

# Achlain Bridges, Fort Augustus Structural Costed Conservation Plan

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9<sup>th</sup> December 2011



In association with:



david narro associates



ARCHAEOLOGY

HERITAGE

CONSERVATION

## Achlain Bridges, Fort Augustus

### Structural Costed Conservation Plan

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<b>On Behalf of:</b>	Forestry Commission Scotland Forest Enterprise Scotland Head Office 1 Highlander Way Inverness IV2 7GB
<b>National Grid Reference (NGR):</b>	Bridge 007 - NH 2857 1203 Bridge 008 - NH 2847 1206 Bridge 009 - NH 2817 1215
<b>AOC Project No:</b>	21979
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This document has been prepared in accordance with AOC standard operating procedures.

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## Summary

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AOC Archaeology Group was commissioned by Forestry Commission Scotland to undertake a Structural Costed Conservation Plan for the Achlain Bridges, Fort Augustus in the Scottish Highlands in line with their aspirations to conserve the bridges as a heritage asset through repair and maintenance as necessary. The three bridges date to the mid 18<sup>th</sup> century and form part of the military road constructed between Fort Augustus and Bernera by Major Caulfeild, the successor of General Wade, in response to the Jacobite uprisings. They form simple single span bridges to support the road over three burns and are named Bridge 007, Bridge 008 and Bridge 009 as defined by Forestry Commission Scotland. Two of the bridges – Bridges 008 and 009 - are located within land which has been designated a Scheduled Ancient Monument and therefore are protected by statutory law.

This Plan incorporates an assessment of the significance of the bridges, an assessment of its current condition and conservation requirements and the identification of the long-term needs to maintain them. In addition, costs have been proposed, on a range of options, as to the repair and consolidation of the bridges for consideration. It should be emphasised that initial findings have identified that repairs to Bridge 007, the easternmost bridge of the three, is considered *Priority 1 Immediate* due to the potential risk to public safety posed by its condition. Repairs to Bridge 008 are considered *Priority 2 Urgent*, ie, that work should be put in hand within a year at most, to prevent further major deterioration and increased cost of repair. Repairs to Bridge 009, the westernmost of the bridges, are considered *Priority 3 Necessary*, which requires that work is recommended prior to a five yearly inspection to ensure that it is still in a state of good repair. It is also recommended that the blocked culvert which is located between Bridge 008 and Bridge 009, be cleared at the same time as any repairs to the bridges.

This Plan has been compiled in collaboration with Robin Kent Architecture & Conservation, David Narro Associates and Hardies Property & Construction Consultants.

## 2 UNDERSTANDING THE ASSET

### 2.1 Site Location

- 2.1.1 The three Bridges are located to the south of the A887 between Achlain and Invermoriston (Figure 1). There are three bridges, two smaller bridges (007 & 008) to the east and a larger bridge (009) to the west. The Bridges are located at National Grid Reference:

Bridge 007: NH 28573 12031

Bridge 008: NH 28475 12063

Bridge 009: NH 28167 12149

- 2.1.2 Access to the Bridges is currently from a large lay-by to the south of the road and up a steep bank whereupon the relatively flat ground associated with the military road is clear, albeit heavily overgrown. The Bridges are located over small burns: Bridge 007 over 'Allt Thomals', Bridge 008 over 'Creagan Mhartainn' and Bridge 009 over 'Allt à Chaise'.

### 2.2 Historical Context

#### 2.2.1 *Military Roads in Scotland*

Following the overthrow of the Catholic monarch James, the accession of the Protestant monarchs William of Orange and Mary Stuart to the thrones of England and Scotland in 1689 created an immediate crisis in Scotland which was only quelled after the Battle of Culloden 57 years later. The dispute was not simply nationalistic or indeed religious, but constitutional, which was crucial to the transition *away* from the absolutism favoured by the Stuarts and therefore critical to the subsequent development of Britain as a nation state.

The first rebellious Jacobite uprising was led by Viscount Dundee and occurred within four days of the 'Glorious Revolution' in April 1689 (Anderson 2009, 75). Although Dundee was defeated, an early victory at Killiecrankie inspired dissidents and allowed Jacobitism to gain support. Whilst the Scottish and (after 1707) the British state was able to defeat substantial rebellions such as another major uprising in 1715, by its very nature the conflict in Scotland was drawn out and insurgent. Military roads were therefore a critical element of the state's response to the crisis. Isolated forts such as the one at Bernera, which was constructed after the 1715 uprising, were only effective if they could be supplied and if necessary speedily reinforced (*ibid*, 76). Writing in 1715 the governor of Fort William, Sir Robert Pollock complained that the sequestered Jacobite castles at Glengarry, Tioram and Eilean Donan were: "...useless ... that besides their not being tenable for want of water, the distance they were from this place [Fort William] through a disaffected country made it impossible to either have correspondence with or intelligence from them" ('Correspondence of James, 1st Duke of Montrose [Fort William] 7 June to 31 December 1715' cited Anderson 2009, 185)

Whilst routes and byways extended across Scotland prior to the military occupation, many were used by the state's soldiers and engineers and the majority of these roads were poorly maintained and unable to cope with the requirements of mobile technological warfare. In particular, there was a need to move heavy artillery quickly to a point of conflict. The construction of military roads may also have been a tactic in sociological terms, extending the authority of the state across the landscape, beyond the fortified outposts to give the occupation a continuous presence. Indeed, there was some degree of hostility to the roads by the local Highland population.

Large-scale military road building commenced during the 1720s in response to complaints by Lord Lovat, chief of the clan Fraser, to George I, following the disbanding of the 'independent companies' (Shepherd 2009, 4). Whilst the roads are commonly associated with General Wade, who completed at least 40 bridges prior to 1740, the majority of the road network was completed by his successor Major Caulfeild who was responsible for the construction of over 600 miles of road, including the Fort Augustus to Bernera route along which the three bridges at Achlain lie (*ibid*, 9; Anderson 2009,

## 1 BACKGROUND TO THE CONSERVATION PLAN

### 1.1 Introduction

1.1.1 This Structural Costed Conservation Plan has been produced by AOC Archaeology in conjunction with Robin Kent Architecture & Conservation, David Narro Associates (structural engineers) and Hardies Property and Construction Consultants (quantity surveyors) for Forestry Commission Scotland. The Plan is intended to inform conservation of the Achlain Bridges (hereafter referred to as the Bridges) and guide future monitoring and conservation decisions.

1.1.2 The Plan will identify the significance of the Bridges and make recommendations regarding the works required to conserve them and will include a methodology for doing so. Indicative costs for a range of conservation options will also be presented. The impact of these plans on the significance of the monument will be assessed and general policies will be offered to ensure that these impacts are minimised. This will allow for maximum retention of the monument's cultural value while allowing for the necessary conservation works to be undertaken. Any further, and more specific, policies drafted or programmes of work suggested should adhere to the general policies laid out within this document.

### 1.2 Layout of the Plan

1.2.1 The plan is broken down into a number of sections, Section 1 being introductory and explaining the purpose and layout of the plan. Sections 2 & 3 will deal with *Understanding the Asset* and identify the historical background to the bridges as well as identify the character of the physical remains in understanding their relative importance and survival as been augmented through the production of a detailed *Measured Survey* undertaken as part of this Plan. This Section is illustrated with detailed elevation, plan and section drawings of each bridge and accompanying photographic plates.

1.2.2 Section 4 will go onto to *Identify the Significance* of the Bridges in terms of cultural, historical and architectural importance.

1.2.3 Section 5 will outline the *Management Issues and Vulnerability* of the structures, which will précis the results of the *Structural Survey and Condition Survey* undertaken on the Bridges. Following on from this, Section 6 will deal with the *Policy Objectives* and outline the context of statutory policy, the general consensus and policy on conservation in relation to the Forestry Commission Scotland plan for the Bridges and outline the general policy of conservation that is relevant as part of this project.

1.2.4 Sections 7 will deal with the more practical issue of the recommended work programme and Section 8 will then go on to identify a number of cost proposals associated with the programme.

1.2.5 Finally, Section 9 will offer general conclusions on the Plan and identify the key objectives and important recommendations that are necessary for the successful conservation and consolidation of the Bridges.

1.2.6 The CMP has a full list of Appendices which will include:

- Appendix 1: Bibliographical and cartographic references
- Appendix 2: Photographic Register
- Appendix 3: Condition Survey and Relevant Drawings associated with comments made (Robin Kent Architecture & Conservation in association with David Narro Associates)
- Appendix 4: Budget Costings for work proposed (Hardies Property & Construction Consultants)

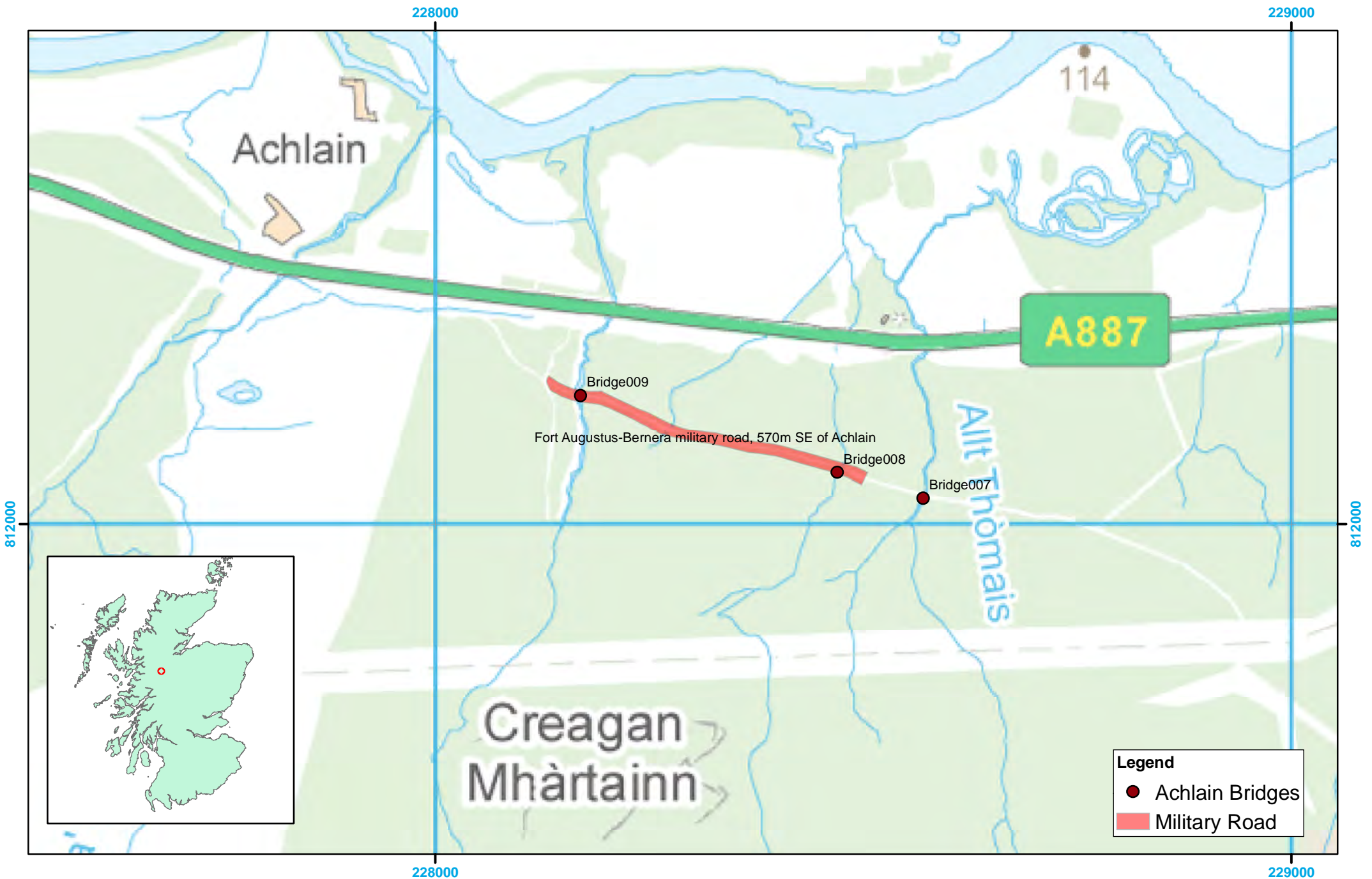


Figure 1: Site Location Plan

96). Whilst with historical hindsight the Jacobite threat may have dispersed in the brutal aftermath of Culloden, the army's road network continued to be expanded and maintained until the end of the 18<sup>th</sup> century when military attention diverted overseas and the Scotland's roads were taken forward by other pioneers such as Thomas Telford.

### 2.2.2 *The Fort Augustus—Bernera Military Road*

Four infantry barracks were built in response to the 1715 uprising in isolated highland locations at Bernera, Inversnaid, Kiliwhimen and Ruthven. Located strategically at the centre of the Great Glen, Kiliwhimen was the largest barracks capable of accommodating 360 men grouped into six infantry companies. The Bernera Barracks, the only one of the four complexes to be located on the west coast, was slightly smaller but was still capable of holding 240 men (Tabraham and Grove 1995, 64). Built in 1718 the fort at Kiliwhimen was short-lived as its position slightly to the south of Loch Ness was found to be disadvantageous and a larger, more substantial replacement fort, Fort Augustus, was constructed slightly to the north from 1727. During the later 1745 Jacobite rebellion the proximity between Fort Augustus and Kiliwhimen proved lethal as the rebels occupied Kiliwhimen and bombarded Fort Augustus from it, inflicting substantial damage on the Hanoverian fortress (Cruden 1960, 235-7 & 239). Bernera by contrast played little role in the uprising of 1745 due to its location within a protestant community. Military occupation by a skeleton force, however, continued until 1797. Fort Augustus was retained for longer, being sold to the Frasers of Lovat in 1867 who donated it to the Benedictine order in 1876 (Tabraham and Grove 1995, 115-6).

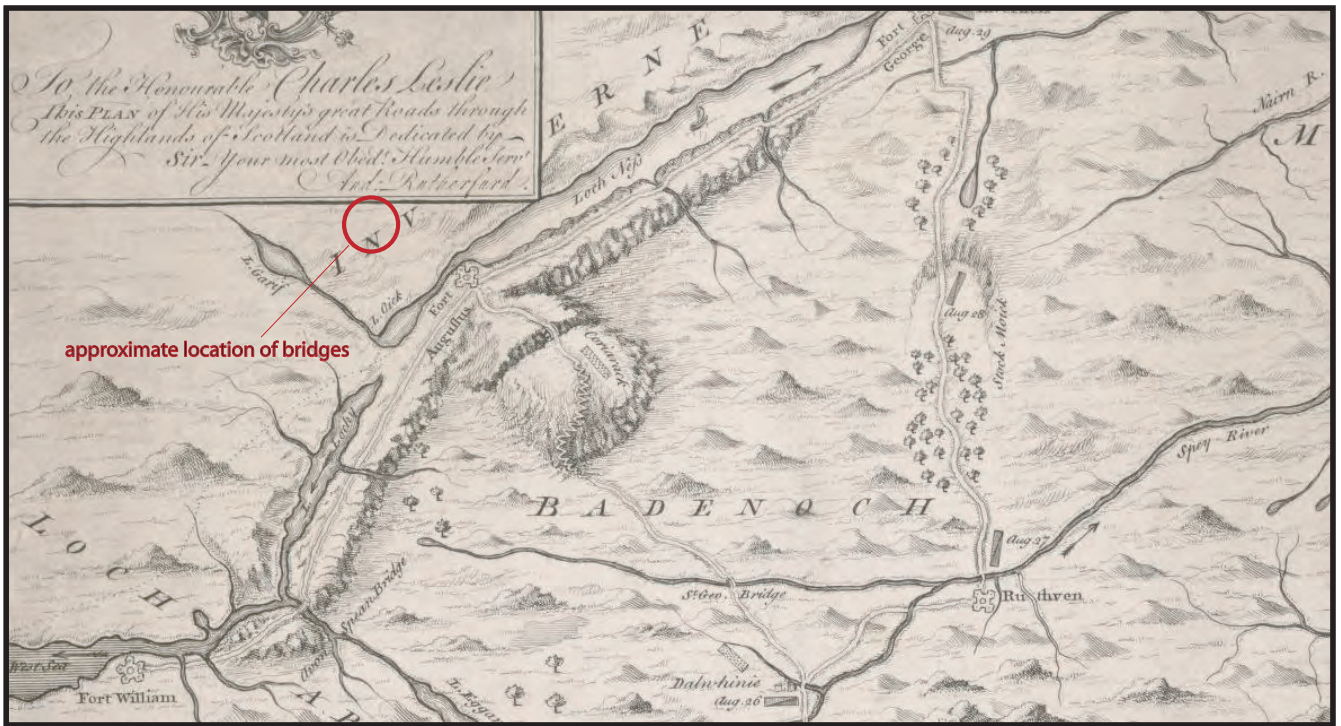
Although the Fort Augustus to Bernera route was the only military road to extend north of the Great Glen its strategic importance appears to have been limited, perhaps as a result of the limited importance of Bernera Barracks, set as they were within a comparatively peaceful neighbourhood. This is perhaps reflected in the relatively late date for the construction of the road, which is omitted from both Herman Moll's and Andrew Rutherford's maps of 1745, although Rutherford does record Fort Augustus (Figure 2). The road is also omitted from a survey of military roads prepared by William Edgar in 1746 (Anderson 2009, 211) although it is clearly depicted on William Roy's Military Survey of 1747 to 1755 (Figure 3) indicating that it had been constructed by at least 1755. Indeed, as Roy was completing his survey, six Wade and Caulfeild roads had been completed and were described by Roy as 'King's Roads' and were represented in his mapping as a double line (as can be seen in Figure 3).

### 2.2.3 *The Three Bridges at Achlain*

Military roads required extensive civil-engineering and numerous bridges and culverts and it therefore cannot be surprising that the Achlain Bridges, located over obscure watercourses, are absent from the cartographic record. Indeed, no contemporary plans or sections for bridges along either Wade or Caulfeild's military roads survive (Anderson 2009, 96). Given the comparatively short lifespan of the Inchnacardoch stretch of the road, it is reasonable to assume that the Bridges are contemporary to the construction of the road (Shepherd 2009, 15). Indeed, it was discontinued as a main route during the 19<sup>th</sup> century in favour of the course now taken by the A887.

Caulfeild's method of construction and tactics when engaging such a challenging terrain followed Wade's general principals. Some water courses were so shallow as to create fords only, although his bridges tended to fall into a distinct typical pattern. His typical bridges were between 3m – 4.9m in width and have a number of characteristic features such as straight and parallel spandrels allowing traffic of about 2.6m – 3.5m over them (Curtis 1978, 481). It is estimated that there was at least 938 bridges associated with Caulfeild's roads and many of the roads and bridges were built by civilian contracts (*ibid*, 483). Caulfeild seems to have taken a much more standardised approach to the road building schemes, with bridges and culverts taken into account and planned prior to commencement of works; between Bridge 008 and 009 there is a culvert which has diverted water underneath the road. Overall, the quality of the roads under Caulfeild's supervision were generally better than Wade's with more confidence in the stones used and structural integrity of the bridges. Split stone was taken from the river/burn over which the bridge was to traverse (hence the voussoirs were





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Figure 2: Extract from Rutherford's map, 1745 showing Fort William, Fort Augustus and Ruthven Barracks prior to the construction of the Fort Augustus - Bernera military road



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Figure 3: Extract from General Roy's Military Survey of Scotland, ca. 1747 - 55



often of different lengths) and the ‘boulder and chip’ method was also used, that is splitting boulders to create a flat face and then building these into the wall and alternating them with smaller stones in the build.

Major Caulfeild died in 1767 and with his death the military road building ceased. By the end of the century the threat of a Jacobite uprising subsided somewhat although the roads still had to be maintained. Clearly, with such an expense, the Government eventually sought to reduce this cost, leaving some remote roads simply abandoned.

One question remains as to the use and condition of the Bernera to Fort Augustus road and its general maintenance by the end of the 18<sup>th</sup> century. The first Statistical Accounts for Scotland (1791 – 99) gives us some indication as to its fate. It writes: ‘...*The military road from Fort Augustus to Bernera, which has for several years past fallen into great disrepair, being totally neglected by Government.*’ The Accounts then go on to describe newer roads which have been established in the Highlands, which very much made old military roads such as this one redundant. From this account, we can surmise that the road and bridges have not been regularly maintained – if at all – for the last 200 years at least.

#### 2.2.4 *The mapping of the road and bridges into the 19<sup>th</sup> century and 20<sup>th</sup> century*

Whilst the route of the military road is well recorded on 19<sup>th</sup> century mapping, it being documented by Thomson in 1832 (Figure 4) and the Ordnance Survey in 1874 (Figure 5) and 1904 (Figure 6), the bridges themselves are omitted. Indeed the Creagan Mhartainn Burn crossed by Bridge 008 is omitted from the 1874 and 1904 surveys.

The 1969 Ordnance Survey map (Figure 7) provides the most detailed cartographic record annotating the bridges with symbols. The most substantial bridge to the west, Bridge 009, is clearly highlighted. The small culvert carrying spring water under the road between Bridges 008 and 009 was not recorded, and is excluded from this map.

Forestry Commission Scotland recently undertook a survey of the 18<sup>th</sup> century military roads within their Highlands estate, recording all stretches under their ownership within the districts of Inverness, Ross and Skye, Lochaber and the North Highland Forest in order to enable it to develop sustainable management strategies (Shepherd 2009, 4). The Achlain Bridges lie within Inverwick Forest which forms part of the wider Inchnacardoch Forest, and they are referenced in this section in the 2009 survey. Whilst the survey found that the Inchnacardoch stretch of the road contained significant remains concentrated within a relatively limited area, it noted that in some places the road was ‘degraded’ and some lengths of the route uncertain (*ibid*, 15 & 21). The Survey records the bridges and the stretch of the road within which they are located thus:

*“The western end contains some exemplary Scheduled early military bridges and a fine section of Scheduled Military Road. The extreme west end however, is incorrectly marked on modern forestry plans. The road continued in an almost straight line to the FC boundary slightly south of the present main road. The section after [east?] of the Scheduled stretch survives as a well-preserved line and is likely to contain many early drainage features yet to be recognised. An attempt was made to record all potential drainage points in this stretch in order to inform future forestry working. A number of previously unrecorded culverts were noted in the sections leading up to the point where the military road becomes subsumed within the matrix of a later track” (Shepherd 2009, 15).*

#### 2.2.5 *Scheduling*

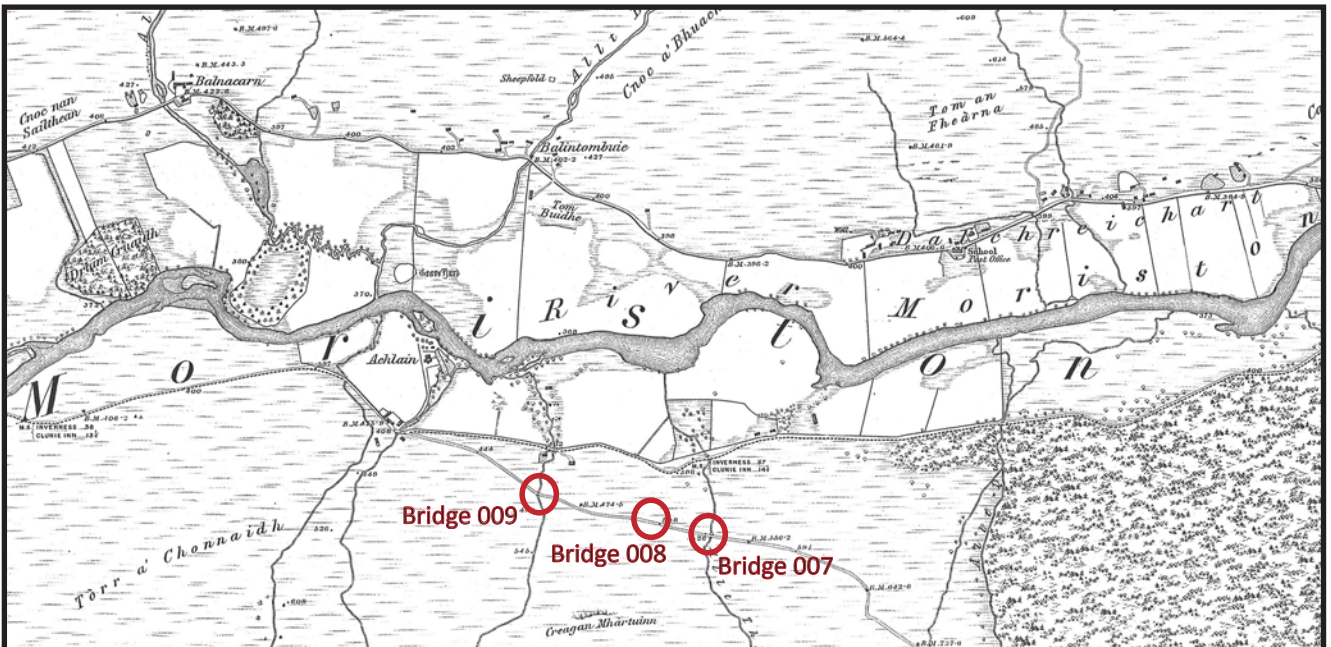
Historic Scotland scheduled a 340m long stretch of the Military Road east of Achlain in 2007 (SM Index No. 11483) deeming the remains of the road along this route to be of national importance. Centred on the middle of the road the scheduling also includes ‘*all associated structures including bridges, ditches, fords and drains, and an area around in which associated evidence may survive*’ (Historic Scotland 2007). Bridge 008 and Bridge 009 are located within the Scheduled area and are therefore included within its

approximate location of bridges



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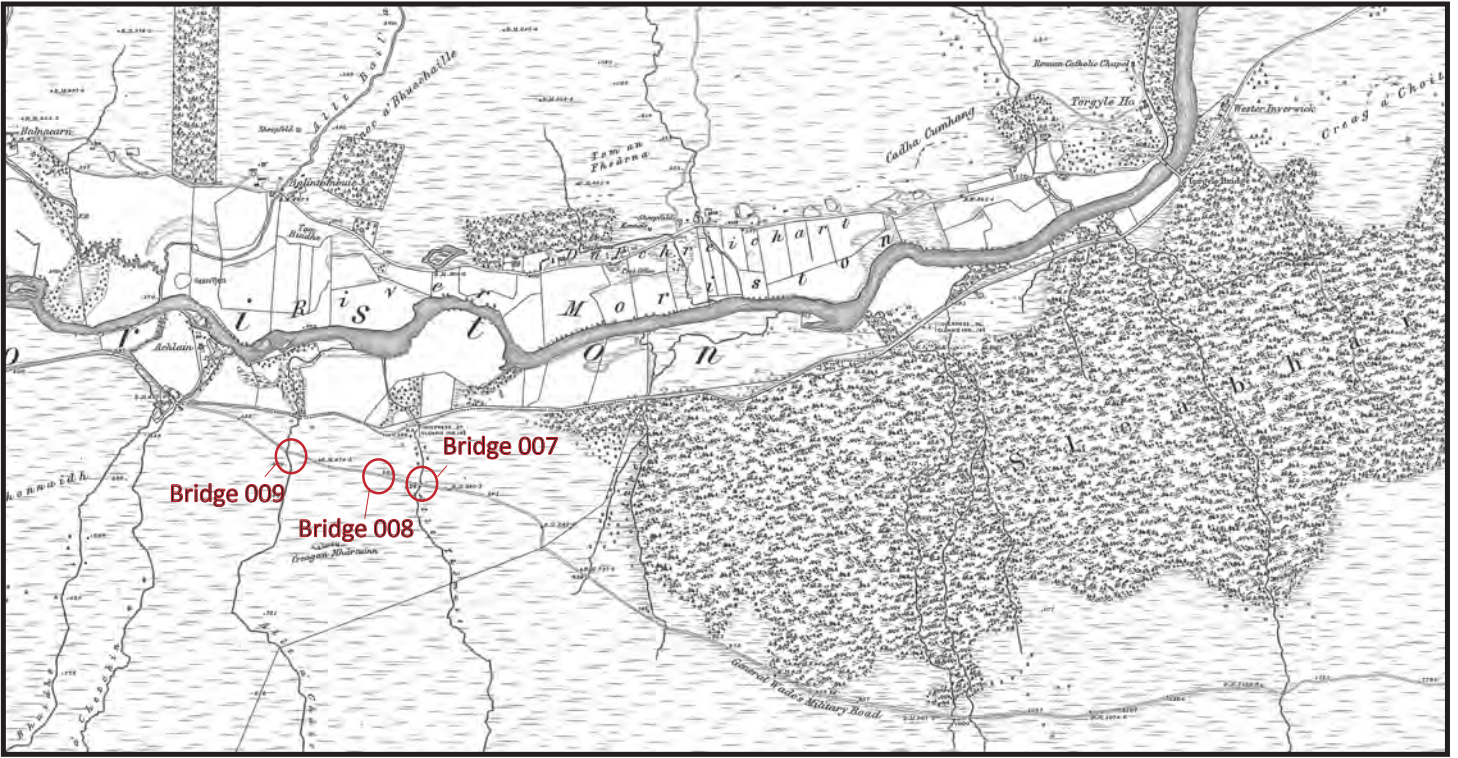
Figure 4: Extract from Thomson's map, 1832 showing the Fort Augustus - Bernera Road still in use



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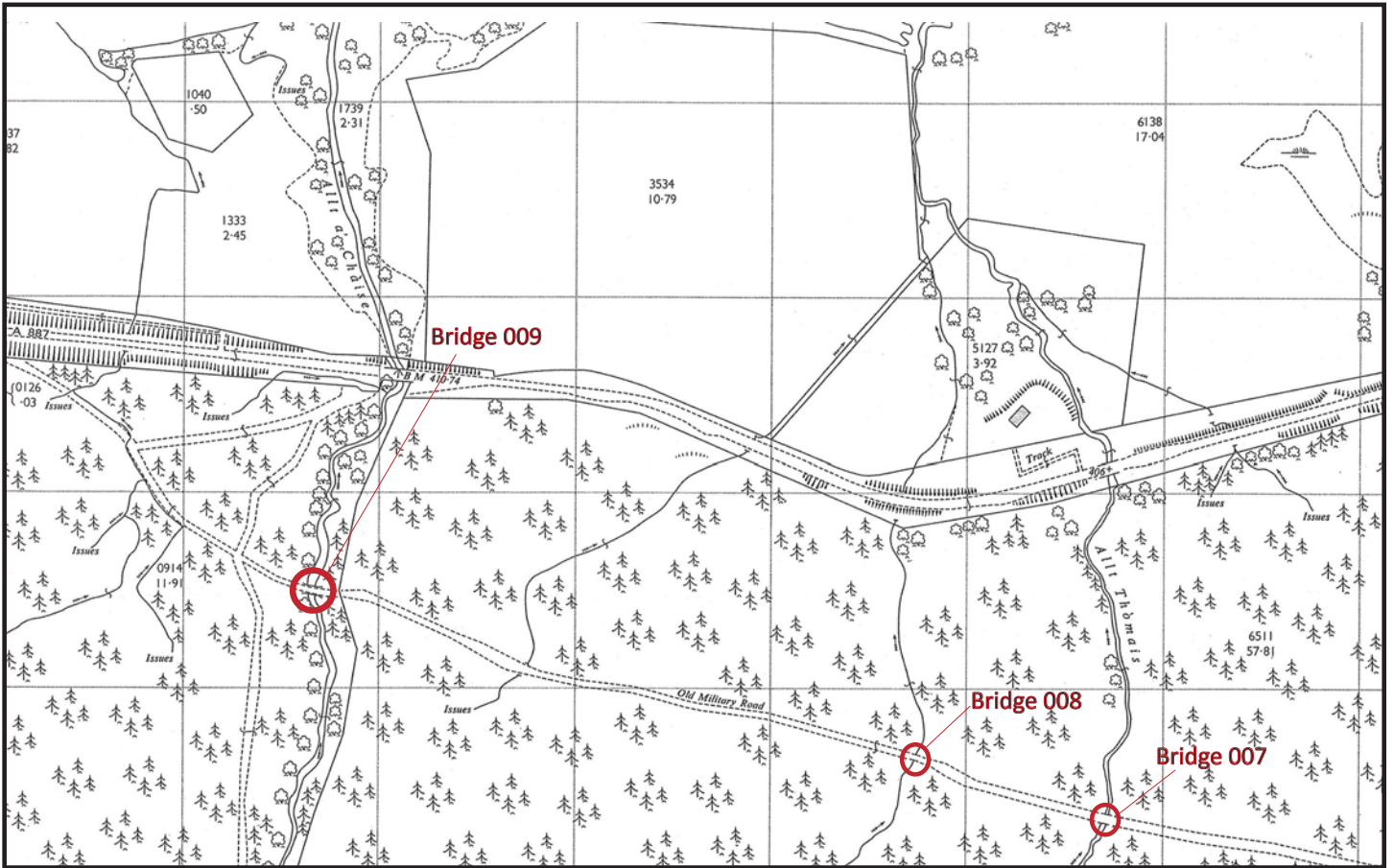
Figure 5: Extract from Ordnance Survey, 1879





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Figure 6: Extract from Ordnance Survey map, 1904



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Figure 7: Extract from Ordnance Survey map, 1969

statutory protection. They are referred to in the scheduling entry as ‘two well-preserved single-arch masonry bridges which measure 3.5m by 11m and 3m by 6m respectively’ (Historic Scotland 2007). The third bridge over the Allt Thomas Burn (Bridge 007) lies east of the designated area and is not Scheduled.

### 2.3 Current Management and Use

- 2.3.1 The Bridges lie in Forestry Commission Scotland land and are little managed. The old military road is currently easily accessed by the public, although is rarely used. Indeed, the road is presently unrecognisable as a former road and is now completely overgrown with grass, fallen trees and stumps.

## 3 MEASURED SURVEY

### 3.1 Introduction

- 3.1.1 A detailed measured survey of the bridges was undertaken to complement this Plan and provide basic existing drawings of the structures. This was completed to a Level 4 standard as defined by English Heritage (2006) and included a 3D laser scan survey of the bridges, a general and detailed photographic record and a detailed written record. The methodology and results of the survey are described in more detail below, and the relevant drawings and photographic plates can be found in [Figures 8 – 16](#) and [Plates 1 – 31](#).

### 3.2 Methodology

#### 3.2.1 Photographic Survey

A general and detailed photographic record of the Bridges was made in black and white print and colour digital using a 35mm SLR camera and digital SLR (Canon 40E) respectively. General views of each side of each bridge (north and south) were made together with details of the stonework (to aid the survey) as well as details of the underside of the bridges. A 1m or 2m ranging pole was used for scale where access and health and safety allowed. A running register of photographs was made on site and is represented in this Plan as [Appendix 2](#).

#### 3.2.2 Written Survey

A general written record of the bridges was made on site using AOC *pro forma* recording sheets noting general construction, basic condition (a more detailed condition survey of the structures was made separately) and basic dimensions.

#### 3.2.3 Drawn Survey

The bridges were all laser scanned using a Faro Focus medium range scanner from various viewpoints around the bridges and supplemented by high resolution digital photography. The scan was then linked together using a Trimble Robotic Total Station to create a 3D image of each bridge. This resulted in point cloud data which was then extrapolated to create a plan, section and north and south elevation of each bridge ([Figures 8 – 16](#)). The scanner is a line of sight instrument and, therefore, could not record what it could not see (ie, areas of stonework behind overgrown vegetation and moss) and these areas have been annotated on the drawings.

### 3.3 Bridge 007

- 3.3.1 Bridge 007 is the smallest and easternmost of the bridges and is constructed of sandstone with stone slate pinnings and forms a single segmental arch with low abutment walls of three courses in depth ([Figures 8 – 10](#)). On initial inspection, the bridges look almost to be of drystone construction, although closer inspection identifies that the build was lime mortared, the majority of which has been washed out by general erosion.

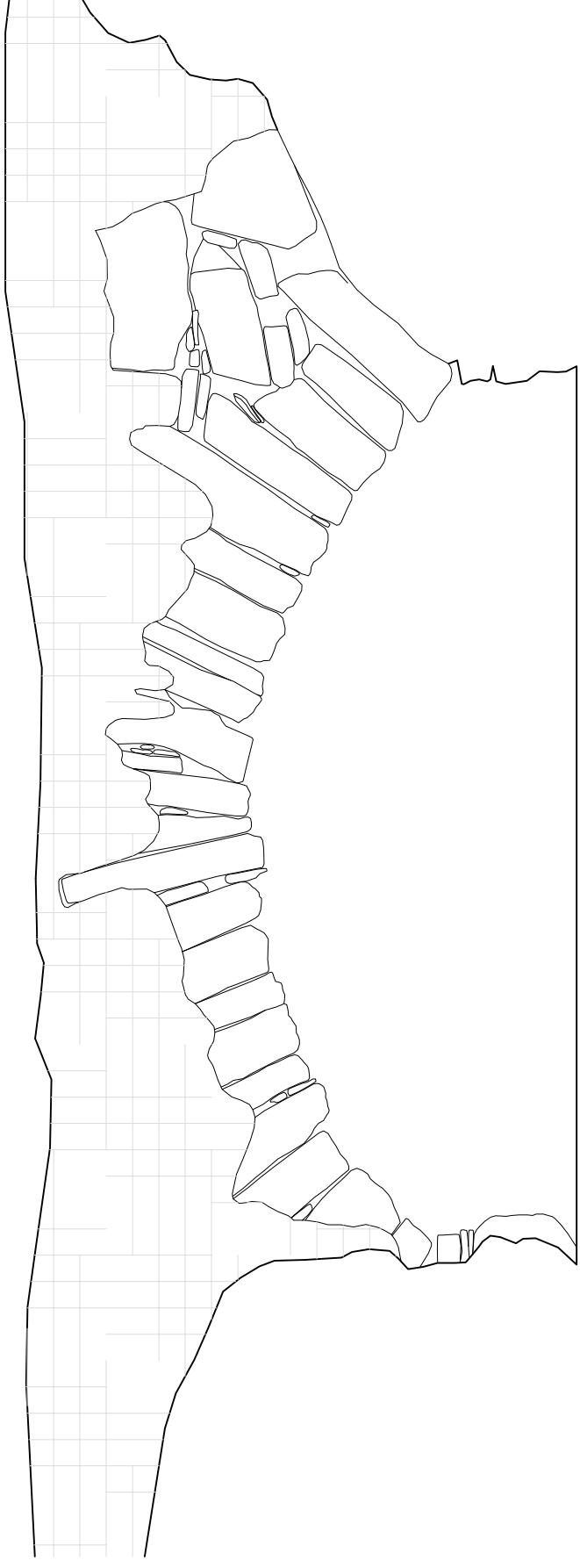


Figure 8: Bridge 007, South Face

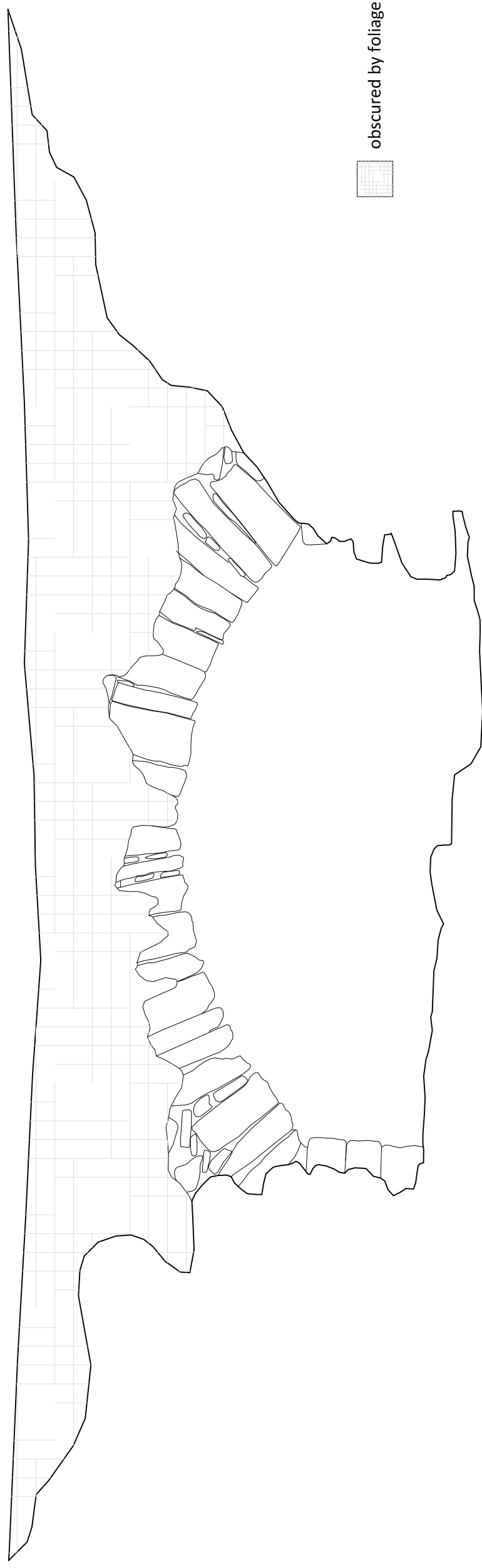
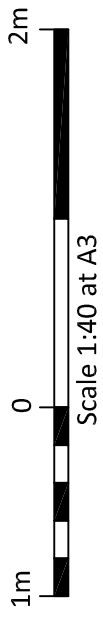
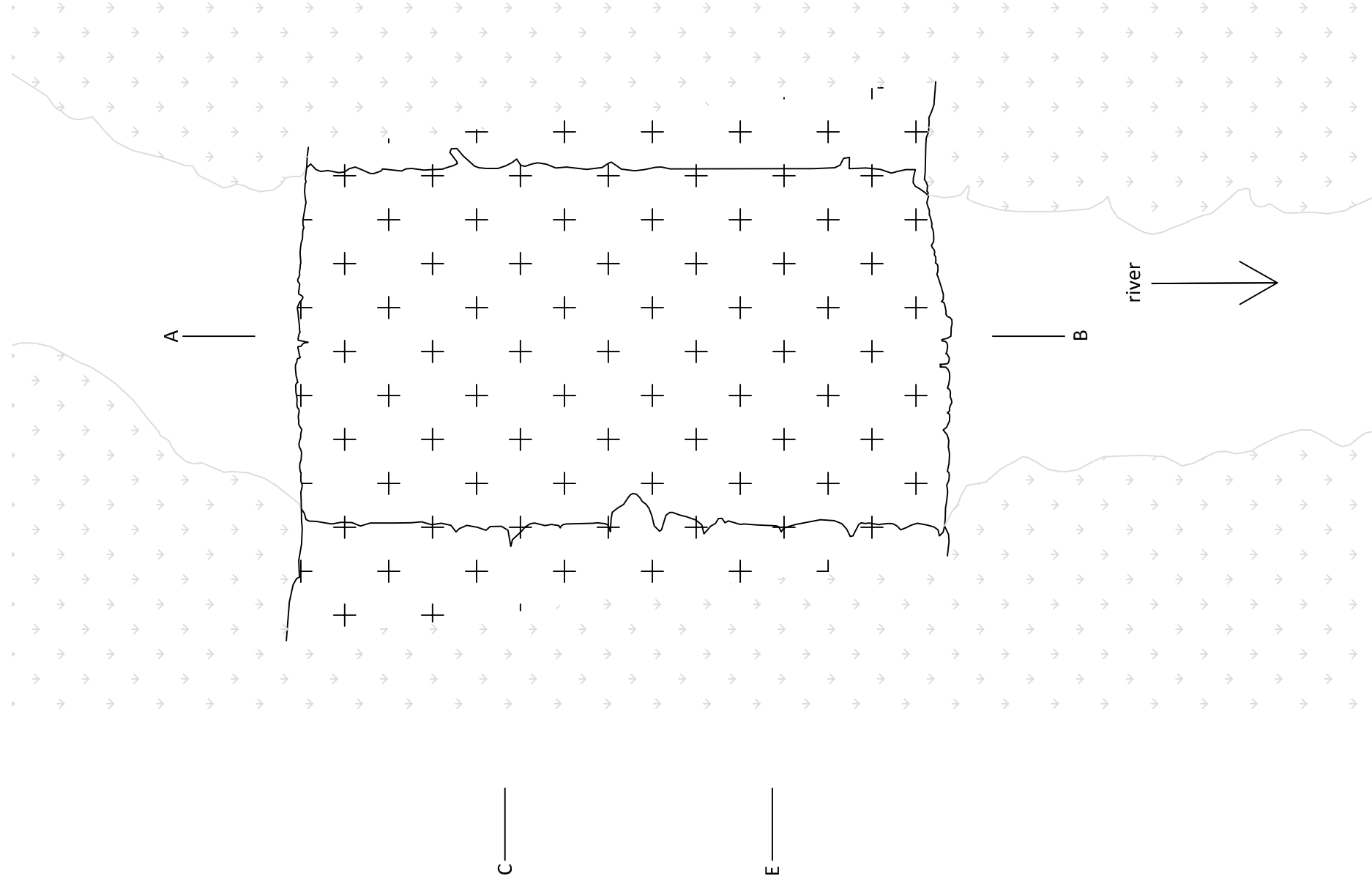


Figure 9: Bridge 007, North Face

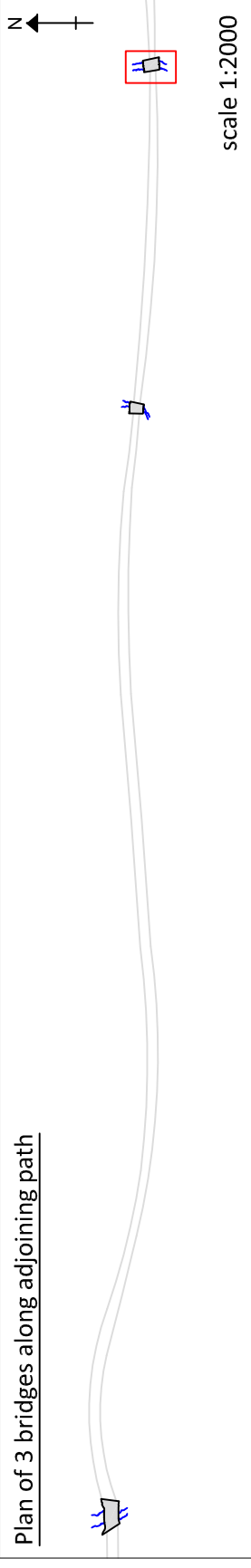


Ground Plan

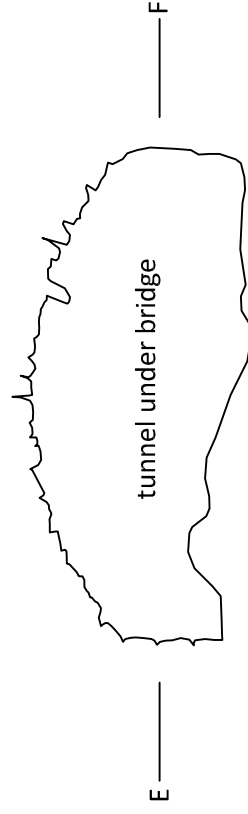
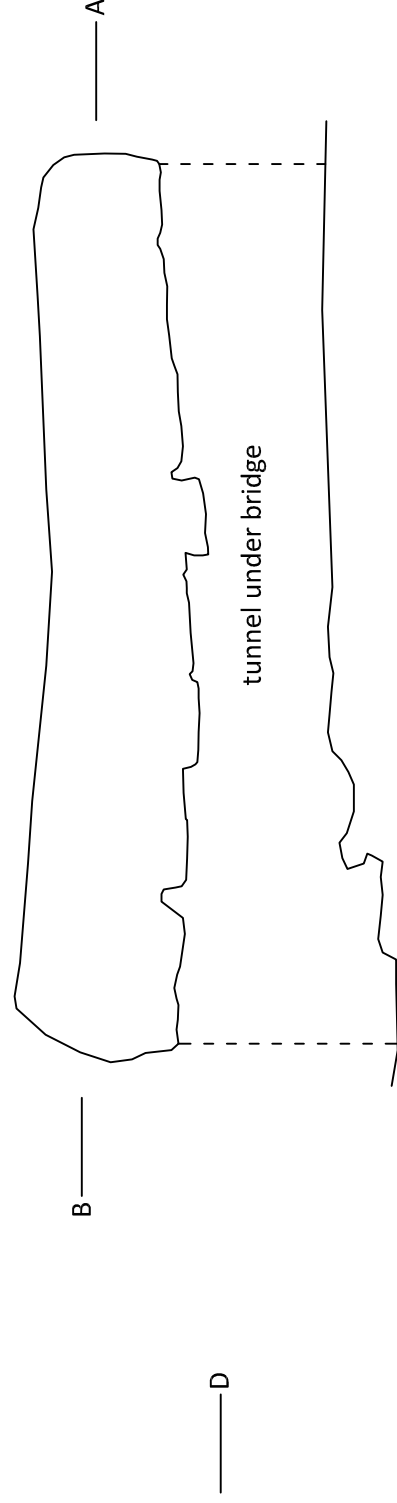


Scale 1:40 at A3

Plan of 3 bridges along adjoining path



Sections



visible ground plan of bridge including reflected arch



ground above river level



Figure 10: Bridge 007 Plan and Sections





Plate 1: Bridge 007, general view of the south side from the south-west



Plate 2: Bridge 007, general view of the south side from the south-east





Plate 3: Bridge 007, general view of the north side from the NNW



Plate 4: Bridge 007, general view of the underside of the bridge to the north side, from the north-west





Plate 5: Bridge 007, general view of the underside of the bridge, from the north



Plate 6: Bridge 008, general view of the south side from the south-west

3.3.2 To the south face, only the on-edge voussoir stones and some stones to the west side, forming the original abutment wall, are visible. The rest of this face is heavily covered in moss and vegetation (Figure 8; Plates 1 & 2). It measures 2.51m in width between the abutment walls and stands approximately 1.00m above the base of the watercourse below. The north face is more accessible although only the voussoir stones are visible beneath the moss and vegetation (Figure 9; Plate 3). It is 2.44m in width between the abutments on this side and 1.16m in height above the base of the watercourse on this side. The underside of the bridge identifies a neatly three coursed abutment wall below the arch which has been greatly smoothed and weathered in the over 250 years of its existence (Figure 10; Plates 4 & 5).

### 3.4 Bridge 008

3.4.1 Bridge 008 is very similar in construction and size to Bridge 007 in that it is a single span segmental arched bridge constructed of sandstone with stone pinnings resting on low abutment walls of three courses in height. No parapet walls now exist (or are completely covered with moss and vegetation if they do survive) and looks, on initial inspection, to be of drystone construction, although its appearance is the result of washed away lime mortar.

3.4.2 The south face of the bridge only has a few voussoir stones exposed and is heavily covered in moss and vegetation (Figure 12; Plates 6 & 7). It measures 1.86m between the abutments and 1.01m in depth from the apex of the arch to the base of the watercourse. The north face has more voussoir stones exposed and measures 1.95m between the abutments and 0.82m in depth from the apex of the arch to the base of the water course. The underside of the bridge identifies the true extent of dislodged voussoir stones with stones hanging down significantly on the east side (Figure 13; Plate 8).

### 3.5 Bridge 009

3.5.1 Bridge 009 to the west is the largest of the bridges and is set on the steepest burn with abutments to the east and west, with a deep face to the north and a much smaller face to the south, which is more difficult to access (Figures 14 – 16). Being the largest bridge, it also appears to be the one in the best condition. It is constructed of sandstone with stone slate pinnings and with ladder pinnings to the walls and forms a relatively large segmental arch over a low abutment wall with an additional wall to the east of the north face which is angled to the north-east and takes in the angle over the road.

3.5.2 The south face, as noted, is much smaller in height as is the bedrock is much higher here. It is also heavily covered in moss and vegetation (Figure 14; Plates 9 & 10). It measures 4.67m in width between the abutments and 2.04m in depth from the apex of the arch to the base of the watercourse on this side, which is significantly lower than the depth on the north face. The north face looked to have been the most substantially built element of all three bridges with a wide arch of thin voussoir stones and surrounding stone rubble build to the exposed abutment walls (Figure 15; Plates 11 & 12). It measures 4.74m in width on this side, only slightly wider than the south side, and is significantly deeper at 2.41m in depth from the apex of the arch to the base of the watercourse. The inside of the arch looks equally as well-built with neat coursed stonework to the abutment walls and beneath the arch (Plate 13).

### 3.6 Old Military Road

3.6.1 The Old Military Road is now only visible as a grassed and boggy path leading east/west through the forestry plantation (Plates 15 – 18). It appears to be seldom used, although the path is well worn. It is unknown what the exact form of the paving of the roads would have been originally, and more archaeological investigation would be needed to decipher what of this has survived. If works are to proceed with the conservation of one or all of the bridges, after Scheduled Monument Consent has



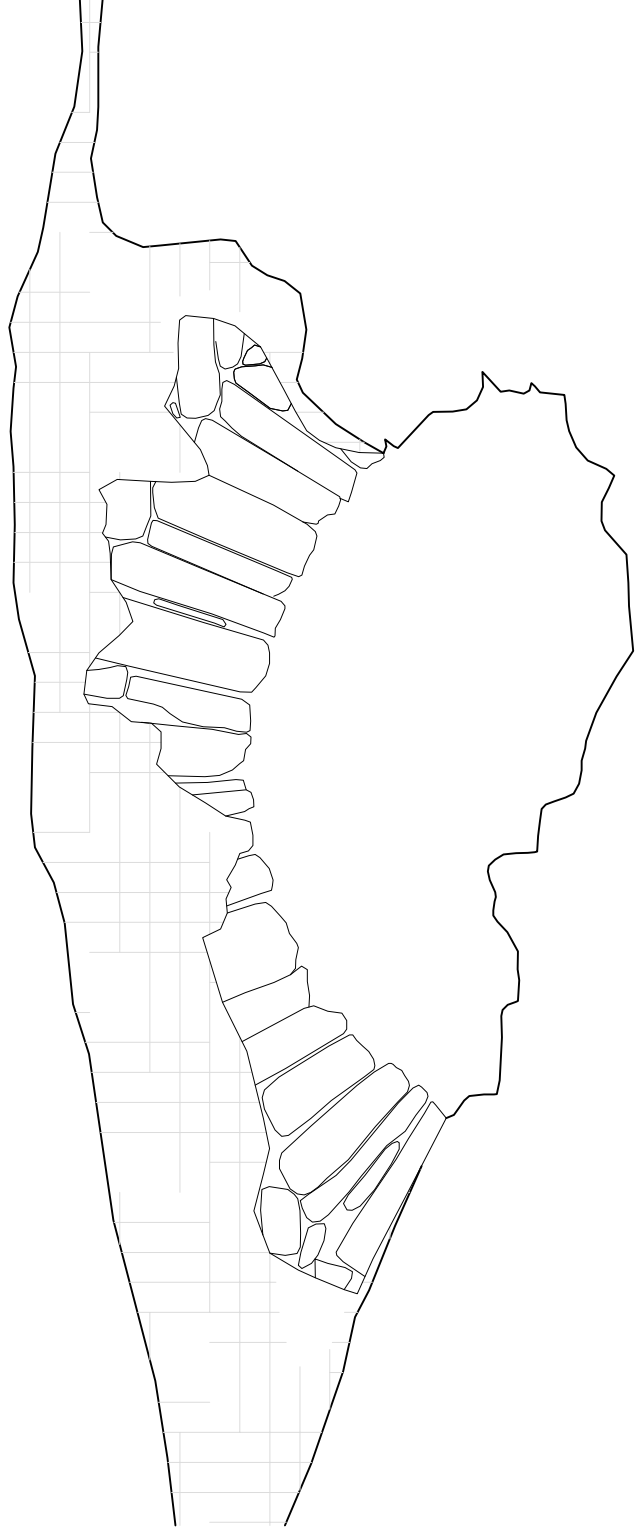
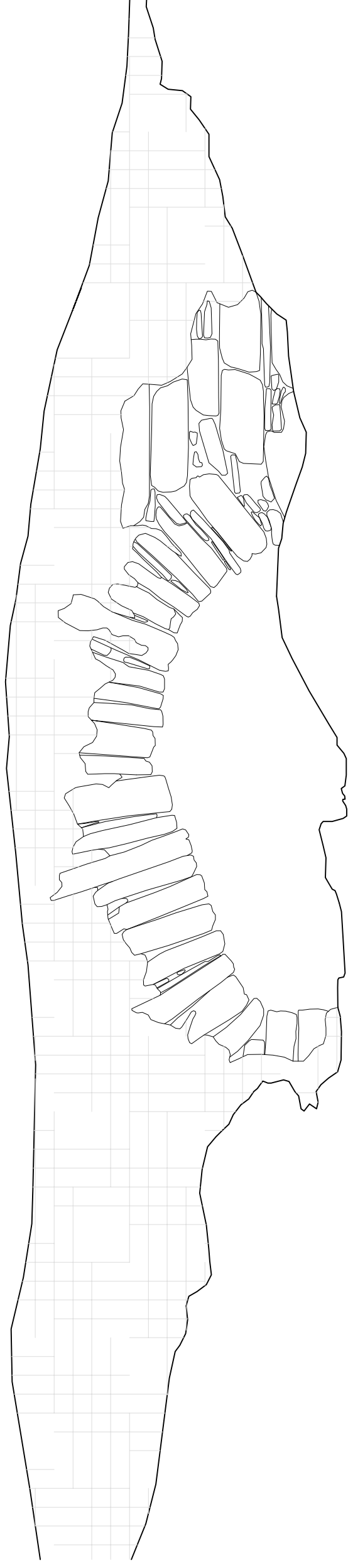


Figure 11: Bridge 008, South Face

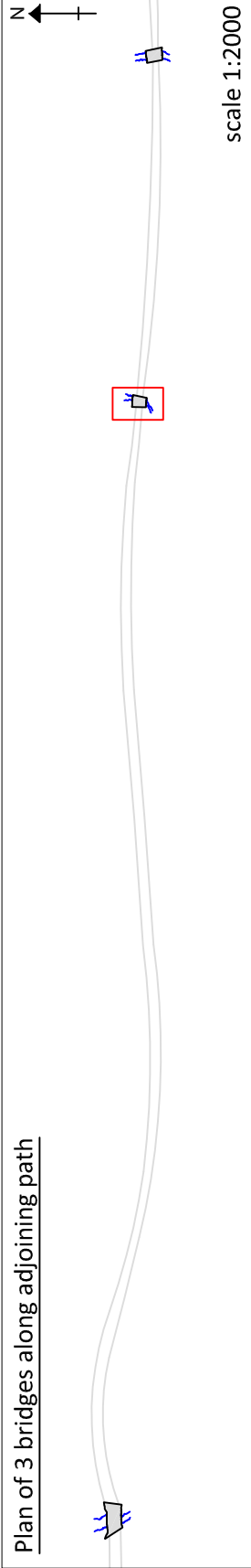


 obscured by foliage

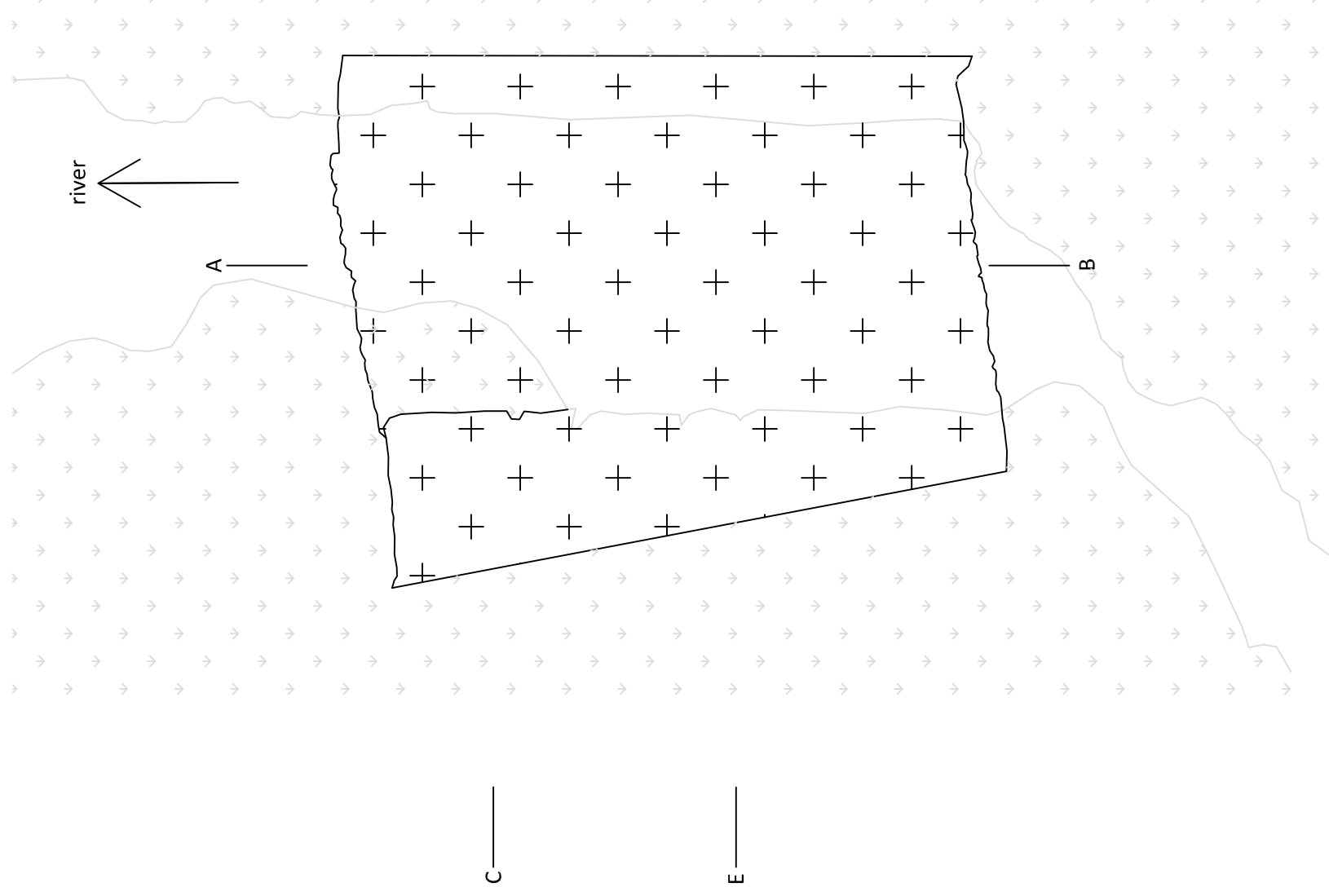
Figure 12: Bridge 008, North Face



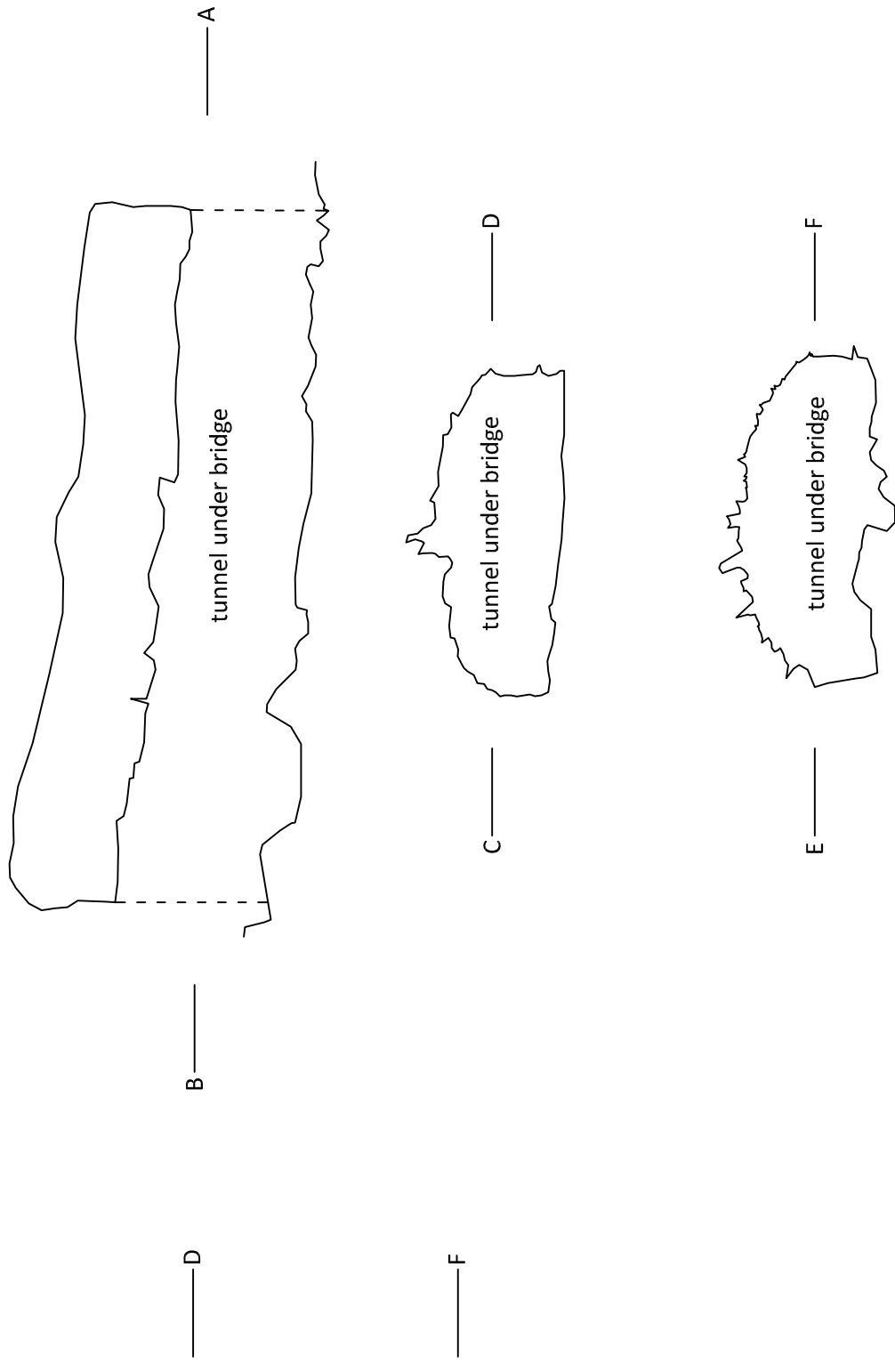
Plan of 3 bridges along adjoining path



Ground Plan



Sections



visible ground plan of bridge including reflected arch



ground above river level



Figure 13: Bridge 008, Plan and Sections





Plate 7: Bridge 008, general view of the north side from the north



Plate 8: Bridge 008, general view of the underside of the bridge on the west side from the north-east



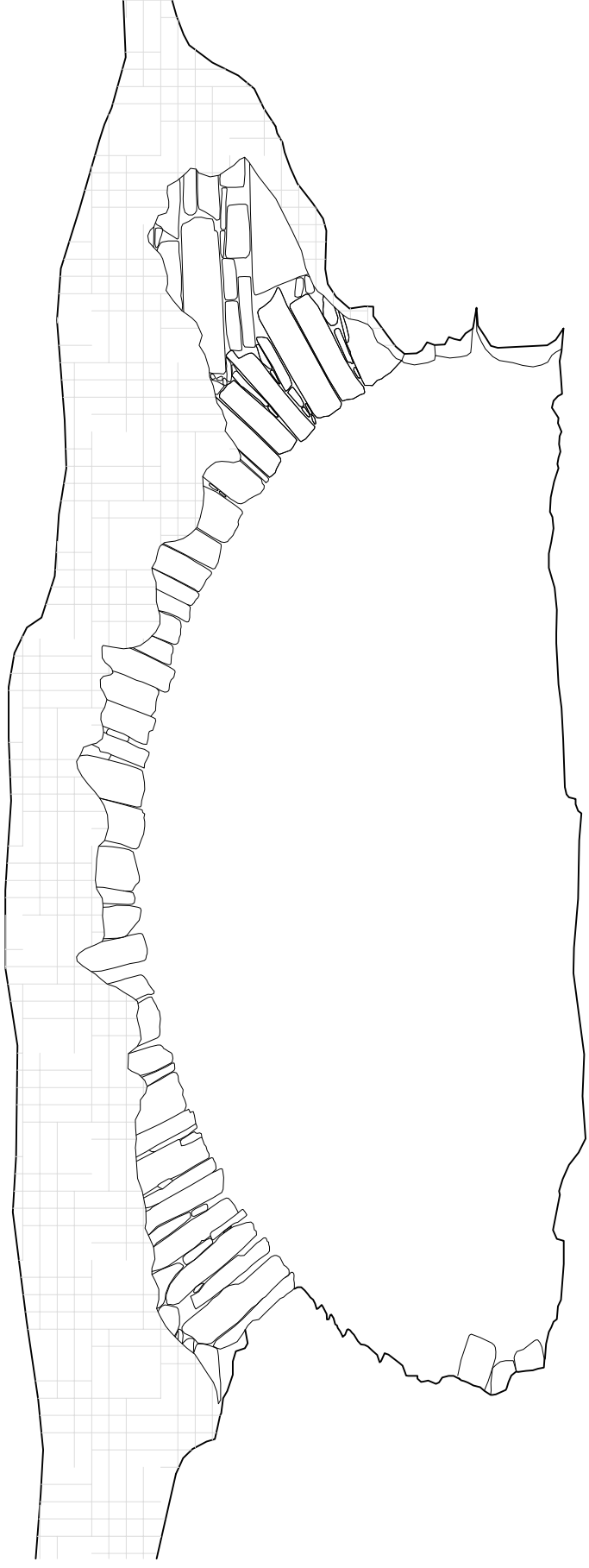


Figure 14: Bridge 009, South Face

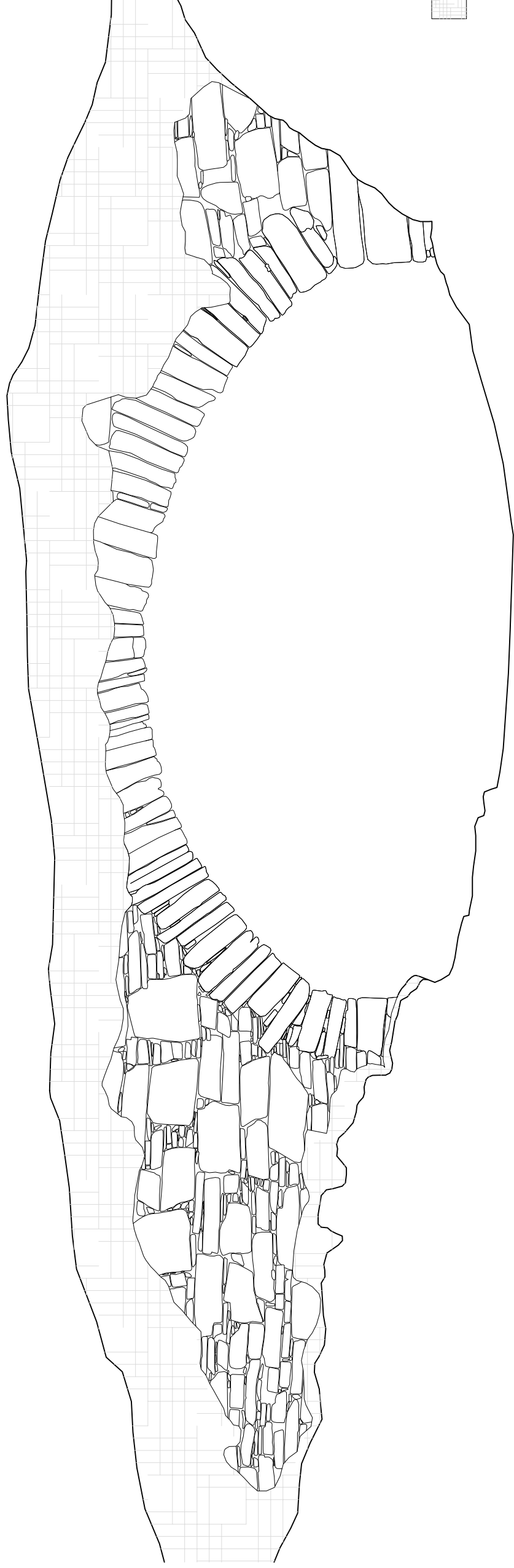
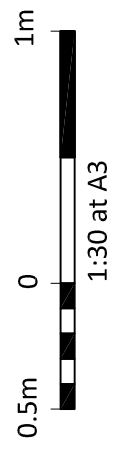


Figure 15: Bridge 009, North Face



obscured by foliage

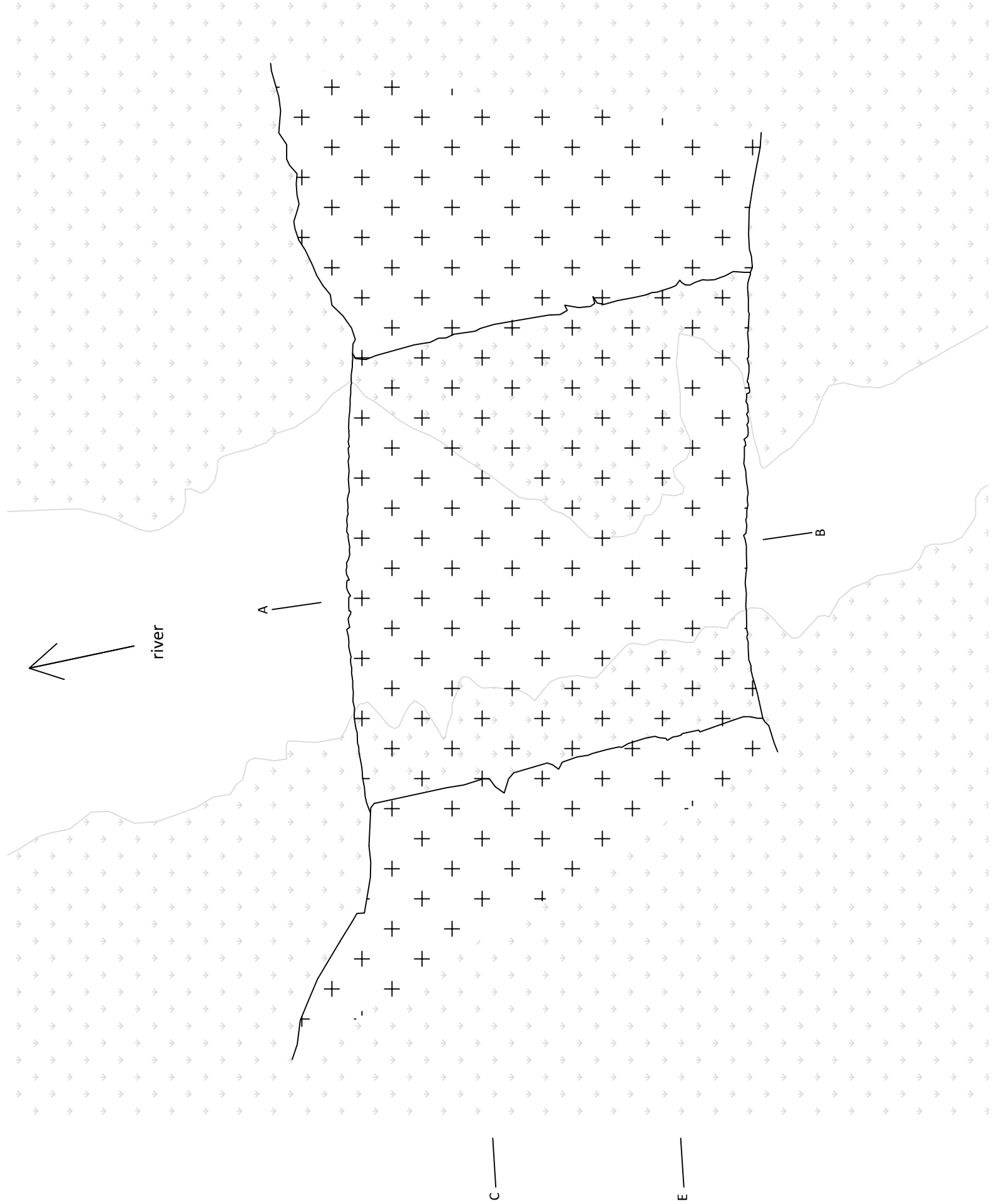




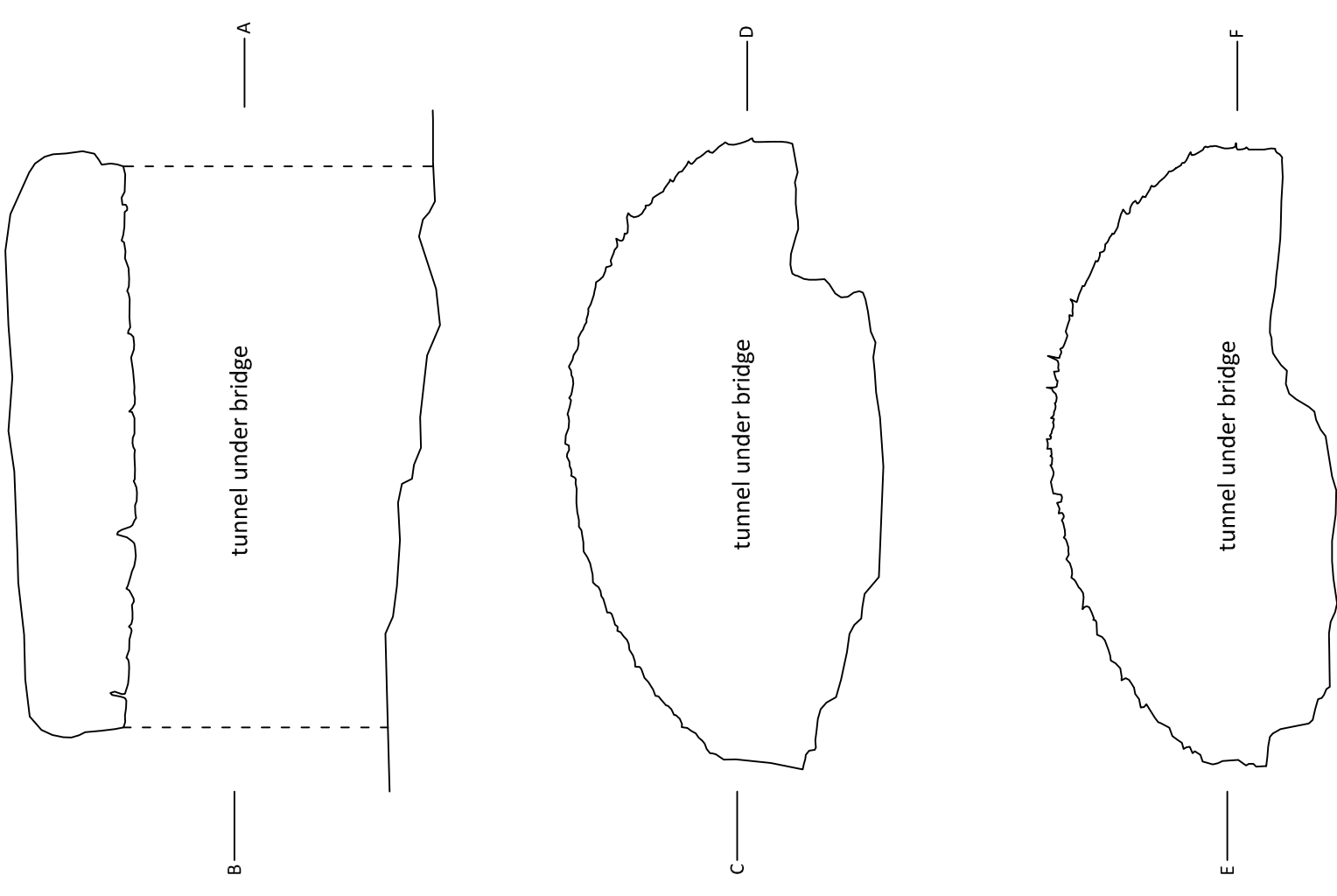
Plan of 3 bridges along adjoining path



Ground Plan



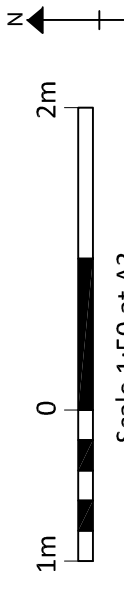
Sections



visible ground plan  
of bridge including  
reflected arch



ground above  
river level



Scale 1:50 at A3

Figure 16: Bridge 009, Plan and Sections





Plate 9: Bridge 009, general view of the south side from the SEE



Plate 10: Bridge 009, general view of the south side of the bridge and the road over the bridge from the south-west





Plate 11: Bridge 009, general view of the north side from the NNW



Plate 12: Bridge 009, general view of the north side from the north-east





Plate 13: Bridge 009, general view of the underside of the bridge on the east side from the north-east



Plate 14: Bridge 009, general view of the underside of the bridge form the north





Plate 15: General view of road over Bridge 007 from the west



Plate 16: General view of road to east of Bridge 008 from the east





Plate 17: General view of road to the east of Bridge 009 from the west



Plate 18: General view of road over Bridge 009 from the east



been granted, then archaeological inspection may shed more light on what has survived of the road over the bridges and in areas immediately adjacent to them should they be required to be exposed.

## 4 ASSESSMENT OF SIGNIFICANCE

### 4.1 Introduction

4.1.1 The significance of heritage assets in this context can be described as the importance of a site or place to both present and future generations which can be measured by a number of criteria. In relation to the Bridges, these terms of significance for the aims of the intended conservation/consolidation works fall under the following headings:

- cultural value
- historical value
- architectural and scientific value

### 4.2 Cultural value

4.2.1 Cultural value is defined as the cultural worth or importance of a heritage asset. The extent of the value is determined by establishing its capacity to inform present or future generations about the past. This definition is readily accepted by heritage professionals both in Britain and internationally. This definition was first fully outlined in the Burra Charter (ICOMOS 1999) which states in article one that ‘cultural significance’ or ‘cultural heritage value’ means *aesthetic, historic, scientific, social or spiritual value for past, present or future generations* (Article 1.2). This sentiment has since been adopted by heritage organisations including Historic Scotland who use the term cultural significance in their Scottish Historic Environment Policy (SHEP) where they claim that to have cultural significance a monument must have a particular ‘*artistic; archaeological; architectural; historic; traditional (factors listed in the 1979 Act); aesthetic; scientific; [or] social [significance] – for past, present or future generations*’ (2009, 63). In the case of many heritage sites and monuments their general cultural value has already been established through the scheduling and listing processes applied by Historic Scotland.

4.2.2 The table below has been used as a guideline for establishing cultural value:



Cultural Value	Criteria
International and National	World Heritage Sites <i>or</i> Iconic Sites and Monuments; <i>or</i> Scheduled Ancient Monuments (Actual and Potential); <i>or</i> Category A Listed Buildings; <i>or</i> Remains of national or international importance, or fine, little-altered examples of some particular period, style or type
Regional	Category B Listed Buildings; <i>or</i> Remains of regional or more than local importance, or major examples of some period, style or type, which may have been altered; Remains of national importance which have been partially damaged.
Local	Category C (S) Listed Buildings <i>or</i> Remains of local importance, lesser examples of any period, style or type, as originally constructed or altered, and simple, traditional sites, which group well with other significant remains, or are part of a planned group such as an estate or an industrial complex; Cropmarks of indeterminate origin; Remains of regional importance that have been partially damaged or remains of national importance that have been largely damaged.
Negligible	Relatively numerous types of remains, of some local importance; findspots of artefacts that have no definite archaeological remains known in their context; Remains of local importance that have been largely damaged; Isolated findspots; Undesignated structures

4.2.3 As was noted above, two of the three Bridges (008 & 009) are included in the scheduling of the military road. Following the methodology above and Historic Scotland’s own definition this means that Bridges 008 and 009 are, as part of the military road, a contribution to its *National* significance. Given its association with the scheduled road, Bridge 007 remains of *Regional* significance, although the degraded condition of the road along this section seems to have precluded it from scheduling. The scheduled road including Bridges 008 and 009 are legally protected by the Ancient Monuments and Archaeological Areas Act 1979.

### 4.3 Historical Value

4.3.1 The historical value of the bridges and the Fort Augustus to Bernera Military Road subsists in their provision of a material record for a portion of the nation’s history. As outlined in Section 2.1 above the road and its associated features, such as the Bridges, are a *physical* link to the military history of the Scotland and Great Britain in the 18<sup>th</sup> century and in some ways objectify the response of the state to rebellion. Indeed they have the potential to inform us about the strategic aims of the military and give insight into the undertaking of large engineering projects of this date.

### 4.3 Architectural and Scientific Value

- 4.3.1 The architectural value on structures like the Achlain Bridges is difficult to define as they are essentially vernacular structures in that they were built to serve a specific purpose using locally sourced materials. Whilst they are pleasing to the eye (both in terms of the immediate and wider landscape) it is their practical qualities – discrete features highlighting the effectiveness of bridge engineering in a challenging terrain – that gives them their overall significance in these terms. Therefore, when assessing the significance of their *architectural* value, we must also turn to their *scientific* value to engage their impact upon the landscape around it and, as a consequence, their ability to enhance the value of the Fort Augustus to Bernera military road as a heritage asset in general. Any conservation work to remove vegetation and expose the bridges visually – without, of course, compromising their condition – would only enhance this value.

## 5 MANAGEMENT ISSUES AND VULNERABILITY

### 5.1 Introduction

- 5.1.1 The following sections outline the current condition of the monument, as assessed in 2011, along with identifying areas of potential future vulnerability.

### 5.2 Condition

#### 5.2.1 Introduction

The following précis of the condition of the Bridges should be seen in conjunction with [Appendix 3](#) which outlines both written detail and illustratively a detailed condition of the Bridges. Inspections of the structures were undertaken by Steve Wood of David Narro Associates on 31<sup>st</sup> October and by Robin Kent of Robin Kent Architecture & Conservation on 14<sup>th</sup> November, and the following précis has been taken from their surveys. Note that the précis given below is a summary only and consultation should be made with Drawings 423/1, 423/2 and 423/3 of [Appendix 3](#) to fully acknowledge a detailed condition of each bridge.

#### 5.2.2 Bridge 007 ([Appendix 3](#), [Drawing 423/1](#); [Plates 19 – 23](#))

The deck of the Bridge 007 has been eroded by water resulting in the lime mortar being washed out. The abutments have been additionally weakened by root action due to the planting of trees in too close a proximity to the bridges and the general erosion of the water course. This has led to general distortion in the geometry of the bridge and has caused the movement and significant slippage of the voussoir stones.

The south elevation shows slipped voussoirs on the west side and there is a particularly badly slipped voussoir to the head of the arch which also leans out slightly ([Plates 19 & 20](#)). Missing pinnings are also present in this face and some of the spandrel stones have been displaced with loose stones and pinnings ([Plate 21](#)).

The north elevation has between 10 – 20 missing arch barrel voussoir stones with large cavities between them. The presence of large stones in the base of the watercourse beneath the bridge also indicate fallen voussoir stones, possibly arch barrel voussoirs, contributing to the erosion of the east abutment ([Plate 22](#)).

The base of the water course is blocked by branch and vegetation debris including a tree stump which is partly blocking the water course ([Plate 23](#)). The slipped voussoirs are also clearly visible to the underside of the arch here.



Plate 19: Bridge 007, detail of south side showing the slipped voussoirs and loose pinnings on the west side



Plate 20: Bridge 007, detail of the south side showing the slipped voussoirs and badly slipped voussoir at the head of the arch





Plate 21: Bridge 007, detail of the south side showing the displaced spandrel stones and loose pinnings on the east side



Plate 22: Bridge 007, detail of the north side showing the slipped voussoirs





Plate 23: Bridge 007, detail of the underside of the bridge showing the partially blocked water course and slipped arch barrel voussoirs to the underside of the arch



Plate 24: Bridge 008, detail of south side showing voussoir stones on the west side



5.2.3 *Bridge 008* (Appendix 3, Drawing 423/2; Plates 24 - 27)

The parapet of Bridge 008 has been lost, with the exception of a few limewashed stones. The deck has suffered from water erosion which has leached the lime out of the mortar leaving only sand and drystone masonry. As with Bridge 007, root action caused by the planting of trees in too close a proximity to the bridge has led to some root action disturbing the abutments of the bridge leading to a veering of the water course to the eastern abutment. The geometry of the bridge has become distorted and there is some loss of voussoir stones.

On the south face, there are missing pinnings to the abutment on the west side and open pinnings and loose joints between the voussoirs elsewhere (Plate 24).

The north face shows considerably more signs of slippage to the voussoir stones to the east side and centre (Plates 25 & 26). There are also badly displaced and collapsed spandrel stones (Plate 27).

Looking at the underside of the bridge, there is a large section of arch barrel voussoirs (at least 10 – 20) to the east side which have slipped downwards by at least ca. 200mm (see Plate 8).

5.2.4 *Bridge 009* (Appendix 3, Drawing 423/3; Plates 28 - 31)

The deck of Bridge 009 has been eroded by water which has led to the leaching of lime and the loss of mortar between the voussoirs which has stained the vault of the bridge. The abutment to the west has also been weakened by root action due to the planting of trees too close to the bridge which has also undermined the watercourse. As a result, the arch barrel has become cracked and there is slight distortion in the geometry of the bridge resulting in the slipping and loss of pinnings.

The south face has three slipped voussoirs to the west side with some missing pinnings. Another slipped voussoir is located to the east side where there are also some open joints and a possible hinge crack in one of the stones. There are also hungry joints and deep cavities and missing pinning stones to the abutment wall on the east side (Plate 28).

The north face has between 10 – 20 slipped and a further 10 – 20 missing voussoirs (particularly in the centre) which has dropped slightly (Plate 29). There are also deep cavities and missing pinnings to the abutment wall on the west side (Plate 30). To the east side, the abutment wall also has missing pinnings and there is a noticeable problem with heavy moss and lichen growth (Plate 31).

### 5.3 Use

5.3.1 All three bridges stand on a thoroughfare within the forestry plantation. The present access to the Bridges is quite difficult, although fully accessible by the public and has been used occasionally by dog walkers and hillwalkers, although public use of the road is thought to be minimal and sporadic (Giles Brockman, pers comm).

5.3.2 In terms of Forestry Commission use of the land, this is not known, although the road does not indicate the heavy use of vehicles to gain access to areas of the plantation, and use of this road is thought to be minimal.

### 5.4 Constraints on conservation

5.4.2 Two of the Bridges (008 & 009) are included in the scheduling of the Fort Augustus to Bernera Military Road and, as such, Scheduled Monument Consent (SMC) will be required to be granted by Historic Scotland before any excavation, conservation or consolidation of the site can take place. The extent of the Scheduled area has been outlined in Figure 1.



Plate 25: Bridge 008, detail of the north side showing the slipped voussoir stones to the east side



Plate 26: Bridge 008, detail of the north side showing the slipped voussoir stones to the centre





Plate 27: Bridge 008, detail of the north side showing the displaced and loose spandrel stones to the western abutment wall



Plate 28: Bridge 009, detail of the south side showing the deep cavities and missing pinning on the abutment wall on the east side





Plate 29: Bridge 009, detail of the north side showing the dropped voussoir stones on the east side



Plate 30: Bridge 009, detail of the north side showing the missing pinnings and failed pointing to the abutment wall on the west side



Plate 31: Bridge 009, detail of the north side showing the missing pinnings and heavy moss and lichen growth to the abutment wall on the east side

## 6 POLICY OBJECTIVES

### 6.1 Policy context

- 6.1.1 Bridges 008 and 009 are currently protected as a part of a Scheduled Ancient Monument under the Ancient Monuments and Archaeological Areas Act 1979. The implications of the Ancient Monuments and Archaeological Areas Act 1979 with regard to local government planning policy are described within Scottish Planning Policy (SPP), Scottish Historic Environment Policy (SHEP) and Planning Advice Notes (PAN) for Scotland. SPP 2010, SHEP '*Scottish Historic Environment Policy*' and PAN 2/2011 *Planning and Archaeology* deal specifically with planning policy in relation to heritage. The planning guidance expresses a general presumption in favour of preserving heritage remains *in situ*. Their 'preservation by record' (ie, excavation and recording, followed by analysis and publication, by qualified archaeologists) is a less desirable alternative.
- 6.1.2 SHEP (Historic Scotland 2009) sets out the Scottish Executive's policy for the sustainable management of the historic environment. Key principles of the policy note that 'there should be a presumption in favour of preservation of individual assets and also the pattern of the wider historic environment; no historic asset should be lost or radically changed without adequate consideration of its significance and of all means available to manage and conserve it' (1.14b).
- 6.1.3 In addition to national policy all three of the Bridges at Achlain are also protected under regional structure plans and local plans. Structure Plans are strategic land-use policy documents designed to cover a period of several years, and which set down policies with regard to various land-use types across a broad region. The *Highland Structure Plan* was approved by Scottish Ministers and became active in March of 2001. Relevant policies contained within the structure plan are presented below.

#### ***Policy BC1 Preservation of archaeological sites***

*Archaeological sites affected by development proposals should be preserved, or, in exceptional circumstances where preservation is impossible, the sites will be recorded at developers' expense to professional standards. Provision will be made in Local Plans for the appropriate protection, preservation and enhancement of archaeological sites.*

#### ***Policy BC2 Archaeology, tourism and education***

*Sympathetically developed and well-managed proposals which increase the tourism potential of archaeological sites or increase public understanding and awareness through research projects will generally be supported.*

- 6.1.4 Local Plans contain the Local Authority policies for land-use and development control across a district. These plans are site specific and include maps showing land-use proposals. The Highland Wide Local Plan was submitted to the Scottish Government in May 2011. Policy 58 of the plan relates to Natural Built and Cultural Heritage. It states:
- *All development proposals will be assessed taking into account the level of importance and nature of heritage features, the nature and scale of development, and any impact on the feature and its setting, in the context of the policy framework detailed in Appendix 6.2. The following criteria will also apply:*
  - *For features of local/regional importance we will allow developments if we believe that they will not have an unacceptable impact on the amenity and heritage resource.*
  - *For features of national importance we will allow developments that can be shown not to compromise the amenity and heritage resource. Where there may be any significant adverse effects, these must be clearly outweighed by social or economic benefits of national importance.*



*It must also be shown that the development will support communities in fragile areas who are having difficulties in keeping their population and services.*

- *For features of international importance (Natura 2000 (SPA, SAC) and Ramsar sites), developments likely to have a significant effect on a site, either alone or in combination with other plans or projects, and which are not directly connected with or necessary to the management of the site for nature conservation will be subject to an appropriate assessment. Where we are unable to ascertain that a proposal will not adversely affect the integrity of a site, we will only allow development if there is no alternative solution and there are imperative reasons of overriding public interest, including those of a social or economic nature. Where a priority habitat or species (as defined in Annex 1 of the Habitats Directive) would be affected, development in such circumstances will only be allowed if the reasons for overriding public interest relate to human health, public safety, beneficial consequences of primary importance for the environment, or other reasons subject to the opinion of the European Commission (via Scottish Ministers). Where we are unable to ascertain that a proposal will not adversely affect the integrity of a site, the proposal will not be in accordance with the development plan within the meaning of Section 25(1) of the Town and Country Planning (Scotland) Act 1997.*

- 6.1.5 Until the Highland Wide Local plan is adopted, the *Inverness Local Plan* remains the active plan. It was adopted in March 2006, seeks to enhance the natural and cultural heritage of Invernesshire by protecting the integrity of landscape designations or areas, including protecting archaeological sites, landscapes, listed buildings and their settings. General Policy BP2 and BP3 apply.

*BP2: The Council will favour development subject to detailed site factors. The Council will permit development unless this would be likely to have a significantly adverse effect on, or be significantly adversely affected by, the features for which the area has been designated. Where it is concluded that any such adverse effects are likely to arise, development will only be permitted where it is considered that these would be outweighed by social or economic benefits.*

*BP3: The Council will presume against development particularly where there would be significant damage to heritage, amenity or public health.*

- 6.1.6 In order to carry out repair works on the Bridges 008 & 009, to make them safe and accessible, Scheduled Monument Consent will be required from Historic Scotland.

## 6.2 Vision for the Bridges

- 6.2.1 The Forestry Commission Scotland has commissioned this plan as the first step in plans to conserve the Achlain Bridges. Sensitive repair and conservation of the Bridges will make them safe to access by foot traffic it will also help to ensure the survival of their historic fabric and cultural significance.

## 6.3 Philosophy of conservation

- 6.3.1 The conservation of the bridges proposed within this plan follows the principles set out in the Burra Charter (1999) and the terminology used here is that specified by the charter. These are not fully rehearsed here - the reader is referred to the Burra Charter documentation<sup>1</sup>- but the following critical terms, principles and their precise meanings should be noted at this stage:

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<sup>1</sup> <http://www.icomos.org/australia/burra.html>

- In accordance with article 2.2 of the charter, *conservation* should always seek to retain the cultural significance of the site, and all acts of conservation should be designed with this aim in mind
- *Conservation* means all of the ways in which a the site should be cared for in order to retain its cultural significance
- *Maintenance* means the continuous protective care of the fabric and setting of a site, and is to be distinguished from *repair*, which involves *restoration* or *reconstruction*.
- *Preservation* means the maintenance of the fabric of the site in its existing location
- *Restoration* means the return of the existing fabric of the site into a known earlier state, without the introduction of new material
- *Reconstruction* means the reinstatement of the site to a known earlier state, and may involve the introduction of new material
- *Adaptation* means the modification of the site to suit existing conditions or proposed use.

6.3.3 Our priorities for conservation as set out below deal firstly with some areas of major concern that require immediate remediation for the safety of the Bridges. These works are also essential under health and safety legislation, for the safety of the visiting public.

## 6.4 General policies

6.4.1 The following conservation priorities are predicated on a sequence of actions necessary to secure the historic fabric of the Achlain Bridges. In the preceding sections, the condition and conservation requirements of the site have been appraised in the light of the need to carry out conservation and repair works. This work programme will inevitably entail physical conservation and consolidation of historic fabric in order to ensure the long-term stability of the Bridges. In addressing these conservation issues, the following conservation principles (CP) must be adhered to.

- Maximise the retention of *in situ* historic fabric.
- Minimise the adaptation of the historic fabric so as only to address issues of health and safety.
- Maximise the use of original fabric in the reconstruction of parts of the monument wherever possible.
- Wherever possible, restoration of historic fabric is preferred to reconstruction.
- Restoration will only be undertaken where the original configuration is demonstrable based on archaeological evidence derived from the site itself.



## 7 WORK PROGRAMME: RECOMMENDATIONS

### 7.1 Introduction

7.1.1 The following is a précis of the results of the Conservation Works Specification in [Appendix 3](#) provided by Robin Kent Architecture & Conservation and is based on their analysis. In particular, reference should be made to [Appendix 3, Drawings 423/4, 423/5 and 423/6](#) and can be summarised as follows

### 7.2 Bridge 007

7.2.1 It has been identified that Bridge 007 is considered a *Priority 1 Immediate*, hence due to the fragile and potential risk to public safety posed by its condition, work should be put in hand without delay to prevent imminent damage or to arrest rapid deterioration. As such, the following works are recommended to be undertaken to ensure consolidation of the works (see Appendix 3, Drawing 423/4):

- Temporarily re-direct water to form safe access
- Remove vegetation, moss, tree roots, including that blocking the water course
- Form centring and packing to support the arch barrel (note no work should be undertaken from below the arch barrel prior to consolidation)
- Excavate deck to extrados under archaeological supervision (as a condition of scheduled Monument Consent)
- Reposition the slipped and indented voussoir stones
- Repoint and consolidate arch barrel
- Rebuild and indent and repoint abutment wing walls and spandrels to re-establish support
- Ease the centering and complete consolidation of the arch barrel
- Re-form the deck and resurface to falls with watershedding layer and a soft topping
- Remove the centering, complete repointing of intrados and indent and repoint abutments

### 7.3 Bridge 008

7.3.1 It has been identified that Bridge 008 is *Priority 2 Urgent*, hence work should be put in hand within a year at the latest to prevent further damage or deterioration which would have additional cost implications to repair. As such, the following works are recommended (see Appendix 3, Drawing 423/5):

- Temporarily re-direct water to form safe access (ie, to the west of the bridge)
- Remove vegetation, moss, tree roots, including that blocking the water course and set aside vegetation from carriageway for re-use
- Form centring and packing to support the arch barrel (note no work should be undertaken from below the arch barrel prior to consolidation)
- Excavate deck to extrados under archaeological supervision (as a condition of scheduled Monument Consent)
- Reposition the slipped and indented voussoir stones
- Rebuild and indent and repoint abutment wing walls and spandrels to re-establish support
- Ease the centering and complete consolidation of the arch barrel
- Re-form the deck and resurface to falls with watershedding layer and a soft topping
- Remove the centering, complete repointing of intrados and indent and repoint abutments

### 7.4 Bridge 009

7.4.1 It has been established that Bridge 009 is considered *Priority 3 Necessary*, hence work should be carried out before the next five-yearly inspection to keep the structure in good repair and maintain its value and usefulness. As such, the following works are recommended (see Appendix 3, Drawing 423/6):

- Remove vegetation, saplings, tree roots and set aside vegetation from carriageway for re-use
- Scaffold to form working platforms and shore as recommended (see Appendix 3, Drawing 423/6)
- Excavate deck to extrados under archaeological supervision (as a condition of scheduled Monument Consent)
- Indent and reportion voussoirs, consolidate and repoint arch barrel from below and above and stitch cracks
- Consolidate and repoint abutment wing walls and spandrels
- Re-form deck and resurface to falls with watershed layer and soft topping
- Excavate and form drain to prevent flooding

## 8 COSTS PROPOSALS

8.1 The following cost proposals outline the estimated cost of undertaking the works as outlined in Section 7, a full and detailed account of which can be found in [Appendix 4](#), as undertaken by Hardies Property & Construction Consultants. This also contains the conditions and clarifications upon which the costs are based.

8.2

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## 9 CONCLUSIONS

- 9.1 This Structural Costed Conservation Plan has successfully identified the significance of the bridges through an understanding of their condition and form, to create a conclusion as to the conservation requirements as they currently exist. Through an understanding of the importance of the bridges as one of the few remaining upstanding bridges associated with Major Caulfeild's road-building programme of the late 1740s – 1750s, their maintenance and care should be a priority in retaining the integrity of this historic asset. The lack of vehicular traffic (and indeed pedestrian traffic) has led to the survival of the bridges and if more use were to be made of this former roadway then the care and maintenance of the Bridges should be a priority.
- 9.2 The recommended options that have been proposed here have identified the requirement for immediate action to be undertaken in the care and repair of Bridge 007, with less urgent (although still essential) care and repair to be undertaken on Bridge 008. Should such options be undertaken, it is also recommended that the blocked culvert located between Bridge 008 and 009 – most probably also constructed as part of the 18<sup>th</sup> century works – be cleared at the same time so as to prevent further flood damage of this section of the road. The costings submitted in this Plan do not take this factor into account, although economies of practicality certainly warrant further investigation into this possibility.
- 9.3 In final conclusion, this Plan has offered full and frank recommendations as to the works required and, should works proceed, it is important that the items listed and highlighted in Appendix 3, namely the Schedule of Rates, Design Risk Assessments and Form of Tender, will need to be addressed if the work is to proceed.

## APPENDIX 1: BIBLIOGRAPHICAL AND CARTOGRAPHIC REFERENCES



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1747 – 55	General William Roy	<i>Military Survey of Scotland</i>
1832	John Thomson	<i>Northern Part of Inverness-Shire</i>
1874	Ordnance Survey	Inverness-Shire Sheet LXVII
1904	Ordnance Survey	Inverness-Shire Sheet LXVII
1969	Ordnance Survey	PLAN NH 2812 & NH 2912



**APPENDIX 2: BLACK AND WHITE AND COLOUR DIGITAL PHOTOGRAPHIC REGISTER**

ACHLAIN BRIDGES, FORT AUGUSTUS: CONSERVATION PLAN

Film	Frame	Bridge	Description	Taken From	Date
1	1 – 3	007	General view of the road	W	02/11/11
1	4 – 5	007	General view of the N facing side	NNE	02/11/11
1	6 – 7	007	General view of the N facing side	N	02/11/11
1	8 – 9	007	General view of the N facing side	W	02/11/11
1	10 – 11	007	General view looking over bridge	E	02/11/11
1	12 – 17	007	General view of the S facing side	SSE	02/11/11
1	18 – 19	007	General view of the S facing side	SSW	02/11/11
1	20 – 21	007	General view looking over bridge	W	02/11/11
1	22 – 23	008	General view looking over bridge	W	02/11/11
1	24 – 25	008	General view of the S facing side	SSE	02/11/11
1	26 – 27	008	General view of the S facing side	S	02/11/11
1	28 – 29	008	General view of the N facing side	NNE	02/11/11
1	30 – 31	008	General view of the N facing side	N	02/11/11
1	32 – 33	008	General view of the N facing side	NNW	02/11/11
1	34 – 35	008	General view looking over bridge	E	02/11/11
1	36	-	Film 1 Registration Shot	-	02/11/11
2	1 – 5	-	Unassigned	-	-
2	6 – 7	009	General view of the S facing side	SW	02/11/11
2	8 – 9	009	General view looking E-wards to the E of Bridge 009 and the road	W	02/11/11
2	10	009	Detail of underside of the bridge on the W side	NE	02/11/11
2	11	009	Detail of underside of the bridge on the W side	SE	02/11/11
2	12	009	Detail of underside of the bridge on the W side	E	02/11/11
2	13	009	Detail of underside of the bridge on the W side	E	02/11/11
2	14	009	Detail of underside of the bridge on the W side	NE	02/11/11
2	15	009	Detail of underside of the bridge on the W side	NE	02/11/11
2	16	009	Detail of the underside of the bridge on the W side (w/o flash)	NE	02/11/11
2	17 – 19	009	General view of the S facing side	SE	02/11/11
2	20 – 22	009	General view looking over bridge	W	02/11/11
2	23	009	Detail of the underside of the bridge on the W side (with flash)	NE	02/11/11
2	24 – 26	009	General view of the N facing side	NNW	02/11/11
2	27 – 32	009	General view of the N facing side	NNE	02/11/11
2	33 – 35	009	General view looking over bridge	E	02/11/11
2	36	-	Film 2 Registration	-	02/11/11



**APPENDIX 3: SPECIFICATION FOR CONSERVATION WORKS, ACHLAIN BRIDGES**  
**ROBIN KENT ARCHITECTURE & CONSERVATION**



## SPECIFICATION

(subject to revision as required for SMC)

### ACHLAIN BRIDGES, FORT AUGUSTUS

### CONSERVATION WORKS

For  
The Forestry Commission Scotland

## CONTENTS

- A Preliminaries / General Conditions (to be added for tendering)
- C Demolition / Alteration / Renovation
- D Groundwork
- F Masonry
- Q Paving
- Z Building fabric

Schedule of Rates (to be added for tendering)  
Design Risk Assessment (to be added for tendering)  
Schedule of Works  
Form of Tender (to be added for tendering)  
Drawings 423/1-6, 10

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December 2011



**C DEMOLITION / ALTERATION / RENOVATION**

**C20 DOWNTAKING**

- 01 **APPROVAL** Only masonry which has been both specified and approved on site by the CA is to be dountaken, rebbeded or rebuilt. Unless otherwise directed by the CA all masonry will be consolidated in its existing situation and condition.
- Take great care not to damage adjacent stones.
  - Report fragile or broken stones to the Architect who may instruct replacement with closely matching stones if directed.
- 10 **EXTENT OF DOWNTAKING** Before starting work, verify with the CA which existing features, stones, abutments, sprandrel walls, etc., are to be dountaken.
- Only take down structures as specified or specifically approved by the CA.
- 07 **CLEARING FALLEN STONES** The Contractor shall, following the CA's approval and Archaeological recording, clear manually loose fallen or piled masonry and a careful manual search will be made of the stones and debris to retrieve any detailed, carved or worked stones which may exist. The Contractor shall set aside any appropriate stonework for safekeeping and pile stones in approved locations for possible reuse.
- Clear all fallen stones in watercourses and above and below bridges to allow free unimpeded flow.
  - Clear fallen stones adjacent to wing walls, for re-use in conservation works.
- 12 **ARCHAEOLOGICAL OVERSIGHT** Dountaking of historic fabric, where approved, shall only be carried out under archaeological oversight, after recording by the Archaeologist.
- 13 **PHOTOGRAPHIC RECORD:** Ensure that the Archaeologist has made a full digital photographic record of all stones prior to commencing any dountaking or raking out, to provide a record of their location and mortar joint widths prior to removal. The photographic record shall be printed out and retained on site as a guide to rebuilding.
- 14 **NUMBERING STONES:** Where the CA has approved dountaking work in preparation for rebuilding, the Contractor shall allow for identification of individual stones by marking with Placca white emulsion paint, wax crayon or other weatherproof means, applied unobtrusively on bed or reverse face, or labelling in an approved way before work starts, to enable the section to be rebuilt to match the original form. Grids to guide positioning shall be drawn using mineral chalk or approved wax crayon. Allowance must be made for removal of markings on completion of work by bristle brushing with water. Labels and marks on bed may be left in situ.
- Record numbers on a copy of the drawing or record photo, which shall be protected and kept available at all times.
- 15 **BENCH MARKS:** Report any bench marks or other inscriptions or survey information found. Do not remove or destroy unless instructed.
- 16 **METHOD OF DOWNTAKING** Where face masonry or corework is to be removed work is to be carried out by carefully extracting individual stones, avoiding damage to adjacent masonry. Work is not to be knocked out or demolished wholesale.

- 17 **STORAGE** Stones removed shall be stored close to their previous location to enable them to be replaced in their original positions easily. Where instructed by the CA any building materials which are considered valuable or delicate shall be carefully and appropriately stored on site and the Contractor will be responsible for their safe custody until their removal or otherwise.
- Store numbered stones on bed and protect from excess or unequal weathering, ground salts, theft, marking, staining or damage or any kind.
  - Store securely in an approved location, not spread around the site or placed under spoil or other materials, and keep a record available at all times of their exact locations.
- 18 **ITEMS OF INTEREST** Report any items of archaeological or natural heritage interest, including tooled and carved stonework, plaster, timber inscriptions or other items found, nests or burrows. Do not remove or destroy unless instructed.
- 20 **FEATURE(S) TO BE RETAINED** The following are to be kept in place and carefully protected, or reinstated where approved for dountaking.
- Existing stonework wherever it is secure.
  - Historic mortar.
  - Pinnings and chips.
  - Existing fallen stones, including voussoirs and pinnings, except where approved for clearance or selected for reuse eg. filling large voids and bulking out joints.
  - Openings and cavities except where approved for indenting, packing and pinning.
- 50 **WORKMANSHIP GENERALLY** Take down structure(s) in accordance with BS 6187 and Health and Safety Executive Guidance Notes GS29/1, 3 and 4.
- Operatives must be appropriately skilled and experienced for the type of work and hold or be training to obtain relevant CITB Certificates of Competence.
  - Site staff responsible for supervision and control of the work are to be experienced in the assessment of the risks involved and in the methods of demolition to be used.
- 55 **SITE HAZARDS:**
- Take adequate precautions to protect site operatives and the general public from slipping or falling during the course of the Works.
- 65 **STRUCTURE(S) TO BE RETAINED:**
- Adequately protect parts of existing structure(s) which are to be kept in place.
  - Cut away and strip out the minimum necessary.
  - Prevent overloading of any part of the structure which is not to be demolished.
- 70 **PARTLY DEMOLISHED STRUCTURE(S):**
- Leave partly demolished structure(s) in a stable condition, with adequate temporary support at each stage to prevent risk of uncontrolled collapse.
  - Prevent materials from overloading scaffolding platforms.
  - Prevent access of unauthorised persons to partly demolished structure(s). Leave safe outside working hours.
  - Form temporary walkways or diversions for walkers.
- 78 **UNFORSEEN HAZARDS:** Report immediately
- Unrecorded voids, equipment, chemicals, asbestos, ordnance, etc. discovered during the works.
  - Method for safe removal: Submit proposals.

86 COMPLETION: Clear away all debris and leave the site tidy on completion. Grade the site to follow the levels of adjacent areas.

**C 30 SHORING** See also Preliminaries / General Conditions

100 SUPPORT OF EXISTING STRUCTURE Support existing structures, including temporary weatherproof coverings specified in A36, as necessary during works.  
- Do not allow new work to be overstressed when removing supports.

110 GENERALLY Before starting work:  
- Examine all available information.  
- Survey the structure, site and surrounding area.  
- Submit detailed method statements and drawings (and calculations if required by the CA) to the CA for transmission to the Structural Engineer.  
- Ensure that all statutory notices have been given and licenses obtained.

140 EXTENT OF SUPPORT WORK:  
- Provide temporary support systems to ensure the safety of unstable parts of the structure during the works, including arch barrels, abutments and wing walls.  
- Prop and shore to ensure safe support of arch barrel and voussoirs of bridge 009, to enable works to be carried on beneath.  
- Prop and shore as necessary abutments, spandrels, parapets as necessary.  
- Provide packing and liners to ensure that centring and shoring do not mark or damage masonry.  
- Submit details of support systems to the SE before starting any work.

150 ARCH CENTERING:  
- Form specially designed arch centering to support existing arch barrels, haunches, voussoirs etc. of bridges 007 and 008.  
- No works to these arch barrels are to be carried out from below until arch barrels have been fully consolidated and centering removed.  
- Slide centering in from side(s), to support full width of bridge arch barrels.  
- Provide jacks or other suitable systems to permit adjustment and easing of arch centering to ensure loads are taken up and carried evenly.  
- Provide flexible expanding packing material to ensure safe support of all voussoirs not in direct physical contact with centering, allow for sagging of arches, and prevent marking or damage to arch barrels.  
- If possible raise centering to correct deformations and reposition slipped voussoirs.  
- After replacement of voussoirs and repointing, gradually ease centering to allow loads to be taken up before completing packing and repointing.  
- Remove centering only after bridges have been stabilised and all loads taken up.

160 CORROSION PROTECTION: No rusty scaffolding or equipment will be used which could stain the masonry.

210 WORKMANSHIP:  
- Carry out work in accordance with Health and Safety Executive Guidance Note GS51, BS8004, section 9.7 and generally in accordance with BS5975 and BS4074.  
- Operatives must be appropriately skilled and experienced for the type of work and hold or be training to obtain relevant CITB Certificates of Competence.  
- Site staff responsible for supervision and control of the work are to be experienced in the methods and erection and maintenance of support systems.

**220 ERECTING SUPPORT SYSTEMS**



- Provide any necessary temporary diversions of watercourses, dams, flumes, piping or coffer dams to enable supports to be formed.
  - Take precautions to prevent damage to support systems caused by flooding or debris that may be washed down burns.
  - Prevent excessive loadings from foundations or connections of support systems being imposed onto existing structures or abutments.
  - Erect support systems and keep in place taking all necessary precautions to prevent damage, and taking due account of any movement of the structure which may occur before or during the work.
  - Promptly repair any damage caused to adjoining parts by erection or connection of support systems. Make good to ensure safety, stability, weather protection and security.
  - Report to the CA any damage caused to the existing structures by erection or connection of support systems. Agree methods of repair with the CA.
  - Check support systems at agreed stages during erection for compliance with the approved design proposals.
- 230 UNKNOWN HAZARDS
- Inform the CA of any unrecorded voids, flues, cavities, etc. discovered during erection of the support systems. Agree with the CA methods for temporary infill, making good, relocation of support connections etc.
- 240 LOADING SUPPORT SYSTEMS
- Complete erection of the following support systems before commencement of any works:
  - Arch centreing.
  - When support systems are erected and kept in place during the works inform the CA and obtain permission prior to easing and dismantling.
- 310 MAINTAINING SUPPORT SYSTEMS
- Provide safe access and safe places of work in the support systems for inspection and maintenance.
  - Regularly inspect and maintain support systems, making good ties, wedges, connections, corrosion protection etc., as necessary.
  - Adequately protect support systems from impact damage by vehicles, plant and site operations.
  - Prevent access of unauthorised persons onto or beneath support systems. Leave safe outside working hours.
- 320 MAINTAINING SUPPORTED STRUCTURE
- Regularly inspect and monitor supported structure to ensure stability. Report any significant movement or deterioration of the fabric of supported structure to the CA.
  - Agree any necessary remedial work with the CA.
  - Adequately protect supported structure from damage by site operations and from staining due to corrosion of support systems.
- 410 DISMANTLING SUPPORT SYSTEMS
- When all permanent connections between supported structure and new construction have been made inform the CA and obtain any required permission to disconnect and dismantle support systems.
- 420 COMPLETION CONDITION SURVEY
- After disconnection of support systems, survey and record the state of structure kept in place.

- Ensure that all defects caused by or due to support systems have been remedied.
  - Agree the completion condition survey record with the CA.
- 440 COMPLETION
- Clear away all support systems and leave the site and any working areas beyond the site boundary in a tidy condition on completion.
- C40 REMOVAL OF VEGETATION, CLEANING** See also Q26 Soft Topping
- 500 SURVEY Verify with CA which trees, shrubs, moss, ivy growths etc are to be preserved and removed. Cut down, grub up main roots and fill voids. Dispose of all wood and vegetation.
- 510 REMOVAL METHODS GENERALLY Cut stems and spot treat vegetation with approved systemic herbicides approved by CA, taking care to avoid contaminating masonry. Remove, including roots, after withering. Spraying of herbicides and burning of vegetation in situ will not be permitted. No air tools, ferrous or non ferrous metal brushes, knives or blades of any kind which could damage stonework shall be used in vegetation removal without prior written approval from the CA.
- Chain saws, if approved for use, shall be operated by trained and certified tree surgeons.
- 531 REMOVAL OF SMALL VEGETATION: Where directed, small herb vegetation, algal growth, lichens and mosses and loosely adherent dirt shall be removed by brushing with non-mechanical bristle brushes, or plastic or wooden spatulas. Herbs and grass should be removed by hand weeding, with spatula or stiff bristle brush, but work should be stopped if any damage to stone is likely to occur.
- 532 REMOVAL OF LARGE VEGETATION: Larger vegetation and trees shall be removed in sections, lowering and not dropping limbs to avoid any damage to the masonry. Branches etc shall be removed from site for disposal. Stumps shall be drilled and poisoned. Burning of vegetation on site will not be acceptable.
- 533 ROOTS: Where ivy, shrubs or trees have roots in or close to masonry, the plants shall be cut back immediately above the point where roots enter the wall or ground. After removal of top growth the parent stem should be cut to a frill girdle and the exposed surfaces coated with a proprietary toxic biocidal paste applied in strict accordance with the manufacturers' instructions. Unless otherwise directed this paste shall be made from ammonium sulphamate crystals. The paste must be kept clear of stone surfaces.
- 534 STUMP & ROOT REMOVAL: Remove all tree stumps and roots in the vicinity of the bridges. Temporary wedges and supports to masonry or individual stones shall be introduced as necessary during removal of roots and surface growth to ensure stability. In every case, the extent of duntaking of masonry to extract roots shall be agreed beforehand with the CA.
- The use of stump grinders and chain saws shall be permitted providing suitable Health and Safety precautions are taken and masonry is not damaged.
- 534 ORGANIC MATERIAL: All organic material, soil and loose matter shall be totally removed from the masonry, any displaced or loose masonry reset or rebbed and the area made good.

- 540 PROTECTION OF ECOLOGY: Protect and do not remove small herbs and wall plants, algal growth, moss or lichens except where specifically directed by the CA.
- 600 CLEANING Brush off all loosely adherent dirt and grime from all masonry surfaces using stiff bristle brushes, prior to repointing or rough racking.
- Do not use wire brushes or mechanical methods.
  - A minimum of water may be used to reduce dust and free obstinate deposits, taking care not to saturate the stones.
  - Clear away all debris and rubbish and remove from site.
- 700 RECORDING The Contractor shall allow the Archaeologist to record surfaces exposed following the removal of vegetation, before commencing any masonry works, to provide a complete archaeological record and highlight any other features that require special protection.



## D GROUNDWORK

### D20 EXCAVATING AND FILLING

- 06 GROUND WATER levels are not known. Make all necessary enquiries concerning ground water level the likelihood of flooding of the burns and allow for variations from that level.
- Take precautions to ensure that sudden rises in water level of streams do not adversely affect the works, scaffolding or access, shoring or other aspects of the work and materials.
  - Make good any damage caused by flooding or overflowing.
- 10 PREPARATORY WORK
- Verify with CA which existing roads and other site features are to be excavated and where materials are to be stored.
  - Verify with CA which trees, tree stumps and roots are to be removed. Cut down, grub up main roots and fill voids.
  - Dispose of all materials not required for reinstatement.
  - Inform the Archaeologist immediately prior to commencing excavation to enable features to be recorded if required, or a watching brief to be arranged.
  - Take precautions to minimise dust and mud including damping down and ground mats.
- 12 ALL EXCAVATION shall be carried out under archaeological supervision to determine the construction and depth of carriageway and bridge deck surfacing and filling materials, and their make up and condition, to inform repair specifications.
- Hand dig only.
  - Protect surviving parapet stones and abutments.
  - Provide temporary coverings to protect from rain etc.
- 15 LEVELS Agree detailed finished levels of each layer with CA and ensure finished surfaces fall away from bridge decks.
- 20 STRIPPING TOPSOIL Excavate from required areas and keep separate for reuse.
- 25 FORMATIONS GENERALLY Make advance arrangements with CA for inspection of excavated abutments, extrados and arch barrels, or substrates as agreed, prior to commencing any consolidation.
- 35 EXCESS EXCAVATIONS Shore excavations as required to ensure stability and protect surrounding features: Maximum depth for hand excavations: 1.2m. Backfill any excavations taken:
- Wider than required with material specified for backfilling laid and compacted in 150mm layers.
  - Deeper than required with well graded granular material or lime concrete.
- 40 SURPLUS EXCAVATED MATERIAL
- Topsoil: Spread and level on site in approved areas.
  - Material not specified to be spread and levelled, or reinstated: Remove from site.
  - Verify with the CA which materials arising from excavations are to be removed from site and promptly remove all materials not required in the works, which the Employer does not wish to retain, and dispose in a manner approved by the local waste regulation authority.

- 50 HAZARDOUS, AGGRESSIVE OR UNSTABLE MATERIALS Do not import or use fill materials which would, either in themselves or in combination with other material or ground water, give rise to a health hazard, damage to building structures or instability in the filling.
- Soluble sulphate content of imported materials for filling must not exceed 1 g/litre when tested to BS 1377:Part 3, clause 5, using a 2:1 water-soil extract.
- 53 WATER Keep excavations free from water until below ground constructions are completed.
- 55 PLACING FILL GENERALLY Ensure that excavations and areas to be filled are free from loose soil, rubbish and standing water.
- Do not use frozen materials or materials containing ice. Do not place fill on frozen surfaces.
  - Place and compact fill against structures, membranes or buried services in a sequence and manner which will ensure stability and avoid damage.
  - Plant employed for transporting, laying and compacting must be suited to the type of material.
- 62 FROST SUSCEPTIBILITY
- General: Except as allowed below, fill must be non-frost susceptible as defined in Highways Agency 'Specification for highway works', clause 801.17.
  - Frost-susceptible fill: Use only within the external walls of buildings below spaces that will be heated. Protect from frost during construction.
- 65 HARDCORE GENERALLY:
- Granular material, free from harmful matter and excessive dust or clay, well graded, passing a 75 mm BS sieve and one of the following:
  - Crushed hard rock or quarry waste (other than chalk).
  - Crushed concrete, brick or tile, free from plaster.
  - Gravel or hoggin.
  - Other hard materials arising from demolition work may be reused as hardcore subject to the CA's prior approval.
  - Soluble sulphate content of imported materials for filling must not exceed 1 g/litre when tested to BS 1377: Part 3, clause 5, using a 2:1 water-soil extract.
  - Do not import or use fill materials which would, either in themselves or in combination with other material or ground water, give rise to a health hazard, damage building structures or cause instability in the filling.
  - Spread and level both backfilling and general filling in layers not exceeding 150 mm
  - Thoroughly compact each layer with a vibratory roller, vibrating plate compactor, vibro-tamper, power rammer or other suitable means.

## **F MASONRY**

### **F10 MASONRY GENERALLY**

- 01 APPROVAL Only masonry which has been both specified and approved on site by the CA is to be doughtaken, rebbeded or rebuilt. Unless otherwise directed by the CA all masonry will be consolidated in its existing situation and condition.
- Take great care not to damage adjacent stones.
  - Report fragile or broken stones to the Architect and allow for replacing with closely matching stones if required.
- 02 ABUTMENTS Particular care is to be taken in repairing abutments, since the stability of the arches is dependant on them.
- Agree extent and means of rebuilding and consolidation of abutments with SE before commencement.
  - Where approved for refacing spandrel or wing walls to abutments, take down in small sections only and rebuild before proceeding.
  - No such works to abutments are to be undertaken without shoring / centering to ensure full support of arch barrels.
  - Monitor condition of arch barrels when working on abutments.
  - Ensure abutments are left solid as originally built prior to easing or removing centering or shoring to arch barrels.
- 03 RECORDING Before commencing masonry works, ensure that all the masonry exposed to view has been recorded and a copy of the photographic and drawn record is available on site to guide the works and ensure that the character of the masonry and dressings is preserved.
- 10 APPEARANCE The shapes and sizes of the new stones are to have the same variations as the existing, and working, tooling, bed alignments, pinnings and scale, joint widths and type of mortar pointing must all match existing adjacent work.
- Rebuilt facework and walling is to closely match the 'boulder and chip' character and construction typical of Major Cauldfeild's masonry bridges, with larger stones alternating with smaller stone slates and ladder pinings.

### **F12 RAKING & REPOINTING See Drawing 423/10**

- 05 EXTENT OF REPOINTING Allow for repointing all joints in the whole areas of walls indicated to an average depth of 200mm.
- Agree with the CA actual areas and depths of repointing after access has been formed and prior to commencing work on each section, to enable cost to be adjusted prior to commencing work.
  - No additional cost will be allowed for areas where repointing has commenced prior to this.
  - Carefully preserve any joints and cavities identified by the Ecologist as potential roost / nest sites.
  - Notify CA of any unexpected cracks, cavities or voids, or if tieing, stitching, tamping or grouting appears to be necessary to maintain structural stability.
  - Allow for repointing deep cavities and holes to full depth of wall / arch barrel.
  - Notify CA if grouting appears to be necessary.



- 10 RAKING OUT GENERALLY Only small areas should be raked at a time in agreement with the CA and not more than 1 m<sup>2</sup> without prior approval of the CA. All existing sound mortar and plaster shall be left intact.
- 14 RETAINING EXISTING Take adequate precautions, including training workforce, to safeguard surviving sound historic mortar and also any traces of plaster from damage. Where instructed by the CA, wall plants shall be retained and protected from damage.
- 17 RAKING OUT JOINTS Rake out deteriorated or loose lime mortar, dirt and organic material and roots. Rake only as deep as necessary to reach sound bedding and jointing mortar. Do not rake out very fine joints.
- 20 PINNINGS Where, as a result of the raking out, existing masonry pinnings (stone slate or chips) and facework became loose and dislodged the affected stones shall be kept and carefully set aside for reuse and replacement in their original correct positions as work proceeds to restore the integrity and character of the masonry.
- Add pinnings of matching stone to tightly pack cavities and holes and bulk out the mortar in wide joints to minimise the amount of mortar used and reduce drying shrinkage, and replicate closely the existing build.
- 25 TOOLS FOR RAKING If necessary manufacture thin bladed saw edged tools for raking fine joints, to ensure that joints are raked clean without in any way damaging, scraping, spalling or fracturing the masonry, damaging the face of the stones, 'lipping' the stones each side of the joint or widening the joints. Rake out by hand and do not use machine tools without the CA's prior written approval.
- 30 JOINT SIZES GENERALLY Preserve the original joint width despite any later 'weathered' widening of the joint at the face of the stone.
- 35 WASHING OUT JOINTS Raked out joints and beds shall be thoroughly washed with clean water by means of a pressure washer, hose or syringe. Water pressure shall be low enough not to disturb any sound remaining mortar, but sufficient to remove all dust and organic material.
- Ensure that there is no pooling of water before repointing proceeds.
- 37 CLEANING All raked out materials shall be collectively disposed of and totally removed from the site. Adequate precautions shall be taken to prevent the raked out material from contaminating the burns or other parts of the wall surface and where caught on projecting masonry the loose material shall be adequately cleaned off and removed to leave no staining.
- 50 REPOINTING GENERALLY Repointing shall proceed from the top downwards and stonework below shall be protected and boards turned up at night, and the wall washed off beneath to prevent lime bloom, staining or other discolouration whilst pointing work is in progress.
- Complete repointing to arch barrel intrados after centering removed.
- 55 MORTAR MIXES FOR REPOINTING As Z21. The mortar mix to be used for repointing will depend on the constituents and mix of the original pointing as well as the nature of the joint to be repointed.
- 60 POINTING TECHNIQUE Mortar shall be carefully pushed into pre-damped (not wet) open joints, using specially adapted or manufactured tamping rods and pointing

keys of a suitable size for the joints, ironing mortar well in and pressing home to ensure that it adheres to the rear, top and sides of the joint, building up deep joints in max 25mm deep layers.

- 61 JOINTING Shall be flat and flush or slightly recessed from the wall face to preserve the joint width without forming ledges, unless specifically directed otherwise by the CA. Mortar must not spread over rounded weathered edges or form a thin skin in any way.
- At least 35mm depth of mortar should always be present.
- 65 FINISH The finish of the new joints shall match the weathered colour and texture of the original, where remaining. A smooth finish on the mortar is to be avoided. Finishes may include, before final set has taken place and when the mortar is leather hard, a light brushing with a bristle brush to raise the aggregate and open the surface or careful washing by spraying with clean water from a syringe, air pressure spray or trigger grip rose. Where a washed finish is directed, care must be taken to ensure that the jet of water does not scour out the mortar or leave lime stains on stonework.
- Include for developing samples of acceptable surface finishing techniques for the CA's approval, and retaining these as a standard.
- 70 SAMPLE PANELS Before any work starts the Contractor shall produce several sample panels demonstrating mixes to be used and finishes achieved for approval by the CA and HS. The sample panels shall be retained on site for comparison throughout the Works.
- Each sample panel to be min. 0.5m<sup>2</sup>.
- 88 CLEANING: Appropriate care and protection must be taken to prevent repointing materials from contaminating the masonry face, and any spill shall be washed away immediately.
- 90 PROTECTION OF REPOINTING: New pointing shall be protected from excess drying or wetting and kept damp for at least 14 days or until properly cured by the use of plastic sheeting and / or dampened hessian coverings (ensuring they do not stain the masonry) or similar methods agreed with the CA. Repointing work shall not be carried out where it is exposed to rain or below 5<sup>o</sup>C expected night time temperature.

## **F13 TAMPING**

- 01 TAMPING Fill deep joints and cavities in masonry using packing and pinnings to bulk out mortar.
- Allow for tamping to the full depth of all arch barrel and facing voussoirs.
  - Allow for tamping deep cavities to an average of 350mm depth from face in the case of spandrels and abutments.
  - Mix to be as Z21.
  - Press mortar manually into place with appropriately designed tamping rods or tools.
  - Thoroughly consolidate in 25mm layers, leaving no voids.
  - Packing and pinnings shall be well bedded into the mortar as tamping work proceeds, not face bedded afterwards.
  - Keep finished tamping mortar 50mm back from the face of the stone, dependant on the location, and subject to the approval of the CA, to allow for final repointing.

## **F14 CONSOLIDATION**

- 10 CONSOLIDATION: Consolidate arch barrels and abutments as indicated and approved by CA:
- Remove all decayed mortar and organic material and clean stones.
  - Downtake loose masonry as described in C20 above.
  - Reposition slipped voussoirs where possible without damage.
  - Indent missing arch barrel voussoirs.
  - Hammer in packing and pinnings and press in mortar to plug all gaps and cavities before repointing.
  - Reset or rebuild, bedding and repointing using new voussoirs and pinnings that match the existing in size, type and build, to ensure the masonry is secure and structurally stable and closely matches the original profile.
  - Preserve irregularities and original detail, including sagging and slipped voussoirs that cannot be repositioned, and displaced stones that are structurally sound.

## **F17 INDENTING**

- 10 INDENTS: Unless otherwise specified by the CA, missing facework shall be replaced by indenting. Type of stone to be used and details of working to be agreed with the CA as below.
- 20 REPLACEMENT OF MISSING OR DECAYED FACINGS: Where new facing stones are specified and approved by the CA the Contractor shall obtain for the approval of the CA stone samples which will match the original in chemical composition, colour, texture, weathering characteristics etc. Stone may be new or second hand as directed by the CA. Where replacement work involves the use of tooling the Contractor shall ensure that a similar style of stonework is achieved, using appropriate types and sizes of chisels etc; work to be to the approval of the CA.

## **F19 STITCHING CRACKS & FISSURES**

- 10 CRACKS Fractures in masonry walling shall be tied as advised by the Structural Engineer and instructed by the CA, dependant on the character of the cracks by the following means:
- Stone stitches / bonders and pinnings closely matching the character of the existing masonry.
  - Overlap crack / fissure min 300mm each side and position at max 600mm intervals.

## **F20 RESETTING / REBEDDING / RE- / BUILDING UP** See also C20 Downtaking

- 02 EXTENT: Where indicated, rebuild walling that has been downtaken, to closely match original, introducing new rubble stone and pinnings to support inadequately supported or badly eroded stones.
- 03 COLLAPSED MASONRY: Unless otherwise directed by the CA the Contractor shall retain undisturbed all fallen or collapsed sections of masonry and consolidate by rough racking and repointing as above.
- Where approved, fallen stones may be returned to original positions.
- 05 RECORDING Before commencing, ensure that the masonry has been recorded by the Archaeologist and obtain a copy of the record to guide the works and ensure that the character of the masonry and the position or any carved stones is preserved.
- Photograph every stone prior to any downtaking and number immediately using wax crayon, emulsion paint or other weatherproof means, applied unobtrusively on bed



- or reverse face. Grids to guide positioning shall be drawn using mineral chalk or wax crayon.
- Store numbered stones on bed and protect from excess or unequal weathering, ground salts, theft, marking, staining or damage or any kind.
  - Store securely in an approved location, not spread around the site or placed under spoil or other materials, and keep a record available at all times of their exact locations.
  - New stones, if required, shall be from approved sources approved as matching existing stones.
- 08      **DEFORMATION:** Unless otherwise directed by the CA, preserve all bulging, leaning, battering, overhanging, slippage, or other evidence of deformation and movement as existing, and where directed additional or replacement masonry shall follow the original wall contours.
- 09      **DETAILS:** Do not fill up gaps in the stone face (either evidence of former features or just missing stones) without specific approval of the CA. Scarcements, joist holes or other gaps in the face, the profile of the wall face, edge of gap, depth of gap etc shall not be altered in any way.
- 10      **FINISH:** Where specified or instructed by the CA new facework (rubble or ashlar) is to match the existing in character and construction. Working, tooling etc of the new stones must match existing adjacent work and the shapes and sizes of the new stones are to have the same variations as the existing. Bed alignments, pinnings and scale, joint widths and type of mortar pointing shall similarly match the original in composition and detail.
- 12      **SOURCE** Approved local second hand stone. The Contractor shall allow for sorting stones and splitting to form pinnings.
- Stone: Samples to be approved as of a suitable size, shape, type and colour to match existing facings, pinnings and core stones.
  - Jointing to match approved sample.
  - Sources: Stone piles approved by the CA.
  - Mortar: As Z21.
  - Joints: As F12 and finished as clause 40..
- 15      **SAMPLE PANELS:** Before new work starts the Contractor shall erect samples of walling for the approval of the CA and as a standard. Maintain and clear away on completion of the works.
- 40      **JOINTING:** Finish exposed joints neatly and consistently as the work proceeds. After the initial set has taken place, stipple joints with a stiff brush to remove laitance and give a coarse texture.

## Q PAVING

### Q20 SUB-BASE

- 01 INVESTIGATION Final design of bridge decks is subject to archaeological investigation and further discussion.
- Place and compact filling material in a sequence and manner which will ensure stability and avoid damage.
  - Allow for forming trial areas to ensure mix and surface treatment are suitable for the purpose.
- 02 PUDDLED CLAY Clay for watershedding layer shall be approved adherent natural clay free from impurities and of consistent texture, well puddled by trampling prior to application as directed by CA in 150mm layers, beaten to provide a unified surface, watered to prevent cracking and finished to the levels shown on drawings and agreed on site prior to laying.
- Include for adjusting / tempering by mixing sand and fibrous material into clay when trampling, to reduce drying cracking.
  - Ram, boss and compact clay material against consolidated voussoirs to fill all voids and cavities and bring bridge deck to a level sloping surface.
  - Lay final coat avg 200mm thick, smoothed and tapered to edges.
  - Final surface to be homogenous and smooth, laid to falls to ensure complete shedding of water and prevent pooling, and free of large cracks that could invite water penetration or lead to erosion.
  - Keep damp and covered to prevent shrinkage.

### Q23 PAVINGS

- 05 WEARING SURFACE Finish carriageway surface with lime bound quarry dust or gravel wearing surface, as directed following archaeological excavation.
- Lay to min falls of 1:30, tapered to edges and married into pathway each side.
  - Thickness 150mm min.
- 10 QUARRY DUST If directed to be:
- Max size of quarry dust 7mm
  - Mix 1:5 quarry dust to putty lime.
  - Spread and level and compact with a 2.5 tonnes roller or other equivalent plant to give a smooth, even surface with regular falls to prevent ponding. In dry weather water during compaction.
- 12 GRAVEL If directed to be:
- Well rounded and graded gravel from 75mm - 35mm down to small stone and grit.
  - Temper with the right amount of sand to bind it firmly when rolled.
  - Spread and level and compact with a 2.5 tonnes roller or other equivalent plant to give a smooth, even surface with regular falls to prevent ponding. In dry weather water during compaction.

### Q26 SOFT TOPPING

- 10 GENERAL: Following consolidating as F15 above and forming clay watershedding layer and wearing surface as described in Q23 above, cover with turf soft topping to protect surface as below.

- 15 TURF: The original turf covering the carriageways, including moss and grass shall be carefully removed, retained and cultivated on plastic sheeting, adding hydroponic gel, and watering and covering as necessary to prevent drying out. Where new turf is required, it shall be selected compatible turf sourced from approved adjacent areas approved by the Client and outwith the Scheduled area, and as recommended by the Ecologist to match the existing.
- Turf to be at least 50mm thick and exclude nettles etc., woody shrubs and tree saplings.
- 20 SOIL: The rich soil from existing deck / wallheads shall be carefully removed, bagged and stored for reinstating on wallheads after consolidation, the bags having waterproof indelible labels identifying the source of the material. Excess material not required in the works shall be disposed of on Completion.
- 28 SPREADING TOPSOIL:
- Spread on top of wearing surface when reasonably dry, and gently firm.
  - Overall minimum depth after firming and settlement to be 100mm:
  - Do not compact topsoil.
- 25 IMPORTED TOPSOIL: Where directed provide as necessary to make up any deficiency existing on site and to complete the work:
- To BS 3882: General purpose grade.
  - Reasonably free of stones and with maximum size of 50 mm in any dimension.
  - Free of weed seeds, roots of perennial weeds, sticks, subsoil and foreign matter.
- 29 TURF to be existing turf and moss, any deficiency made up using selected compatible local turf at least 50mm thick, laid to break bond and lap all angles, held in place with beech pegs where required.
- Lay turf on topsoil, to blend in with existing ground levels and slope away from the centreline and head of the arch, pressing firmly into position, but do not compact.
  - Water turf after applying, to prevent drying out.
  - Replace any dried out turfs.
- 30 TURFING: The detailed specification of the soft topping will be decided in following site investigations by the Archaeologist and instructed by the CA. Generally, turf will be placed directly on the wearing surface or consolidated wallheads on a shallow bund of soil sloped to sides to allow for drainage.
- Reinstated existing in the same positions it was taken from.
  - Lay turves to break bond and lap all angles without any depressions or dips that could hold water.
  - Carry turf over edges of spandrel walls to shed water from deck.
  - Press firmly into position, but do not compact.
- 40 WATERING: Prevent drying out by watering turfs using perforated hoses and sprays until rooting has taken place. The amount of watering at each season to be agreed with the CA in consultation with the Ecologist and Structural Engineer.
- Replace any dried out turfs with matching turf at the end of the rectification / defects liability / maintenance period.



## R12 DRAINAGE

- 30 Investigate and clear any existing drainage trenches, culverts, overflows etc. as directed, within vicinity of bridges.
- 67 RUMBLING DRAIN(S): Allow for forming rumbling drain to provide overflow around bridge 009:
- Liner: Lotrak geotextile membrane 10/7 from Don & Low Ltd (Tel: 01307 452200) or equivalent.
  - Granular material: Clean broken rock or gravel, size range 150 mm to 75 mm.
  - Line bottom and sides of drain with geotextile membrane. Insert vertical inspection/distributor pipe(s) and horizontal distributor pipe(s) if required. Fill up with granular material. Cover top with geotextile membrane before backfilling with as-dug material.
  - nom. depth and width of drainage trench 450mm x 450mm.
  - Wearing surface cover: 100mm, as Q23.

## Z21 MORTARS

- 05 MORTAR ANALYSIS Allow for specialist analysis to be carried out by Construction Materials Consultants Ltd, Wallace House, Whitehouse Road, STRILING FK7 7TA, T 01786 434708, F 01786 475133 [mail@cmcstirling.co.uk](mailto:mail@cmcstirling.co.uk) or similar, of min. 3 selected samples of the existing lime mortar, to inform the aggregate specification.
- 20 SAND FOR MORTAR, bedding and blinding to be sharp, washed sharp pit sand to & 1200:1976, free from impurities and stored under cover on clean bases.
- To BS 1199 and 1200 unless specified otherwise, well graded with max 5mm aggregate.
  - Colour and texture to be approved by the CA as a suitable match with the historic mortar and proportions maintained throughout the works.
  - Sand for facework mortar to be from one source, different loads to be mixed if necessary to ensure consistency of colour and texture.
  - When a range is specified (e.g. 1:1:5-6) use lower proportion of sand for Grade G sands and higher proportion for Grade S.
- 37 LIME PUTTY to be traditional non-hydraulic slaked lime putty, to comply with BS 890:1972 Part 4, with a density of not less than 1.35 kg/ltr.
- Hydrated lime to be slaked directly from well burned high calcium limes classified as CL90 in BS 890, 'pure' or 'fat' limes.
  - Mature for at least 90 days in containers that permit drainage of excess water.
  - Supply in airtight containers. Supplier to be approved.
  -
- 37A HOT LIME: The use of hot lime mortars will be considered as an alternative to the mortars specified, subject to suitable method statements.
- 38 HYDRAULIC LIME shall be certified, fresh, bagged hydraulic lime NHL2 or NHL3.5 as approved, used in strict accordance with the manufacturer's instructions. Storage as for cement. Suppliers: Hirst Conservation Materials Limited, Laughton, SLEAFORD, Lincolnshire NG34 0HE, Tel. 01529 497517, Fax 01529 497518, [www.hirst-conservation.co.uk](http://www.hirst-conservation.co.uk) ; Masons' Mortar, 77 Salamander Street, EDINBURGH, EH6 7JZ. Tel: 0131-555-0503, [www.masonsmortar.co.uk](http://www.masonsmortar.co.uk) ; Bleaklow Industries Ltd., Hassop Avenue, HASSOP, Derbyshire. Tel: 01246-582284, [www.bleaklow.co.uk](http://www.bleaklow.co.uk) ; or other approved.
- 39 BAGGED LIME (LIME HYDRATE): Not to be used unless directed by the CA.
- 50 ADMIXTURES To BS 4887. Do not use in mortar unless specified or approved. Do not use calcium chloride or any admixtures containing calcium chloride. Do not add small quantities of cement to lime mortars as this reduces performance.
- 70 MAKING HYDRAULIC LIME MORTAR
- Measure hydraulic lime powder, initially at least, accurately by weight, and accurately note the volume after tamping well down. Thereafter an equivalent volume measure may be used, subject to regular check weighing to maintain consistency.
  - Measure the specified sand/aggregate materials accurately by volume using clean gauge boxes.
  - Thoroughly mix aggregate and dry hydrate in an approved mixer and add water gradually to achieve a stiff but plastic consistency. Continue mixing for 20 minutes. Thorough hand mixing is acceptable for small quantities; the material should be well

beaten and compressed (not simply turned over with a shovel) for around 30 minutes.

- Ensure that all plant, tools and banker boards etc are kept clean at all times.
- Proportions of mixes are for damp sand, as normally available on site. Do not alter these proportions unless instructed by the CA.
- After mixing allow the mortar to stand for a period. Storage and maturing times for lime mortar mixes with hydraulic properties are dependent on the speed of the hydraulic set. These materials are to be used before the hydraulic set takes place. The specified mortar should normally be made up several hours before required for use and stored in cool covered conditions. Make up samples and check setting times on site to establish working criteria and agree relevant times with the CA.

## 200 USE OF MORTARS GENERALLY

- Water for mortars is to be fresh clean drinking water, free from impurities which would adversely affect the performance of the mortar.
- Avoid intermixing and contamination between stored materials and other building materials, debris or other deleterious matter.
- Keep plant and banker boards clean at all times.
- Do not mix or knock up mortars when the air temperature is at or below 5 °C and falling or below 1 °C and rising.
- Use within about one hour of mixing at normal temperatures. Do not use after the initial set has taken place and do not retemper.
- Lime mortars should not be mixed or used between 1 October and 1 April, or when there is a risk of frost. If this is unavoidable, the mortar (whether stored or already applied) must be adequately protected until all risk of frost has passed. Work must be kept damp and protected at least 7 days after application and protected from frost, sun, wind and excessive wetting for as long as possible thereafter.
- Work involving lime should only be carried out by skilled tradesmen, who have attended training courses and are also experienced in the use of lime mortars.
- Lime mortars should be used the same day they are mixed or knocked up.
- Do not retemper hydraulic lime mortars after the set has started and discard all material not used within this time.

## 250 PROTECTION OF LIME MORTAR WORK: Protect all new lime mortar work as described below to provide the correct curing conditions for at least two weeks from the time of placement.

- Where ambient temperatures within the scaffold enclosure are at or below 8°C during and after placing lime mortar effective protection is to remain in place beyond this 2 week period until the mortar has cured. (Note also requirements for on-going winter protection.) Protection is likely to involve measures such as wind/debris netting on the scaffold, hessian sheets or panels kept damp as required, polythene sheeting or haps laid over the work, close covering with insulating batts, etc. Care should be taken to avoid 'wind tunnel' effects within the scaffold.
- Control the rate of drying and curing of new lime mortar in order to ensure the material dries slowly from the depth outwards. Avoid premature surface drying and rapid or uneven drying. Where necessary carry out regular mist spraying to maintain this moist condition. Work back initial cracking in the days following repointing. Cracking found after this time, or once the pointing has set/dried should be cut out and replaced.
- Protect new lime mortar work from rain and from damage by discharge from rainwater goods or run-off. Ensure temporary rainwater disposal arrangements are in place where rainwater goods are removed or non-existent.
- Protect new lime mortar from frost until cured (i.e. for a minimum of 2 weeks, and for longer as necessary when the speed of curing is reduced by ambient temperatures



below about 8 or 10°C) and protect lime mortar from freezing whilst saturated for a period of at least 3 months after placing.

- Do not use the specified gauged lime mortars after the beginning of October unless full frost protection will be available for the duration of the first winter.

300 MORTAR MIXES: To be approved following the production of several sample mix panels for the CA's and HS approval, prior to repointing commencing. Provisional mixes to be as follows:

- Rebuilding / tamping / consolidating - 2:5 NHL5 hydraulic lime: soft and coarse building sand. The use of a pourable mortar eg with casein additive will be considered for filling up all gaps in the arch barrel masonry.
- General repointing - 2:5 NHL3.5 hydraulic lime : soft and coarse building sand.

# NOTE

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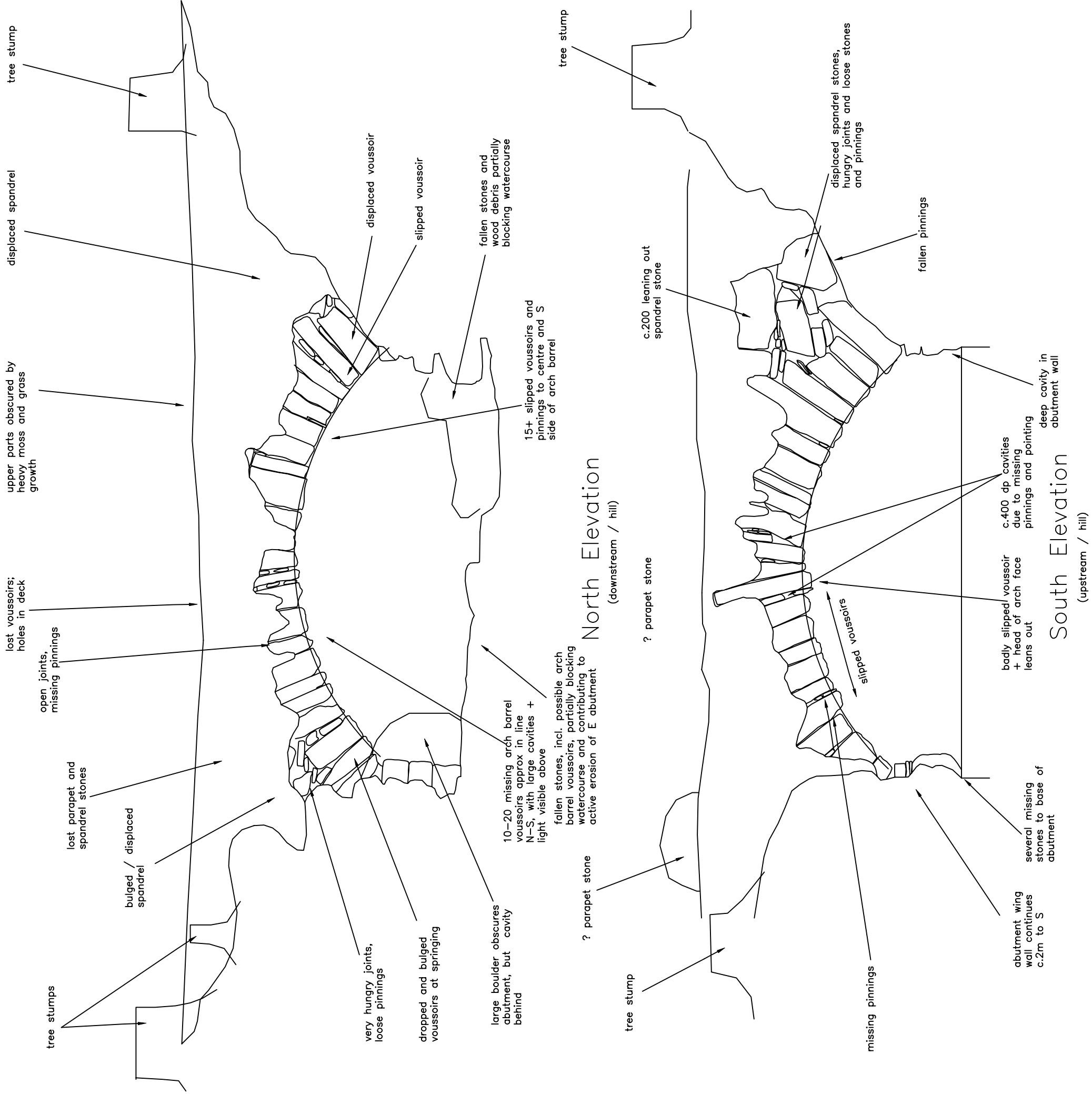
# SUMMARY

Condition inspections were carried out on 31 October and 14 November by David Narro Associates, Consulting Structural and Civil Engineers and Robin Kent Architecture & Conservation.

Dating from 1748-53 and constructed by Major Caulfeild as part of the military road between Fort Augustus and Glenelg barracks, the bridge across the Ait Thomais burn has been neglected since 1784. It comprises a segmental arch on low abutment walls, the SW abutment continuing beyond the line of the bridge. It is constructed from sandstone and stone slate pinnings, originally lime mortared.

The parapets have been lost, and the deck has been eroded by water, resulting in most of the lime mortar washing out, leaving little more than dry-stone masonry. The abutments have additionally been weakened by root action due to planting of trees in close proximity and erosion by the watercourse, leading to distortion of the geometry, slippage and significant loss of voussoirs, resulting in holes in the deck.

Providing access is limited to occasional hill walkers there does not appear to be an imminent risk of significant collapse, but the bridge is potentially hazardous due to the holes and risk of further slippage of voussoirs, some of which are loose, and IMMEDIATE action should be taken to repair and conserve it to ensure public safety and prevent further deterioration. It must NOT be used by vehicles.



No.	Revision/Issue	Date

Project Achlain Bridges Conservation Plan  
 Client Forestry Commission Scotland  
 Forest Enterprise Scotland  
 Head Office 1 Highlander Way  
 INVERNESS IV2 7GB  
 Title Bridge 007 - Condition  
 Scale 1:25@A3  
 Date 30 November 2011

Drawing number 423/1  
 Autocad ref: 423existing

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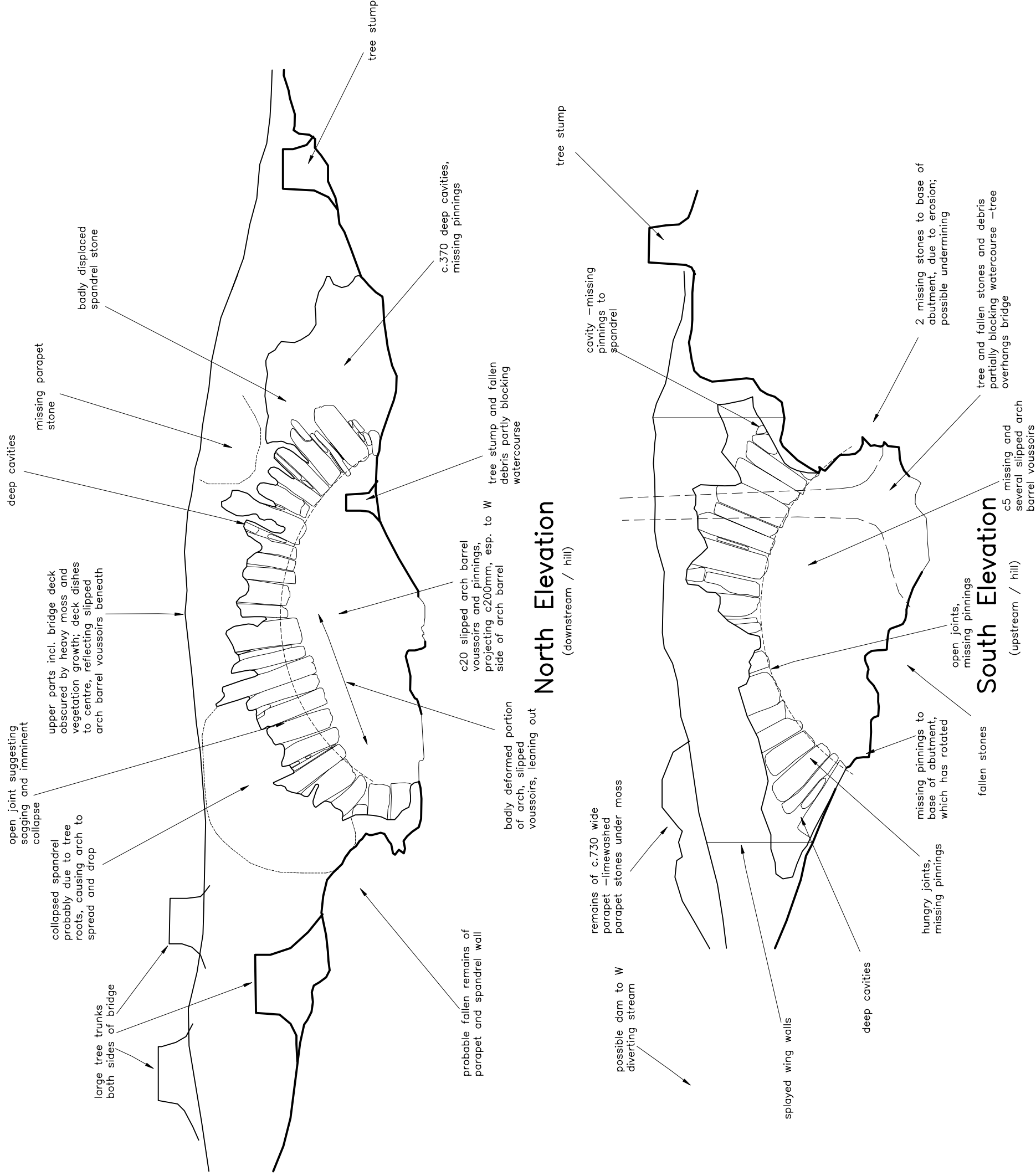
## SUMMARY

Condition inspections were carried out on 31 October and 14 November by David Narro Associates, Consulting Structural and Civil Engineers and Robin Kent Architecture & Conservation.

Dating from 1748-53 and constructed by Major Caulfeild as part of the military road between Fort Augustus and Glenelg barracks, the bridge across this Creagan Mhartaigh burn has been disused since 1784. It comprises a segmental arch on low abutment walls, the S wing walls are played to direct the water beneath the bridge. It is constructed from sandstone and stone slate pinnings, originally lime mortared.

The parapets have been lost with the possible exception of a couple of limewashed stones, and the deck has been eroded by water, resulting in most of the lime having leached out of the mortar, leaving little more than sand and dry-stone masonry. The abutments have additionally been weakened by root action due to planting of trees in close proximity and erosion by the watercourse, which is directed at the base of the E abutment, leading to severe distortion of the geometry and extensive slippage and some loss of voussoirs.

Providing access is limited to occasional hill walkers there does not appear to be an imminent risk of significant collapse, but the bridge is in URGENT need of repair and conservation as soon as possible to prevent further deterioration. It must NOT be used by vehicles.



No.	Revision/Issue	Date

Project Achlain Bridges Conservation  
 Plan  
 Client Forestry Commission Scotland  
 Forest Enterprise Scotland  
 Head Office 1 Highlander Way  
 INVERNESS IV2 7GB  
 Title Bridge 008 - Condition  
 Scale 1:25@A3  
 Date 30 November 2011

Drawing number **423/2**

Autocad ref: 423existing

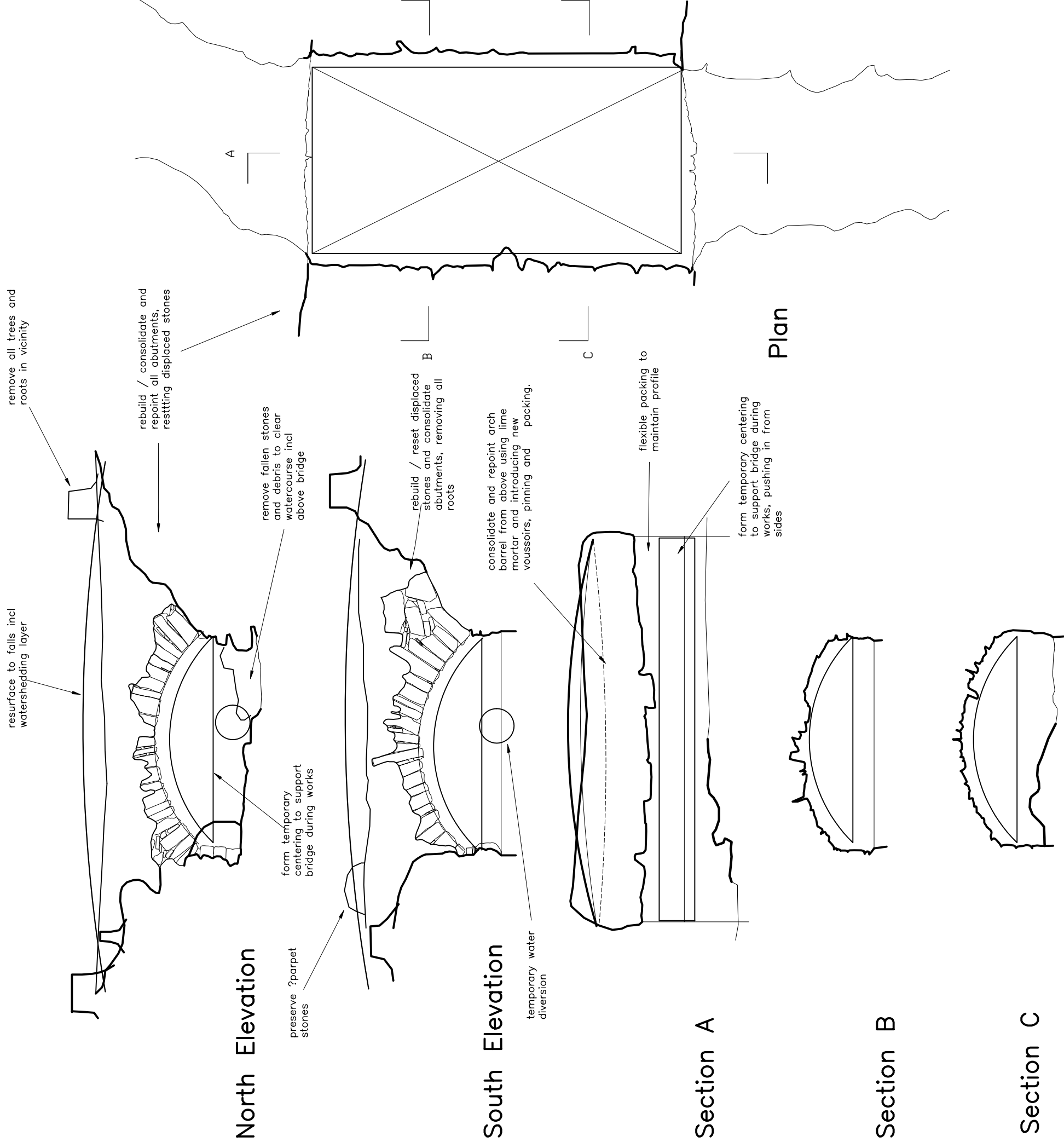
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 CONSERVATION  
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## Methodology

- 1 Temporarily redirect water to form safe access.
- 2 Remove vegetation, moss etc, trees and roots, including debris blocking watercourse. Set aside vegetation from carriageway for re-use.
- 3 Form centering and packing to support arch barrel.
- 4 Excavate deck to extrados under archaeological oversight.
- 5 Reposition / indent slipped / missing voussoirs.
- 6 Repoint and consolidate arch barrel from above.
- 7 Rebuild / indent and repoint abutment wing walls and spandrels to reestablish support.
- 8 Ease centering and complete consolidation of arch barrel.
- 9 Re-form deck and resurface to falls with watershed layer and soft topping.
- 10 Remove centering, complete repointing of intrados and indent and repoint and abutments.

NOTE No works to be undertaken from below arch barrel prior to consolidation.

No.	Revision/Issue	Date

Project Achlain Bridges Conservation  
 Plan  
 Client Forestry Commission Scotland  
 Forest Enterprise Scotland  
 Head Office 1 Highlander Way  
 INVERNESS IV2 7GB

Title Bridge 007 – Proposals  
 Scale 1:50@A3  
 Date 30 November 2011

Drawing number **423/4**  
 Autocad ref: 423existing

## NOTE

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## Methodology

- 1 Temporarily divert water to form safe access, eg. to W of bridge.
- 2 Remove vegetation, moss etc, trees and roots, including debris blocking watercourse. Set aside vegetation from carriageway for re-use.
- 3 Form centering and packing to support arch barrel.
- 4 Excavate deck to extrados under archaeological oversight.
- 5 Reposition / indent slipped / missing voussoirs.
- 6 Repoint and consolidate arch barrel from above.
- 7 Rebuild / indent and repoint abutment wing walls and spandrels to reestablish support.
- 8 Ease centering and complete consolidation of arch barrel.
- 9 Re-form deck and resurface to falls with watershedding layer and soft topping.
- 10 Remove centering, complete repointing of intrados and indent and repoint and abutments.

NOTE No works to be undertaken from below arch barrel prior to consolidation.

No.	Revision/Issue	Date

Project Achlain Bridges Conservation  
 Plan  
 Client Forestry Commission Scotland  
 Forest Enterprise Scotland  
 Head Office 1 Highlander Way  
 INVERNESS IV2 7GB

Title Bridge 008 – Proposals

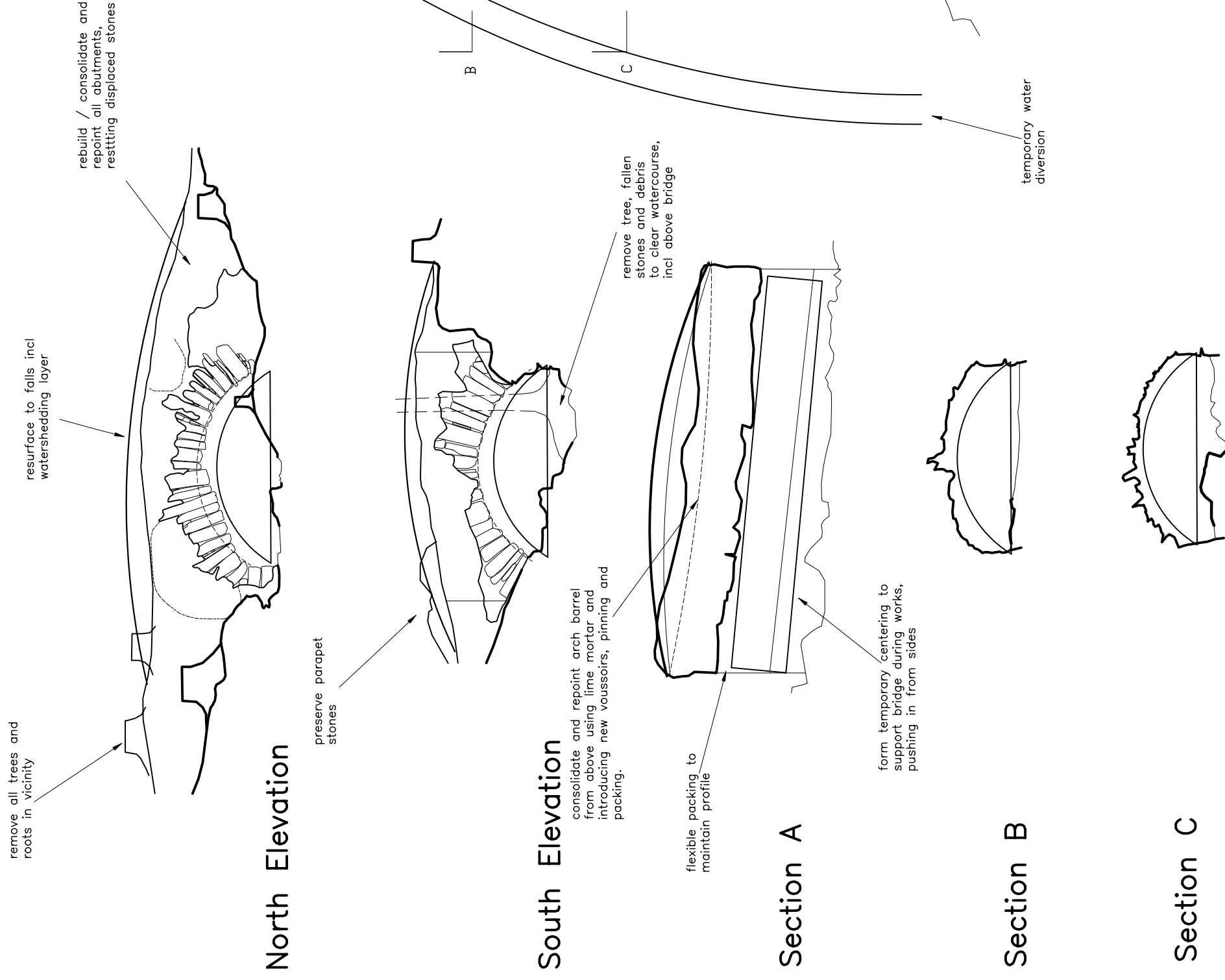
Scale 1:50@A3

Date 30 November 2011

Drawing number **423/5**

Autocad ref: 423existing

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reset displaced stones

remove all trees and roots in vicinity

repoint arch barrel, replacing missing voussoirs, packing and pinning from below

### North Elevation

resurface to falls incl watershedding layer

repoint voussoirs, packing and pinning

indent missing stones and pin cavities to abutments both sides

### South Elevation

consolidate and repoint arch barrel before placing watershedding layer

pecially designed scaffolding access and safety barriers

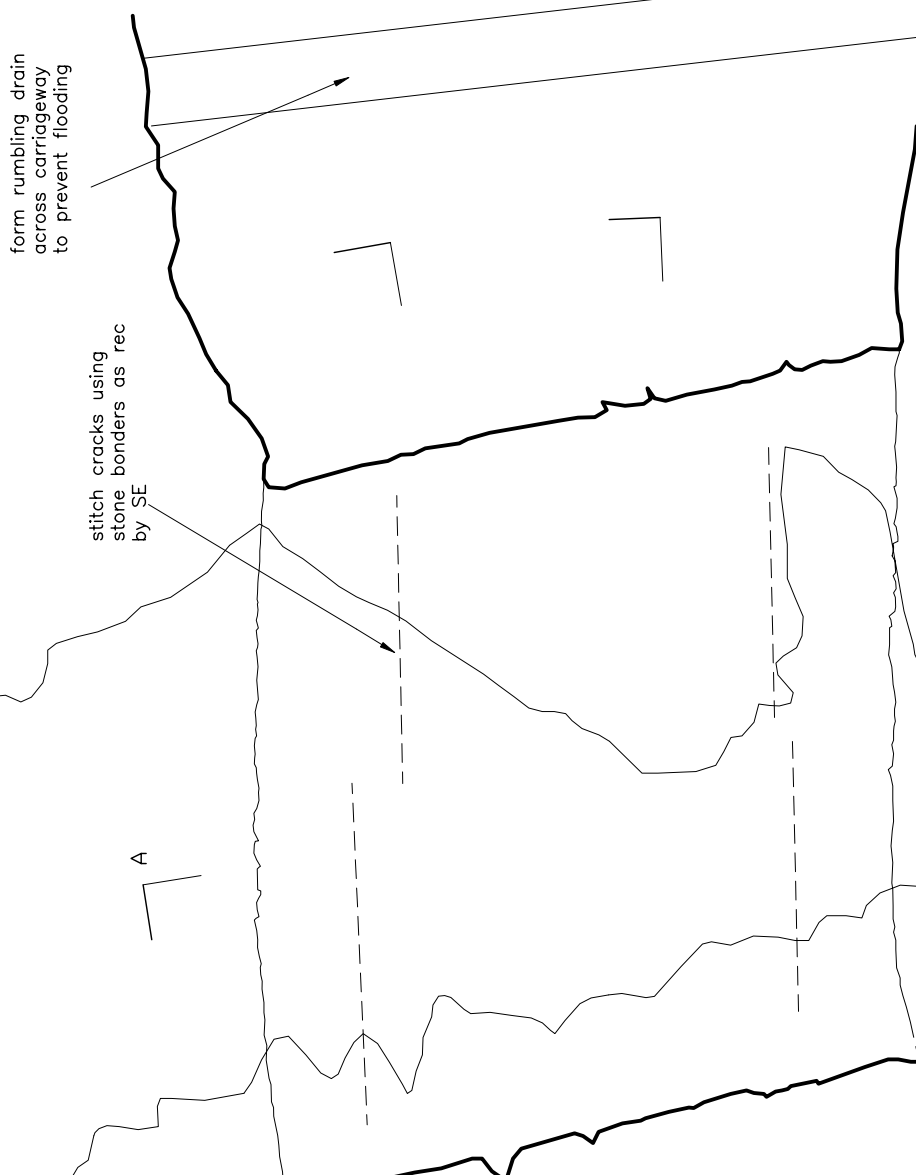
### Section A

form safe access platform

### Methodology

- 1 Remove vegetation, saplings, tree roots. Set aside vegetation from carriageway for re-use.
- 2
- 3 Scaffold to form working platforms and shore as recommended
- 4 Excavate deck to extrados under archaeological oversight.
- 5 Indent / reposition voussoirs, consolidate and repoint arch barrel from below and above, stitching cracks.
- 6
- 7 Consolidate and repoint abutment wing walls and spandrels.
- 8
- 9 Re-form deck and resurface to falls with watershedding layer and soft topping.
- 10 Excavate and form drain to prevent flooding.

### Plan



form rumbering drain across carriageway to prevent flooding

stitch cracks using stone bonders as rec by SE

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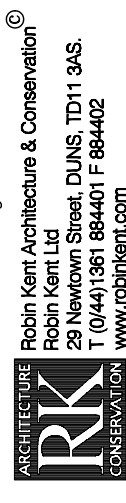
No.	Revision/Issue	Date

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Title Bridge 009 – Proposals  
 Scale 1:50@A3  
 Date 30 November 2011

Drawing number **423/6**

Autocad ref: 423existing



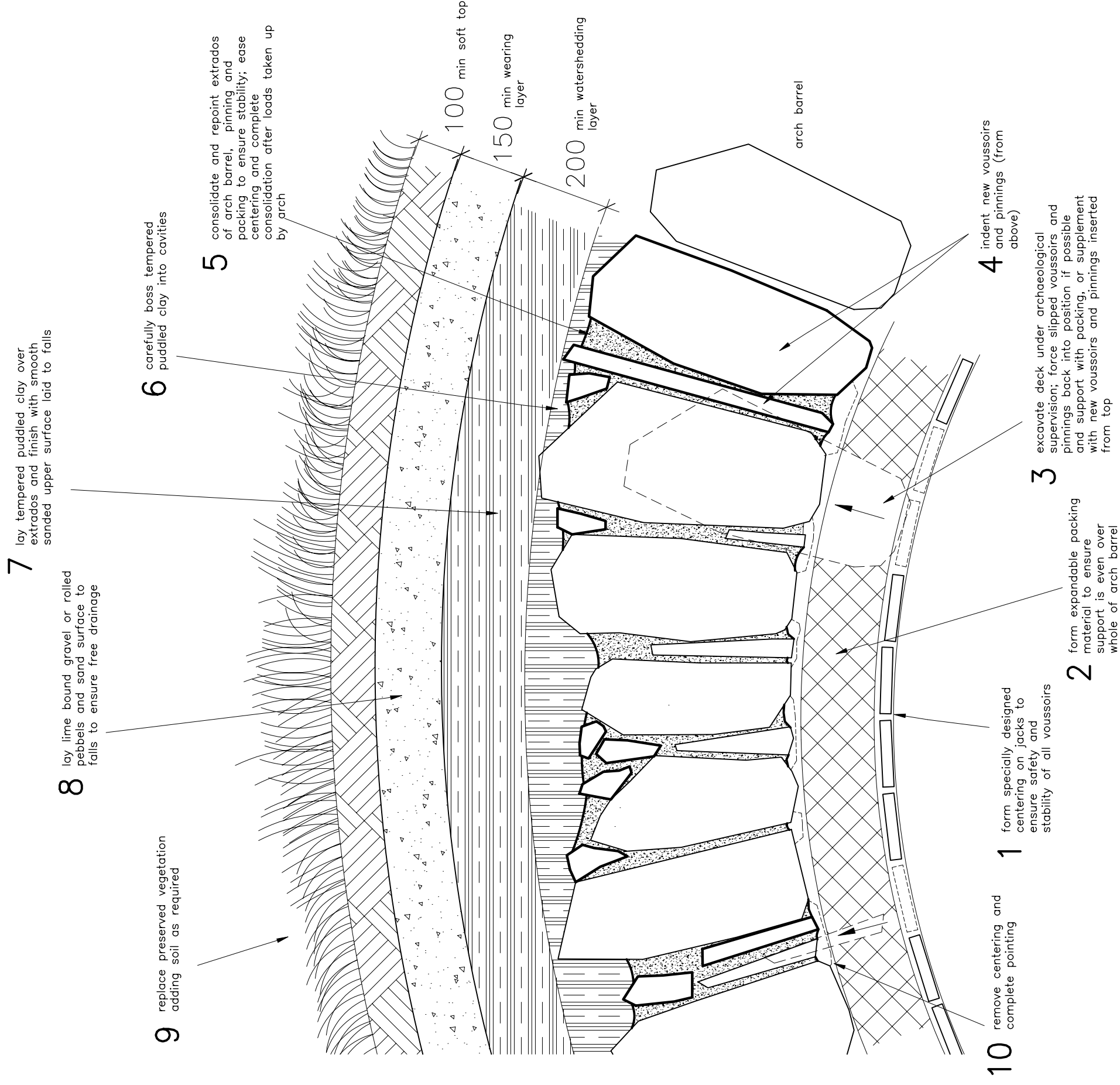
form safe access platform

### Section B

### Section C

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9 replace preserved vegetation adding soil as required

8 lay lime bound gravel or rolled pebbles and sand surface to falls to ensure free drainage

7 lay tempered puddled clay over extrados and finish with smooth sanded upper surface laid to falls

6 carefully boss tempered puddled clay into cavities

5 consolidate and repoint extrados of arch barrel, pinning and packing to ensure stability; ease centering and complete consolidation after loads taken up by arch

10 remove centering and complete pointing

2 form expandable packing material to ensure support is even over whole of arch barrel

3 excavate deck under archaeological supervision; force slipped voussoirs and pinning back into position if possible and support with packing, or supplement with new voussoirs and pinning inserted from top

4 indent new voussoirs and pinning (from above)

scrape surface to open it and expose aggregate after initial leather set; final profile to be flush or slightly recessed, not bulging, projecting or feathered over stones

use pinning to ensure no joints are wider than 25mm

carefully preserve all existing pinning and replace in repointing, using new pinning where required to preserve and replicate 'boulder and chip' appearance of build and support facings

build up hungry joints and cavities in 25mm layers using packing stones to minimise bulk of mortar, and compacting using tamping rods

rake out all failed mortar, earth and roots and wash joints clean

carefully preserve all sound mortar

depth of repointing to be twice joint width or min 35

2W min

25 max

25 max

25 max

25 max

25 max

25 max

25 max

25 max

25 max

## 2 General Repointing 1:2

Project Achlain Bridges Conservation Proposals  
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 Title **Masonry Details**  
 Scale 1:10 + 1:2 @A3  
 Date 30 November 2011  
 Drawing number **423/10**  
 Autocad ref: 423details.dwg

## 1 Consolidation and Paving 1:10