Staffordshire County Council

SEVENTY BRIDGE (B3396)

Structural Appraisal Report

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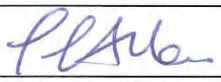
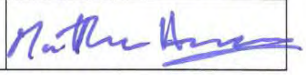
Checked By	Bob Allen	
Approved By	M. R. Houghton	

Issue	Status	Date
01	First Issue	18th January 2011
02	Second Issue	
03	Final Issue	

Contents

1. Introduction

As part of the Churnet Valley Living Landscape Partnership Scheme, Staffordshire County Council undertook a Structural Appraisal on Seventy Bridge, (B3396). The aim of the Structural Appraisal was to assess the existing condition of Seventy Bridge, and develop an economical yet functional repair scheme which would be in-keeping with the bridge. Once a suitable bridge repair scheme had been developed this could be priced up and a bid put forward for potential Heritage Lottery Funding.

The Inspection took place on Tuesday 23rd November 2010. The weather conditions during the inspection were dry and cool, (1 to 5 ℃), although there had been some rain in the days proceeding the inspection.

Seventy Bridge is a single span stone masonry arch structure which carries Public Right of Way Route 40 and 43 over the disused Uttoxeter Branch of the Caldon Canal. To the south of the bridge is a water pumping station owned and run by South Staffordshire Water Plc.

Based on the previous reports by GCA(2004) and Coxah with Gardener(2004), the bridge is believed to have been constructed prior to 1811 which coincides with the completion date of the Uttoxeter Branch of the Caldon Canal. The main purpose of the bridge is believed to have been a pedestrian, livestock and cart access over the Caldon Canal.

Route 40 and 43 are designated Pedestrian Rights of Way, however analysis of Seventy Bridge has shown it to be capable of carrying 3.5 tonnes gross vehicle weight, which is adequate for pedestrian usage.

It is concluded Seventy Bridge is in poor condition with much of its surfacing and original parapets being robbed out. The bridge requires urgent attention to safeguard the long term sustainability of the structure.

This inspection was carried out without the use of specialist equipment and the following remedial works are recommended as a minimum.

- Remove all vegetation within 2.0 metres of the bridge footprint.
- Arch ring, spandrels, substructure and wing-walls – repair and repoint.
- Waterproof and resurface the bridge deck.
- Install a timber safety fence parallel to each parapet.
- Remove all trees growing close to or out of the bridge structure.
- Repair and resurface the towpath below the bridge.

All accessible and visible parts of the structure were inspected during the Inspection. The buried foundations and the invert or canal bed were not inspected.

This report summarises the findings of the Inspection and lists recommendations for future maintenance and monitoring of the structure.

$BCI_{ave} =$ 39.89% $BCI_{crit} =$ 39.52%

2. Description of the structure

Seventy Bridge is a single span masonry arch structure, (measured as 4.9 metres between abutments with no skew). The bridge structure carries Public Right Of Way Route 40 and 43 over the disused Uttoxeter Branch of the Caldon Canal. The bridge is constructed from a coarse sandstone or gritstone believed to have been quarried locally being similar in nature to stone mined at the local Hollington quarries.

The bridge is believed to have been constructed prior to 1811 and is not currently a listed structure. The parapets consist of large stone blocks sitting above the arch spandrel and wing walls. It appears that much of the original stone forming the parapets and surfacing over the bridge have been robbed out, probably to construct local buildings. The parapets are now very low over the bridge. On the west elevation the original string course has been retained but the parapets, consisting of stone similar in nature to the dressed blocks forming the bridge, are approximately 400mm above bridge surface or pavement level. On the east elevation the stringcourse has gone and the parapets consist of undressed stones only 200 to 300mm above bridge deck level. The stone wing walls curve out to form a funnel at the north and south approaches. There is a difference in level of approximately 3.0 metres between the approaches making the bridge a reasonably steep bridge to traverse over the 13 metre longitudinal deck length being nearly 1 in 2 at the south approach. The deck is approximately 3.5 metres wide at mid-span and widens out at the approaches to approximately 5.0 metres. The span to rise of the arch is approximately 1:4 which is a standard canal arch ratio used in early classical arch theory, (built by rule of thumb).

The surfacing over the bridge is in poor condition consisting of exposed stone blocks and the original clay waterproof liner. The original deck waterproofing is now deemed to have failed due to water penetration through the stone arch barrel below.

The Uttoxeter Branch of the Caldon Canal is currently disused, however the canal below the bridge is open and filled with water. Due to the water penetration through the deck the existing stone bridge is subject to cyclic wetting and frost freeze action.

Access to the bridge can be gained on foot by Public Right Of Way Route 40 or 43. Vehicle access to the bridge can only be gained by permission of South Staffordshire Water Plc via Green Lane and the pumping station unpaved access track.

3. Detailed condition report

3.1 Deck elements

3.1.1 Primary Deck Elements (1)

The primary deck element consists of a single span masonry arch spanning approximately 4.9 metres between abutments. The arch is constructed from identical square cut stone blocks minimum of 300mm thick at the crown.

Over 40% of the exposed intrados, (arch soffit) is deemed to be saturated with water penetrating from the deck. It is estimated that between 5 mm to 25mm of surface stonework has weathered over the last 200 years.

No significant cracking through the stonework blocks was found during the inspection of the stone arch barrel. It was established that significant mortar loss of the joints is present. It is estimated 1% of the soffit of the arch barrel is delaminating or unsound and 40% of the arch barrel had areas of water saturated joints. Based on visual inspection 60% of the joints require repointing.

On the east elevation the cap stone appears to have dropped slightly as denoted by the extra wide un-mortared joint above the block. It is believed this is a localised defect accompanying minor arch ring movement.

3.2 Load Bearing Substructure

3.2.1 Foundations (8)

The bridge is believed to be founded on reasonably shallow spread foundations based on past experience of canal bridges of this type, although this is to be verified.

The wing walls show signs of minor settlement which is attributed to the action of trees growing in close proximity to the bridge. Tree roots can be seen infesting the lower masonry courses of retaining wall adjacent to the bridge. The north east abutment appears to be in distress due to a semi-mature sycamore tree growing out of the abutment.

3.2.2 Abutments (9)

Both abutments are constructed from large stone blocks with mortar joints.

The South abutment is suffering from localised areas of mortar loss and facial erosion. It is estimated that approximately 3% of the south abutment contains defective, (delaminating / voided), stonework blocks. The exposed face of the stonework is coated in patches of both lichen and moss. The base of the abutment appears to be saturated as water is drawn into the bottom course of stonework via capillary action.

The North abutment is also suffering from localised areas of mortar loss and facial erosion. It is estimated that approximately 5% of the north abutment contains defective, (delaminating / voided), stonework blocks. The exposed face of the stonework is coated in patches of both lichen and moss. The base of the abutment appears to be saturated as water is drawn into the bottom course of stonework via capillary action. The North East Abutment has a semi-mature Sycamore Tree growing out of the foundations which is causing stone blocks to separate locally around the base of the tree.

Based on visual inspection 70% of the joints require repointing on the abutments.

3.2.3 Spandrel Wall (10)

The spandrel walls are constructed from large stone blocks with mortar joints. Both elevations require extensive re-pointing.

Both the east and west elevation spandrel walls were found to be in poor order. A number of stone blocks have weathered badly with almost complete mortar loss between the joints. Large areas of the spandrel walls are covered in moss and other vegetation and require clearing for proper inspection and assessment.

The spandrel walls are in poor condition generally but are deemed to have no serious noticeable structural defects, (masonry lines are reasonably level with no major cracking). Based on visual inspection 30% of the joints require re-pointing on the spandrels.

3.2.4 Piers / End Pilasters(11)

There are four end pilasters which terminate with the end of the remnant parapets at each corner of the bridge. Each stonework pilaster is believed to be founded on a shallow spread foundation and is corbelled out slightly at base level. The end pilasters measure 400 wide by 450 long in a square configuration.

Assessment of the piers revealed several localised areas of delaminating or hollow stone, (estimated at 5%). Based on visual inspection 25% of the joints require re-pointing.

3.3 Durability Elements

3.3.1 Superstructure Drainage (15)

The deck drainage consists of water rain runoff down the southern approach slope onto a grassed area. The problem with the current deck drainage system is that it is scouring away the bridge deck surfacing exposing stone blocks and slowly removing the remaining clay waterproof deck liner. The removal of the deck waterproofing is allowing water to penetrate the stone arch barrel causing further deterioration of the bridge.

3.3.2 Substructure Drainage (16)

No substructure drainage was noted during the inspection.

3.3.3 Waterproofing (17)

Based on the level of localised water penetration throughout the intrados of the arch and the exposed surfacing on the bridge deck showing the existing clay liner, no adequate waterproofing is deemed to exist on the deck of this structure.

The hypothesis that no adequate waterproofing exists on the deck of this structure is further verified by the extent of staining on the intrados of the arch ring.

3.4 Safety Elements

3.4.1 Handrail / Parapet / Safety Fences (23)

The parapets consist of large stone blocks sitting above the arch and spandrel walls. It appears that much of the original stone forming the parapets and surfacing over the bridge have been robbed out, probably to construct local buildings. The parapets are now very low over the bridge. On the west elevation the original string course has been retained but the parapets consisting of stone similar in nature to the dressed blocks forming the bridge are approximately 400mm above surfacing level. On the east elevation the stringcourse has gone and the parapets consist of undressed stones only 200 to 300mm above paving or surface level.

The parapets are not deemed adequate for pedestrian restraint due to perishing of the mortar joints, low height and heavily weathered condition. Based on visual inspection 50% of the joints require re-pointing on the parapets. It is recommended as a minimum a timber safety fence should be installed running parallel to the existing parapets to prevent bridge users falling off the bridge.

3.4.2 Footway / Verge / Footbridge Surfacing (25)

The footway surfacing is very poor and consists of exposed stone blocks and clay over the bridge, creating a highly uneven and slippery deck surface. The alignment from the south approach over the bridge is very steep approximately 1 in 2 and may not be suitable for all pedestrians.

It is recommended that a new deck surfacing be installed and the south approach slope is re-graded to make the footpath easier to traverse. The new surfacing could incorporate a damp proof membrane to act as a simple deck waterproofing system over the bridge.

3.5 Other Bridge Elements

3.5.1 Invert / River Bed (26)

The canal span invert consists of a clay liner with an accumulation of rotting vegetation and stone debris. The east and west canal approaches to the bridge are heavily silted up and infested with vegetation.

The canal depth at the time of the inspection varied to a maximum of 1.1 metres.

The north abutment of the canal span has stone pitching or dry stone retaining walls which are integral with the abutment substructure and foundations.

In front of the south abutment there is a 1.4 metre wide towpath supported by dry stone retaining walls, which also form part of the canal channel.

The canal bed is relatively uneven but no defects or problems of note where encountered.

3.5.2 Wing Walls (31)

The four wing walls are all constructed from large stone blocks with mortar joints and are believed to be founded on shallow spread foundations. Each wingwall is curved through nearly 15˚ and is integral to the bridge. Each wingwall rakes down from parapet base level to a small newel pier / pilaster formed from stonework just above ground level.

All of the wing walls suffer from localised stone erosion . The mortar joints to the wing walls require extensive vegetation clearance, (especially Ivy), and re-pointing.

Based on visual inspection 58% of the joints require repointing on the wing walls.

4. Maintenance recommendations

4.1 Option (1) Low Cost / Low Aesthetic and Heritage Value Scheme

Item	Maintenance required	Priority / Year	Estimate Cost
1	Resurface, waterproof and regrade south approach for easier and safer pedestrian access.	High 2012	£ 16,000
2	Repoint and repair : Arch ring, spandrels, parapets abutments, elevations and wingwalls.	High 2012	£14,500
3	Remove vegetation and trees from round the bridge.	High 2012	£7,500
4	Install new timber safety fence inline with parapets.	High 2012	£2,000
5	Locally clear out canal and repair towpath.	High 2012	£5,000
	Total Short Term Expenditure		£45,000
	Total Estimated Expenditure		£45,000

The benefits of this bridge maintenance scheme are that the bridge can be upgraded to an adequate condition at a relatively low cost.

The downside of this bridge maintenance scheme is that the aesthetics of the bridge may be visually reduced. A secondary consideration is that the original construction of the bridge will not be restored, which may be a heritage issue.

Note: A provisional sum of £75,000 should be included for assessing and repairing the bridge foundations, (worst case scenario). It is unlikely that moderate foundation settlement will cause failure of the bridge; however due to the close proximity of trees and the penetration of large roots into the structure it is anticipated some future foundation works will be required.

Assessment of the foundations will require vegetation removal and intrusive exploration of the existing foundations. An alternative to a foundation assessment approach would be to undertake general inspections every two years to monitor future foundation settlement and its effects on the bridge then take appropriate action as required.

4.2 Option (2) Moderate Cost / High Aesthetic and Heritage Value Scheme

Item	Maintenance required	Priority / Year	Estimate Cost
1	Resurface with cobbles / setts, (reuse existing uncovered setts), waterproof and regrade south approach for easier and safer pedestrian access.	High 2012	£ 24,000
2	Repoint and repair : Arch ring, spandrels, parapets abutments, elevations and wingwalls.	High 2012	£14,500
3	Remove vegetation and trees from round the bridge.	High 2012	£7,500
4	Upgrade stone parapets to assumed original level with copings based on similar stone bridges of this type. Provide timber fencing to approaches as required.	High 2012	£68,000
5	Locally clear out canal and repair towpath.	High 2012	£5,000
	Total Short Term Expenditure		£119,000
	Total Estimated Expenditure		£119,000

The benefits of this bridge maintenance scheme are that the bridge will be enhanced aesthetically. The drawback of this maintenance scheme is the increase in cost, estimated as an extra £74,000, to reinstate the bridge to something approaching its original condition.

Note: A provisional sum of £75,000 should be included for assessing and repairing the bridge foundations, (worst case scenario). It is unlikely that moderate foundation settlement will cause failure of the bridge; however due to the close proximity of trees and the penetration of large roots into the structure it is anticipated some future foundation works will be required.

Assessment of the foundations will require vegetation removal and intrusive exploration of the existing foundations. An alternative to a foundation assessment approach would be to undertake general inspections every two years to monitor future foundation settlement and its effects on the bridge then take appropriate action as required.

5. Conclusions

Seventy Bridge is in very poor condition and requires urgent remedial works to prevent further deterioration of the bridge structure.

The only uncertainty is the current condition of the existing foundations and how these have been affected or damaged by the close proximity of large trees. A number of both mature and semi-mature trees have grown up adjacent to the bridge over a long period of time, (in excess of 100 years).

Analysis of Seventy Bridge has indicated it is currently capable of carrying 3.5 tonnes gross vehicle weight. If the cover over the arch is increased and the perished mortar joints repointed the load carrying capacity of the bridge may be increased by 150%.

Due to the robust construction of Seventy Bridge the structure is not deemed dangerous or prone to collapse at present. The structure is considered to be in very poor condition and it is advised a watching brief should be placed on Seventy Bridge until repair works have been undertaken. Ideally the bridge should be inspected at six monthly intervals to monitor future deterioration and if necessary close the bridge to protect public safety.

In the short term the following actions should be undertaken to economically maintain the bridge in adequate condition.

- Resurface, waterproof and regrade the south approach for easier and safer pedestrian access.
- Repoint and repair the arch ring, spandrels, parapets, abutments, elevations and wingwalls.
- Remove vegetation and trees from round the bridge.
- The highest priority should be to upgrade the existing parapets to protect public safety, (falling hazard on a pedestrian right of way).
- Locally clear out the canal and repair the towpath.

In the long term the bridge foundations should be comprehensively assessed and if required repaired or upgraded. An alternative to a foundation assessment approach would be to undertake general inspections every two years to monitor future foundation settlement and its effects on the bridge then take appropriate action as required.

Once the repairs as outlined above have been undertaken there is no reason why Seventy Bridge should not provide a further 200 year of useful service to local residents or visitors to the Churnet Valley.

It should be noted that all costs for works are based on a bridge maintenance contractor undertaking the works. The costs estimated in this report could be reduced substantially, (estimated at 25 to 50%), if volunteers undertook all manual operations.

Appendix A Principal Inspection Proforma

PRINCIPAL BRIDGE INSPECTION

Bridge Name: **Seventy Bridge**		Road Name: **Public Right Of Way Route 40 & 43**	
Bridge Ref/No: **B3396**		Road Ref/No: **ROW 40/43**	**Bridge Type Code:**
Map Ref: **SK 091 428**		Span: **1** of **1**	Primary deck element: 01
O.S.E.: **409069**	O.S.N.: **342771**	Span Length (m): 4.9	Primary deck material: L
All above ground elements inspected: **YES** ~~NO~~		Photographs: **YES** ~~NO~~	Secondary deck element: 20
Number of construction forms in bridge/span: **1**			Secondary deck material: P

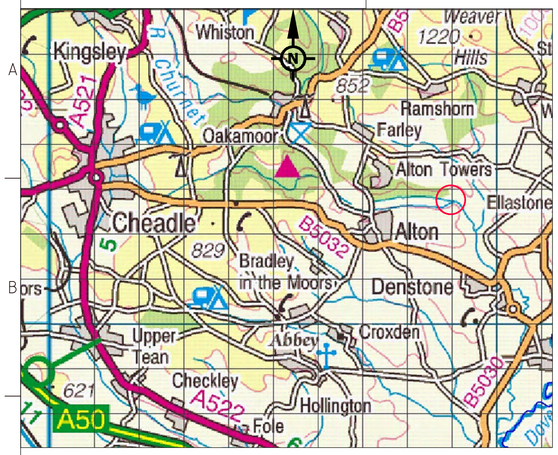
Set	No	Element Description		S	Ex	Def	W	P	Cost	Comments Remarks
Deck Elements	1	Primary Deck Element (Table 2)		3	E	3.2	Y	H	14,500	See 3.1.1 in report
	2	Secondary elements	Transverse beams							
	3		Element from Table 3							
	4	Half joint								
	5	Tie beam/rod								
	6	Parapet beam or cantilever								
	7	Deck bracing								
Load-bearing Substructure	8	Foundations		2	B	6.6	Y	H	unclear	See 3.2.1in report
	9	Abutments (inc. arch springing)		3	E	3.2	Y	H	See 1	See 3.2.2 in report
	10	Spandrel wall/head wall		3	E	3.2	Y	H	See 1	See 3.2.3 in report
	11	Pier/column		3	E	3.2	Y	H	See 1	See 3.2.4 in report
	12	Cross-head/capping beam								
	13	Bearings								
	14	Bearing plinth/shelf								
Durability Elements	15	Superstructure drainage		4	D	8.2	Y	H	Option	See 3.3.1in report
	16	Substructure drainage								
	17	Waterproofing		3	D	14.2	Y	H	See 15	See 3.3.3 in report
	18	Movement/expansion joints								
	19	Painting: deck elements								
	20	Painting: substructure elements								
	21	Painting: parapets/safety fences								
Safety Elements	22	Access/walkways/gantries								
	23	Handrail/parapet/safety fences		5	E	3.7	Y	H	Option	See 3.4.1 in report
	24	Carriageway surfacing								
	25	Footway/verge/footbridge surfacing		3	D	9.4	Y	H	See 15	See 3.4.3 in report
Other Bridge Elements	26	Invert/river bed		5	E	7.2	Y	H	5,000	See 3.5.1 in report
	27	Aprons								
	28	Fenders/cutwaters/collision protection								
	29	River training works								
	30	Revetment/batter paving								
	31	Wing walls		3	E	3.2	Y	H	See 1	See 3.5.3 in report
	32	Retaining walls		3	E	3.2	Y	H	See 1	See 3.5.4 in report
	33	Embankments		4	E	5.1	Y	H	7,500	See 3.5.5 in report
	34	Machinery								
Ancillary Elements	35	Approach rails/barriers/walls								
	36	Signs								
	37	Lighting								
	38	Services								
	39									

S – severity, **Ex** – extent, **Def** – defect, **W** – work required, **P** – work priority	Inspection Date: 23/11/2010	Next Inspection. (month/yr) 6 Monthly

Appendix B

Existing General Arrangement Layout (Photograph Location Drawing)

Drawing No. **CDB105/B3396/01**



LOCATION PLAN
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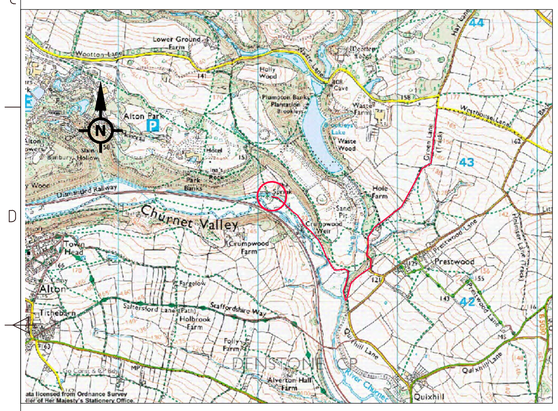
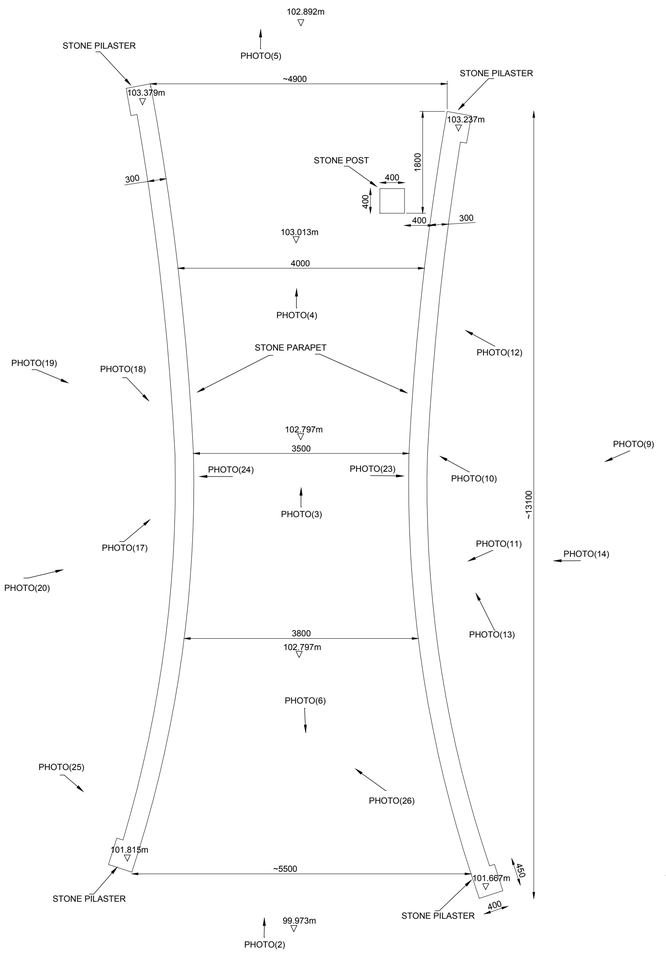
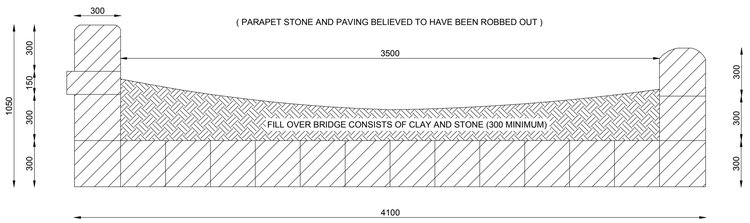


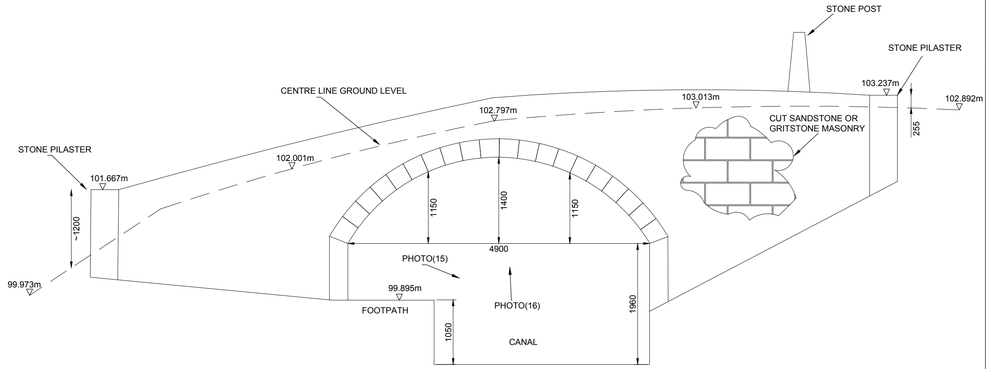
ROUTE PLAN
(1:5000)



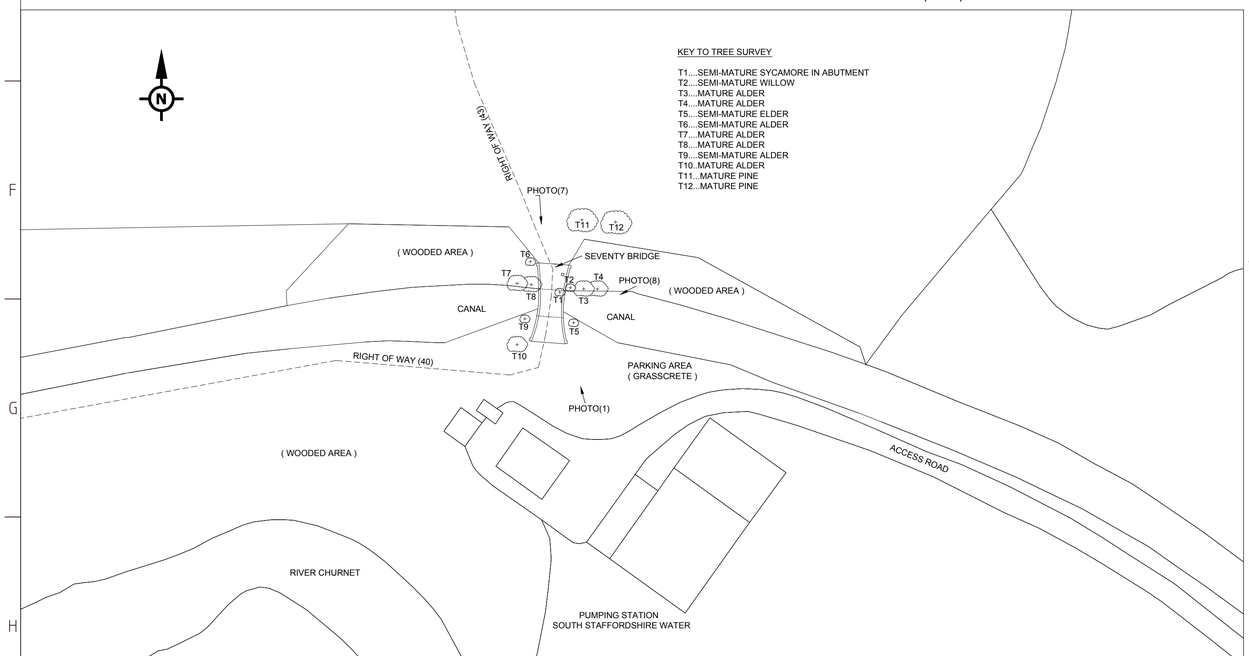
PLAN LAYOUT
(1:50)



SECTION THROUGH ARCH
(1:20)



EXISTING EAST ELEVATION
(1:50)



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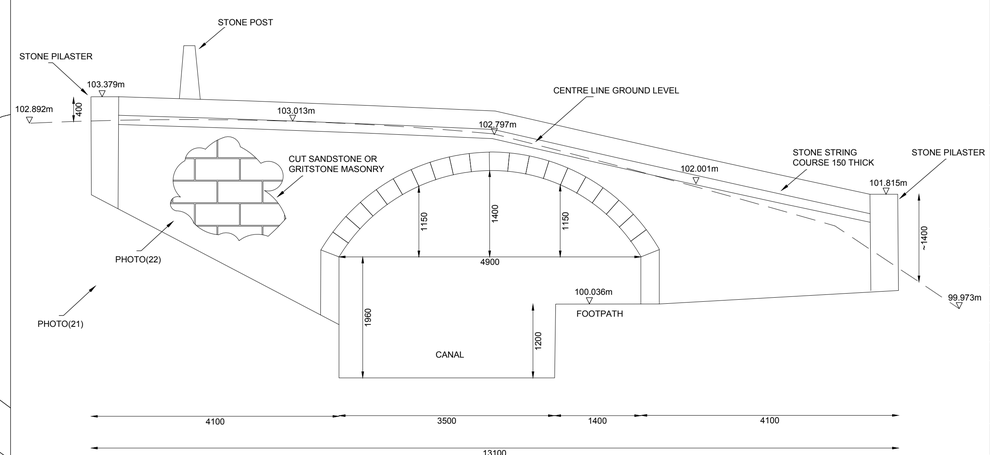
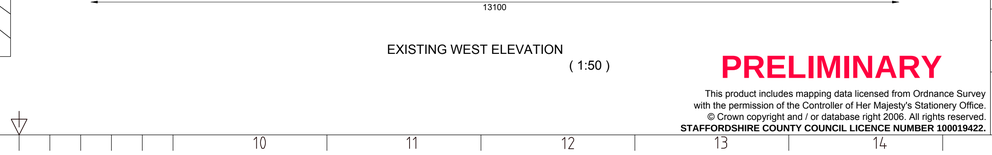




EXISTING WEST ELEVATION
(1:50)

PRELIMINARY

STAFFORDSHIRE COUNTY COUNCIL
HIGHWAYS
RIVERWAY
STAFFORD
ST16 3TJ

TECHNICAL NOTES

1) All dimensions in millimetres, all levels in metres *AOD*, the base level is 100.00m taken from the corner of the 900*900 Stanton manhole cover in the car parking area of the pumping station.

2) All information derived from a comprehensive bridge survey conducted on the 23/11/2010.

3) The following photographs can be viewed in the structural appraisal report and are referenced on the Existing General Arrangement.

Photo(1): Bridge Deck from Pumping Station.

Photo(2): Bridge Deck from South approach

Photo(3): Bridge Deck surfacing clay and large stone undressed blocks.

Photo(4): North approach viewed from bridge deck.

Photo(5): North approach from bridge threshold.

Photo(6): South approach and pumping station from bridge.

Photo(7): View of south approach from north threshold.

Photo(8): East elevation of seventy bridge heavily overgrown.

Photo(9): East elevation, showing arch ring separation.

Photo(10): East elevation, apex stone of arch ring settled denoted by gap.

Photo(11): East elevation, south spandrel in good order.

Photo(12): East elevation, north spandrel in good order.

Photo(13): North abutment viewed from east elevation in poor condition.

Photo(14): South abutment viewed from east elevation, towpath in poor condition.

Photo(15): North abutment and arch ring, note water penetration to apex of arch.

Photo(16): Arch barrel apex in fair condition, except for extensive water penetration.

Photo(17): North Abutment from West elevation in poor condition.

Photo(18): South towpath support wall in poor condition.

Photo(19): West elevation, heavily overgrown with trees and vegetation.

Photo(20): West elevation, south spandrel in good order.

Photo(21): West elevation, north spandrel heavily overgrown with Ivy.

Photo(22): West elevation, north spandrel significant mortar loss.

Photo(23): Eastern canal approach from bridge.

Photo(24): Western canal approach from bridge.

Photo(25): West elevation, south pilaster in fair condition but significant mortar loss.

SEVENTY BRIDGE REFURBISHMENT SCHEME

EXISTING GENERAL ARRANGMENT

F				
E				
D				
C				
B				
A	-	-	-	-

Amendments — By Chkd Date

Prepared	Produced	Checked
jd	jd	pra

Job Code: CDB0105 — **A1**

Grid Ref. 409068, 342771

Date: NOV 2010 — Scale: As Shown

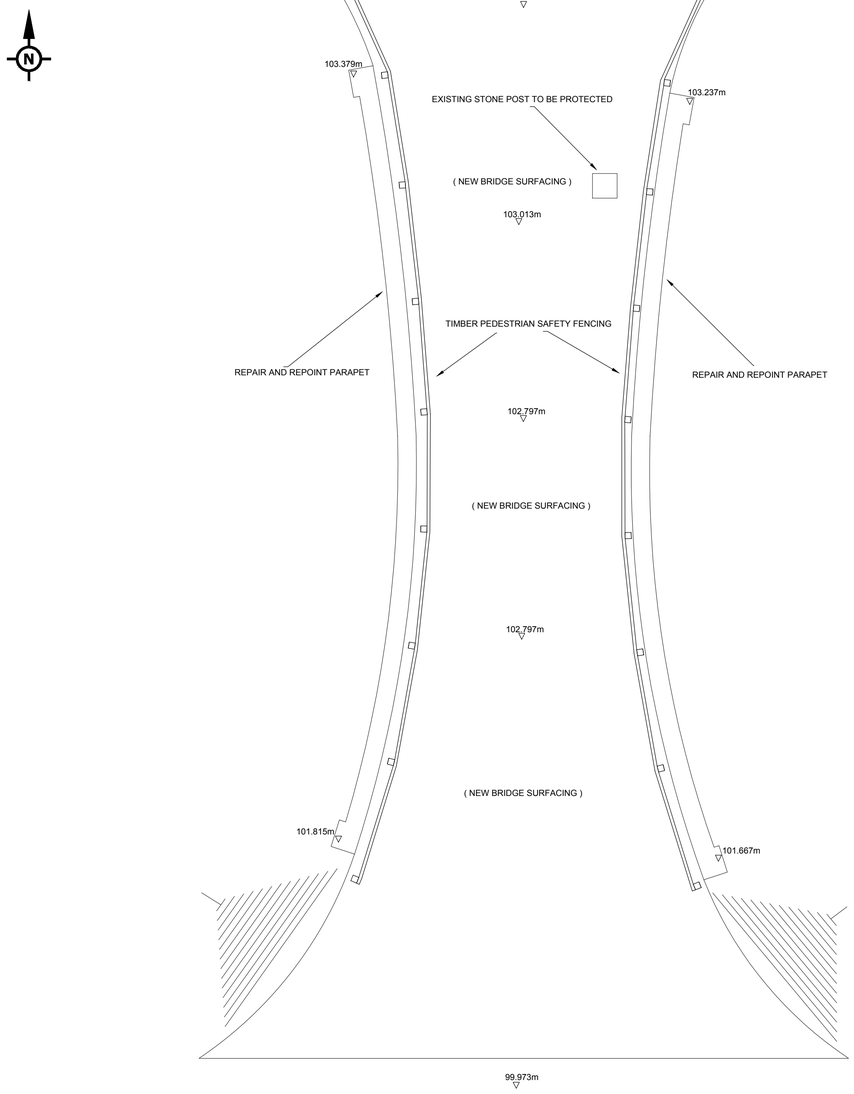
Drawing No. **CDB105/B3396/01**

Trim to this line for A1

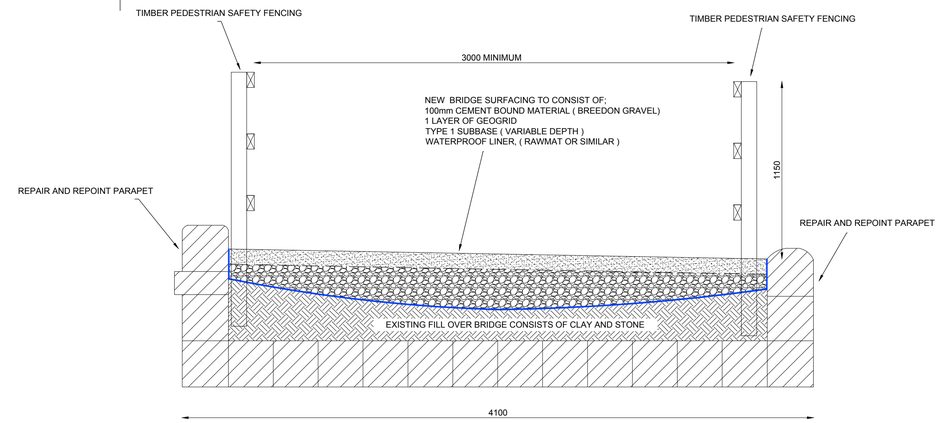
Appendix C

Proposed Option (1) General Arrangement

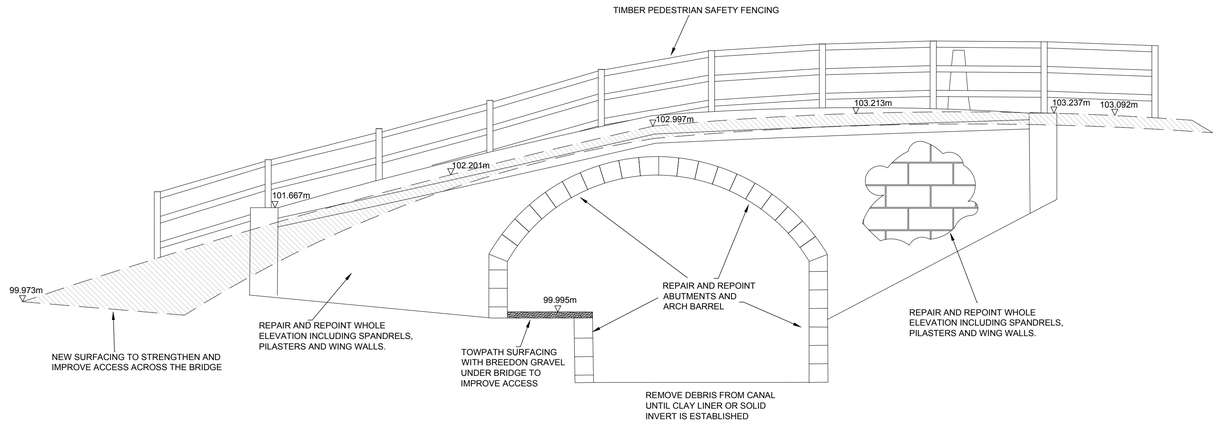
Drawing No. CDB105/B3396/02



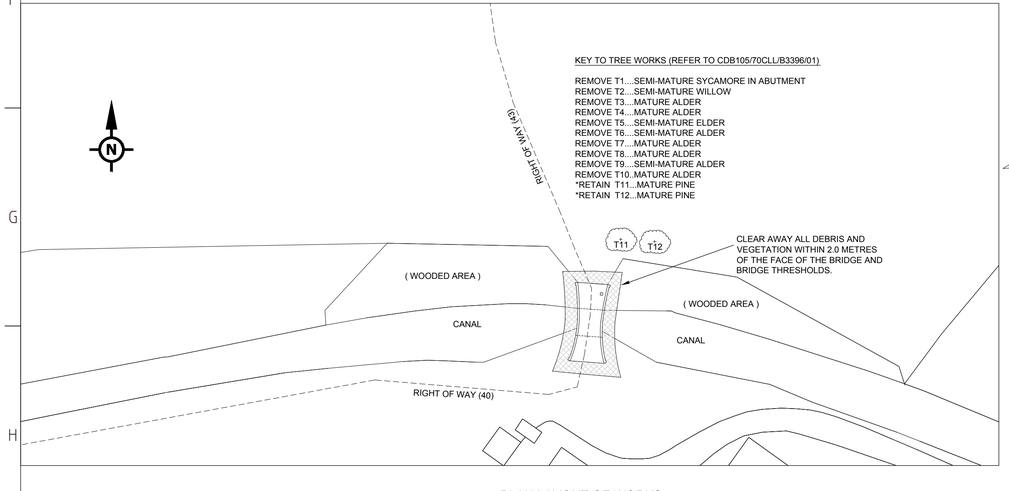
PLAN LAYOUT OF BRIDGE DECK
(1:50)



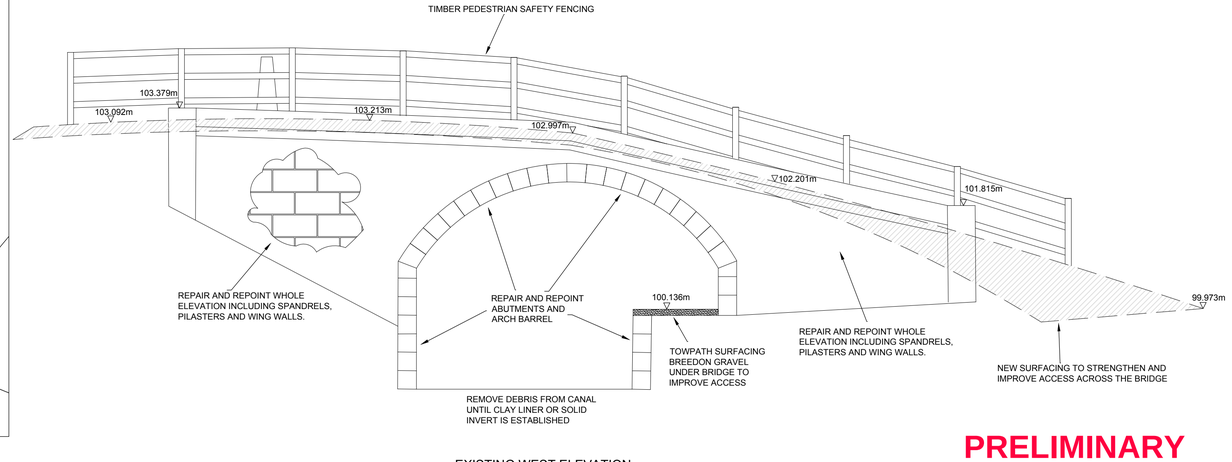
SECTION THROUGH ARCH
(1:20)



EXISTING EAST ELEVATION
(1:50)



PLAN LAYOUT OF WORKS
(1:500)



EXISTING WEST ELEVATION
(1:50)

PRELIMINARY

STAFFORDSHIRE COUNTY COUNCIL
HIGHWAYS
RIVERWAY
STAFFORD
ST16 3TJ

TECHNICAL NOTES

1) All dimensions in millimetres, all levels in metres *AOD*, the base level is 100.00m taken from the corner of the 900*900 Stanton manhole cover in the car parking area of the pumping station.

2) The underlying philosophy of the refurbishment works is to try and retain as much of the existing bridge structure as possible. The bridge will be strengthened and improved for pedestrian access with a balanced approach. The proposed works will ensure the existing bridge aesthetics are not compromised, (all works in keeping with the existing ancient rural look of the structure), but ensuring the bridge is enhanced for safe pedestrian usage.

3) The extent of the works can be described as follows;

a. A number of trees are currently growing either out of the bridge structure or very close to the bridge. It is recommended that trees T1 to T9 inclusive marked on drawing CDB105/B3396/01 should be removed. Old arch bridges generally have very shallow foundations which can be easily damaged by the action of tree roots in close proximity to the structure.

b. All vegetation within 2.0 metres of the bridge structure should be removed to allow full assessment and repair of the existing structure.

c. The whole stonework arch structure should be repaired and repointed with suitable lime mortar. The stonework repairs could include replacing or dressing and turning damaged stone blocks.

d. The bridge deck should be waterproofed with a simple damp proof membrane and resurfaced. The grade on the south approach of the bridge could be improved and a better walking surface constructed which would be in keeping with the bridge. The new waterproofing layer would supplement the clay layer and minimise water penetration through the stone arch barrel greatly improving the long term durability of the structure. By increasing the depth of material over the arch barrel the bridge will be inexpensively strengthened.

e. A timber safety fence is recommended to run parallel to the bridge parapets out into the bridge approaches. The new fencing will guide pedestrians over the bridge and minimise the risk of people falling off the bridge.

f. The towpath below the bridge should be surfaced to improve access below the bridge for future inspection and maintenance works.

4) Based on simple measure the following quantities have been established to help develop a cost estimate for the bridge refurbishment works.

Stonework repair and repoint.....83m²
Remove vegetation.....253m²
Remove Trees.....5 semi-mature & 4 mature
Timber Pedestrian Safety Fence..42 linear metres
Breedon Gravel CBM.....142m²
Type 1 subbase.....27m³
Waterproof Liner.....205m²
Geotextile.....205m²
Canal debris removed.....12m³

Estimated labour resource to undertake all works in fair weather 1280 man hours, (4 men, working 8 hours per day, 5 days per week, for 8 weeks), estimate includes travelling time to this remote site.

5) This work would be subject the Construction (Design and Management) Regulations 2007. Therefore a competent Principle Contractor and CDM-Co-ordinator would need to be appointed by the client commissioning the works.

6) Before works begin advice and if necessary consent should be obtained from the Local Council Tree Officer and Natural England to ensure compliance with Environmental / Ecological Legislation.

7) Before works begin agreement should be made with adjacent land owners on the scope and nature of the works which may affect their property.

SEVENTY BRIDGE REFURBISHMENT SCHEME

PROPOSED OPTION (1) GENERAL ARRANGEMENT

F				
E				
D				
C				
B				
A	-	-	-	-

Amendments — By Chkd Date

Prepared	Produced	Checked
jd	jd	pra

Job Code: CDB0105 — **A1**

Grid Ref. 409068, 342771

Date: NOV 2010 — Scale: As Shown

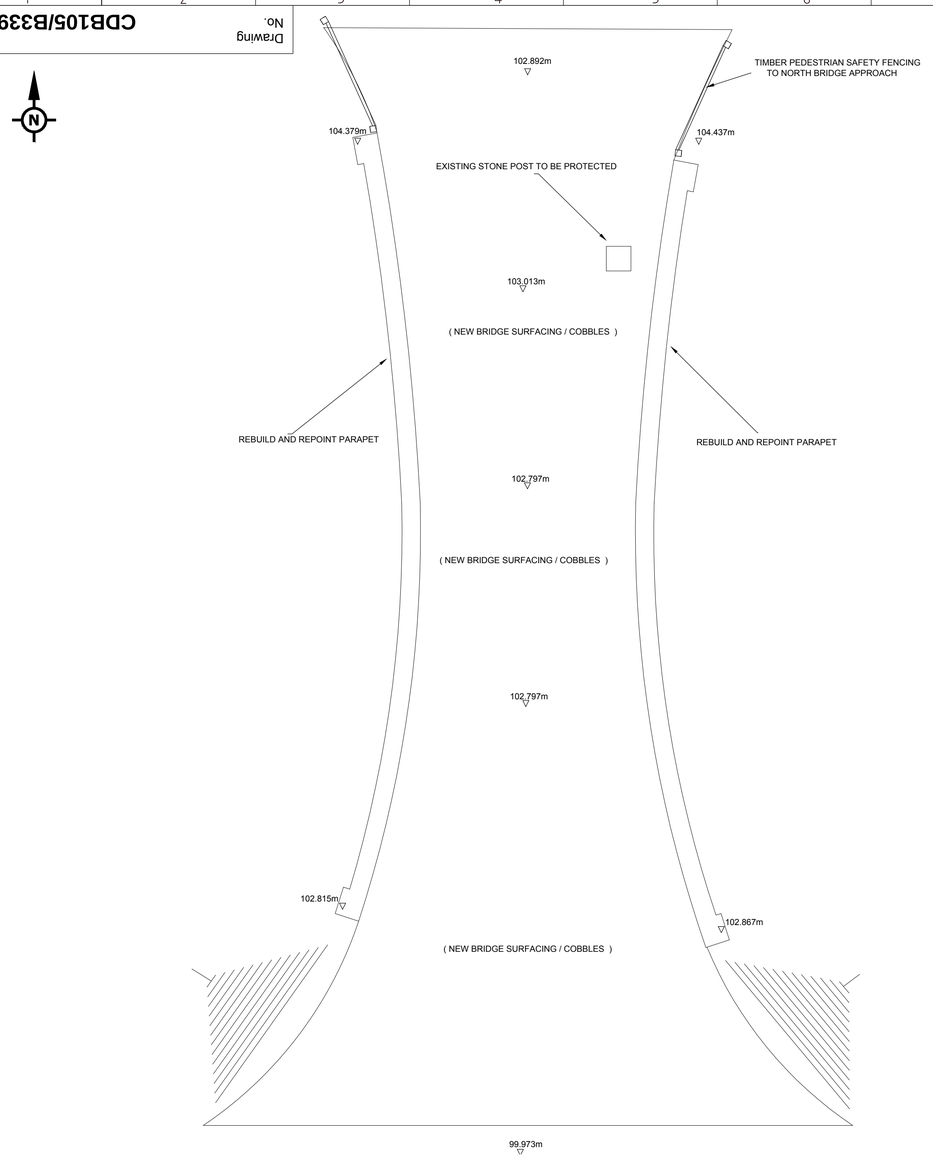
Drawing No. **CDB105/B3396/02**

Trim to this line for A1

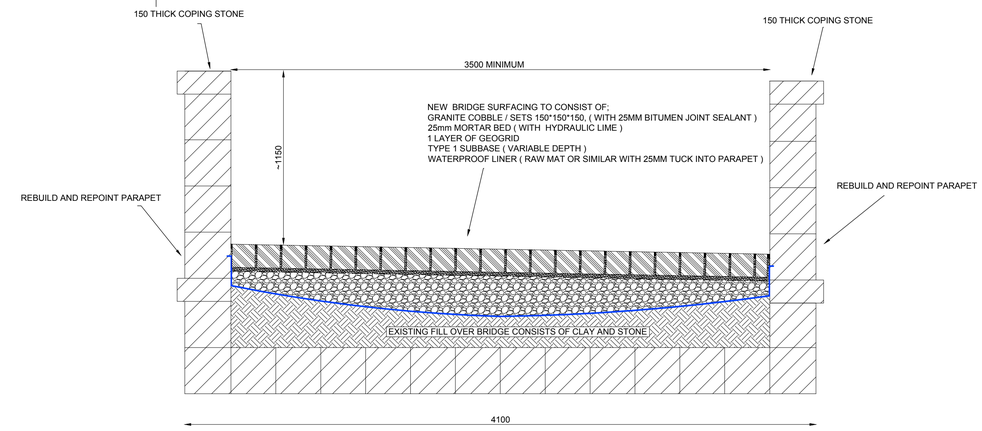
Appendix D

Proposed Option (2) General Arrangement

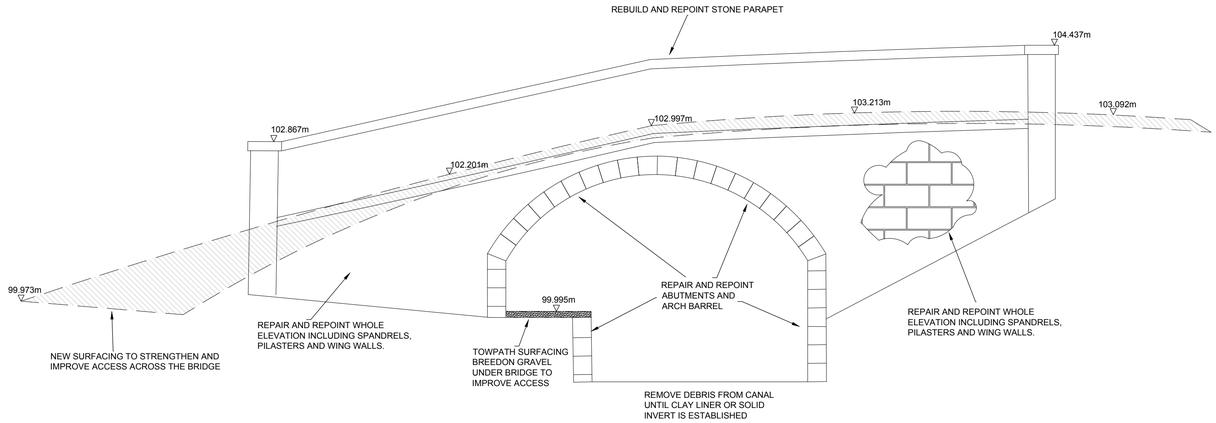
Drawing No. CDB105/B3396/03



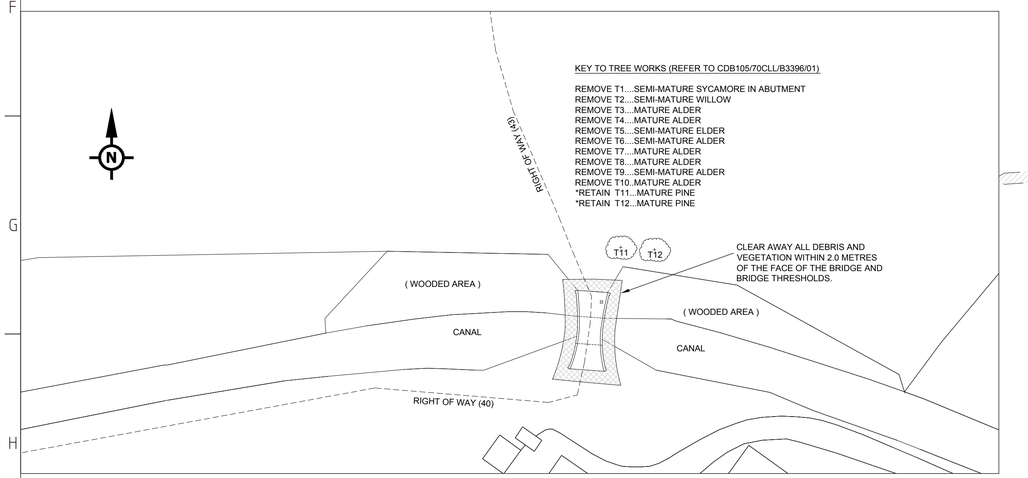
PLAN LAYOUT OF BRIDGE DECK
(1:50)



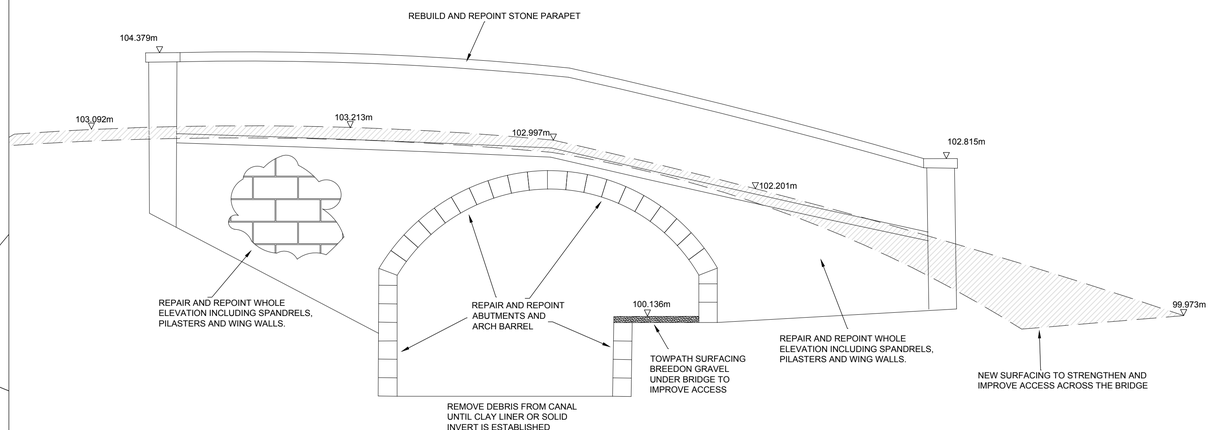
SECTION THROUGH ARCH
(1:20)



EXISTING EAST ELEVATION
(1:50)



PLAN LAYOUT OF WORKS
(1:500)



EXISTING WEST ELEVATION
(1:50)

PRELIMINARY

Staffordshire County Council

STAFFORDSHIRE COUNTY COUNCIL
HIGHWAYS
RIVERWAY
STAFFORD
ST16 3TJ

TECHNICAL NOTES

1) All dimensions in millimetres, all levels in metres *AOD*, the base level is 100.00m taken from the corner of the 900*900 Stanton manhole cover in the car parking area of the pumping station.

2) The underlying philosophy of the refurbishment works is to try and retain as much of the existing bridge structure as possible. The bridge will be strengthened and improved for pedestrian access with a balanced approach. The proposed works will ensure the existing bridge aesthetics are not compromised, (all works in keeping with the existing ancient rural look of the structure), but ensuring the bridge is enhanced for safe pedestrian usage.

3) The extent of the works can be described as follows;

a. A number of trees are currently growing either out of the bridge structure or very close to the bridge. It is recommended that trees T1 to T9 inclusive marked on drawing CDB105/B3396/01 should be removed. Old arch bridges generally have very shallow foundations which can be easily damaged by the action of tree roots in close proximity to the structure.

b. All vegetation within 2.0 metres of the bridge structure should be removed to allow full assessment and repair of the existing structure.

c. The whole stonework arch structure should be repaired and repointed with lime mortar. The stonework repairs could include replacing or dressing and turning damaged stone blocks.

d. The bridge deck should be waterproofed with a simple damp proof membrane and resurfaced. The grade on the south approach of the bridge could be improved and a better walking surface constructed which would be in keeping with the bridge. The new waterproofing layer would supplement the clay layer and minimise water penetration through the stone arch barrel greatly improving the long term durability of the structure. By increasing the depth of material over the arch barrel the bridge will be inexpensively strengthened. It is believed the bridge originally had a cobble paved deck this should be reinstated to enhance the bridge aesthetics.

e. Based on similar stone bridges of the period it is believed the stone parapets were originally 1200 high but were robbed out for building stone. To reinstate the original character of the bridge the existing stone parapets should be repaired and rebuilt with stone matching the existing bridge construction.

f. The towpath below the bridge should be surfaced to improve access below the bridge for future inspection and maintenance works.

4) Based on simple measure the following quantities have been established to help develop a cost estimate for the bridge refurbishment works.

Stonework repair and repoint.....83m²
New stone parapets (300 thick)...34m²
New coping stones (150 thick)....30m
Remove vegetation.....253m²
Remove Trees.....5 semi-mature & 4 mature
Timber Pedestrian Safety Fence..4 linear metres
New granite cobbles / sets.....142m²
50mm mortar bed and joints.....142m²
Bitumen sealant to cobbles.....142m²
Type 1 subbase.....27m³
Waterproof Liner.....205m²
Geotextile.....205m²
Canal debris removed.....12m³

Estimated labour resource to undertake all works in fair weather 1536 man hours, (4 men, working 8 hours per day, 5 days per week, for 12 weeks), estimate includes travelling time to this remote site.

5) This work would be subject the Construction (Design and Management) Regulations 2007. Therefore a competent Principle Contractor and CDM-Co-ordinator would need to be appointed by the client commissioning the works. Before works begin advice and if necessary consent should be obtained from the Local Council Tree Officer, Natural England and where required adjacent landowners.

SEVENTY BRIDGE REFURBISHMENT SCHEME

PROPOSED OPTION (2) GENERAL ARRANGEMENT

F				
E				
D				
C				
B				
A	·	·	·	·

Amendments — By Chkd Date

Prepared	Produced	Checked
jd	jd	pra

Job Code: CDB0105

Grid Ref. 409068, 342771

A1

Date: NOV 2010 — Scale: As Shown

Drawing No. **CDB105/B3396/03**

Trim to this line for A1

Appendix E Photographs

Photo(1): Bridge Deck from Pumping Station.
Photo(2): Bridge Deck from South approach
Photo(3): Bridge Deck surfacing clay and large stone undressed blocks.
Photo(4): North approach viewed from bridge deck.
Photo(5): North approach from bridge threshold.
Photo(6): South approach and pumping station from bridge.
Photo(7): View of south approach from north threshold.
Photo(8): East elevation of seventy bridge heavily overgrown.
Photo(9): East elevation, showing arch ring separation.
Photo(10): East elevation, apex stone of arch ring settled denoted by gap.
Photo(11): East elevation, south spandrel in good order.
Photo(12): East elevation, north spandrel in good order.
Photo(13): North abutment viewed from east elevation in poor condition.
Photo(14): South abutment viewed from east elevation, towpath in poor condition.
Photo(15): North abutment and arch ring, note water penetration to apex of arch.
Photo(16): Arch barrel apex in fair condition, except for extensive water penetration.
Photo(17): North Abutment from West elevation in poor condition.
Photo(18): South towpath support wall in poor condition.
Photo(19): West elevation, heavily overgrown with trees and vegetation.
Photo(20): West elevation, south spandrel in good order.
Photo(21): West elevation, north spandrel heavily overgrown with Ivy.
Photo(22): West elevation, north spandrel significant mortar loss.
Photo(23): Eastern canal approach from bridge.
Photo(24): Western canal approach from bridge.
Photo(25): West elevation, south pilaster in fair condition but significant mortar loss.

Photo(1): Bridge Deck from Pumping Station.

Photo(2): Bridge Deck from South approach

Photo(3): Bridge Deck surfacing clay and large stone undressed blocks.

Photo(4): North approach viewed from bridge deck.

Photo(5): North approach from bridge threshold.

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Photo(13): North abutment viewed from east elevation in poor condition.

Photo(14): South abutment viewed from east elevation, towpath in poor condition.

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Photo(21): West elevation, north spandrel heavily overgrown with Ivy.

Photo(22): West elevation, north spandrel significant mortar loss.

Photo(23): Eastern canal approach from bridge.

Photo(24): Western canal approach from bridge.

Photo(25): West elevation, south pilaster in fair condition but significant mortar loss.

Photo(26): Parapets and surfacing running over the bridge deck in poor condition.

Appendix F

Arch Bridge Analysis