



Free4m 0502

Bishopsford Rd Bridge, Merton

Repair Proposals

27/01/20	Initial Issue	P01
Date	Reason for distribution	Revision

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EXECUTIVE SUMMARY

Following partial collapse of the 3 span masonry bridge in June 2019 Free4m Consulting Ltd was commissioned by FM Conway to review potential causes. Free4m completed the commission in June 2019 ref: 0502RP001 P01 Bishopsford Rd Bridge - Interim Report on Partial Collapse.

In January 2020 Free4m Consulting Ltd was commissioned to explore and develop repair options to remediate damaged portions of the bridge. Following meetings with LB Merton, WSP and FM Conway it was agreed the remedial works could be split in two categories:

1. Works required to reinstate the bridge to the condition FM Conway would have arrived at following completion of strengthening works being undertaken at the time of collapse
2. Works required to secure the future of the bridge with respect to existing scour remediation and scour protection

A detailed photographic record of inspectable parts of the damaged arch barrels was undertaken on 20/01/20. The weather was dry and sunny with a light breeze.

The images were stitched to form a 3D model using bespoke photogrammetry software. Observations made from the 3D photogrammetry model were used to inform the repair proposals and following discussions with LB Merton, WSP and FM Conway two repair proposals were considered valid:

- Option 1 – Full Reinstatement
 - This option demolishes span 1 and half of span 2 including pier 1. Scour survey and remediation is carried out to pier 1, north abutment and wingwalls. Full masonry units used to re-build the arch barrels, footbridge and highway bridge pier 1, north abutment, spandels and wingwalls. This option allows for reinstatement of masonry to the pre-collapse masonry line for both span 1 and span 2 arch barrels.
- Option 2 – Structural Reinstatement
 - This option demolishes half span 1 i.e. to crown of span 1 including pier 1 (footbridge only). Scour survey and remediation is carried out to pier 1, north abutment and wingwalls. Full masonry units used to re-build the arch half barrel, footbridge pier 1, north abutment, spandels and wingwalls. This option allows for reinstatement of masonry to the pre-collapse masonry line for span 1 arch barrel but not for span 2 arch barrel. The photogrammetry shows the void behind the delaminated portion of the span 2 arch barrel may be locally repaired using brick wedges with the spandrel masonry repaired to aesthetically

OBSERVATIONS

Span 1

1. In the main the south half of the arch barrel (taken from the crown) appears to be substantially intact as can be seen from the photogrammetry cross sections in Appendix 1
2. The highway bridge appears to have been extended at some time denoted by the change in brick colour from red to blue. The extension appears to be to the upstream side of the highway bridge
3. A historic spandrel in red coloured brick was noted in a photo taken during the strengthening works. This corroborates the findings of the photogrammetry
4. A slope in the bedding joints exists in the section of the barrel leading to the upstream footbridge suggests the highway bridge has settled historically with the upstream footbridge forming a hard-spot giving rise to the sloping bedding joints
5. There appears to be a tear in the crown of the arch barrel
6. At the downstream end stone springing was noted with a lack of fit of masonry units and different masonry bond

Span 2

1. Damage to the barrel appears to be limited to a section of the masonry arch barrel stemming from upstream extending to approximately 50% of the arch barrel. The displaced section of brickwork is worst at the upstream spandrel, in excess of 25mm, diminishing to origin approximately 50% of the barrel length.

REPAIR OPTIONS

1.1 OPTION 1 – FULL REINSTATEMENT

This option proposes taking down the entirety of span 1 and half of span 2. The following associated elements will be demolished and re-built:

- North abutment
- Wing walls
- Spandrels
- Highway bridge pier 1
- Upstream footbridge pier 1

A scour survey will be carried out and appropriate remediation executed depending on findings. All masonry will be re-built to match in with the lines of the original bridge. Existing services will be supported in-situ throughout the repair works. The concrete saddle will then be reinstated to the Arcadis details with final reinstatement of the highway surfacing, pilasters and ironwork.

1.2 OPTION 2 – STRUCTURAL REINSTATEMENT

This option proposed taking down span 1 to crown only as the south half of the barrel appears intact from the photogrammetry survey.

The following associated elements will be demolished and re-built:

- North abutment
- Wing walls
- Span 1 spandrels to crown only
- Upstream footbridge pier 1
- Localised repair to span 2 (north) spandrel with brick wedges inserted to void in barrel resulting from storm damage

A scour survey will be carried out and appropriate remediation executed depending on findings. All masonry demolished as part of this option will be re-built to match in with the lines of the original bridge. Existing services will be supported in-situ throughout the repair works. The concrete saddle will then be reinstated to the Arcadis details with final reinstatement of the highway surfacing, pilasters and ironwork.

This option differs from option 1 insofar as it considers the bridge load carrying capacity can be reinstated via rebuilding half of span 1 with associated wingwalls, abutment and

spandrels as described with compression ensured in span 2 by introducing brick wedges to the void behind the delamination.

To achieve insertion of the brick wedges the upstream spandrel (under the footbridge soffit) will be removed and brick wedges inserted. The spandrel will then be re-built to align with the arch barrel thereby presenting an aesthetically pleasing finish.

It is considered the displaced brickwork within the arch barrel will not be readily visible as the upstream footbridge blocks much of the light and consequently view. The river is not navigable and accordingly is not transited.

1.3 COMPARISON OF OPTIONS

Repair Option	Start on site	Works in the river start	Works in the river end	Calendar days in river	Finish on site	Weeks on site	Estimate of cost
North and Central span repair without planning	30th March 2020	30th March 2020	1st July 2020	94 Days	4th August 2020	19 Weeks	£707,890.92
North and Central span repair with planning	13th May 2020	13th May 2020	14th August 2020	94 Days	17th September 2020	19 Weeks	£707,890.92
North span repair without planning	30th March 2020	30th March 2020	20th May 2020	52 Days	14th July 2020	14 Weeks	£452,002.58
North span repair with planning	13th May 2020	13th May 2020	3rd July 2020	52 Days	27th August 2020	14 Weeks	£452,002.58

APPENDIX 1 – PHOTOGRAMMETRY MODEL IMAGES

Photos from 3D model

Upward view



Elevation towards abutment



Upstream to the right. Note very different bricks at RH end marking an extension.

At downstream end is a crack and void a little over one metre in which also marks an extension.

Elevation towards pier



The end extensions are clearer here. At the downstream end it stands on stone.

Upward view inclined towards abutment

Tear in crown. White is where the camera couldn't see anything but is not clear sky.



Settlement Cracks



At the upstream end of the pier, the extension is tilted up to the upstream. The crack suggests that is a long standing rotation but it is unlikely to have been built that way. The tilt goes all the way to the crown.



At the downstream end the new build us evidenced by:

Stone springings

Different bricks

Lack of fit

Different bond



Old spandrel wall

Concrete backing of extension

As at the downstream end, The new bricks are all in stretcher bond



This fissure begins at the interface between old and new but seems to show a degree of bonding in.



A view into the large void. The vertical wall at the back is the shell of the abutment which was then filled with rather poorer workmanship and bricks.



The rounded corners on the bricks confirms this is a long standing fracture. The small stub of brick arrowed would have pulled out rather than breaking in this event.

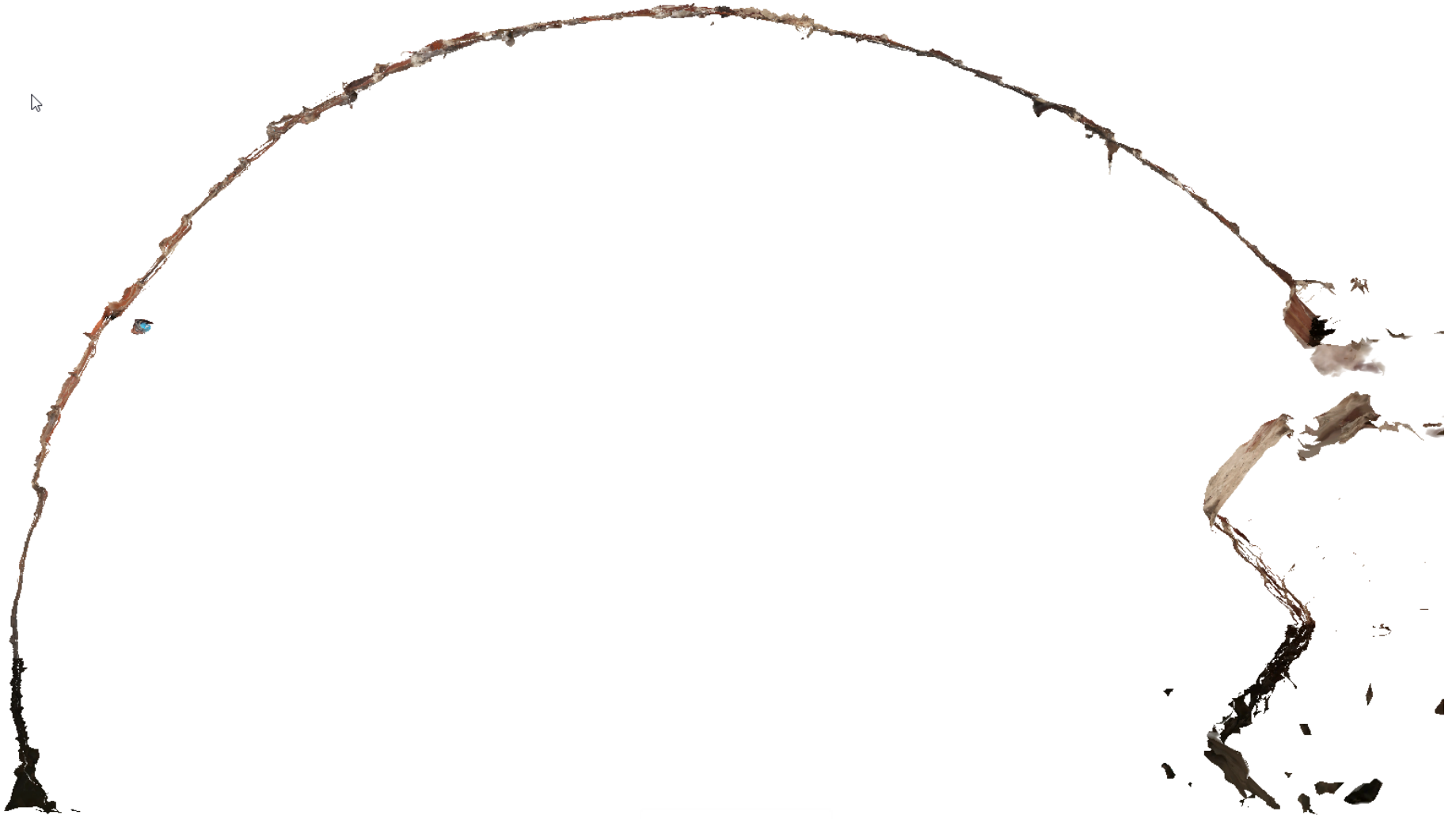


This shows that the rings are fully bonded, not snap headers.

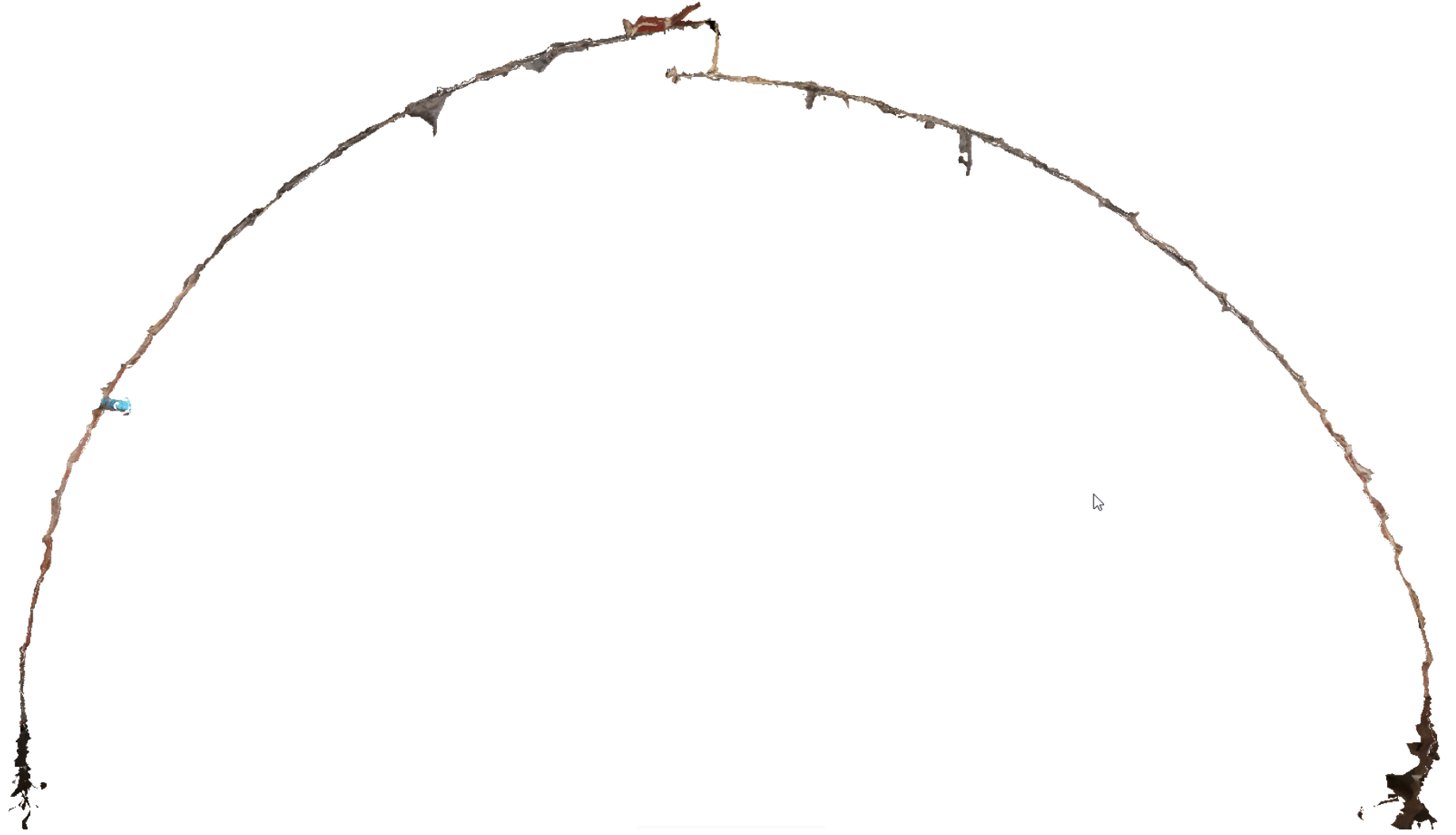
Sections Looking downstream starting from Up stream end







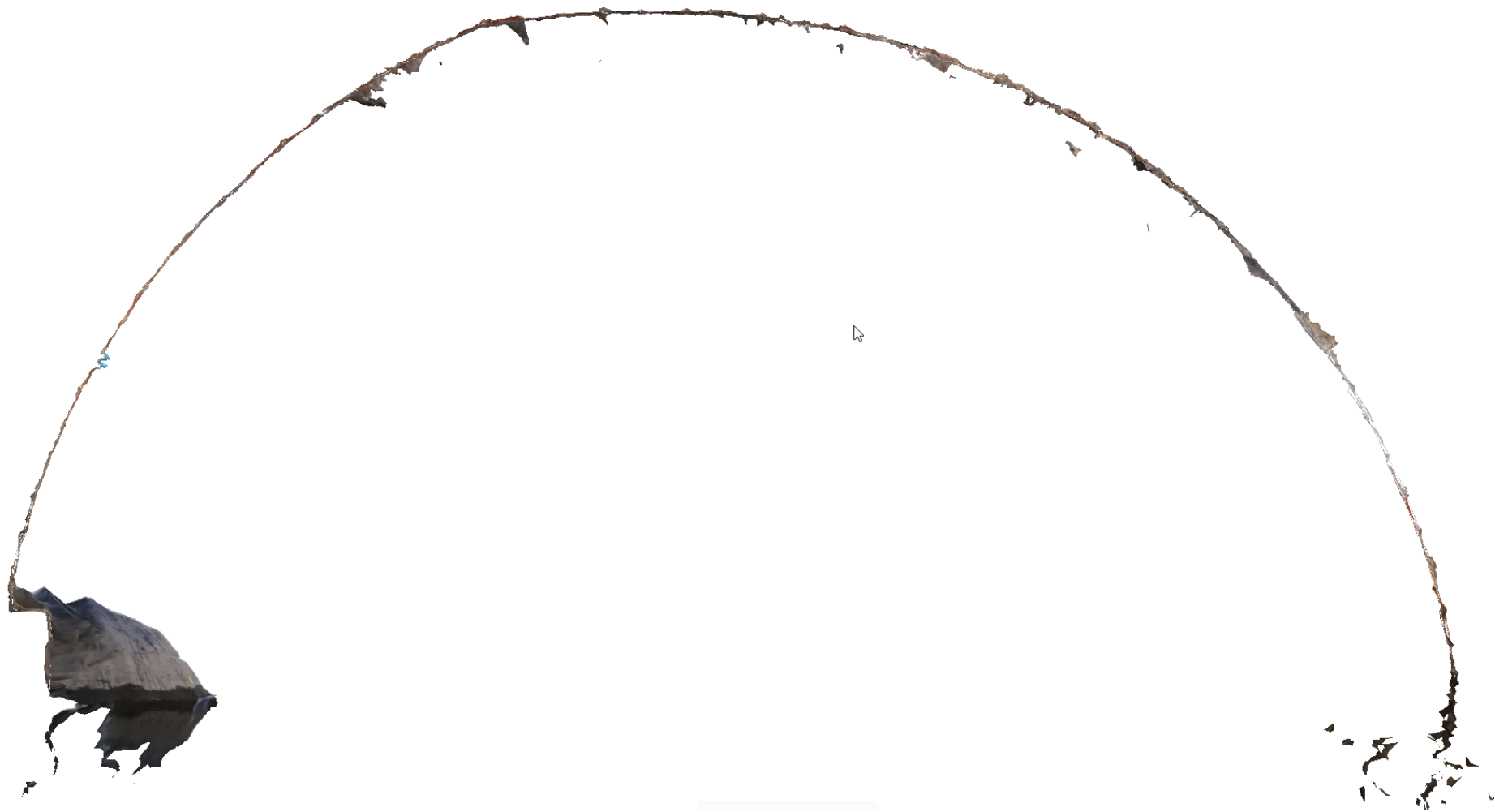






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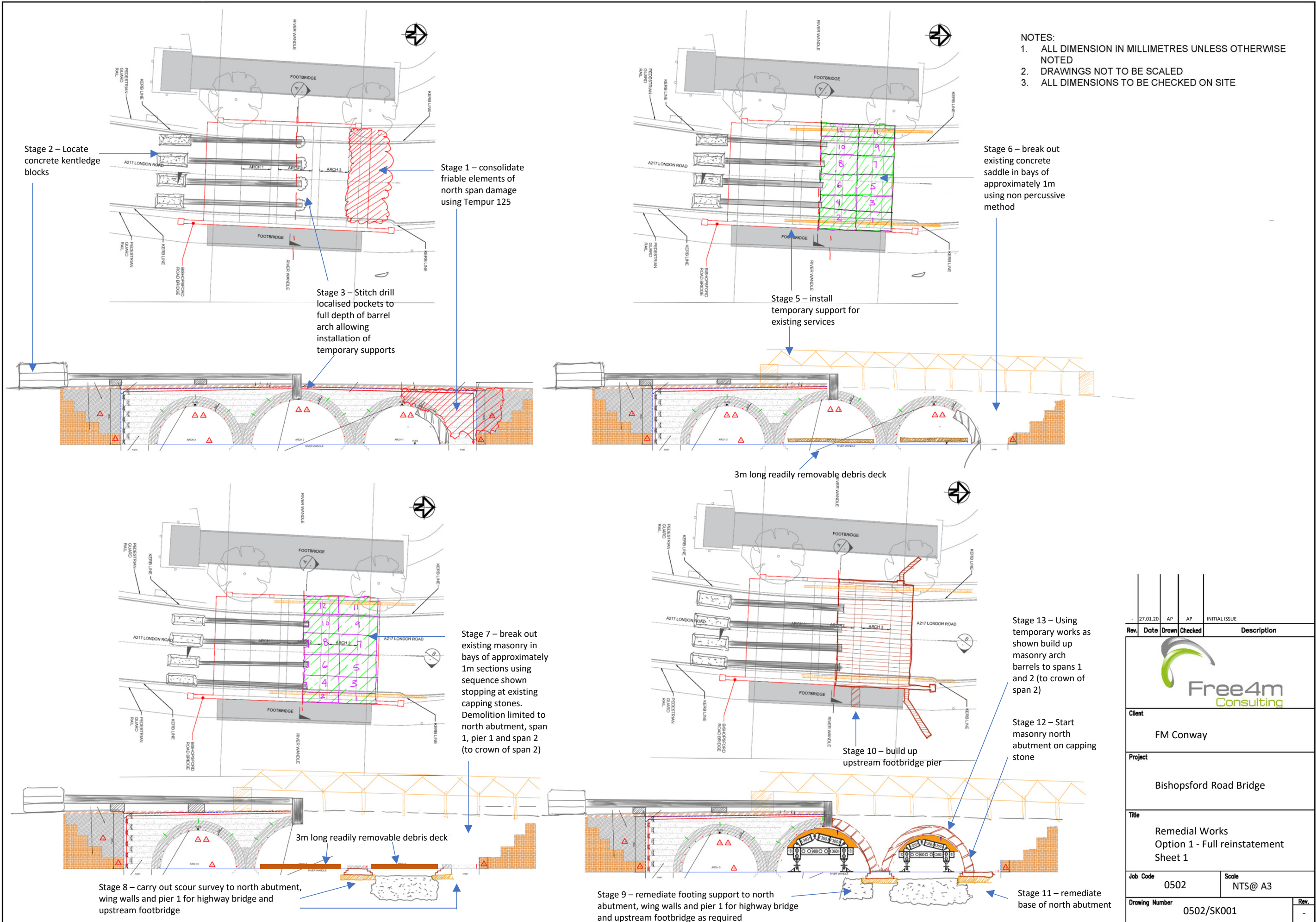
△



A few original photographs of details.



APPENDIX 2 – REPAIR OPTIONS INDICATIVE WORKS STAGES



- NOTES:
1. ALL DIMENSION IN MILLIMETRES UNLESS OTHERWISE NOTED
 2. DRAWINGS NOT TO BE SCALED
 3. ALL DIMENSIONS TO BE CHECKED ON SITE

Stage 2 – Locate concrete kentledge blocks

Stage 1 – consolidate friable elements of north span damage using Tempur 125

Stage 3 – Stitch drill localised pockets to full depth of barrel arch allowing installation of temporary supports

Stage 5 – install temporary support for existing services

Stage 6 – break out existing concrete saddle in bays of approximately 1m using non percussive method

3m long readily removable debris deck

Stage 7 – break out existing masonry in bays of approximately 1m sections using sequence shown stopping at existing capping stones. Demolition limited to north abutment, span 1, pier 1 and span 2 (to crown of span 2)

Stage 13 – Using temporary works as shown build up masonry arch barrels to spans 1 and 2 (to crown of span 2)

Stage 12 – Start masonry north abutment on capping stone

Stage 10 – build up upstream footbridge pier

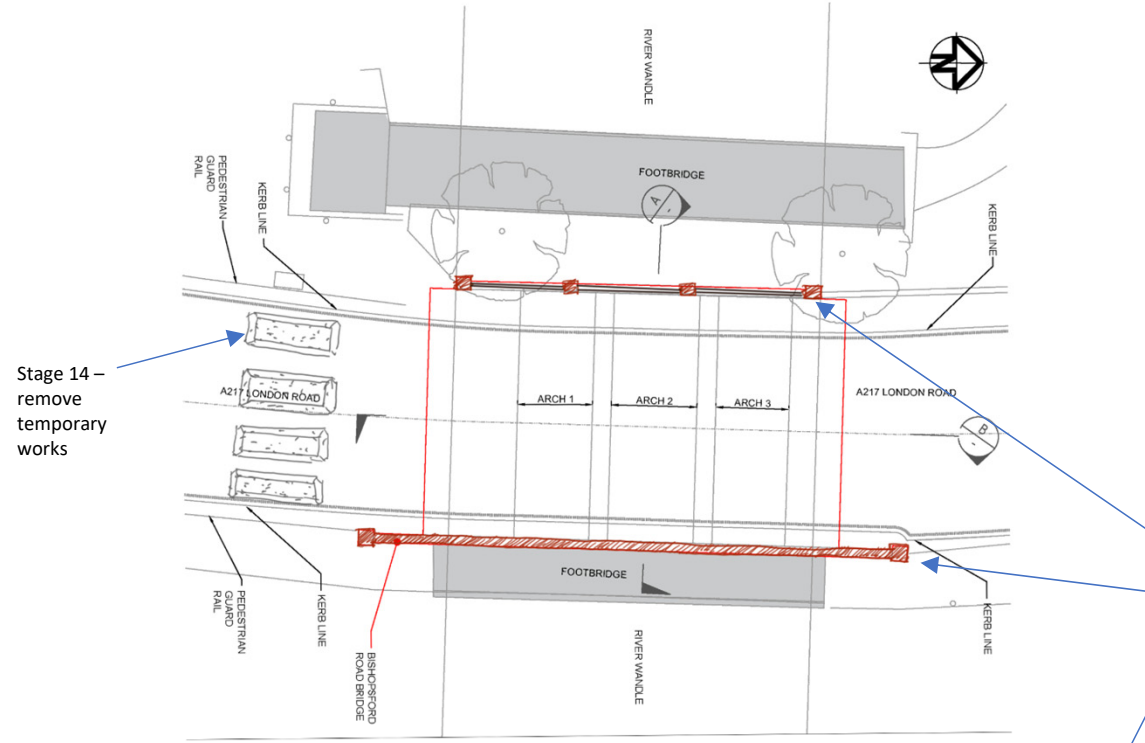
Stage 8 – carry out scour survey to north abutment, wing walls and pier 1 for highway bridge and upstream footbridge

Stage 9 – remediate footing support to north abutment, wing walls and pier 1 for highway bridge and upstream footbridge as required

Stage 11 – remediate base of north abutment

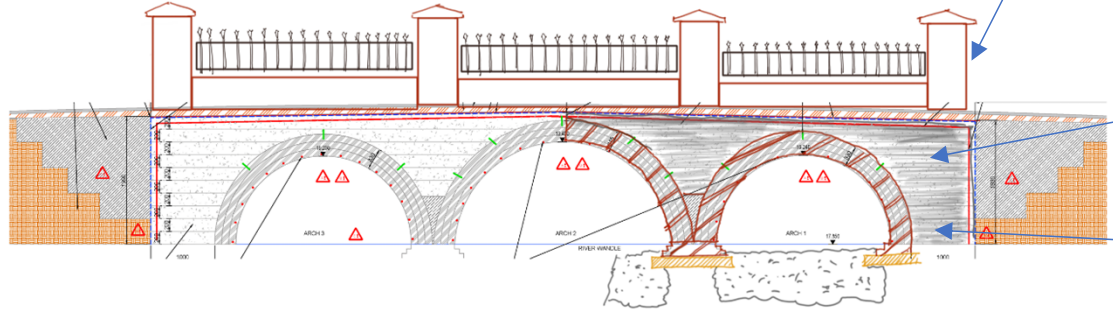
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Client FM Conway					
Project Bishopsford Road Bridge					
Title Remedial Works Option 1 - Full reinstatement Sheet 1					
Job Code 0502				Scale NTS@ A3	
Drawing Number 0502/SK001					Rev. -

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Stage 14 – remove temporary works

Stage 17 – reinstate masonry walls, pilasters and railings

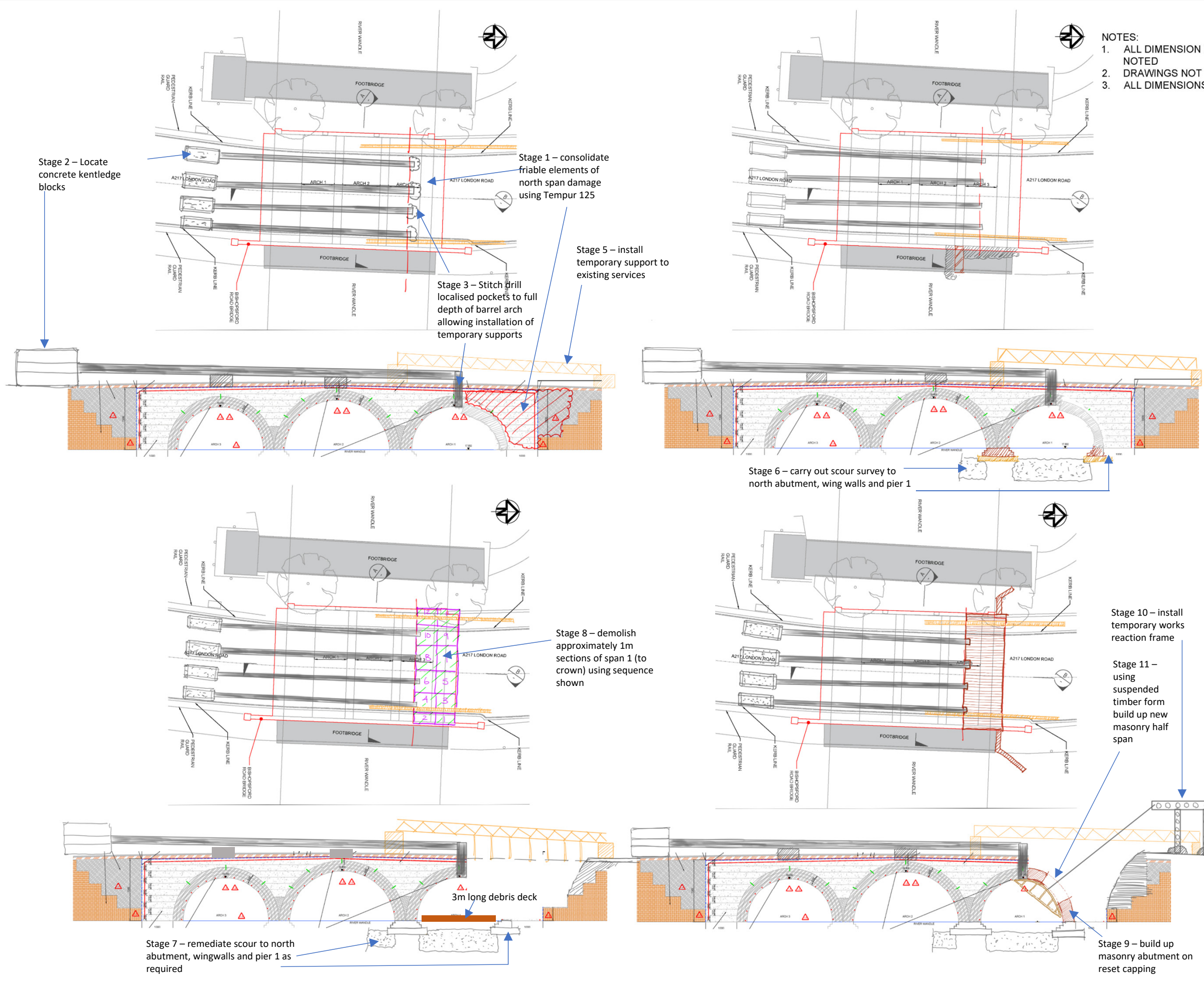


Stage 16 – backfill using concrete to form new saddle in accordance with Arcadis details

Stage 15 – build up masonry spandrels and associated wing walls

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	27.01.20	AP	AP	INITIAL ISSUE
				
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Project Bishopsford Road Bridge				
Title Remedial Works Option 1 - Full reinstatement Sheet 2				
Job Code 0502			Scale NTS@ A3	
Drawing Number 0502/SK002				Rev. -

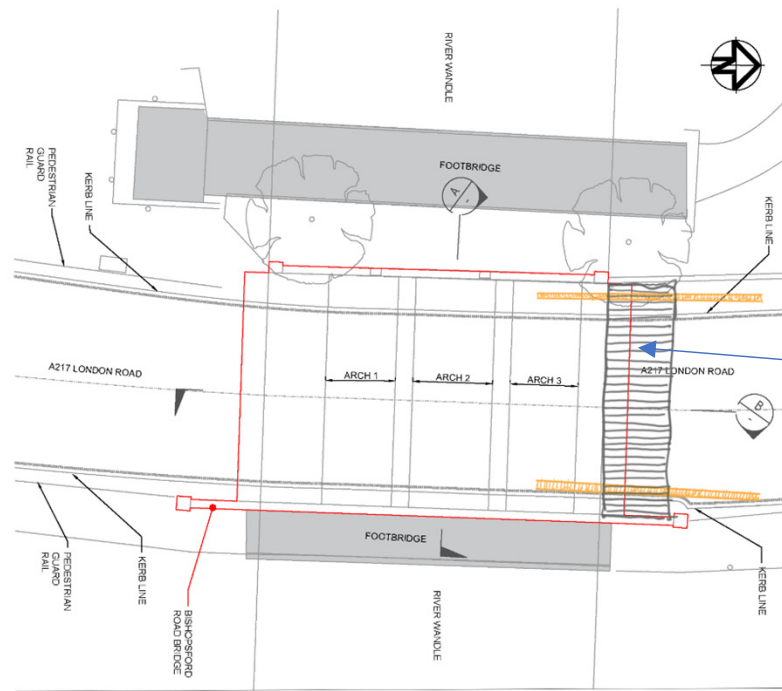
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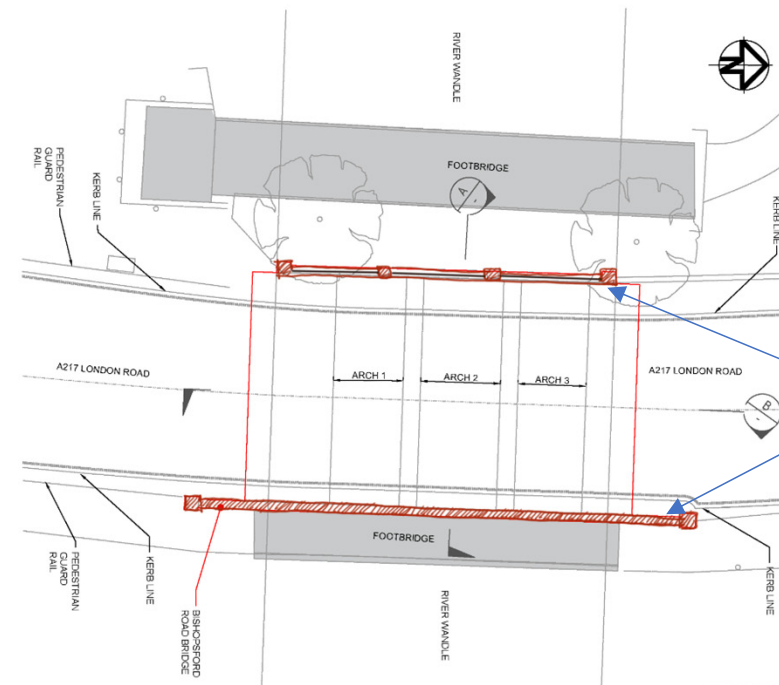
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FM Conway				
Project				
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Title				
Remedial Works Option 2 – Structural reinstatement Sheet 1				
Job Code			Scale	
0502			NTS@ A3	
Drawing Number				Rev.
0502/SK003				-

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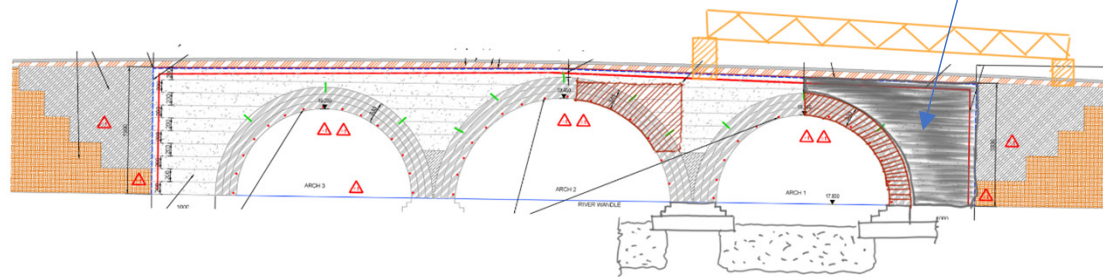
Stage 14 – remove temporary works



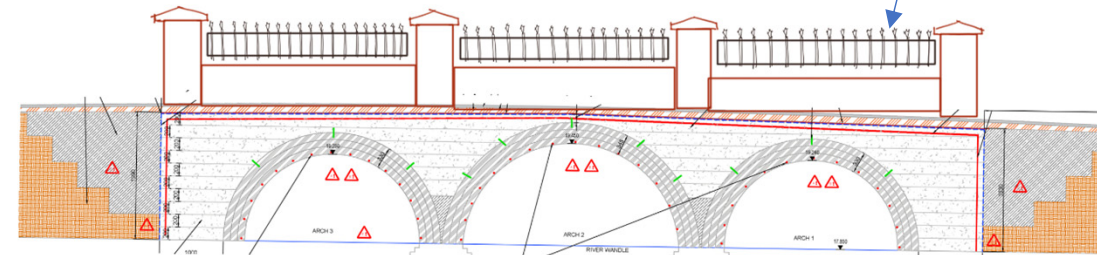
Stage 16 – backfill using concrete to form new saddle in accordance with Arcadis details




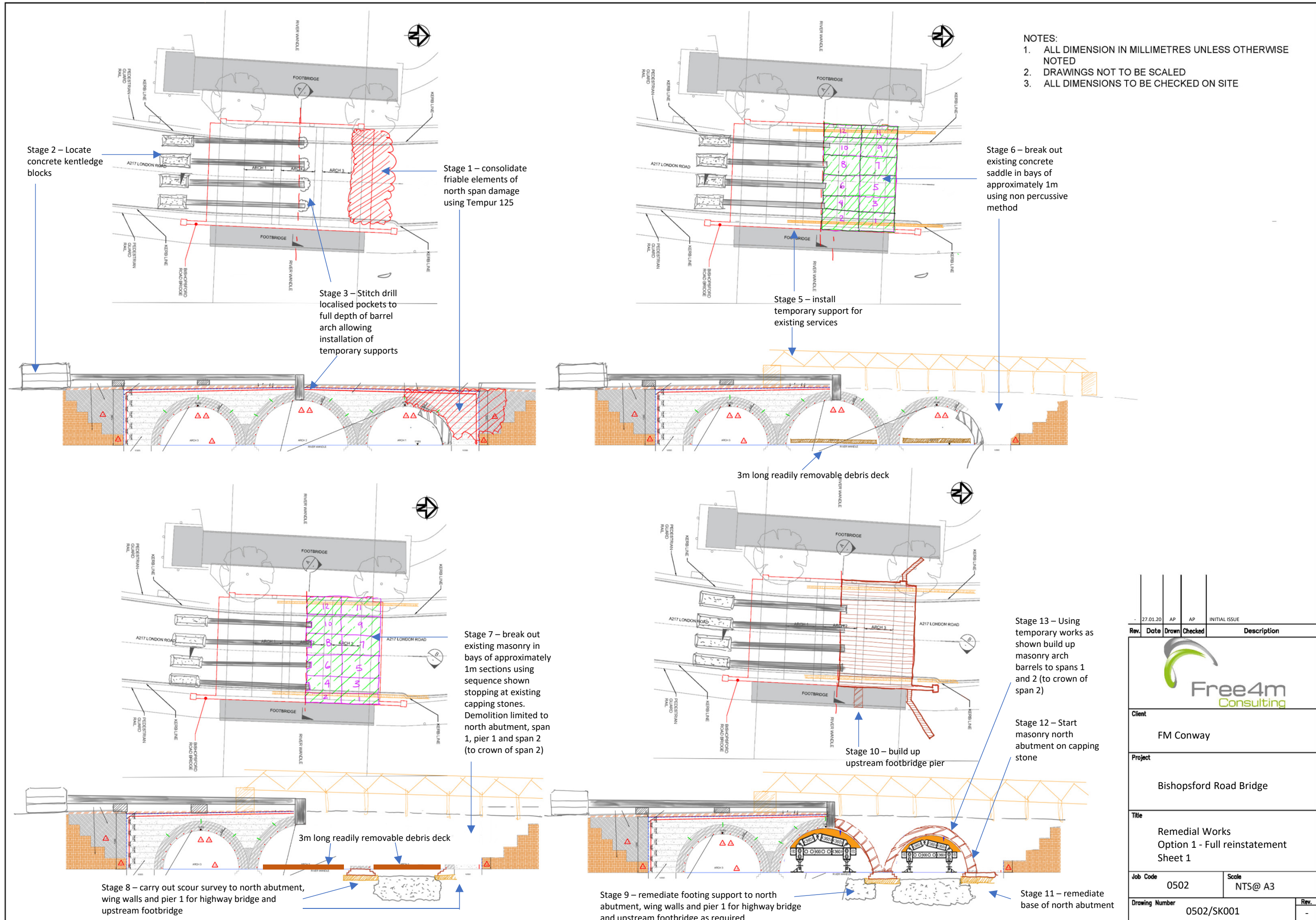
Stage 15 – build up masonry spandrel and associated wing walls



Stage 17 – reinstate masonry walls, pilasters and railings



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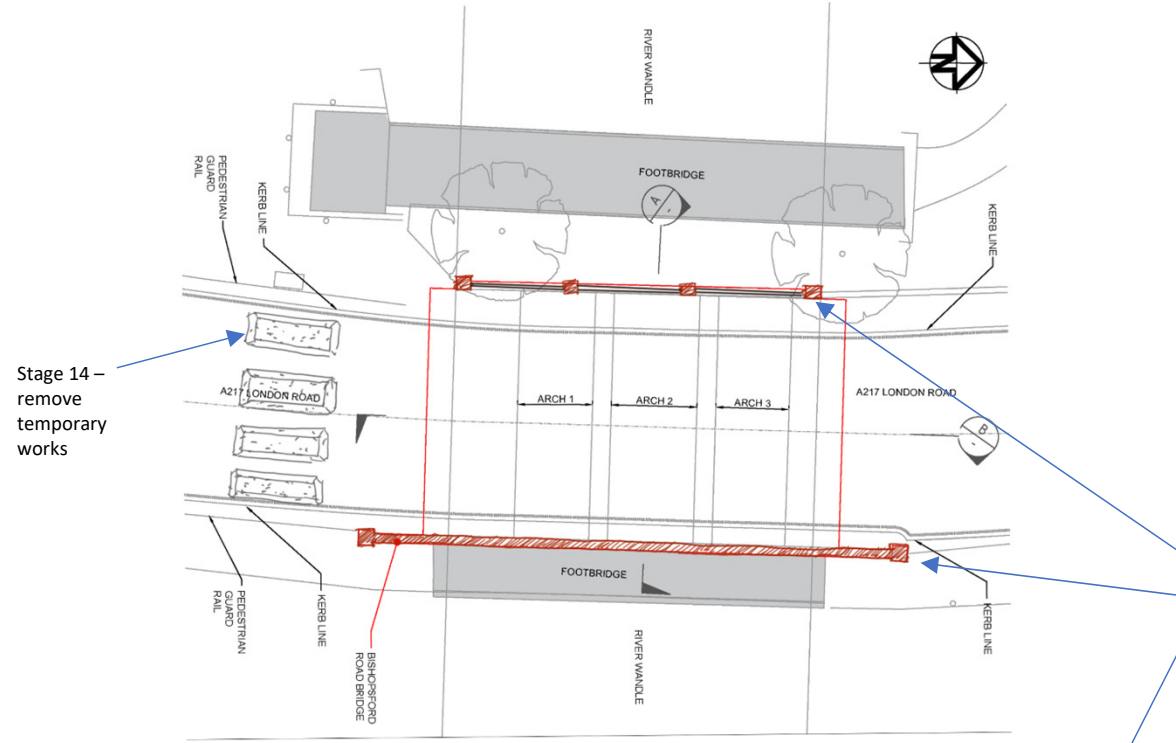
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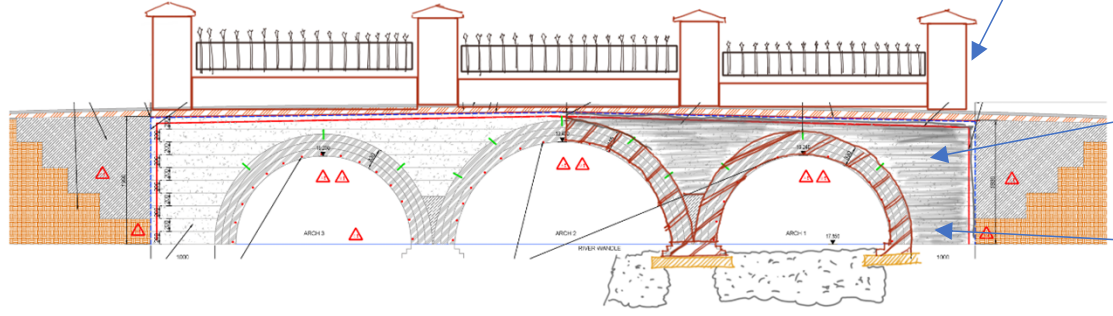
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Drawing Number 0502/SK001				Rev. -

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Stage 14 – remove temporary works

Stage 17 – reinstate masonry walls, pilasters and railings

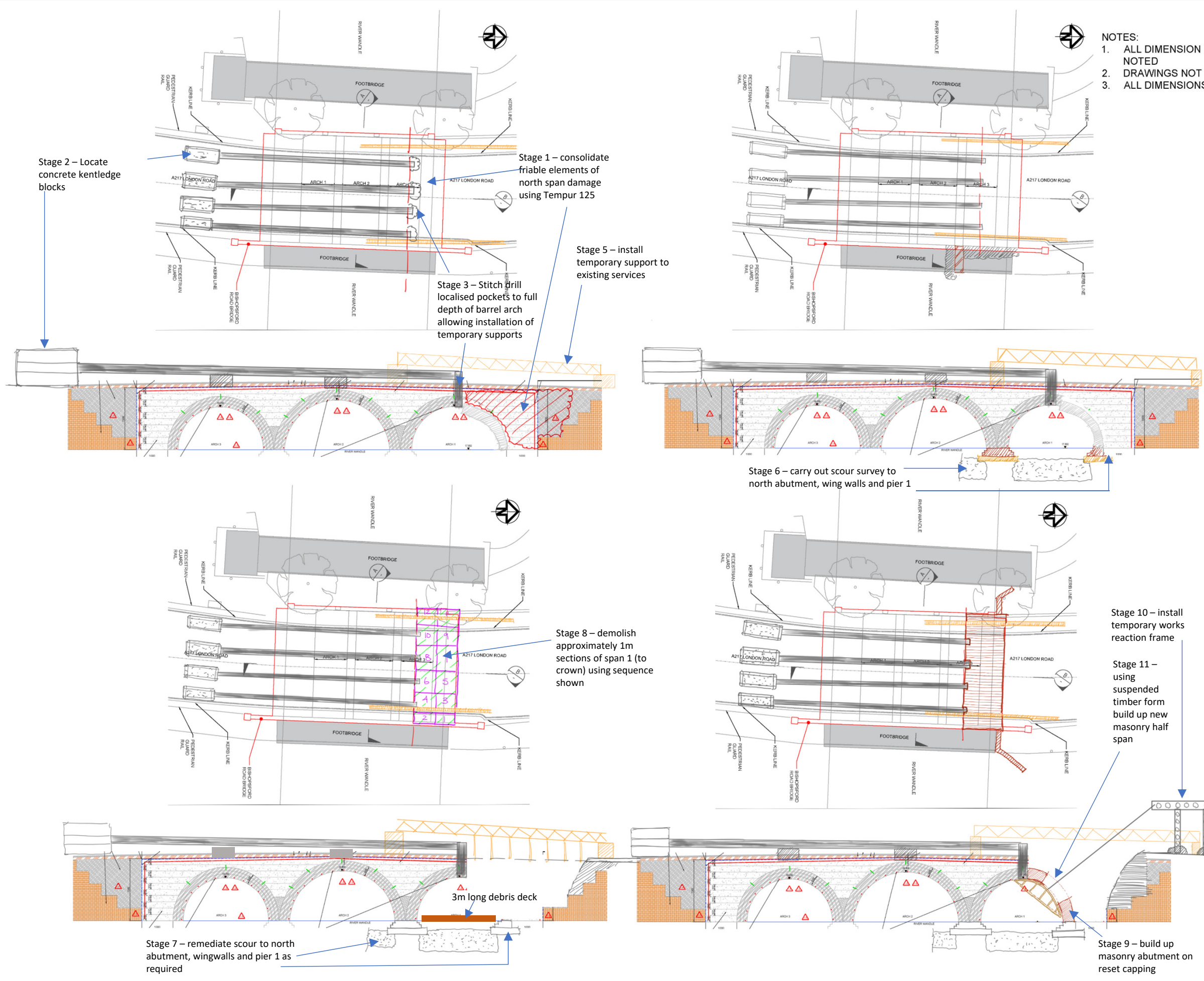



Stage 16 – backfill using concrete to form new saddle in accordance with Arcadis details

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Job Code 0502			Scale NTS@ A3	
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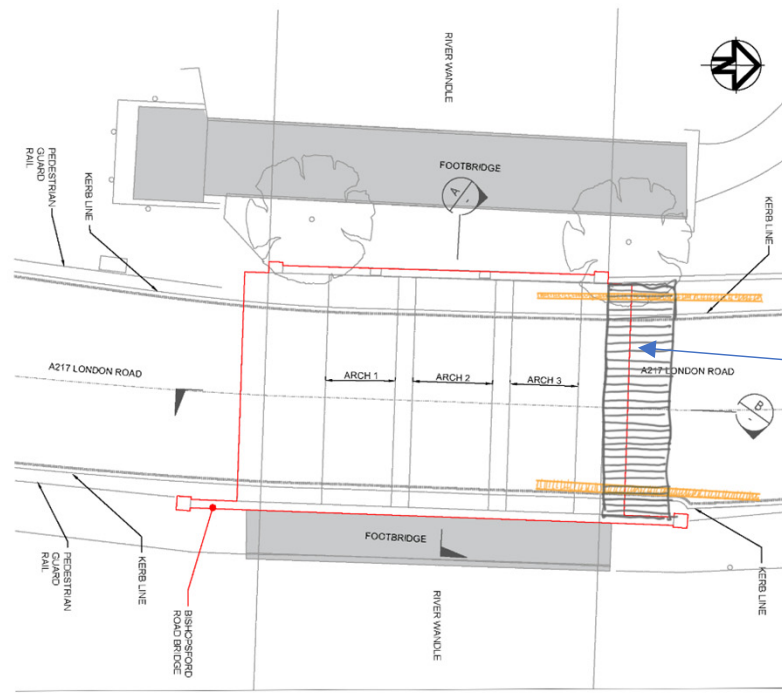
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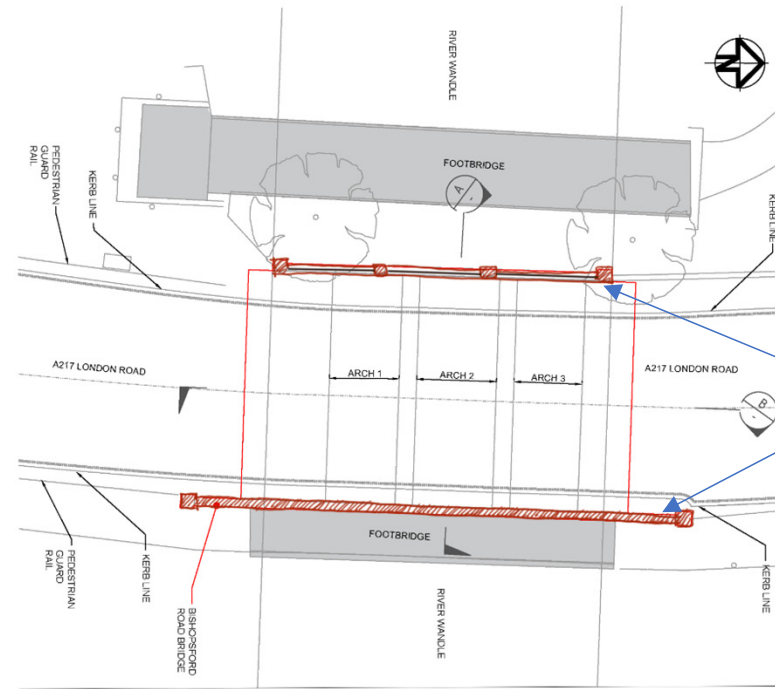
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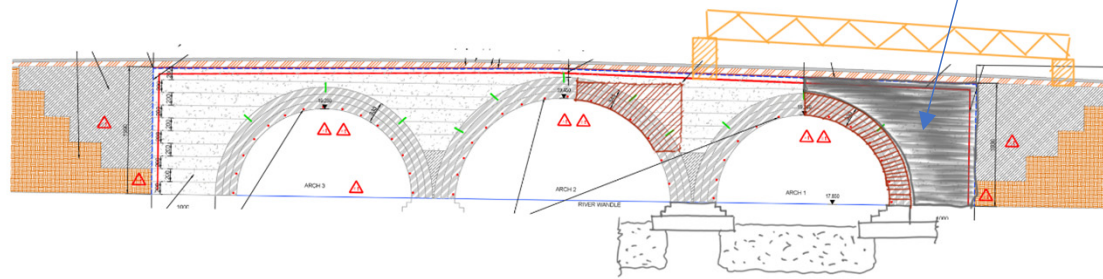
Stage 14 – remove temporary works



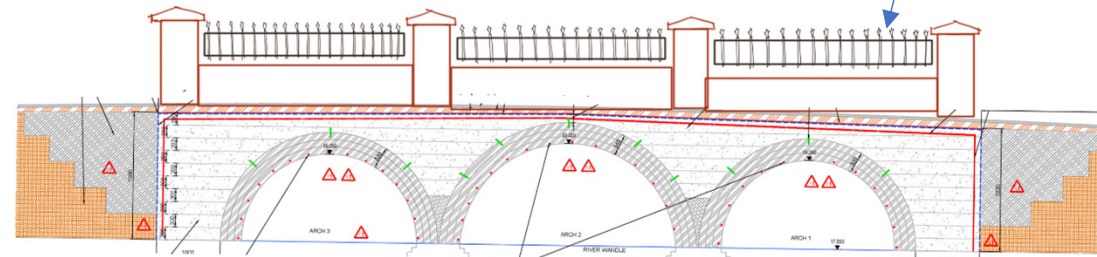
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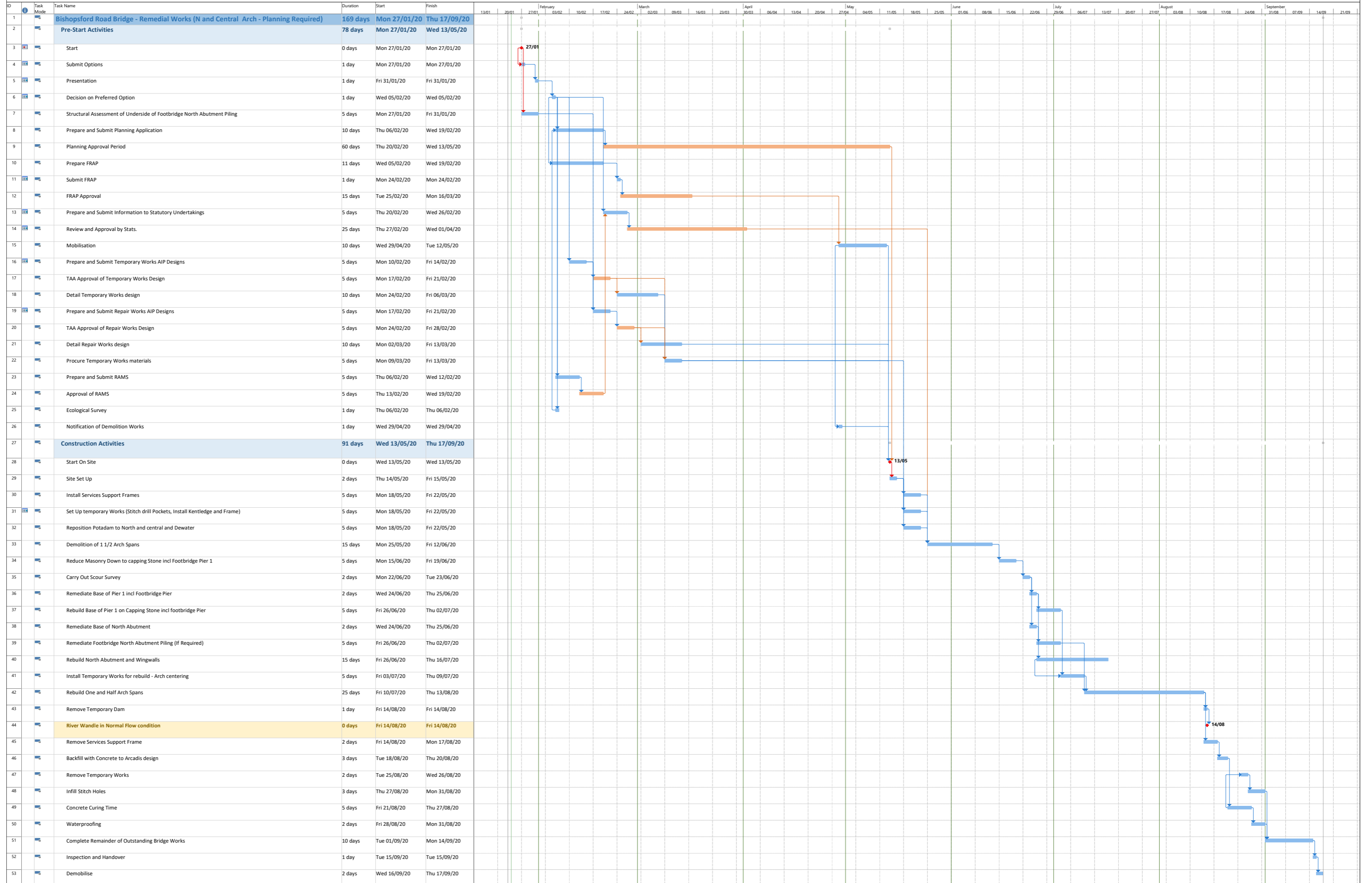


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0502			NTS@ A3	
Drawing Number				Rev.
0502/SK004				-



Bishopsford Road Bridge Remedial Works

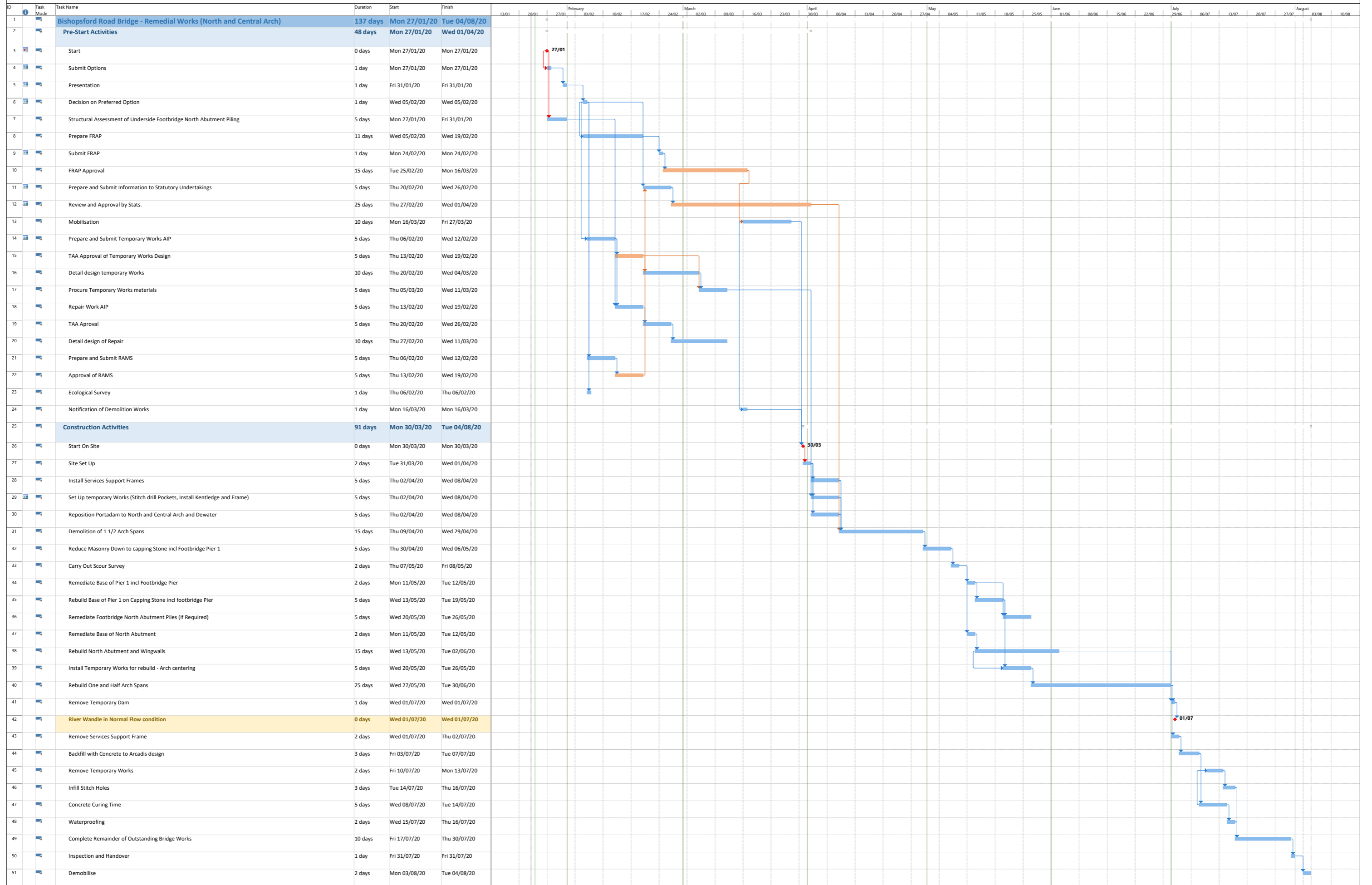
OPTION I WITH PLANNING





Bishopsford Road Bridge Remedial Works

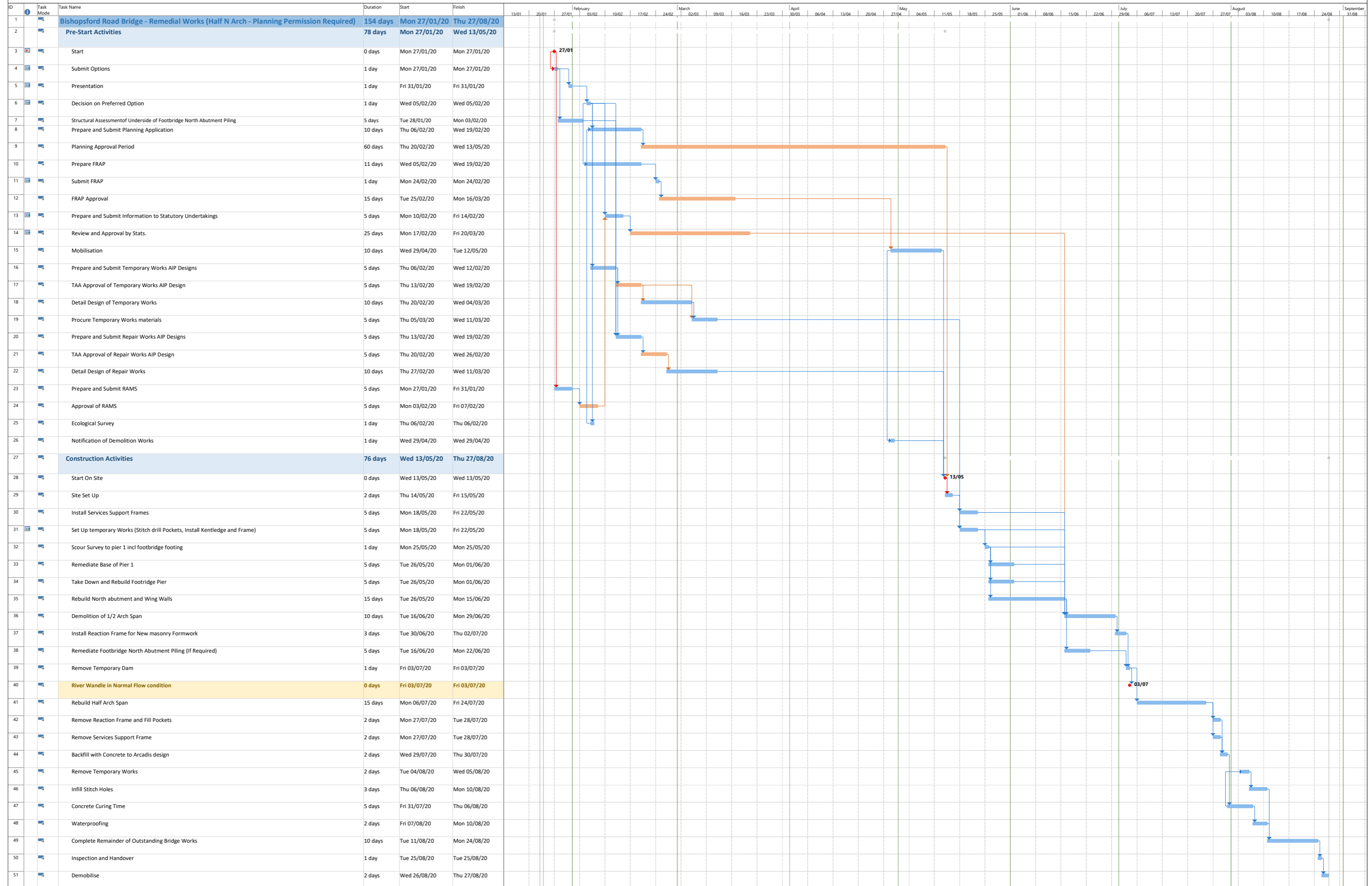
OPTION I





Bishopsford Road Bridge Remedial Works

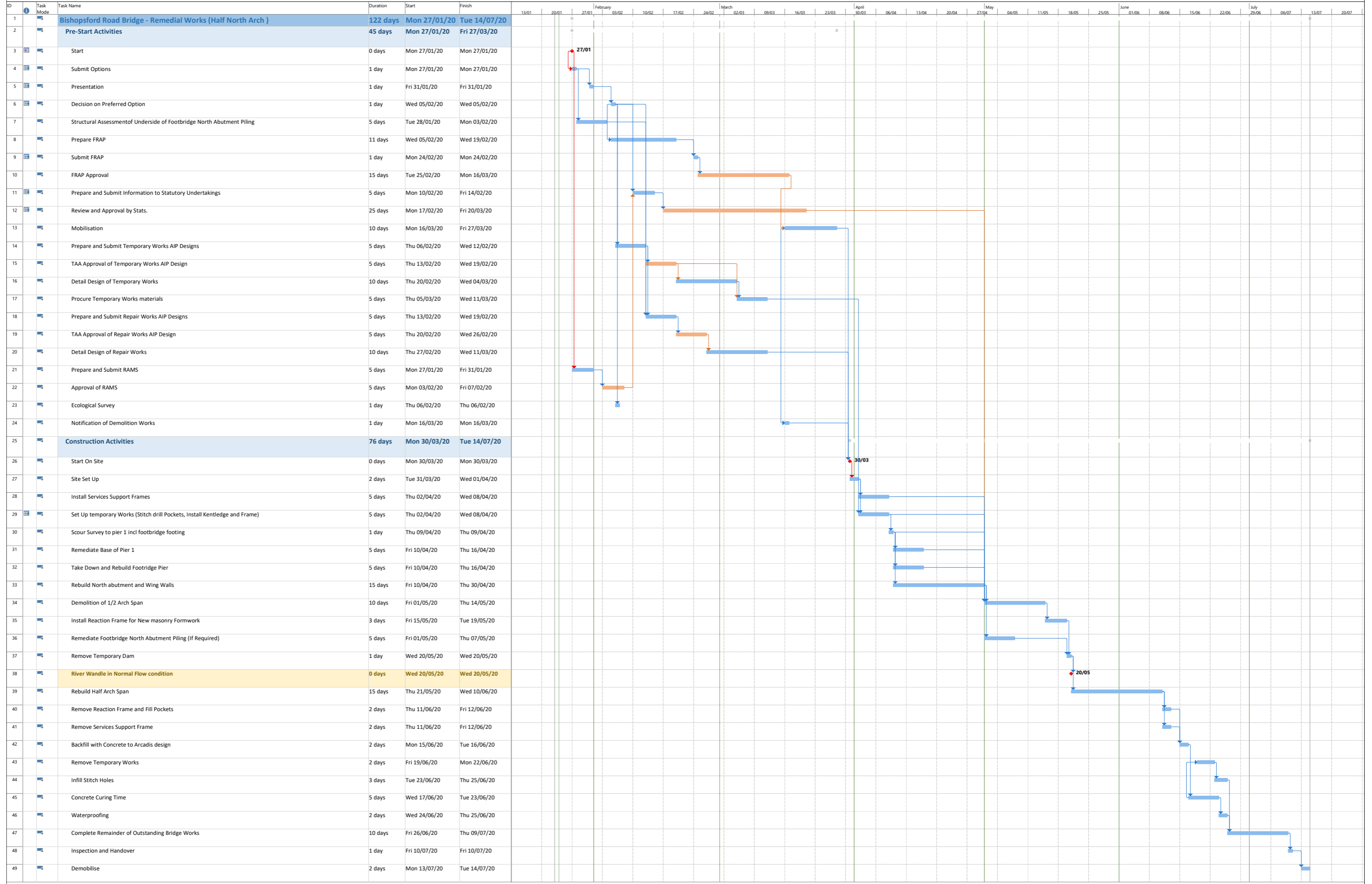
OPTION 2 WITH PLANNING





Bishopsford Road Bridge Remedial Works

OPTION 2





OPTION REPORT BRIDGE REPAIR WORKS – Bishopsford Road Bridge

FMC - Structures

CLIENT London Borough of Merton

SITE ADDRESS Bishopsford Road (A217), Mitcham

ASSESSOR Matthew Smith / Tony Parasram

POSITION FM Conway Ltd

DATE 25th January 2020

DESCRIPTION OF ACTIVITIES Remedial works to Bishopsford Bridge

Please refer to table below for explanation of 'Degree of Risk' and Residual Risk' computations. Determined values are at the discretion of the assessor.

Severity >	1	2	3	4	5
Likelihood >	Negligible	Minor	Major	Critical	Catastrophic
1 Improbable	1 LOW	2 LOW	3 LOW	4 LOW	5 LOW
2 Remote	2 LOW	4 LOW	6 LOW	8 MEDIUM	10 MEDIUM
3 Occasional	3 LOW	6 LOW	9 MEDIUM	12 MEDIUM	15 HIGH
4 Regular	4 LOW	8 MEDIUM	12 MEDIUM	16 HIGH	20 HIGH
5 Probable	5 LOW	10 MEDIUM	15 HIGH	20 HIGH	25 HIGH

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	RISK	CONSEQUENCE(S)	DEGREE OF RISK			CONTROL MEASURE(S)	RESIDUAL RISK			PERSON RESPONSIBLE FOR CONTROL MEASURES
			L	S	R		L	S	R	
Ia.	Uncontrolled collapse of masonry spans during cutting of pockets for installation of temporary works	Loss of life for operatives	3	5	15	<p>Use of Tempur 125 to be injected into the structure to bind elements together to ensure a more controlled reaction to drilling a demolition works.</p> <p>Detailed methodology sequencing the works.</p> <p>Use of specialist PPE for all operatives (lifelines)</p> <p>Mini pontoon / crash deck installed under each cutting location.</p>	1	3	3	Designer / Site team / Specialist Contractor
Ib.		Extension of works programme	3	5	15	<p>Use of Tempur 125 to be injected into the structure to bind elements together to ensure a more controlled reaction to drilling a demolition works.</p> <p>Additional terminal float within the programme to ensure the works are carried out individually</p> <p>Mini pontoon / crash deck installed under each cutting location.</p>	1	3	3	Designer / Site team / Specialist Contractor
Ic.		Reduction of bridge flow capacity	3	5	15	<p>Use of Tempur 125 to be injected into the structure to bind elements together to ensure a more controlled reaction to drilling a demolition works.</p>	1	5	5	Designer / Site team / Specialist Contractor

FMC - Structures

					12	<p>Long reach excavators on site to remove structural collapse and return capacity to the river.</p> <p>Mini pontoon / crash deck installed under each cutting location.</p>			4	
2a.	Vibration arising from cutting of temporary works pockets	Friability of damaged masonry spans	3	4	12	<p>Use of Tempur 125 to be injected into the structure to bind elements together to ensure a more controlled reaction to drilling a demolition works.</p> <p>Core drilling methodology to be adopted to ensure a controlled cutting operation to form pockets.</p>	1	4	4	Designer / Site team / Specialist Contractor
3a.	Uncontrolled collapse of span 1 during phased demolition	Loss of life for operatives	3	5	15	<p>Use of Tempur 125 to be injected into the structure to bind elements together to ensure a more controlled reaction to drilling a demolition works.</p> <p>Detailed methodology sequencing the works.</p> <p>Use of specialist PPE for all operatives (lifelines)</p> <p>Mini pontoon / crash deck installed under each demo location.</p>	1	3	3	Designer / Site team / Specialist Contractor
3b.		Extension of works programme	3	5	15	<p>Use of Tempur 125 to be injected into the structure to bind elements together to ensure a more controlled reaction to drilling a demolition works.</p> <p>Additional terminal float within the programme to ensure the works are carried out individually</p>	1	3	3	Designer / Site team / Specialist Contractor

FMC - Structures

					15	<p>Mini pontoon / crash deck installed under each cutting location.</p>			5	
3c.		Reduction of bridge flow capacity	3	5	15	<p>Use of Tempur 125 to be injected into the structure to bind elements together to ensure a more controlled reaction to drilling a demolition works.</p> <p>Long reach excavators on site to remove structural collapse and return capacity to the river.</p> <p>Mini pontoon / crash deck installed under each cutting location.</p>	1	5	5	Designer / Site team / Specialist Contractor
4a.	Instability of new works on existing foundations	Undue settlement of new works causing damage to finishes and/or compromise to load carrying capacity. Collapse of new works.	3	5	15	<p>Carry out scour survey with appropriate remediation measures prior to commencement of new works</p> <p>Use of inert ground remediating materials.</p> <p>Hold point on programme, in methodology and with the inspection and test plan</p>	1	5	5	Designer / Site team / Specialist Contractor
5a.	Temporary works obstructing flow at times of high demand	Potential formation of eddy current leading to scour. Potentially damaging hydrological loads on bridge superstructure	2	5	10	<p>Works methodology to minimise duration of temporary works in river.</p> <p>Temporary works designed to be removed in short period.</p> <p>Derive support for temporary works from highway level where possible.</p> <p>Portadam to be opened up to give make capacity to the river in the event of a flood warning.</p>	1	2	2	Designer / Site team / Specialist Contractor

FMC - Structures

6a.	Damage to existing services during remedial works	Loss of life for operatives, damage to plant.	4	5	20	<p>Minimise breakout of concrete from around services where possible.</p> <p>Retain services in existing concrete as far as practicable and provide support to concrete encased services throughout works</p> <p>Provide support gantry to all services remaining in the structure.</p> <p>Divert those services that can be diverted on to adjacent structures</p> <p>Use drill and burst techniques to remove concrete around services</p>	1	5	5	Designer / Site team / Specialist Contractor/ Statutory Authorities
6b.		Loss of service to local area	4	5	20	<p>Minimise breakout of concrete from around services where possible.</p> <p>Retain services in existing concrete as far as practicable and provide support to concrete encased services throughout works</p> <p>Provide support gantry to all services remaining in the structure.</p> <p>Divert those services that can be diverted on to adjacent structures</p> <p>Use drill and burst techniques to remove concrete around services</p>	1	5	5	Designer / Site team / Specialist Contractor/ Statutory Authorities
6c.		Extension to programme.	4	5	20	<p>Minimise breakout of concrete from around services where possible.</p>	1	5	5	Designer / Site team / Specialist Contractor/ Statutory Authorities

FMC - Structures

						<p>Retain services in existing concrete as far as practicable and provide support to concrete encased services throughout works</p> <p>Provide support gantry to all services remaining in the structure.</p> <p>Divert those services that can be diverted on to adjacent structures</p> <p>Use drill and burst techniques to remove concrete around services</p> <p>Time within programme SA's to review methodology and gantry designs</p>				
7a.	Instability of upstream footbridge north abutment	Undue settlement or collapse of upstream footbridge north abutment	4	4	16	<p>Carry out assessment of pile capacity to footbridge north abutment to establish effects of partial loss of founding material to pile circumference</p> <p>Structure shut to members of the public.</p> <p>Suitable back fill material to be specified and testing in line with Inspection and Test Plan</p>	1	4	4	Designer / Site team / Specialist Contractor
8a.	Adverse impact to local fish spawning	Disruption to local fish spawning cycle	5	4	20	<p>Carryout ecology survey</p> <p>Establish key period for fish spawning.</p> <p>Develop and manage works programme to ensure works completed outside of fish spawning.</p>	1	4	4	Designer / Site team / Specialist Contractor

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					12	Ensure works impacting the watercourse are contained within the portdam.			3	
9a.	Non remediation of masonry defects within affected arches/spandrels	Bridge load capacity compromised	3	4	12	Use of photogrammetry survey data to conclude nature and extent of masonry defects. Remedial works designed and programmed Works design to ensure required load capacity can be achieved.	1	3	3	Designer / Site team / Specialist Contractor
10a.	Behavioural change in the bridge due to change in masonry arch shape	Potential change in load carrying capacity	3	4	12	Use of photogrammetry survey data to check shape of masonry arches and consider whether change in shape has occurred leading to appropriate action. Remedial works designed and programmed Works design to ensure required load capacity can be achieved.	1	3	3	Designer / Site team / Specialist Contractor
11a.	Working over water	Drowning	5	5	25	Access to site restricted. Edge protection and working at height methodologies utilised. Fall restraint systems utilised when deemed required by full construction risk assessment. Buoyancy aids worn by all operative plus life lines installed within the works area.	1	5	5	Designer / Site team / Specialist Contractor

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I1b.		Harm to local ecology	5	4	20	<p>Use of portadam for all works over water</p> <p>Use inert materials.</p> <p>Ecology survey prior to start of works.</p> <p>Utilise methodology to minimise overall works programme and time of temporary works in river regime</p>	1	4	4	Designer / Site team / Specialist Contractor
I2a.	Un planned closures of the structure post repair works	Significant disruption to local residents.	3	4	12	<p>Work collaboratively with LB Merton and the TAA to ensure the permanent works design satisfies the performance criteria of the structure.</p> <p>AIP's and design check allowed for in costings and programme.</p> <p>CAT checks for both temporary and permanent works.</p> <p>Strict adherence to specification design RAMS and inspection and test plan.</p>	1	4	4	Designer / Site team / Specialist Contractor
I3a.	Failure of permanent works (brickwork)	Undue settlement of new works causing damage to finishes and/or compromise to load carrying capacity. Collapse of new works.	3	4	12	<p>Work collaboratively with LB Merton and the TAA to ensure the permanent works design satisfies the performance criteria of the structure.</p> <p>Strict adherence to specification design RAMS and inspection and test plan.</p> <p>Test panels and benchmarking undertaken in advance of the site works.</p>	1	4	4	Designer / Site team / Specialist Contractor



OPTION REPORT BRIDGE REPAIR WORKS – Bishopsford Road Bridge

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14a.	Loss of client and contractor professional reputation within the local community	Significant negative social media activity. Abuse of workforce on site. Antisocial behaviour / graffiti around site	5	3	15	<p>Full communication plan</p> <p>Use of public liaison officer</p> <p>Customer service training for site team.</p> <p>Use of news letters and literature to demonstrate the choice of design and techniques offer the quickest possible reopening of the bridge.</p> <p>Review of programme to carry out weekend working or extended hours to accelerate the programme</p> <p>Project engages with local charity (Food bank) to give back to community whilst we work on site.</p>	1	3	3	LB Merton / WSP / Site Team / Specialist Contractors
15a.	Planning permission required	Extension of programme	3	3	9	<p>Programmes produced to show impact of planning.</p> <p>Areas of the programme identified for acceleration.</p> <p>Legal advice to be taken on the retrospective planning</p> <p>Collaborative working with LB Merton to look at the discussions held regarding planning for new bridge / full demo.</p>	2	2	4	LB Merton / Designer / FM Conway
GENERAL COMMENTS										

PERSON UNDERTAKING RISK ASSESSMENT:		DATE OF ASSESSMENT:	
SIGNATURE:		DATE OF NEXT REVIEW	



OPTION REPORT PROGRAMME SUMMARY – Bishopsford Road Bridge

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CLIENT

London Borough of Merton

SITE ADDRESS

Bishopsford Road (A217), Mitcham

Note: Estimates include for 5% Risk and 10% Contingency

Repair Option	Start on site	Works in the river start	Works in the river end	Calendar days in river	Finish on site	Weeks on site	Estimate of cost
North and Central span repair without planning	30th March 2020	30th March 2020	1st July 2020	94 Days	4th August 2020	19 Weeks	£707,890.92
North and Central span repair with planning	13th May 2020	13th May 2020	14th August 2020	94 Days	17th September 2020	19 Weeks	£707,890.92
North span repair without planning	30th March 2020	30th March 2020	20th May 2020	52 Days	14th July 2020	14 Weeks	£452,002.58
North span repair with planning	13th May 2020	13th May 2020	3rd July 2020	52 Days	27th August 2020	14 Weeks	£452,002.58