revised completion date of December 2016.
- Works Programme revised further again in July 2016, revised completion date of February 2017.
- Projected Works Programme Completion date end of April 2017.

- Bridge was opened to pedestrians and cyclists on: 28th April 2017.
- Bridge was re-swung for maritime boat traffic use on: 22nd May 2017.
- Actual Substantial Completion of Structural Works was on: 29th June 2017
- Bridge was re-opened to vehicular traffic (Southbound only), on: 10th July 2017.

The bridge was finally reopened to vehicular traffic on Monday 10th July, rather than after structural works completion. This was deliberate, from a transport perspective a decision was made to accelerate the highway improvements works programme of the adjoining Public Realm Works under the Cycling Ambition Fund (CAF) Scheme. The original intention under the CAF programme was to complete their works under separate consecutive weekend road closures (TTRO's). This would have undoubtedly caused further additional disruption and congestion to the Network plus reputational damage attracting further media criticism and press exposure onto the Council.

2.0 Cabinet Report - March 2016

As advised in report (March 2016), after removal of the solid timber decking and the kentledge “pig iron” ingots, the condition of the hidden internal structural elements of the bridge would be fully known and could therefore be assessed further. Remaining options and estimated costs were considered at this juncture within the Report and these are briefly summarised as follows:

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|---|---------------------------|
| • Continue with existing Refurbishment Works to full extent | 1.20million (Est). |
| • New Operational Swing Bridge for vehicular/pedestrian traffic | 5.50 million. |
| • New Operational pedestrian/cyclist footbridge | 2.50 million |
| • “Replica Style” Bridge operational bridge replacement | 6.50 million |

3.0 Historic England (HE) Considerations

Ongoing informal discussions with (HE) on the matter of replacement of the existing bridge with a new bridge had indicated that a very strong and robust case would need to be demonstrated by the Council and would require full Listed Approval to allow removal of this bridge. (HE) will have a vested interest to ensure that the original integrity of the existing structure (as far as is practicable possible) is retained and would not be in favour of replacement. With the level of works now required on the bridge as being substantial, BCC would also need to apply for Listed Consent to undertake the required refurbishment works as required.

4.0 Cabinet Report Decision

The decision from the Cabinet was that there was little choice other than to proceed with the original reported recommendations and to continue with the Refurbishment works, with a new revised completion date of September 2016 and subsequent revised outturn cost estimate of 1.20million. In late December the “teardown work” was finally completed and it was then assessed that approximately **30%** of the original bridge would now not be considered structurally competent and would require full and total replacement. A subsequent new revised Special Structural Inspection was completed by another outside Consultants and the recommendation of this report would be that further existing structural components of the bridge would additionally require replacement and further structural strengthening.

5.0 Scrutiny Report - Revised estimated additional reported costs – As of November 2016

The original works programme (based on the CH2M Consultants 2014 Inspection Report), had anticipated the replacement of up to 17 No. cross beams and some other additional associated web and main girder repairs, with estimated costs at 290K. The remainder of refurbishment costs, including full painting, new decking and ancillary masonry repairs etc. brought the overall project cost to fully refurbish the bridge to 400K, with a proposed programme of 6 months construction period, bringing the bridge brought back in full operation by the end of March 2016.

As the work progressed, the proposed programme duration increased significantly. This was because the revised projected estimated structural replacement/repairs have risen significantly due to major additional

requirements to replace large plated web sections of all the main girders, the extent of which had not been visible or accessible during The CH2M Principal Inspection in 2014.

On exposure and grit blasting of paint and corrosion of all these exposed structural elements, the overall condition of the bridge was far worse than originally anticipated or reported and consequently well beyond any additional estimated projected “judged” contingency that could have originally been factored in by BCC.

As a consequence of the extremely poor structural condition of the bridge (once fully exposed), it became necessary to structurally re assess the overall structural capacity of the bridge again in terms of capacity to ensure the loads the bridge is required to deal with and also its “operational” function as an intact and structurally competent swing bridge.

The outcome of this new structural reassessment undertaken indicated that the bridge would not be able to take the required current traffic loadings and in its original pre-contract condition and was in fact being structurally “overloaded” which had resulted in the bridge slightly “buckling” and distorting of the main beams at the narrow slender front nose end during normal trafficking.

The consequences of this main beam distortion are that the bridge required further new additional designed in “strengthening” stability measures, along with the other new additional beam and component replacement (due to major corrosion loss) of structural members, all of which were well beyond the original scope of the original intended refurbishment works. These additional new “strengthening measures” were quickly redesigned by Craddy Consultants, and were reprogrammed in with the main works and were undertaken by the Principal Contractor. This increase in the extent and scope of the “strengthening” work created the consequential negative impact on the prolongation of the Works programme and the overall outturn cost of the complete works. Final projected Construction Programme assessed completion of the works in late April 2017.

6.0 Scrutiny Report(s) Financial Summary Estimates

TMT Report:	May 2015	Estimated Costs to Project	400k
Cabinet Report:	March 2016	Revised Estimated Costs	
	1.200m		
Scrutiny Report July 2017		Final anticipated Completion Costs	1.332m

7.0 Maintenance History of Structure:

From the maintenance records unearthed it would appear that the bridge had never had a full and comprehensive structural refurbishment since its original construction circa, (1879). Some of the original transverse beams at the counterbalance section were replaced in 1954 and similarly again in 1980’s with various miscellaneous “accessible” minor girder repairs completed on a regular basis throughout the working years for this structure.

The original design and construction of this grade II listed structure results in it being impossible to gain access to the hidden counterbalance area which is totally enclosed and covered with tightly fitted large “timber baulk” planking decking covered over with a boarded road surfacing system. This counterbalance area therefore acted like a “sponge” for moisture and 100% of all the cross beams in this area were required to be replaced, similarly about 40% of the main beam steelwork was either replaced or over plated and bracketed with various different “bespoke” repair assemblies setups. The new working design life of these refurbishment structural works is expected to be in the region of **30 years**, before major Capital replacement investment works would be again required.

The newly “evolving refurbishment design” as part of this refurbishment works involved total replacement of the timber planking decking and surfacing with a much lighter (by 30%) GRP (Glass Reinforced Plastic), “bespoke” planking which, (after extensive lobbying), and submission for Listed Consent requirements was finally approved for use by Historic England (HE).

The benefit of this new material (GRP), is that firstly it is at least a third lighter than the timber decking of same size and thus will reduce the overall dead weight of the bridge with a loss of about 20 tonnes of static counterweight “pig iron” ingots. This reduces the overall working loads on the mechanical operational components associated with the bridge movement during operation.

Secondly, these GRP planks were installed with a 6-10mm wide “air gap” which will allow the water to drain straight through and out of the structure and will also allow for air circulation throughout the internal counterbalance area which will significantly reduce the normal corrosion cycle to the bridge.

Thirdly, the bespoke design of these GRP planks will allow these planks to be mechanically secured and thus removed at timely maintenance intervals to allow BCC to inspect fully the internal components throughout the bridge and maintain the bridge comprehensively, thereby increasing the overall longevity of the structure.

With the new structural components, which have all been galvanised, plus the additional strengthening measures, the bridge will now no longer be structurally “overstressed” by the traffic loadings which was discovered when the bridge was reassessed in early 2016. Again these protection measures such as the galvanisation of all new components as well as a complete repainting system will increase the overall working life of this structure, with the additional benefit to being able to gain access to inspect, maintain and replace components without major removal works and at a much reduced ongoing site expense.

The refurbishment works on the operational components of the bridge will also increase the operational reliability of the bridge structure during swing operations. BCC have also undertaken facilitation and improvements works to the abutments which will hopefully remove the ongoing problem of the bridge “jamming” in operation during times of increased temperatures during very hot weather..

As this bridge’s central location means that it may always be under transport review usage, the flexibility of the new designed GRP decking and footways are such that it will be reasonably straightforward and relatively cheap to adjust and retrofit for the appropriate trafficking use, as and when this is required.

8.0 Summary of Full Structural Works

- The final outturn costs of the works to the bridge is expected to be **1.332 million.**
- The final construction programme is now 20 months, with full completion on **10th July 2017***

The original overall considered repair/replacement options that were available:

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|---|----------------|
| 1. Full Refurbishment of bridge and Strengthening and GRP Decking (Option 1). | 1.332 million. |
| 2. New Operational Swing Bridge for vehicular/pedestrian traffic | 5.500 million. |
| 3. New Operational pedestrian/cyclist footbridge | 2.500 million. |
| 4. Replica Style” Bridge operational bridge replacement | 6.500 million. |

Option 1. Is the therefore still the cheapest and most appropriate technical option and has now resulted in the Council having a fully strengthened and refurbished and fully operational Grade II Listed Heritage swing bridge structure, capable of taking the intended traffic loadings anticipated.

The bridge was finally reopened to vehicular traffic on the 10th July*, rather than after structural completion. This was deliberate decision, as from a transport perspective it was decided that it was more appropriate to accelerate the Cycling Ambition Fund (CAF), works programme of the adjoining highway/cycleway improvement Works. The original intention under the CAF works programme was to complete their works under separate weekend bridge and road closures. This would have resulted in further additional disruption to the Network and reputational damage to the Council.

The decision was therefore taken to delay the reopening of Prince Street Bridge to vehicular traffic and to complete all the surrounding CAF highway works on both Prince Street and Wapping Road, which was substantially achieved on Monday 10th July.

Additionally the following benefits as a consequence to the refurbishment works to Prince Street Bridge have added the following improvements to the resilience of the whole Transport network within this city centre transport corridor:

- The structural refurbishment and structural works will give the structure a further 30 years design life
- The GRP Decking makes the bridge lighter, reduce deadweight and improve operational capacity.
- The GRP Decking will allow full access to all internal components of bridge for inspection and works.
- The Bridge will now be free draining and thus will reduce corrosion propagation significantly.
- The bridge decking system allows the bridge configuration to be changed relatively easily.
- BCC will have managed to fully retain for future use an historic Grade 2 Listed Structure
- The operational function of the bridge will have been greatly improved due to the reduction in weight and the flexibility and adaptability of the GRP decking.
- The operational opening and closing time of the swing bridge has reduced due to the improvements on the operational components, which will reduce traffic congestion during bridge swings.
- The refurbishment works to the masonry abutments will remove the problem of the bridge jamming during times of hot weather due to thermal expansion of the bridge.

9.0 Operational Usage of Bridge and the effects on the Network

The maintenance works to the bridge necessitated full closure to vehicular traffic with pedestrian and cycle facilities retained through the introduction of a bespoke scaffold structure. Prior to closing the bridge carried total two way peak hour flows of around 600 vehicles. While the inbound movement in the morning peak and the outbound movement in the evening peak are heaviest the outbound movement is heaviest across the whole day.

The overall capacity was restricted by the use of traffic signals that enabled shuttle working on one side of the bridge with the other side of the bridge reallocated to pedestrians and cyclists. Prince St Bridge is a busy pedestrian and cycling route linking a number of key cycle routes, pedestrian routes and tourist attractions.

The original closure required vehicles to find alternative routes across the river and resulted in occasional severe congestion on Prince St and the Grove during the evening peak. Congestion from Temple Way and Temple Circus leads to queues on Redcliff Way which restricts capacity at Redcliff roundabout. The queue wraps around the roundabout and prevents traffic and buses from exiting Redcliff Bridge.

This is in part due to network wide congestion but the situation is exacerbated by the closure of Prince St Bridge. Traffic that previously moved from Redcliff Way and Redcliff St to Redcliff Bridge (towards Prince St) interrupted the heavy flow from Redcliff Hill towards Temple Circus.

With these traffic movements removed, Redcliff Hill dominates and prevents egress from Redcliff Bridge. The effect is so severe that despite the low volume of traffic using this route delays of between 45 minutes and 1 hour were regularly experienced during busy congested periods around the Christmas period in 2015.

While there has been some additional congestion in the morning peak inbound on Redcliff Hill and Commercial Rd, severe issues have not been experienced. On a normal day traffic issues are not severely worse during either peak although the effect is noticeable

10.0 Additional Operational Considerations:

During the life of the refurbishment works on this structure, a number of other transport related works have been in place across the city all of which have contributed to traffic diversions and occasional severe congestion incidents. These works made it impossible to accurately assess the individual impact of closing Prince St Bridge to the Network:

- City Centre works – major remodelling work with associated congestion and traffic diversions
- Cattlemarket Rd closure in both directions
- Metrobus works across the city centre, notably Temple Way bus lane and Colston Avenue.
- Various minor works and schemes – Coronation Rd traffic signal replacement, Clarence Rd, utilities works etc
- Easton Rd, Whitby Rd bridge replacements – some distance away but diversionary effects spread across the city

A number of these works are either completed or due to be completed prior to the end date for the refurbishment works, however other major transport schemes have begun, most notably the remodelling of Temple Circus and Bath Bridges. Capacity on the main routes will be retained as far as possible throughout the Temple Circus and Bath Bridges works but there will inevitably be some impact on congestion and diversionary movements.

The finished Temple Circus scheme will deliver similar capacity to the current layout across the area but some routes will benefit from reduced delays and others will experience additional delays. Traffic flows are likely to adjust over the first few months until settled routes are established. Bus journeys through the junctions are likely to see significant benefits as are pedestrian and cycle movements. The main benefit to traffic will be the simplification of the network enabling better control of the various movements and reducing the likelihood of the roundabout locking up and reducing capacity across the area. This will enable the traffic control centre to better manage the operation of traffic through the area and queues to prevent some of the issues currently experienced at Redcliff Roundabout.

In addition to these works the Cycle Ambition Fund will be delivering a new segregated cycle route on Prince St and Wapping Road either side of Prince St Bridge, starting in mid April.

Cycling and walking facilities across the bridge were improved in 2009 when one side of the bridge was reallocated to cycling and walking. The success of the scheme plus other improvements to cycling and walking across the area, new attractions such as M Shed and developments such as Wapping Wharf have led to increasing numbers of people walking and cycling across the bridge.

The scaffold bridge has been welcomed and, while cyclists have to dismount, safety is improved through segregation from traffic both across the bridge and on either side.

When operational the main issues are conflict between pedestrians and cyclists on the bridge and southbound cyclists having to swing across oncoming traffic to access the pedestrian/cycle only half of the bridge.

11.0 Future Usage:

The factors detailed above necessitate careful consideration of what to do when the bridge is reopened. The Prince St cycle route and the major works at Temple Circus will put additional strain on the local road network and the city centre network as a whole. Certain sections of the Prince St cycle scheme also require one direction of traffic to be prohibited to enable the works to be completed.

The bridge will therefore open initially in the southbound direction only and the northbound movement will be temporarily prohibited. This will enable safe and efficient construction of the Prince St cycle scheme and assist

with reducing congestion during the works required at Temple Circus. Making the bridge one way only will enable additional capacity for traffic exiting the central area which is generally subjected to the heaviest congestion. This will both remove the issue detailed above that caused delays to buses during the full closure and also assist with releasing additional congestion pressure caused by the Temple Circus works.

The Temple Circus works are likely to last at least 12 months. The one way temporary prohibition for northbound traffic will remain on place for the duration of the Temple Circus works and will then be reviewed following completion of those works.

Appendix A

Condition Photo's supplied in a spate document

Appendix B

Drawings supplied in a separate document