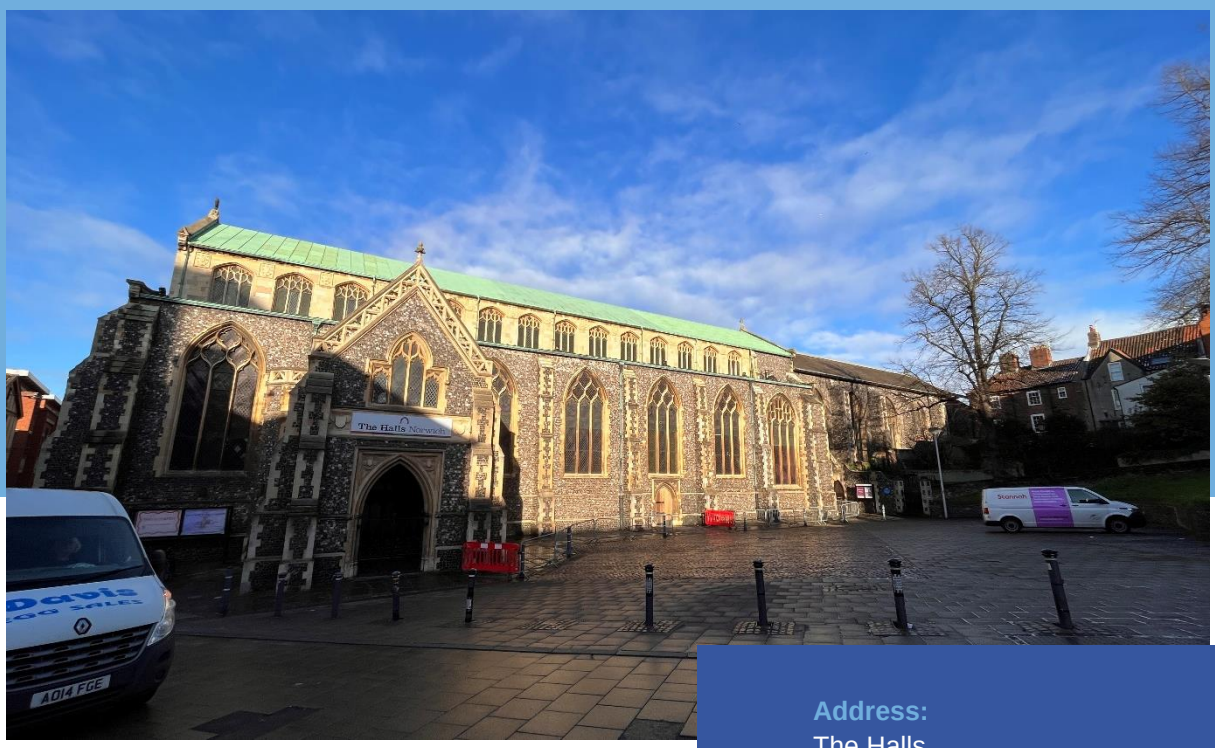
The Halls – Works Required
Revision B



Subject of Survey:
The Halls, St Andrews Plain, Norwich NR3 1AU

Client:
Norwich City Council

Reference:
22.67 **REV B**

Purpose:
Building Survey / Feasibility

Important notice:

This report is based on the visual inspection of the readily accessible areas of the property only and in accordance with the limitations contained within our scope of service provided to you previously. We have not inspected woodwork or other parts of the structure which are covered, unexposed or inaccessible and we are therefore unable to report that such parts of the property are free from defect.

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Survey by:
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Date of Survey:
Nov 2022

Date of Report:
Dec 2022

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1 Executive Summary

1.1 Instructions and inspection

Roche Chartered Surveyors were instructed by Norwich City Council to review a list of recommend works at St Andrews Halls, Blackfriars and The Cloisters. The purpose of the report is to advise on the necessity and urgency of the works, and to provide guidance on costs. Roche employed Wright Consulting Engineers to advise on the structure of the property.

The property is a Grade I listed former church and priory that forms part of a Scheduled Ancient Monument. The property is currently utilised as a concert and events venue.

The inspections were carried out during November and December 2022.

1.2 Report Status

At the time of writing we are awaiting further reports from Anglian Water regarding inspections of drains in St Georges Street, and budget costs for secondary glazing to the stained glass windows.

1.3 St Andrews & Blackfriars

The lead roof to the north of St Andrews Hall has been repaired and is in good condition, but a means of safe access is required to allow the rainwater gullies to be cleaned.

There are a number of flashings to the copper roof which are in poor repair, in two locations these should be repaired immediately as they are actively allowing water ingress.

There is a section of gable end that is finished in cement render and allowing water ingress, this is damaging internal timbers. This should be dealt with in the short term.

The main timber roof structure has been reported as being in fair condition, repairs are required but can be carried out at the same time as re-roofing occurs.

The rainwater goods require limited immediate repairs, but can largely be refurbished with a wider re-roofing project.

The external walls are likely subject to ongoing movement but no immediate repairs are thought to be required. Additional monitoring of the walls should be instigated.

The copper roof to St Andrews Hall is at end of life and should be replaced. This could be postponed in the short term but it carries a risk of widespread failure in extreme weather, delay will also likely lead to more damage to the timber roof structure and a higher eventual cost. It is considered likely a temporary roof will be required to facilitate the re-roofing, this will significantly increase the cost of the works. Estimates for the temporary roof vary from £222,000 to £676,000 depending on the method chosen. Further investigations are required to ascertain whether the cheaper version is feasible. The re-roofing works are expected to cost around £290,000.

The felt roof over the Crypt is at end of life and should be renewed, we recommend an alternative product is used and the drainage of the roof is changed to reduce the risk of future leaks.

The rainwater goods to Blackfriars should be cleaned and some immediate patch repairs carried out, further maintenance should follow when access is provided.

The stain-glass windows to St Andrews and Blackfriars are largely in poor condition. These are considered dangerous and should be refurbished immediately. Combined with access, the total anticipated cost of this is £620,000. The internal secondary glazing has been a contributory factor in the deterioration of the windows, this should be renewed as part of the refurbishment. We estimate a provisional cost of £180,000.

1.4 The Cloisters

The external decorations and rainwater goods at the Cloisters were suffering from general wear and tear but this is considered suitable to be covered by an external refurbishment in the medium term. This would consist of providing access, overhauling and decorating rainwater goods, overhauling a valley gutter, decorating and repairing windows. The total combined cost of this would be in the region of £50,000.

There is one window to the second floor which is suffering from significant timber decay and should be renewed immediately prior to the glazing becoming a hazard.

An external brick retaining wall is in poor condition and requires repairs and propping, an estimated cost for this is £50,000.

1.5 Summary of Costs

The total of costs identified is £1,652,000, of which £720,300 are considered urgent and £822,600 are required in the short term. A further £109,100 are required in the medium term.

The main costs are associated with the refurbishment of the stained-glass windows (£800,000 (inclusive of secondary glazing renewal)), and installation of a new copper roof with associated repairs to the timber structure (circa £570,000).

There are possibilities to achieve significant savings by combining access scaffolds for the re-roofing and refurbishment of the stained glass windows.

These budget figures are exclusive of VAT and all professional and statutory fees. The costs are budgets only and do not constitute a fully priced feasibility study. The nature of the re-roofing works means estimating the cost of a temporary roof is particularly difficult. Further budget costs from contractors are due to provide additional cost evidence.

2 Building Key Point Status

2.1 Summary of Key Points

We recommend the report is read in full, however highlight a number of key points at a glance below:

Immediate Works

- Patch repairs to rainwater goods
- Cleaning rainwater goods
- Repairs to stain-glass windows
- Propping / repairs to external retaining wall

Required works

- Provide new copper roof
- Provide new felt roof
- Re-activate movement sensors
- Repairs to external retaining wall
- Renew secondary glazing

Recommended Works

- Patch repairs to slate roofs
- External decoration of Cloister windows
- External decoration and maintenance to Cloister rainwater goods

High Value Items

- Stained glass windows: £800,000 (incl. secondary glazing)
- New copper roof: £290,000
- Repairs to retaining wall: £50,000
- Temporary roof: £222,000

Costs Summary

- Urgent works : £720,300
- Short term works : £822,600
- Medium term works: £109,100

Costs Summary

- Costs exclude VAT and professional fees.
- Costs dependent on how works are procured.
- Scope to reduce costs through combined use of access scaffold

Immediate works are considered hazardous and should be carried out as soon as possible

Required works should be carried within the next 24 months

Recommended works should be carried out within 5 years

3 Introduction

3.1 Instructions

Roche Chartered Surveyors were instructed by Norwich City Council to review the priority A and B works listed in the document in Appendix 2. The remit was to advise on acceptable timeframes for undertaking the works, and likely associated costs.

3.2 Report Status

At the time of issuing Revision A of the report we are awaiting the following:

	Report	Date Expected
1	Costs for drainage repairs	Jan 2023
2	Anglian Water – investigation into foul drainage	w/c 19.12.2022
3	Anglian Water – investigation into deep storm drain	Jan 2023

3.3 Limitations

This Report is based on a visual inspection of the readily accessible areas of the property only and in accordance with the limitations contained in our Scope of Service provided to you previously. No steps were taken to expose elements of the structure otherwise concealed or to remove surface finishes for examination of underlying elements.

We were not instructed to make arrangements for specialist surveys of the water distribution systems, the mechanical systems or the electrical systems or for these to be tested by a specialist.

We have not been instructed to determine floor loadings, nor instructed to organise a Fire Risk Assessment, a Health and Safety Audit or an Access Audit to ascertain compliance with the Equality Act.

We were unable to gain access to the following areas:

- Access to high level elevations of Blackfriars and the Cloisters was from ground floor only with the use of binoculars.
- Access externally to the roof of Blackfriars is not possible and we have relied on drone footage.

3.4 Information Provided

Limited information has been provided on the property. The following documents were provided or sourced:

- Partial floor plans
- Building Survey Reports from Janus dated August 2022
- Listed building entry from Historic England
- Demise plan of property
- Crack Monitoring Reports dated 2012

3.5 Date of Inspection

Our inspections were undertaken during November 2022 on a number of different dates, at which time the weather was varied but typically dry with temperatures between 10 and 14C.

The inspections were undertaken by David Hall MRICS on behalf of Roche Chartered Surveyors, Josh Halton Farrow of Wright Consulting (Engineers) and Joe Lovelock and Patrick Hughes of Hutton and Rostron (timber specialists).

3.6 Orientation

For the purpose of this report, we have assumed the elevation facing south onto St Andrews Plain is the front elevation. The terms 'left' and 'right' are used when facing an object. When referring to elevations the points of compass are referred to.

3.7 General Description

The property is a Grade I Listed former church and priory, and also forms part of a Scheduled Ancient Monument. See Appendix 3 for the listing description.

4 St Andrews and Blackfriars

4.1 Lead Roof

The flat lead roof to the north of St Andrews Halls covers the infill section between the Hall and Cloisters accommodating WCs and ancillary space. The roof slopes towards the Hall and drains in outlets directly abutting the north elevation of the Hall.

The initial report identifies an area of missing lead flashing to an upstand, this has subsequently been repaired. While there is some minor wear and tear to the roof we did not note any further defects that will require addressing in the short to medium term. The roof finish is considered to be in good condition.

It was noted during our inspection that the rainwater outlets in this area were partially blocked and it was reported verbally that access to the area for maintenance had been prohibited due to a risk from falls. We recommend this is addressed as a matter of urgency to allow regular clearance of rainwater goods to re-commence. The exact nature of the fall protection is beyond the scope of this report, but we would expect it to involve ladder access onto the lead roof and low-level protection to prevent falls through the stained-glass windows on the north aisle. We estimate the cost of these works to be in the region of £5,000 + VAT.

4.2 Weather Flashings and Abutments – Copper

4.2.1 Verges

The copper weather flashings to a number of verges are defective and have led to internal water ingress. In places the existing flashings appear to be inadequately dressed into the base of the coping stones.

To the eastern verge on the southern aisle, and the southern pitch of the nave the flashings are loose and require reinstating to prevent ongoing water ingress. This should be carried out immediately.

To the north aisle the western verge flashings are loose and have previously been fixed through into the masonry. We recommend these are renewed with new copper flashings.

To the north aisle the eastern verge has poor mortar pointing to the head of the verge and should be repointed.

The repair of the verge flashings may require isolated removal of the adjacent coping stones to facilitate the correct detail.

4.2.2 Window flashings

The copper flashings to the base of the nave windows (on the aisle roof) are aged but generally in repair, we recommend these are renewed as part of the wider re-roofing works. The pointing to the heads of the flashings has partly failed on the southern elevation and requires repointing.

4.2.3 Access

The works to the south nave roof will require localised scaffold access via the south aisle roof, with edge protection to allow the window flashing repairs. The timber condition report will advise whether it is safe to physically access the southern aisle roof, initial verbal reports suggest it will be safe. To the north aisle it may be possible to undertake the works with edge protection and an access tower only.

4.2.4 Costs

The total cost to renew, repair and repoint the flashings is expected to be £1,850 +VAT. If the works are undertaken independently of the main roof refurbishment, providing scaffold access and edge protection is expected to cost in the region of £14,000 + VAT.

4.3 Timber Roof Structure – St Andrews

Please refer to the structural report and specialist timber report in Appendix 5 for full details.

In summary, there are a number of areas of timber decay some of which require localised structural repairs, however moisture readings predominantly showed areas of decay to be historic with no evidence of ongoing deterioration. The exception to this is in the organ roof void where the timber abuts a section of high-level gable end that has failing cementitious render. Moisture levels within this area where high enough to allow timber decay through fungal attack (dry rot) or wood boring insects. This should be rectified in the short term.

It was noted that were no wall or eaves plates in places, this results in some principal rafters bearing directly onto the wall above the windows, causing cracking. An allowance to install eaves plates should be made. Further new bespoke steel connections should be introduced to strengthen the structure with isolated timber repairs undertaken where historic timber decay has occurred.

It is considered prudent to undertake the repairs when the property is re-roofed. An estimate of costs for timber repairs is £50,000 + VAT.

4.4 Timber Roof Structure - Blackfriars

Please refer to the structural report and specialist timber report in Appendix 5 for full details.

In summary, the roof structure to Blackfriars is modern and partly from steel encased in timber. There are a number of areas that have suffered from timber fungal decay and insect attack, but these are all currently dry and not on-going. We recommend repairs are carried out when access is next provided.

The steel members within the roof structure are suffering from corrosion, while this is not currently causing an issue it is recommended that the steel is exposed and treated in the medium term to prevent further corrosion causing structural issues.

The cost for the timber repairs are included within section 4.3 of this report. The costs for treating the steel are difficult to estimate without further investigation to ascertain how easily they can be exposed. We have made an allowance of £50,000 + VAT as a provisional sum, but this could vary widely.

4.5 Rainwater Goods – Copper

The copper gutters and downpipes to St Andrews Hall are a largely in repair but tired, with a number of immediate repairs required.

The gutters to the nave and north aisle roof are in a tired condition with evidence of isolated minor leaks indicated by staining on the stonework beneath. The exact causes of the leaks is not immediately apparent without full access, but it is considered likely isolated sections of guttering will require renewal.

The gutter outlets, swan necks and downpipes are largely in repair albeit tired, many have been fitted with stainless steel screws to hold them together, and the downpipe brackets are loose or de-bonded on most downpipes. Despite this, the rainwater goods are largely functioning well, we recommend that downpipes are re-secured and all joints overhauled with the next roof refurbishment.

The eastern most gutter outlet on the southern pitch of the nave roof has failed with the swan neck dislodged from the downpipe. There is evidence of a previous patch repair and the wall is saturated in this area. A new swan neck and downpipe should be fitted immediately.

To the western most downpipe on the north aisle roof, the bottom section has split and is saturating the wall. This should be repaired immediately.

To the eastern most downpipe on the north aisle the downpipe is partially missing and should be renewed immediately.

The cost to carry out the immediate repairs to the downpipes is £950 + VAT excluding access. Access to the repair on the south aisle could be combined with the flashing repair in section 4.2 of this report. Should the repair be carried out in isolation the cost of safe scaffold access would be £8,500 + VAT.

The cost to overhaul the rainwater goods as part of a wider roofing scheme is £7,200 + VAT.

We noted that access to the aisle roofs has been prohibited. This removes the ability to periodically clean out the nave and aisle gutters. An access solution should be provided as soon as possible to allow regular maintenance. The exact method is beyond the scope of this report, but we suggest fixed access ladders and a clip-on lanyard system could be provided sympathetically.

4.6 External Walls

Full details can be found in the engineer's report in Appendix 5.

In summary, there are a number of areas of concern including cracking and spalling stonework, but no urgent works are required. It is considered likely that the movement is ongoing, but this requires a period of monitoring to confirm whether the movement is seasonal (expansion and contraction), or ongoing and will require intervention.

Further works to re-activate the monitoring sensors should be undertaken in the first instance.

There are multiple areas where stonework is delaminating or has been repaired with a cement based mortar, we recommend a full schedule of stone repairs is produced and this is managed annually through a planned maintenance regime.

4.7 Roof – Copper

The roof to St Andrews Hall nave and aisles is finished with copper.

To the southern aisle and porch, with the exception of some abutment flashings covered in section 4.2 of this report, the roof covering appears to be in good condition.

The roofs to the nave and north aisle are at end of life. There have been numerous previous patch repairs which have failed, or are close to failure. Approximately 60% of the roofs have had secondary fixings applied through the seams of the copper sheets, many of these are lifting and do not appear to be watertight. A number of sheets to the centre of the nave have been fixed through with an apparent lead solder used to seal the fixings, this is reacting with the copper and is likely leading to localised water ingress.

The copper sheets throughout are dishing (bulging in the middle), it is not clear what is causing this, but it could be due to the limited thermal movement permitted by the secondary fixings applied.

The extent of the secondary fittings leads us to believe there has been previous concerns over the copper sheeting suffering from wind lift. Due to the large extent of the secondary fixings that have failed or are failing, there is a risk of high wind causing widespread damage, albeit this is not possible to quantify.

We have not undertaken intrusive investigations to understand the build up of the roof structure, but it is likely to contain 2 layers of timber boarding separated by timber purlins/ rafters/ battens. Given the condition of the external sheeting we consider it highly likely that there is ongoing localised water ingress that is being absorbed by the timber structure. This will be causing ongoing damage and the longer the roof covering is left in its current condition the more likely widespread repair to the timber structure will be required.

In summary, the roof is at end of life and is likely letting in small quantities of water that are being absorbed in the structure. It could fail comprehensively in extreme weather. The more advisable route is to renew the covering now, but it could continue for a few years in much the same condition as it is currently, this will however lead to it slowly deteriorating to a point where further damage to the timber roof structure and internal finishes occurs.

Due to the buildings listed status, we consider it highly likely that fitting a temporary roof will be required as a condition of the listed building consent. This is particularly difficult to achieve because the north elevation of the property has been in-filled meaning any bridging structure will have to be supported through the lead roof. The exact design or method of providing this requires further study to understand the least disruptive option, but it will likely require areas of roof to be opened up to allow columns to be passed through.

Following budget costs that have been received, the cost to renew the roof covering including access is estimated to be £290,000 + VAT. We have allowed a provisional sum to carry out repairs to 5% of the timber roof structure within this cost. It should be noted that wholesale costs for copper are experiencing widespread fluctuations. The exact method of the access and scaffolding also requires significant further design. These factors mean the cost of a fully designed project could vary widely.

We have received 3No costs for the temporary roof that follow two basic design principles. One allows for erecting a scaffold from within the hall and constructing canti-levered supports through the clerestory windows. The cost for this was circa £676,000. The two further costs allowed for supporting the temporary roof on the copper roof and supporting this by propping the roof timbers internally. The costs for this option were circa £300,000 and £222,000 respectively. The internal propping option is significantly cheaper, but further investigation is required to ensure this is feasible.

4.7.1 Gable End

At high level between the junction of St Andrews Hall and Blackfriars, there is a short section of gable wall that is finished in a cementitious render. The render has some minor cracking and has previously been patch repaired. The internal inspection has identified that it is allowing water to penetrate the masonry, this is in turn causing elevated moisture levels in the adjacent timbers in the roof void over the organ.

We recommend the cement render is carefully removed and the area re-rendered with a lime based render that allows the masonry to breath. It is likely that localised re-detailing and masonry

repairs will also be required. The works should be carried out in the short term, if there is a delay to the main roofing works (past, say 2 years) we would recommend carrying them out as a standalone project.

The works should be completed in conjunction with the main roofing works, if it is carried out separately, we estimate that including access it would cost in the region of £55,000 + VAT. If carried out as part of the wider roof refurbishment, the cost would likely be in the region of £1,500 + VAT.

4.8 Roof – Slate

The roof to Blackfriars Hall is finished with slate. We were not able to access the roof and have had to rely on the drone photos provided by the Janus survey. The photos shows limited slipped slates; it is advisable to provide access and replace the missing slates to prevent those around being prone to excessive wind lift.

There are currently no immediate leaks and the lack of widespread slipped and missing slates would indicate there is currently no inherent issue requiring significant works. The costs to replace the missing slates is expected to be limited to circa £500, with the majority of the costs linked with providing safe access. The cost of providing safe access is likely to be in the region of £35,000, albeit this could be provided in conjunction with scaffold to repair the tracery windows covered in section 4.13 of this report.

4.9 Roof – Mineral Felt

The flat roof over the Crypt, part Cloisters and the plant area to the north of Blackfriars is finished with bituminous felt. The roof finish is aged and in poor condition, with a number of active leaks noted internally, and patch repairs applied from a liquid plastic externally. We consider the roof to be at end of life and recommend it is replaced in the short term to minimise further damage to the internal fabric.

The roof is flat but has multiple levels and volumes of plant directly adjacent to Blackfriars Hall. The current rainwater drainage is convoluted and has resulted in ponding on the surface which increases the risk of further leaks. We recommend that as a part of any future re-roofing, insulation cut to falls is installed to simplify the drainage, reduce ponding and improve thermal efficiency of the buildings beneath.

The estimated cost of installing a new roof is expected to be in the region of £60,000 + VAT including access.

4.10 Drainage

Drainage inspections were undertaken by Eastern Drainage during the weeks commencing 5th and 19th December 2022. The drainage report and plan should be referred to in Appendix 4.

In summary, the drains are largely serviceable but with a large quantity of minor repairs required, typically involving lining minor cracks and damage to salt glazed drainage pipes.

There are two areas of collapsed drains in the Cloisters that should be addressed in the short term to facilitate rainwater draining away from the building. The remaining repairs should be included in a planned maintenance regime. We are awaiting costs for the drainage repairs, but estimate the immediate repairs will cost in the region of £5,000 + VAT.

It was noted that there is no ground rainwater drainage in the former Chapter House area with rainwater goods in this area discharging onto the ground. Consideration should be given to extending existing drainage runs to allow rainwater to drain away from the buildings.

A further drainage inspection of the main sewers in St Georges Street has been requested from Anglian Water to ensure that the movement in the structure of St Andrews Hall is not being caused by leaking drains in the highway. Anglian Water have reported that inspecting the drains in this area requires a partial road closure and winching operatives into a 6-metre-deep storm drain.

Planning of this survey is continuing; we have not yet received a firm date but this is reported to be likely in January 2023. Costs associated with any repairs to the drains in the highway would fall to Anglian Water.

4.11 Rainwater Goods – Cast Iron and Lead Lined Gutters

4.11.1 Lead lined gutter to Blackfriars

The rainwater goods to Blackfriars Hall consist of timber eaves with lead lined integral gutters discharging into cast iron downpipes. To the south, and part of the north elevation the downpipes subsequently discharge onto the flat roofs of the buildings abutting the Hall.

Access to the lead lined gutter was limited to drone photography, being viewed from binoculars from the cherry picker and a pole camera.

The gutter lining appeared to be largely in fair condition with exception of a section of gutter on the north elevation that had failed completely with localised significant timber decay. To the east end of the south gutter, and the west end of the north gutter there was significant plant growth. The failed section of gutter on the north elevation was heavily clogged with plant growth and it is likely the issue has been caused by water overlapping due to the blockage. The eaves gutter detail was generally in poor decorative condition.

In the first instance the gutters should be cleaned to ensure they are free flowing, this will require local scaffolds. Once the gutters are cleaned we strongly recommend they are cleaned regularly using a gutter vacuum system to remove low levels of detritus before it builds up to the current level.

The failed section of gutter should be repaired with local timber splice repairs and a new section of lead.

We have assumed that access will be provided with the scaffold for the roof and windows. No access has been included in the costs. The estimated cost of clearing the gutters is £600 + VAT. The estimated cost of repairing the section of damaged gutter is £2,500 + VAT. The estimated cost of decorating the eaves is £1,600 + VAT. Should the initial clearing and repair works not be carried out in conjunction with the roof and window repairs, we estimate separate access would cost in the region of £15,000 + VAT.

4.11.2 Cast Iron Downpipes to Blackfriars

The cast iron downpipes are in fair condition but suffering from decorative disrepair. To the south elevation the eastern downpipe appeared to be blocked at high level, this should be cleared as a priority. To the western downpipe on the south elevation some minor repairs are required. The fixings to all downpipes are in poor condition, we recommend these are overhauled and the downpipes are decorated when access is next provided.

The cost to clear the blocked downpipe including access is estimated to be £2,500 + VAT. The cost to carry out the minor repair, decorate and re-fix the remaining downpipes is estimated to be £1,500 + VAT.

4.11.3 Porch over entrance

To the slate roof over the porch entrance to the rear of St Andrews Hall the lead lined gutters are full of debris. We understand that access has been prohibited on health and safety grounds. The area should be accessed immediately with the use of ladders and the gutters cleared. Failure to do this will likely lead to damage to the internal finishes, and eventually roof structure. We recommend that a fixed access system is installed in the short term to allow regular maintenance of the gutters in this area. The cost to clean the gutters now is estimated at £400 + VAT.

4.12 Rainwater goods PVCu

There are limited PVCu rainwater goods to the north of the crypt. The rainwater goods are in complete disrepair and discharging rainwater onto soft red brick and flint retaining wall. These should be renewed and connected to below ground drainage as a priority. We estimate the cost to be in the region of £500 + VAT.

4.13 Windows

There are stained glass windows to each of the bays of St Andrews Hall to the north, south and west elevations. To Blackfriars the windows are to the north, south and east elevations.

The windows are thought to date from the Victorian period and have partially reached end of life.

The windows to the clerestory and north elevation are largely in good condition and look to have been refurbished but require some minor patch repairs where damage has occurred.

The windows to the south elevation and west elevations of St Andrews Hall are in poor condition, the glazing has largely become disconnected from the saddle bars (which provide lateral support). The lead is disformed with the windows bulging throughout, this has led to isolated broken quarries (diamond shaped pieces of glass) which in turn is allowing water ingress. We consider the condition of the windows hazardous, they should be repaired as soon as possible.

The condition of the windows has been exacerbated by the secondary glazing that has been fitted. This causes overheating in the void between the glazing, which will further distort the lead. Conversely however given the windows current fragile condition the secondary glazing will also provide some protection to the windows being blown out by positive pressure in the building that occurs when doors are open in windy conditions. We understand there is an intention to fit new secondary glazing as a means of noise control, we recommend this introduces a means of ventilating the void between the glazing to prevent overheating.

The windows are in an extremely fragile condition and overhang areas that pedestrians frequent. We understand measures to prevent access to the immediate areas beneath the windows has been taken and recommend this is maintained until the windows can be secured.

To Blackfriars Hall the main windows to the south and north elevation are in fair condition, but the tracery at the head of the windows is in poor condition with distorted glazing unconnected to the saddle bars. Isolated saddle bars have also failed and should be repaired. The main glazing to the east elevation is in very poor condition and widely distorted, this is hazardous and should be repaired as soon as possible.

The glazing to the clerestory windows on the north elevation is in good condition, but the stone mullions to isolated windows have had cement mortar repairs carried out. This has eroded the sandstone below to an extent that a number of mullions are close to failing and require replacement.

All the windows that are in disrepair would clearly benefit from being repaired, we consider however the windows in the western gable of St Andrews to be the most urgent given the proximity of pedestrians.

We estimate the following costs to undertake the repair works:

- St Andrews Hall, west gable £120,000
- St Andrews Hall, southern elevation £180,000
- Blackfriars, east elevation £40,000
- Blackfriars, tracery £150,000
- St Andrews, stone mullions £3,000

- Scaffold access to St Andrews west gable £20,000
- Scaffold access to St Andrews south elevation £40,000
- Scaffold access to Blackfriars tracery £60,000

- Scaffold access to Blackfriars east elevation £10,000

We are awaiting budget costs for new ventilated secondary glazing to the windows on the south and west elevations of St Andrews Hall (to replace existing non-ventilated glazing). We have allowed a provisional sum of £20,000 per window - £180,000 total cost.

Costs exclude VAT and professional fees.

5 The Cloisters

5.1 Rainwater Goods

The rainwater goods to the cloisters are from cast iron gutters and downpipes with a number of valley gutters to the western buildings.

All rainwater goods were a little tired and in need of general maintenance but were not suffering from serious defects. We recommend access is provided in the short to medium term to decorate, overhaul seals and re-secure the downpipes.

Although there is only one downpipe on the north elevation of the cloisters there is no evidence of water overflowing the gutter in surcharge conditions. We recommend the drainage plans are checked to investigate what is involved in installing a second downpipe, this however does not need to be a priority.

The valley gutters to the western buildings are in fair condition and there are no signs of any active leaks. The application of a secondary water-proofing treatment to the eastern most gutter indicates it has previously leaked, we recommend this is overhauled when access is next provided.

There are concerns about access to these areas for regular cleaning and maintenance. Consideration should be given to installing a permanent means of access, possibly via access hatches within the roof pitches if deemed acceptable to the conservation officer. Works to make the roof voids more accessible should also be carried out by removal of redundant water tanks and enlarging loft hatches.

The cost to provide access to allow decoration and repairs to rainwater goods is estimated to be £22,000 + VAT. The cost to decorate and carry out patch repairs to the rainwater goods is estimated to be £5,500 + VAT (provisional sum for repair). The cost to overhaul the valley gutter, assuming it utilizes the decoration scaffold is estimated to be £5,400 + VAT.

5.2 External Walls

5.2.1 The Cloisters

For full details please refer to the engineer's report in Appendix 5, sections 3.34 to 3.42.

In summary, the external walls are largely performing well, but have multiple areas of weathered and deteriorating masonry. These should be incorporated into a maintenance schedule so that they can be addressed in a timely fashion. The arches over the first-floor rectangular windows require tying back to the main structure, this should be undertaken when access is next provided. We estimate this will cost in the region of £9,000 + VAT.

5.2.2 The Crypt (Former Chapter House walls)

For full details please refer to the engineer's report in Appendix 5 (paragraph 3.45).

The retaining wall adjacent the Crypt (referred to in the Engineer's report as the *Former Chapter House Walls*) is unstable and requires repairs and restraint installing. Extensive masonry repairs are required to replace weathered and spalling bricks and tie the walls together with horizontal tie bars to provide some lateral strength. Further works to the head of the wall to allow it to shed water

are required. Finally, the engineer considers it prudent to install an intermediate buttress to the wall to provide further strength and stability.

Further details are required, but our initial estimate is the repairs will cost in the region of £50,000 + VAT. This should be carried out as soon as possible.

5.2.3 Arches

The arches facing into the Garth are in poor condition with a spalling render finish over brick. There is no immediate health and safety concern over the structural stability of the arches, but the condition of the render is continuing to deteriorate and will lead to further loss of historic fabric. We recommend that access is provided and the arches are repaired with a conservation mortar. The existing material will require some analysis to allow the correct repair mortar to be identified. We estimate the cost of a repair to be £5,000 + VAT including access.

5.3 Roofs – Slate

The pitched roofs to the Cloisters are finished with slate and appear to be in fair condition. There are a small number of missing slates, we recommend these are renewed when access is next provided to prevent excessive wind lift on adjacent slates causing further damage. There are no signs of internal water ingress. An estimated cost excluding access is £500 + VAT

5.4 Weather Flashings and Abutments

The weather flashings and abutments are largely in fair condition commensurate with the main roof covering. These should be checked closely when access is next provided and any necessary repairs carried out.

5.5 Timber roof structure

The engineer gained access into the main roof structure over the two-storey section of the Cloisters, for further details please see section 3.49 in Appendix 5.

The structure was found to be in good condition with no significant defects, albeit the area had accumulated a lot of dirt and there was very limited fire stopping noted. It is recommended the area is cleaned and the fire separation is reviewed.

5.6 Windows

The windows are timber single glazed sliding sash or tilting casement opening units. Windows throughout are tired with decorative disrepair, minor repairs required to opening mechanisms, catches, glazing and external timber, but they are largely free from serious defects.

1 No window to the second floor is suffering from significant timber decay and should be renewed as soon as possible prior to the glazing becoming loose and hazardous.

Generally, we recommend that a full external decoration and overhaul with sundry repairs is carried out in the medium term. We have assumed this would be carried out in unison with the repairs and decoration of the rainwater goods so have not allowed separate access costs. We estimate the cost to decorate and overhaul the windows of the cloisters would be £15,000 + VAT.

The cost to renew the window in poor condition is £2,000 + VAT.

5.7 Drainage

See section 4.10 of this report.

6 Summary of Costs

= Immediate / Urgent = Required / Short term Necessary – medium term

Item	Report Section	Description	Cost	Priority
1	4.1	Provide access to allow cleaning of lead roof gullies	£5,000.00	
2	4.2	Weather flashings including access	£15,850.00	
3	4.5	Immediate repairs to copper rainwater goods*	£950.00	
4	4.10	Drainage repairs to collapsed drains**	£5,000.00	
5	4.11.1	Immediate repairs and cleaning of lead gutter to Blackfriars	£3,100.00	
6	4.11.1	Access for immediate repairs to Blackfriars	£15,000.00	
7	4.11.2	Clear blocked downpipe to Blackfriars	£2,500.00	
8	4.11.3	Clear rainwater goods over porch entrance	£400.00	
9	4.12	Renew PVCu rainwater goods to crypt	£500.00	
10	4.13	Overhaul St Andrews Windows - west Gable	£140,000.00	
11	4.13	Overhaul St Andrews Windows - south elevation	£220,000.00	
12	4.13	Overhaul Blackfriars Windows - east elevation	£50,000.00	
13	4.13	Overhaul Blackfriars Windows - tracery	£210,000.00	
14	5.2.2	Provisional sum for repairs to Crypt wall**	£50,000.00	
15	5.6	Renew 1 window to Cloisters	£2,000.00	
		Sub total	**£720,300.00**	
16	4.3	Undertake repairs to main roof structure**	£50,000.00	
17	4.5	General overhaul of copper rainwater goods	£7,200.00	
18	4.6	Re-activate movement monitoring equipment and access reports	£2,000.00	
19	4.7	Install new copper roof finish	£290,000.00	
20	4.7	Temporary roof to St Andrews Hall***	£222,000.00	
21	4.7.1	Replace render on gable end*	£1,500.00	
22	4.9	Overlay mineral felt roof	£60,000.00	
23	4.11.2	Patch repairs and redecoration to cast iron downpipes on Blackfriars*	£1,500.00	
24	4.13	Overhaul stone mullions to clerestory window	£3,000.00	
25	4.13	Renew secondary glazing**	£180,000.00	
26	5.1	Overhaul valley gutter to Cloisters*	£5,400.00	
		Sub total	**£822,600.00**	
27	4.4	Treat steel to Blackfriars roof structure**	£50,000.00	
28	4.8	Patch repairs to Blackfriars roof*	£500.00	
29	4.11.1	Decorate eaves to Blackfriars*	£1,600.00	
30	5.1	Provide high level access to Cloisters	£22,000.00	
31	5.1	Decorate rainwater goods and carry out patch repairs to Cloisters	£5,500.00	

32	5.2.1	Securing brick arches to first floor windows in Cloisters	£9,000.00	
33	5.2.3	Render repairs to arches on Cloisters	£5,000.00	
34	5.3	Patch repairs to Cloisters roof*	£500.00	
35	5.6	Patch repairs and decoration to Cloister windows *	£15,000.00	
		Sub total	**£109,100.00**	

* Costs do not include access
** Provisional sum costs only, further reporting is required.

All costs exclude VAT. Costs may be subject to main contractor overheads and preliminaries depending on how they are procured.

Please note that where we have provided costs, these are indicative budget costs only and do not include any allowance for inflation. They are based on the items being carried out as a substantial package of works during normal working hours.

Should you require further advice on obtaining best value or how to manage maintenance budgets effectively please do not hesitate to contact Roche Chartered Surveyors.

N.B Priorities are given as guidance only, the full report should be read and understood for individual issues.

7 Further Investigations

7.1 Further Monitoring / Investigation

Throughout the report items have been identified as requiring further monitoring. For ease of reference, these are collated here:

- A schedule of stone defects / repairs should be compiled
- Monitoring of the structural movement
- Further investigation into the feasibility of internal propping of a temporary roof
- Historic study of property to ascertain former works carried out
- The floors in the west of the cloisters should be checked to see if ventilation is still required.
- Sampling of historic render to arches in the Cloisters

8 Summary and Recommendations

We recommend that this report be read in its entirety, but summarise some of the principal points as follows:

a. The lead roof requires a safe means of access providing to allow for regular cleaning of the drainage gullies.
b. Some isolated flashings to the copper roof require immediate attention.
c. The timber structure requires some repairs, but these can be carried out in conjunction with a re-roofing project.
d. The gable end between Blackfriars and St Andrews requires re-rendering.
e. There are some immediate rainwater good repairs required to St Andrews and Blackfriars.
f. The external walls are likely moving but no immediate works are envisaged.
g. The monitoring devices for the movement to the external walls should be re-activated.
h. The copper roof to St Andrews requires renewal. The sooner this is carried out the less damage to the timber roof structure will occur, and the cheaper the works will likely be.

i. The works to re-roof St Andrews will likely require a temporary roof installing, the exact method of this requires further study.
j. The felt roof over the Crypt is at end of life and should be renewed. This should incorporate insulation and alternative drainage to reduce the risk of future leaks.
k. The stained-glass windows are in very poor condition and require widespread repairs; where these overhang pedestrian areas they are considered hazardous.
l. The Cloisters are largely in fair condition, but a programme of external maintenance will be required in the short to medium term.
m. The retaining wall in the former chapel area requires repair and strengthening.
n. Urgent works are estimated at circa £190,300 + VAT
o. Short term works are estimated at circa £1,172,600 + VAT
p. Short to medium term works are estimated at circa £109,100 + VAT
q. There is scope to reduce costs with combined use of access scaffolds.
r. Currently there is some difficulty in assessing costs accurately, further information is expected shortly.

We trust that this report meets your requirement, but should you have any queries or require any clarification of the above points please do not hesitate to contact us.

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Partner

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9 Confidentiality

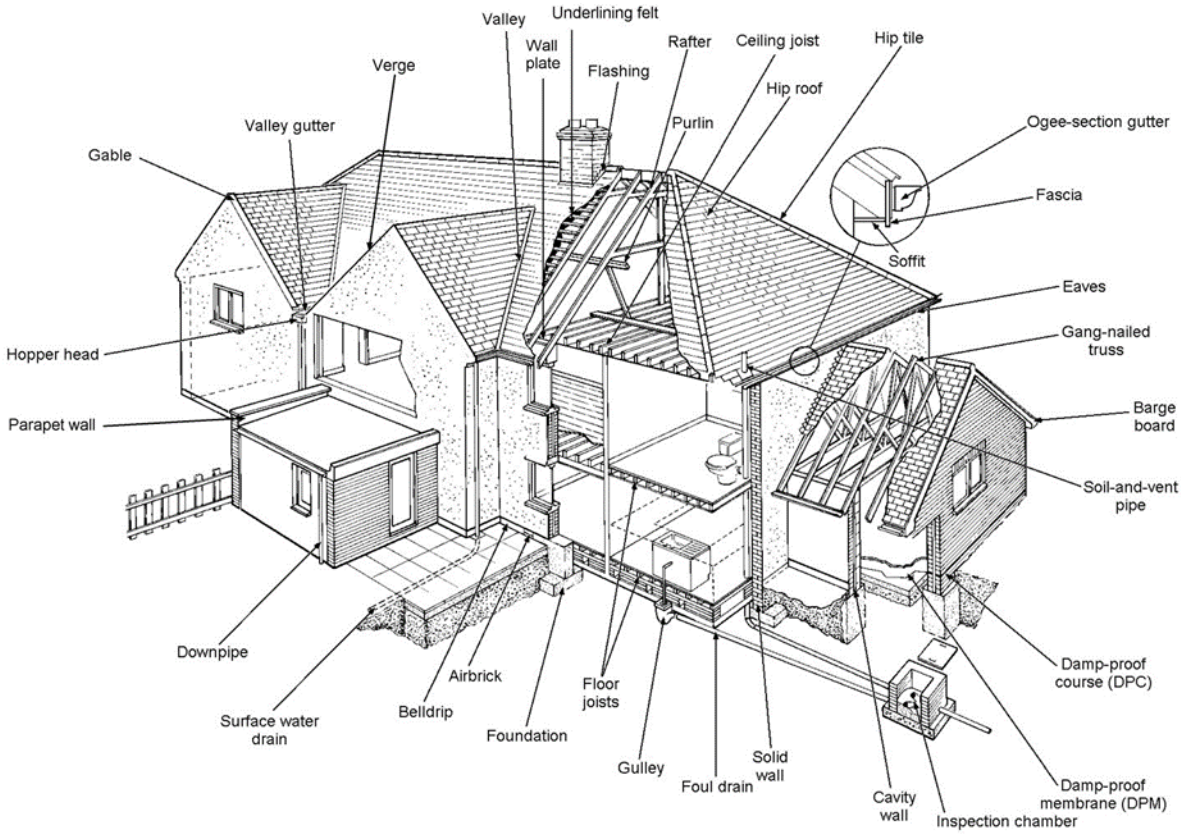
This report has been prepared solely for the purpose stated and is to be regarded as confidential to the persons to whom it is addressed, and it is intended for use by them only. Consequently, in accordance with our normal practice, no responsibility is accepted to any third party in respect of the whole or any part of its contents.

10 Glossary of Terms Used

Where the following times have been used they mean:

Immediate / Urgent	As soon as possible
Short term	Next 24 months
Medium term	2- 5 years
Long term	5-10 years

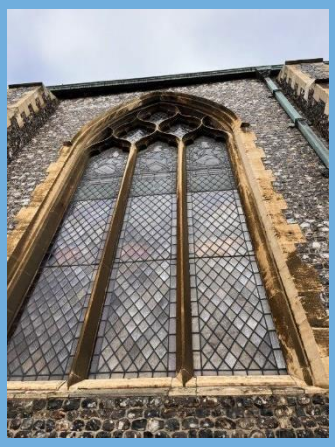
Typical construction terms are illustrated below:



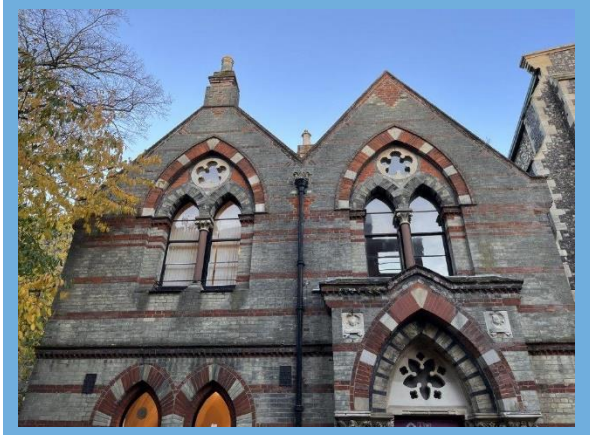
ROCHE

Appendix 1

Selected Photographs



West Elevation Stain Glass Window



Front Elevation - Cloisters

North Elevation - Cloisters

Nave roof – north pitch

Poor lead fixings to centre of copper sheet

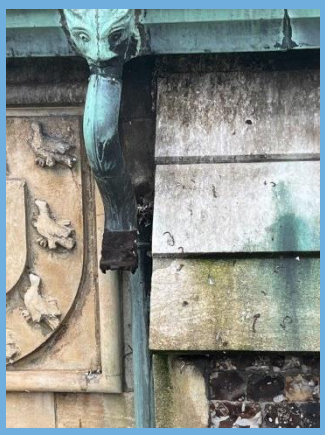
Copper sheets ‘dishing’

Failed patch repair to copper

Fixings to copper sheet seams

Copper abutments in poor condition

Failed copper flashing to nave



Disconnected swan neck to nave

Felt roof in poor condition

Cloister window at end of life

Typical Cloister window internally

Cloister valley gutter

Copper RWG in poor condition

Leaf debris to Cloister valley gutter

Blackfriars gutter in disrepair

Appendix 2

List of Priority A&B works

Condition Report Table

Information taken from Condition Surveys completed by Janus in August 2022

Table should be read in conjunction with surveys for further detail.

St Andrews & Blackfriars Hall

Category A Table

Category A Definition - Defects which are serious and need to be repaired, replaced, or investigated further urgently. There is a high possibility that these defects will lead to significant decay or failure of the fabric if they are not addressed immediately or pose a significant risk to health and safety.

Element	Budget	Recommendations
Roof 2 – Lead	£5,000	In order to provide long term confidence in the lead covering's ability to shed water, this roof does require repairs in the immediate term where sections of the lead dressing are missing. It would also be prudent at this juncture for an experienced lead worker to undertake a phase of maintenance and sundry repair to prolong the covering's life. For information, all new leadwork should follow the codes and details as set out by the Lead Sheet Training Academy – https://leadsheet.co.uk/.
Weather Flashings & Abutments – Copper	£7,000 (repair)	In the short term the weather flashings should be inspected and repaired by an experienced roofer on a temporary basis until a wider re-roofing scheme can be undertaken. **The roof structure however may be compromised to the east section of the south aisle however (where the access ladder terminates), so care should be taken.** Longer term, the flashings should be renewed as part of the recommended renewal of the Roof Covering of Roof 1 in order to provide confidence in the long-term ability of this roof to shed water and to make best use of high-level access. For information, all new copper roofing works should follow the codes and details as set out by the Copper Roofing Advisory Service.
Timber Roof Structure - Roof Void 1 – St Andrew's	£3,000 – inspection	The most important recommendations concerning the condition of Roof Void 1's timber structure relates to undertaking the recommended works surrounding the Roof Coverings, Flashings & Abutments, and Rainwater Goods in order to halt water ingress into the building and associated decay to the timber roof structure. See also Presence of Bats. Due to evidence of dry rot, to provide confidence I highly recommend that roof timbers are inspected internally, which will require the use of a MEWP (cherry picker). It would also be highly beneficial for

Element	Budget	Recommendations
Hall Nave & Aisles		this inspection to utilise a electronic resistance drill (such as this https://rinntech.info/products/resistograph/) to provide some empirical data. This should be undertaken prior to accessing the roof externally. Due also to the condition of the Roof Coverings, Flashings & Abutments, and Rainwater Goods, from a budgeting perspective, when the roof covering is renewed, some repair and/or replacement of timbers should be anticipated. It is very difficult at this point to quantify the cost, but it could easily run into tens of thousands – possibly £50,000 plus VAT. Please note that access to Roof Void 3, which forms the roof structure of the southwest porch to St Andrew's Hall, was inaccessible during our inspection.
Timber Roof Structure - Roof Void 2 – St Andrew's Hall	£1,000 - inspection	Whilst the affected timbers have probably been in their current poor condition for some time (possibly decades) the presence and advanced nature of decay is concerning and likely requires repair to provide long term confidence in the structural efficacy of the roof timbers. We would advise that further investigations are undertaken utilising an electronic resistance drill (such as this: https://rinntech.info/products/resistograph/) to provide some empirical data. Timber repairs should, where required, be undertaken on a like-for-like basis, with a minimum intervention and maximum retention philosophy employed.
Rainwater Goods – Copper	£30,000	Misaligned rainwater pipes should be repaired immediately, especially to the south aisle, to begin the process of drying the timbers internally. Care should be taken when accessing the roof however due to the issues discussed in Roof Structure. At this juncture the system requires a full overhaul, which would include removing all units, inspecting/repairing then refixing them external walls and connecting to the subterranean drainage system. All gutters, hoppers, and downpipes must be cleared of debris to prevent overtopping. We would advise that a degree of replacement of some of the copper units should be anticipated as part of these works and should be undertaken on a like-for-like basis. Ensuring that rainwater can effectively migrate away from the building fabric is the easiest way of preventing water ingress and associated defects. Going forwards, all gutters and downpipes should be cleaned out annually – the importance of this cannot be overstated.
External Walls -	>£100,000	The ongoing structural movement at the west end of St Andrew's Hall needs to be investigated further. We would advise that the movement is monitored, and the results assessed by a suitably

Element	Budget	Recommendations
Structural Movement		experienced and qualified conservation-accredited (CARE) Structural Engineer, who would also be able to advise if any temporary structural works are required. Consideration needs to be given to the Health and Safety risk to pedestrians due to the potential for falling masonry. We noted during our visit that restaurant seating is located beneath the buttresses on the west-end of the building, which could pose a liability risk. See also Services and Masonry & Mortar.

Category B Table

Category B Definition – Defects which require repairing or replacing but are not considered to be either serious or urgent. It is possible however that if these defects are not addressed within the next 12 months, they will deteriorate rapidly.

Element	Budget	Recommendations
Roof 1 - Copper	£150,000	Due to the general declining condition of this roof covering, ongoing water ingress and subsequent risks to internal elements and fabric, as well as concern regarding the damage that might occur should a live load be added, on balance, full replacement of this roof covering is the only real option, which is required ASAP. Repair is possible, but at this point is more than likely represents a false economy. The longer it is left, the more at risk there is to the roof structure becomes which will – in all likelihood – lead to a larger repair bill. The roof coverings of the southwest porch and southern aisle have been renewed more recently, although we would recommend that a further assessment of their condition is made once high-level access is next achieved, and, depending on these findings, consideration of including these sections in the required re-roofing scheme. The age of the roof suggests that repair is possible rather than wholesale replacement. You should be aware that in undertaking a roof replacement project the level of energy efficiency of the element requires upgrading under Part L of the Building Regulations. How to achieve this whilst maintaining the building's technical function requires careful thought, but we always recommend the use of vapour permeable and sustainable insulation types such as flax, sheep's wool and wood fibre. We would also advise that timber repairs to the roof structure should be anticipated as part of the required roof renewal scheme, indeed we have never been involved with a reroofing project where this hasn't been the case, although we are unable to advise on the extent of this until further opening works are undertaken. For information, all new copper roofing works should follow the codes and details as set out by the Copper Roofing Advisory Service. See also Presence of Bats and Roof Structure.
Roof 3 – Slate	£5,000 for repair	Repairs should be undertaken to the covering in the next 12 months, including the replacement of slipped or missing slates, in order to ensure it continues to be watertight.

Element	Budget	Recommendations
		Due to the roof's age, on-going repairs should be anticipated over the coming years in order to ensure the covering remains water tight.
Roof 4 – Mineral Felt	£20,000	The patch repairs that have been undertaken historically have prolonged the lifespan of theses sections of roofs, but these are now beginning to fail themselves and water ingress is occurring internally. In order to preserve the building fabric and ensure no long-term damage, we recommend a replacement of these roof coverings within the next 12 months rather than continued repair, which at this point would almost certainly represent a false economy. On a side note, we would advise that Listed Building and Scheduled Monument Consent is unlikely to have been granted for the application of a modern mineral felt roof covering. As the life expectancy of roofing felt is so short, it would be prudent to consider a longer lasting material such as EDPM. Some timber repairs to the structure beneath should be expected as part of the required renewal works.
Weather Flashings & Abutments – Lead	£25,000	We would advise the lead gutters are cleared of debris in order to avoid further risk of water ingress in the immediate term and to allow for a more detailed inspection and for a course of sundry repairs to be undertaken where needed.
Rainwater Goods – Cast Iron Downpipes & Lead-Lined Gutters	£35,000	Misaligned rainwater pipes should be repaired immediately to protect the associated fabric and mitigate the risk of decay. The system requires a full overhaul to ensuring all downpipes are connected to the subterranean drainage system, and all gutters, hoppers, and downpipes must be cleared of debris to prevent overtopping. It is likely that the existing cast iron downpipe units can be shot blasted and retained. On completion, all cast iron elements should be fully redecorated, and you should consider the use of a natural linseed oil-based paint (where units have been completely stripped), which has far greater longevity than modern paint. Consideration should be given to providing additional downpipes to the system serving Blackfriars' Hall in order to ensure that the risk of overflowing gutters is minimised. All new downpipes should connect to the subterrain external drainage system. Ensuring that rainwater can effectively migrate away from the building fabric is the easiest way of preventing water ingress and associated defects.

Element	Budget	Recommendations
		Going forwards, all gutters and downpipes should be cleaned out annually – the importance of this cannot be overstated.
Rainwater Goods – PVCu	£5,000	Misaligned rainwater pipes should be repaired immediately to protect the associated fabric and mitigate the risk of decay. Longer term however, this part of the rainwater system requires a full overhaul to ensuring all downpipes are connected to the subterranean drainage system, and all gutters, hoppers, and downpipes must be cleared of debris to prevent overtopping. Ensuring that rainwater can effectively migrate away from the building fabric is the easiest way of preventing water ingress and associated defects. Going forwards, all gutters and downpipes should be cleaned out annually – the importance of this cannot be overstated.
Windows	£50,000	The historic leaded lights of the Halls require a complete overhaul, including the renewal of the leadwork, which will necessitate them being removed from the church. Some repairs to the masonry window dressings should also be anticipated. Good ventilation is paramount for buildings such as this to prevent condensation/damp. It is important, therefore, that all windows are fully operable for this reason. There is an opportunity to markedly improve the building's overall thermal efficiency by installing secondary glazing.
Services	£2,000 – CCTV survey	You should be aware that all service installations deteriorate with age and use and in this instance, they are likely to be of some age. They should therefore be inspected and tested at regular intervals to check whether they are in a satisfactory condition for continued use. I highly recommend that you commission a CCTV drainage survey of the existing subterranean drainage network to ensure it is performing effectively. It is quite possible that a defective system is at last partly to blame for the issues discussed above concerning Structural Movement and Internal Low-Level Damp.

St Andrews & Blackfriars Hall – The Cloisters

Category A Table

Category A Definition - Defects which are serious and need to be repaired, replaced, or investigated further urgently. There is a high possibility that these defects will lead to significant decay or failure of the fabric if they are not addressed immediately or pose a significant risk to health and safety.

Element	Budget	Recommendations
Rainwater Goods – Cast Iron	£20,000	To provide confidence, at this juncture the rainwater system generally requires a scheme of inspection/testing and refurbishment including a comprehensive clean-out and all gutters and downpipes. It should be anticipated in doing so that some (perhaps 25%) of the goods will require replacing or blasting and redecorating. Ensuring that rainwater can effectively migrate away from the building fabric is the easiest way of preventing water ingress and associated defects. Going forwards, all gutters and downpipes should be cleaned out annually – the importance of this cannot be overstated. See also: Weather Flashings and Abutments
External Walls - Structural Movement	£10,000 – for investigations	Further investigations are required, which will include monitoring the cracks and may well involve the digging of trial holes. It is also highly recommended that a CCTV survey and mapping of the existing subterranean drainage is undertaken, as outlined in Services. You should consult with conservation accredited (CARE) structural engineer as to how best to ascertain the root cause of the movement and how to arrest it – which unfortunately may involve a significant intervention.

Category B Table

Category B Definition – Defects which require repairing or replacing but are not considered to be either serious or urgent. It is possible however that if these defects are not addressed within the next 12 months, they will deteriorate rapidly.

Element	Budget	Recommendations
Roofs 1-4 – Slate with Clay Ridges.	£5,000	The condition of the roof coverings suggest that they were last re-laid in the region of 40 years ago. You would expect a roof in the UK to last between 70 – 90 years, so it is around middle aged. As there are a number of slipping slates, at this juncture it would be highly beneficial in order to prolong the covering's life and mitigate any risk of falling material/risk to health, to speak to a roofer with historic buildings experience to undertake a phase of maintenance and repair - which would include replacing slipped/missing and chipped slates. The roofer will find the drone pictures – which are downloadable via a link at the beginning of this report – very helpful. See also Presence of Bats and Roof Structure, Weather Flashings and Abutments & Rainwater Goods.
Weather Flashings & Abutments - Lead	£5,000	As with the Roof Covering, the leadwork is now likely to be around middle age. Though there was no evidence of significant defect at the time of the inspection, it has obviously experienced some issues historically and is of the age where details can start to become loose and small cracks and fissures can appear – all of which is repairable. A phase of maintenance and repair at this juncture is therefore highly recommended, which should be undertaken by an experienced lead worker (which is different to a roofer). They can undertake in-situ repairs to the lead where required using lead patches where necessary, and re-boss details should they be loose. The maintenance regime should include the full clearing and disposal of debris. Special attention should be paid to valley gutters, especially the gutter between Roofs 2 and 3.
Timber Roof Structure - Roof Voids 1 - 4	£300	The inspection was undertaken during a dry period at the height of summer. It is recommended therefore that timbers, especially those adjacent to areas of (probable) water ingress are inspected again after a wet spell. It is also highly recommended that a longer ladder is kept on-site and that the structure of Void 3 is inspected. As all of the roof coverings were likely replaced under one intervention relatively recently though, it seems likely that significant defect would be discovered. There is an opportunity to significantly improve the building's energy efficiency by increasing the amount of insulation in the voids.

Element	Budget	Recommendations
External Walls – Arches	£3,000	A more detailed inspection of the arches is required, probably utilizing a tower scaffold, to assess the condition of the render. It is likely through careful conservation that much of the material can be stabilized in-situ. Deficient areas can be re-rendered in an appropriately specified lime render, which is likely to require some sampling of the existing.
Windows	£15,000 for repairs	A more detailed inspection of the windows is required to determine their operation. Any missing/broken cords should be replaced, or inoperable windows eased and adjusted. The windows internally are now in need of a rub down and redecoration, at which time some sundry repair should be anticipated – though I do not believe it to be overly onerous. There is an opportunity to markedly improve the building's overall thermal efficiency by installing either draught proofing or secondary glazing.
Services	£2,000 – CCTV survey	You should be aware that all service installations deteriorate with age and use and in this instance, they are likely to be of some age. They should therefore be inspected and tested at regular intervals to check whether they are in a satisfactory condition for continued use. I highly recommend that you commission a CCTV drainage survey of the existing subterranean drainage network to ensure it is performing effectively. It is quite possible that a defective system is at last partly to blame for the issues discussed above concerning Structural Movement

Appendix 3

Listing Entry

Former Dominican Friary (Blackfriars) Norwich: St Andrew's Hall and Blackfriars' Hall, The Crypt, the south range, the East Garth and east cloister walk, the West Garth, and west boundary wall

Official list entry

Heritage Category: **Listed Building**

Grade: **I**

List Entry Number: **1220456**

Date first listed: **26-Feb-1954**

Date of most recent amendment: **10-Jun-2016**

Statutory Address 1: **The Halls, St Andrew's Plain, Norwich, Norfolk, NR3 1AU**

This List entry helps identify the building designated at this address for its special architectural or historic interest.

Unless the List entry states otherwise, it includes both the structure itself and any object or structure fixed to it (whether inside or outside) as well as any object or structure within the curtilage of the building.

For these purposes, to be included within the curtilage of the building, the object or structure must have formed part of the land since before 1st July 1948.

Understanding list entries *(https://historicengland.org.uk/listing/the-list/understanding-list-entries/)*

Corrections and minor amendments *(https://historicengland.org.uk/listing/the-list/minor-amendments/)*

Location

Statutory Address: The Halls, St Andrew's Plain, Norwich, Norfolk, NR3 1AU

The building or site itself may lie within the boundary of more than one authority.

County: Norfolk

District: Norwich (District Authority)

Parish: Non Civil Parish

National Grid Reference: TG2314108814

Summary

Former friary, originally constructed by the Friars Penitential in the C13 but largely rebuilt by the Dominicans in the C14 and C15. The church was converted into municipal halls in c1540, and the buildings restored and altered in 1861 and 1863.

Reasons for Designation

The former Dominican friary (Blackfriars), Norwich, a medieval friary built from the C13 onwards, is listed at Grade I for the following principal reasons:

* Rarity: as the most complete surviving medieval friary in England and one of only 15 friaries to retain significant upstanding remains; * Degree of survival: the friary church is substantially intact and three ranges of the cloister retain a substantial proportion of medieval fabric; * Architectural interest: the arches of the cloister arcade and vaulted ceiling of the south walkway are an impressive medieval survival whilst the former church is a fine example of Perpendicular Gothic architecture; * Design: the former church, with a tall, wide, open nave with slender arcade piers, provided good sight lines for large public gatherings and well reflects the friars ethos for learning and preaching, as well as ensuring its continued use as municipal halls since 1540; * Materials: the claustral complex represents an early use of brickwork in medieval England, whilst the limestone ashlar of the church clerestory was an expensive material imported into the region; * Historic interest: as a friary with a major role in the community for nearly 300 years before serving a municipal role for nearly 500 years since the Dissolution, including as stables for army horses during Kett's Rebellion (1549), a mint during the Great Recoinage (1696), England's first public lending library (1716), and halls where Charles Dickens read and the opera singer Jenny Lind performed during the mid-C19; * Group value: through association with the scheduled remains of the friary and proximity with the adjacent listed buildings on Elm Hill, St Georges Street and Princes Street, including the St Peter Hungate Church.

History

A friary was established on this site by the Penitential Friars in 1258 but was later taken over by the Dominicans and occupied until the Dissolution of the Monasteries in 1538. A friary was an institution housing a community of friars. The friars (from the Latin 'frater' meaning 'brother') were a religious movement which advocated a 'mendicant' lifestyle, of absolute poverty, supported exclusively by begging and the gift of alms. Friars lived in the community,

preaching and undertaking charitable works, often moving from town to town. Nevertheless, they did establish permanent bases; friaries, from which, unlike monks, they emerged to fulfil their mission. The buildings centred on a church and a cloister and usually contained a refectory (dining hall), a chapter house and an infirmary (for the care of the sick). Five orders of friars established friaries in Norwich: the Dominicans (known by the colour of their robes as 'Black Friars'), the Franciscans ('Grey Friars'), Carmelites ('White Friars'), Austin Friars and the Penitential Friars ('Sack Friars').

The Dominicans were founded by St Dominic in 1218 as a religious order committed to learning and preaching. They arrived in England in 1221 and reached Norwich five years later, establishing a friary to the north of the river Wensum, between what is now Colegate Street and Golden Dog Lane. In 1307 they took over the buildings of the Penitential Friars, south of the River Wensum, after that order was supressed by Pope Clement V. A church and other buildings already existed; the C13 chapel (originally dedicated to St Mary but subsequently re-dedicated to St Thomas-a-Becket) and an adjacent vestibule (now known as 'The Crypt') still survive today. The Dominicans remodelled these buildings; inserting brick vaulted ceilings to support upper floors. They obtained the surrounding properties and expanded the friary. It eventually included the area between the river on the north, Princes Street on the south, St George's Street on the west and Monastery Lane and Elm Hill on the east. A new cloister was constructed with a covered walkway and four ranges built around an open courtyard (the cloister garth). On the east side was a dorter (dormitory) and chapter house, on the west was a frater (refectory), and at the north were probably kitchens and storerooms. From c1327 a church dedicated to St John the Baptist was built at the south (on the present site of St Andrew's Hall and Blackfriars' Hall). The west end could only be completed after 1345 when royal sanction was given to construct over two roads; one that continued the line of Elm Hill westward and another at right angles to it.

In 1413 a serious fire broke out in Norwich. Two friars were killed and the Dominican's church and conventual buildings suffered severe damage. They temporarily moved back to their original site across the river until 1449 while carrying out rebuilding. The church was reconstructed between c1440 and 1470 but incorporated several windows of the earlier building. It comprised a large nave and chancel separated by a cross passage (the 'walking place'), which was surmounted by a tower. The nave is now St Andrew's Hall and the chancel is Blackfriars' Hall. Many of Norwich's wealthiest families donated towards its construction, including the Appleyards, Wetherbys and Cliftons. The Dominicans used both the church and a preaching yard to the south to deliver lectures and sermons. The Friary possessed an extensive library and there is evidence that there was a regular school of philosophy and lectures open to local parish priests and clergy. The Friars performed the usual offices (church services) but welcomed the public to their evening service of compline. An anchoress was housed within the friary and led a life dedicated to prayer, meditation and counselling. The first recorded is Katherine Foster who lived in a cell north of the chancel in 1472; three arched recesses survive of this building. By the 1530s the friary suffered a decline and several possessions and properties were sold off. Part of the churchyard was leased to a haberdasher, William Alman, who was licenced to build a house provided he threw 'nothing filthy' from his windows.

In 1538 the friary was suppressed as part of the Dissolution, and the furnishings sold. It was purchased by the City Council; the mayor, Augustine Steward, paying £81 in 1540 and a further £152 in 1544. He proposed 'To make the churche a fayer and large halle, well pathed, for the mayor and his bretherne…for their common assemblyes…to fynd a perpetual free-scole therin' and to keep a chapel 'to pray to Almightye God'. The building was repaved, lodgings built at the east, and three chambers added over the south porch for the priest. Part of the preaching yard was leased out as a garden. The nave of the church was converted into an assembly hall called the 'New Hall' and used for a variety of purposes including: ceremonial feasts, Guild meetings, as a corn market, as Assize Courts, and for receptions. The walls were white-washed, benches built between the pillars, and the crossing arch blocked up. The Norwich City Library was established in the south porch (rebuilt in 1774), which became the first public lending library in the country in 1716 but later moved in 1794. Several buildings were constructed around the west porch. An inventory records a pantry, buttery, kitchen, 'scalding house' (for preparing meat), backhouse, 'buttying house' (for sifting bran and flour), wet and dry larders and a counting house. The chancel became a municipal and guild chapel. In the later C16 there was a large influx of Dutch and French-speaking Protestant refugees into Norwich, bringing particular skills in textile production. The Dutch population (also known as 'strangers' or 'walloons') began to use the chancel from 1579, which became known as the 'Dutch Church', and services continued in Dutch until 1929.

The cloister was used for a range of purposes after the Dissolution. The Earl of Warwick stabled his horses at the site

in 1549 whilst on his way to suppress Kett's rebellion. During the later C16 the refectory was used as a granary and part of the cloister was used by the Norwich Grammar School. Several buildings were used to examine and seal cloths produced by the Walloon weavers. The reredorter (lavatories) was converted into a water cistern, occasionally used as a swan pen. A pulpit and seats were installed in the preaching yard, which became known as the Green Yard. The east range became a place of worship used by Presbyterians from 1672 and Baptists from 1689. A mint was established within the cloister during the Great Recoinage of 1696. In 1712 a hexagonal tower positioned over the cross passage of the church dramatically collapsed. The buildings were repaired (albeit without the tower) and continued to serve civic functions. From 1712 to 1859 part of the cloister served as a workhouse. In 1824 St Andrew's Hall became the venue of a triennial music festival; The Norfolk and Norwich Festival, and an organ built by John Gray was installed at the west end.

Two major restorations were undertaken in the mid-C19. In 1861 the cloister was altered: the exterior walls were repaired in brick; new windows and a second floor added above the south cloister walk to provide 'Hall Keeper's apartments'; the west elevation of the west range was refaced with polychrome brick, the upper floor heightened, a stair turret added at the east, and a small enclosed garden created at the west (resulting in the demolition of several buildings). The north range of the cloister may also have been demolished at this time; maps indicate that it was torn down between 1762 and 1885. St Andrew's Hall hosted performances by the opera singer Jenny Lind in 1856 and readings by Charles Dickens in 1859 and 1861. In 1863 the City Surveyor, T.D. Barry, carried out major changes to the hall: a new arch was inserted at the east end and the organ placed beneath it; the west front was refenestrated; the south porch reconstructed; buttresses on the north side repaired; the windows restored; the internal piers and arches restored; the ceiling redecorated; replastering and re-pointing carried out; and new 'retiring rooms' for performers built between the hall and south cloister walkway. Becket's chapel was partly demolished in 1876 and a new organ installed in St Andrew's Hall in 1880. The new organ, built by Bryceson Brothers and Ellis, retained the central case of the earlier organ (the organ console and some of the mechanical parts were replaced in 1927 and 1984). In 1899 a Technical Institute was built to the north of the cloister (now Norwich University of the Arts). Blackfriars' Hall was utilised by the Royal Engineers during the First World War. A new wooden floor was inserted after the war and the roofs of both halls were repaired.

In 1915 the former friary was scheduled. It was one of the first sites in Norfolk to be scheduled, as indicated by its original old county number: Norfolk 4. In 1954 the standing buildings were Grade I listed. The east window of Blackfriars' Hall was restored in 1959. A programme of alterations were undertaken in the 1970s and 1980s including: the excavation and repair of Becket's Chapel; redecoration of Blackfriar's Hall with oak panelling to display civic portraits; a new stage, pull out seating and double glazing in St Andrew's Hall; a bar inserted into the cross passage; further restoration of the cloisters, and conversion of the vestibule next to Becket's Chapel into a café. In 1988 the first floor of the south porch was re-plastered and remains of an earlier porch discovered within the structure. The organ in St Andrew's Hall was awarded a 'Historic Organ Certificate of Recognition' by the British Institute of Organ Studies (BIOS) in 2010, which was revised to Grade II on the National Pipe Organ Register in 2016. The BIOS listing stated that the organ is listed at 'Grade II for the surviving elements of the 1827 Gray case and the contribution it makes to the architectural ensemble of the building, and for the surviving Bryceson pipework'. In 2011 the East Garth building was refurbished and a lift inserted. The two halls continue to serve many purposes in 2016; as a venue for conferences, antique fairs, markets, weddings, concerts and an annual beer festival. The east and west ranges (East and West Garth) are used by Norwich University of the Arts.

Details

Former friary, originally constructed by the Friars Penitential in the C13, but largely rebuilt by the Dominicans in the C14 and C15. The church was converted into municipal halls in c1540, and the buildings restored and altered in 1861 and 1863.

MATERIALS: Coursed and random rubble flint, including some knapped flint, with limestone and brick dressings. The former church has a limestone ashlar clerestory. Polychrome brick to west elevation of West Garth. Copper, slate, pan-tiled and felt-covered roofs.

PLAN: Former cloister forming three sides of a quadrangle with west range (The West Garth), east range (The East Cloister Walk and East Garth), and south range (including South Cloister Walk), and former church (St Andrew's Hall and Blackfriars' Hall) to the south.

ST ANDREW'S HALL AND BLACKFRIARS' HALL (THE BLACKFRIARS' CHURCH)

Dominican friary church, now two municipal halls. C14 origins, largely rebuilt in 1440-1470 following a fire, and converted to halls c1540 with further alterations in 1863 as part of a restoration by the City Surveyor Thomas Barry.

PLAN: an aisled nave of seven bays (now St Andrew's Hall) divided by a cross passage from a chancel of five bays (now Blackfriars' Hall).

EXTERIOR: the south front faces St Andrew's Plain and comprises a lean-to aisle of seven bays, an ashlar clerestory of fourteen bays, and then the walkway and chancel to the east. A knapped flint plinth and an ashlar string course are carried round the building beneath window level. The aisle has five bays of C14 Decorated windows, an 1863 Perpendicular porch in the second bay from west, and a C15 Perpendicular window in the seventh bay. All are separated by stepped buttresses. The Decorated windows are of three lights with reticulated tracery under two-centred arches, and the Perpendicular window is of four lights with embattled transoms stepped up and down. The porch projects forward two bays and is two-storeys high with angled buttresses. It has a south doorway formed of a pointed arch of two moulded orders rising on shafts with foliated capitals, set under a square head with roundels in the spandrels enriched with quatrefoils and shields. Within it is a mid-C19 wrought-iron gate. Above the doorway is an ashlar frieze decorated with quatrefoils and shields and then a four-light window in the gable. The latter comprises two lights under a two-centred arch and two side lights under square heads, all with ogee tracery. Surmounting the gable is an ashlar parapet with a trefoil fretwork design and a finial. In the west elevation is a projecting stair-turret and a pointed two-light window whilst at the east are two pointed two-light windows to the ground floor and a square-headed mullioned window to the first floor. All the porch openings have hoodmoulds with foliated-stops or head-stops. The clerestory windows are each of three lights with cusped ogee tracery under four-centred arches. They are separated by square panels bearing shields with the coat of arms of the Erpingham family. In the fourth bay of the south aisle is a mid-C19 doorway inserted beneath the window, which comprises a two-centred arch set in a square head with quatrefoils in the roundels. There is a closely-matching mid-C19 doorway to the cross passage set within a projecting single-storey porch with a fretwork parapet. A mid-C19 flint wall with a limestone coping extends south from the south-east corner. Set into the wall is a gateway with flint and limestone capped piers and a wrought-iron gate. The cross passage and chancel have Perpendicular windows under two-centred brick arches; three lights to the former and five lights to the latter. All have embattled transoms stepped up and down. Each bay is separated by stepped buttresses.

The east front of the chancel (now Blackfriar's Hall) has a Decorated window of seven lights with curvilinear tracery under a two-centred arch, largely restored in 1959. It is flanked by angled buttresses which are pierced by two arches forming a passage adjoined by railings. Attached to the south is a flint boundary wall which contains a two-centred arched gateway with a hoodmould.

The north front is similar to the south elevation but the fenestration comprises entirely Perpendicular windows: five windows in the chancel; six windows and a C14 arched doorway in the north aisle; and fourteen windows to the clerestory. In the first bay of the chancel are three segmental-headed arched recesses and a blocked square-headed opening. These originally formed part of a medieval anchorite's cell that projected from the building. In the following bay is a pointed arched doorway under a large brick round-headed opening. The south cloister walk is adjoined to the church by an 1863 infill block with a lean-to roof.

The west front faces St George's Street and was re-fenestrated in 1863. It comprises a large Perpendicular window of five lights to the nave and two three-light Perpendicular windows to the aisles. Four C15 stepped flint buttresses separate the bays but three of these are pierced by mid-C19 arches to form a pedestrian passage next to St George's Street. Beneath the nave window is a large doorway approached by steps, which contains mid-C19 wooden doors with decorative wrought-iron hinges. The doorway is formed of a pointed arch of two moulded orders rising on shafts with foliated capitals, set under a square head with roundels in the spandrels enriched with quatrefoils and shields.

Above it is a hoodmould with head-stops. On either side of the doorway are flint flushwork panels decorated with trefoils and shields. Set in the angled buttress at the north-west corner is a pointed arched doorway.

The former nave, now St Andrew's Hall, has a pitched copper roof with limestone decorative crosses to the gables, and copper down pipes. There are copper-covered lean-to roofs over the aisles, and a slate roof with lead flashings to the former chancel, now Blackfriars' Hall.

INTERIOR: The south porch of St Andrew's Hall contains stone benches and a mid-C19 timber screen with diamond leaded lights and double doors. A two-centred arched doorway containing a C15 iron-studded timber door with carved tracery and coats of arms leads through to St Andrew's Hall. The porch has a chequered tiled floor. A wrought-iron gate in the west wall provides access to the staircase to the first floor, which contains a cast iron stove set within a chamfered stone fireplace.

St Andrew's Hall occupies the nave and side aisles of the former church. The nave arcades comprise seven bays of two-centred arches supported on piers formed of four shafts separated by wide hollow chamfers. The inward facing shafts continue up to the level of the clerestory to carry corbels supporting the hammer-beam roof, which has double butt-purlins and a ridge-piece. The lean-to roofs over the aisles are supported by arched braces resting on corbels. Set into the wall at the east end is a mid-C19 two-centred arch resting on angel corbels. The responds are formed of four shafts separated by chamfers decorated with blind tracery. An organ built by Bryceson Brothers and Ellis in 1880 occupies the space under the arch, whilst a C20 timber stage is situated in front of it. The organ has a central oak case of 1824 with a Gothic fretwork design incorporating tracery, quatrefoils and pinnacles. It is Grade II listed in the British Institute of Organ Studies National Pipe Organ Register. On either side of the east arch are two late C20 foyers. The hall windows largely contain mid-C19 diamond leaded lights but there are stained glass panels in the south aisle and west window of the nave. The hall has a C20 timber floor.

The cross passage (or 'walking place') between the two halls now forms a foyer containing a reception desk and wheelchair lift, with a late C20 bar in a partitioned space beneath the east arch of St Andrew's Hall. There is a mid-C19 partition containing pointed arches and blind tracery set into the arch. A C18 memorial stone is mounted on the east wall and there is a C15 four-centred arched doorway leading to a stair turret in the north-east corner.

Blackfriars' Hall occupies the chancel of the former church. It is approached from the west through a four-centred arched doorway containing a mid-C19 timber door with stained glass panels. The hall has a rafter and purlin roof with single butt-purlins, a ridge piece, and arched braces on wall posts. There are carved angel and foliage bosses where the principal rafters and purlins meet. Set into the north wall is a c1639 architectural memorial tablet to Reverend Johannes Ellison, senior minister of the Dutch congregation, and, beneath it, a brass plaque to his son. A C15 two-centred arched doorway at the east end of the north wall provides external access. The hall contains a C20 stage at the east end and a 1920s timber floor that is raised above the original stone floor slabs and memorial stones. The windows have mid-C19 diamond leaded lights. Attached to the south side of the hall is a late C20 service range, which is not of special interest.

SOUTH RANGE AND THE CRYPT

South range of Dominican Friary, originally serving as the south cloister walk, library, and possibly the Prior's quarters and infirmary. C15, altered in 1861. A lean-to of 1863 is attached to the south whilst to the south-east is a vestibule (now known as 'The Crypt') built by the Friars Penitential in the C13 but altered by the Dominicans in the C14.

PLAN: two storey gabled range rising to three storeys at north-west corner where there is a projecting rectangular stair-turret. A single storey lean-to of 1863 is attached to the south and to the south-east is the vestibule known as The Crypt. Further east are the remains of Becket's Chapel (a scheduled monument).

EXTERIOR: the north elevation of the south range faces the cloister garth. On the ground floor is a four-bay arcade of two-centred, quadruple-chamfered, brick-built arches separated by stepped buttresses. The first floor has nine lancets or pointed-arched windows containing sashes or fixed panes, whilst the second floor has two lancet windows with fixed panes set within a side gable. The projecting staircase contains slit windows and lancets. The arches of the

ground-floor arcade contain C20 glass panels except for two mid-C19 timber doors with decorative wrought-iron hinges in the third bay. There are several blocked openings at first floor level. Both the mid-C19 stair-turret and third floor have flint and brick banding to the walls.

The east elevation of the south range has two lancet windows to the first floor. It is adjoined at the south-east by The Crypt; a two bay rectangular building. The south range has a slate covered roof whilst The Crypt has a flat felt roof.

INTERIOR: On the ground floor is the south cloister walk; a C15 rib-vaulted walkway 15 bays long. The vaults are built of brick, plastered and limewashed, and rest on stone corbels supported by engaged columns. Several rib-vaulted rooms, now serving as stores and a kitchen, and a mid-C19 stairwell are attached to the west end of the north wall. The room nearest the stairwell contains two blocked stone arches in its south and west wall. The first floor has offices, dressing rooms and toilets leading off a corridor at the east end. There are traces of a pre-1861 decorative scheme including a curved cornice to two rooms and a niche in the south wall of the corridor. At the west end is a toilet and two meeting rooms with mid-C19 stone fireplaces and exposed timber-framing to the roof. The fireplaces have foliage carving to the spandrels, and one has Corinthian columns and corbels supporting the mantelshelf. There are mid-C19 timber-boarded doors with decorative iron hinges to the meeting rooms, toilet and adjacent stairwell. The second floor contains a later C19 toilet and a meeting room.

The 1863 infill range between the south cloister walk and St Andrew’s Hall contains several storage rooms, modern services and toilets. There is a mid-C19 four-centred arched doorway within the ladies toilet with carved spandrels depicting the coats of arms of Norwich and the Guild of St. Georges.

The Crypt is approached at the west through a four-centred arched doorway with carved spandrels. It contains a mid-C19 door with decorative iron hinges. A staircase leads down into the square rib-vaulted vestibule or ante-chapel, which has chamfered brick vaults supported on a central stone pier with a moulded capital. There is a blocked C14 quadruple-chamfered arched window in the west wall, and a blocked C14 arched window, two part-blocked windows and an arched doorway in the east wall. The remaining openings were inserted in the C19 and C20. Next to the east doorway, which leads out to the remains of Becket’s Chapel, are two arched recesses, one of which may have served as a stoup.

EAST GARTH AND EAST CLOISTER WALK

East range of Dominican Friary, originally serving as the east cloister walk and dorter. C15, altered in 1861 and in 2011.

PLAN: A two storey range (now known as the East Garth) with a hipped roof, attached to a single-storey east cloister walkway at the south.

EXTERIOR: the west front of the east range faces the cloister garth. The ground floor comprises a six bay arcade of two-centred, quadruple-chamfered, brick-built arches; four arches to the East Garth, separated by stepped buttresses, and two arches to the east cloister walkway attached at the south. The first floor is set-back from the ground floor. It contains several blocked openings as well as five C19 casement windows and a C15 cinquefoil-headed single-light window under a hoodmould in the third bay. This is the only surviving original window within the cloister. There are four dormers to the attics. The arches of the ground floor arcade contain C20 glass panels and 2011 fixed panes apart from the first bay which is partly infilled with brick with a 2011 timber-boarded door. The main entrance is through a glass doorway in the third bay. The north elevation has several blocked doorways which originally led to buildings on the north side of the cloister.

The east elevation of the East Garth has three bays separated by buttresses. At ground floor level there is a large blocked segmental-headed brick arch to the first bay, a blocked square-headed doorway to the second bay and a sash window in the third bay. The first floor contains two blocked openings in the first bay, two casement windows with timber lintels to the second bay, and two small casements to the third bay. There are four dormers and a corbelled brick chimney to the roof. The south elevation contains two sash windows and a dormer window. Attached to the east side of the east cloister walk are the remains of the chapter house (a scheduled monument).

INTERIOR: The East Garth contains a computer room, offices and photography studio. On the ground floor are remains of the C14 inner wall of the cloister walkway and cross walls displayed within glass cases (these form part of a scheduled monument). The joists to the first floor are supported by straight braces. One tie beam survives to the roof, which is otherwise a rafter and purlin roof.

WEST GARTH AND FIRST BAY OF ADJOINING RANGE

West range of Dominican Friary, originally serving as the west cloister walk, frater, and possibly the kitchen. C15, altered in 1861 when the west elevation was refaced in polychrome brickwork by the architect James S Benest.

PLAN: A two-storey gabled range (now known as the West Garth), and the first bay of an adjoining two-storey gabled range at the north, which incorporates C15 flint-built fabric and formed part of the north-west corner of the friary cloister.

EXTERIOR: the east front of the west range faces the cloister garth. On the ground-floor are (from left to right): a three bay arcade of two-centred, quadruple-chamfered, brick-built arches; a mid-C19 semi-circular brick stair turret built against the fourth arch; a lean-to entry porch; and a carriage entrance. The first floor includes four mid-C19 casement windows and several blocked openings. The three arches of the ground floor arcade contain two mid-C19 casement windows and a late C20 doorway. Originally the arches were separated by stepped buttresses; two survive between the first and second, and third and fourth bays. The stair turret is constructed of red brick with a corbelled eaves cornice beneath a conical slate roof. It is lit by three narrow shoulder-arched windows. Immediately to the north is the entrance porch covered by a lean-to roof. In the sixth bay is the segmental-headed carriage entrance. The range has a slate roof with a limestone coping to the gables.

Attached to the north side of the west range is a low two-storey range adjoined to the former Technical Institute of 1899 (now Norwich University of the Arts). The first bay of this range incorporates C15 flint-built fabric and formed part of the north-west corner of the friary cloister. It has a segmental-headed casement window to the ground floor, a sash window to the first floor, and a pan-tiled roof containing a dormer window and red-brick chimney stack.

The west elevation of the west range was elaborately refaced by James S Benest in Gothic Revival style in 1861. It is built of cream-coloured brickwork laid in Flemish bond with red brick banding to the walls, limestone and blue brick dressings, and a red brick plinth. There are seven bays; the southern two bays are an extension of the south cloister range, which projects four bays from the front of the elevation, whilst the remaining five bays form part of the West Garth. The ground floor of the extension has a pointed arched doorway of two orders resting on Corinthian columns to the southernmost bay, and paired sash windows under pointed arches to the adjacent bay. Set into the arch of the doorway is a tympanum pierced by a cinquefoil and quatrefoils, supported on corbels decorated with angels. The surrounding brickwork projects from the elevation, being flush with the outer order of the arch, and is surmounted by a brick cornice and tile covering. In the spandrels of the arch are two stone busts. A corbelled string course separates the storeys and is carried around the whole of the west front. To the first floor are two gable windows; paired sashes in pointed arched surrounds with geometric tracery. The dividing mullions are formed from Corinthian columns. A corbelled chimney stack is built into one of the gables. The north elevation of the extension is similar to the west. The ground floor contains a pointed arched doorway of two orders, three lancet windows and a sash window under a pointed arch of two orders. In the first floor is a paired sash window under a side gable, a narrow lancet, and an elaborate tripartite window of three recessed cusped lancets with octafoil tracery, each under side gables. The remaining five bays of the elevation comprise a ground floor with (from north to south): a carriage entrance, two single sashes under pointed arches and two tripartite sashes under pointed arches supported by Corinthian columns, recessed within segmental pointed arches under hoodmoulds. To the first floor are five gable windows (and a sixth behind the south cloister extension); three single sashes under pointed arches and two-paired sashes matching those of the south cloister extension. A corbelled string course runs between the window cills and there is a cornice and brick parapet to the roof. The gables are surmounted by cross finials and moulded brick chimney stacks.

INTERIOR: The west range contains a photography studio, offices and art studio. There is an 1861 common rafter roof with ashlar pieces supporting the rafters and soulaces supporting the collars.

SUBSIDIARY FEATURES: A polychrome brick BOUNDARY WALL with a red brick plinth, brick buttresses, and blue brick banding and patterning, encloses a garden in front of the west range. There is a C20 gate set into the west side of the wall and an adjoining flint return wall. The west boundary wall contributes to the special interest of the principal buildings and is included in the listing.

Pursuant to s.1 (5A) of the Planning (Listed Buildings and Conservation Areas) Act 1990 ('the Act') it is declared that the following are not of special architectural or historic interest: the early C21 glass screen and kitchen units in the south porch of St Andrew's Hall; the C20 stage and stage lighting, retractable seating, late C20 foyers, and glass automatic sliding doors in St Andrew's Hall; the glass automatic sliding doors, reception desk, wheel chair lift, early C21 staircase, and late C20 fitted bar in the cross passage (or 'walking place'); the C20 stage, 1980's timber panels and late C20 chandeliers in Blackfriars Hall; the C20 and early C21 internal partitions within the infill range between St Andrew's Hall and the south cloister walk; the C20 glass fire screen, late C20 stair lift in the south cloister walk; the C20 internal partitions, fitted worktops and fixtures to the kitchens and store rooms adjoining the north-west side of the south cloister walk; the C20 cupboards and stairs in The Crypt; the boiler room, boiler and plant; the external steel staircase to the East Garth; the internal 2011 lift and staircase, 2011 internal partitions and doors, and steel trusses to the photographic studios in the East Garth; the external steel staircase to the West Garth; the C20 and C21 internal partitions and suspended ceilings in the West Garth; as well as all C20 and early C21 toilets and toilet cubicles. In addition it is declared that the whole of the late C20 lean-to service range attached to the south side of Blackfriars Hall is not of special architectural or historic interest.

Legacy

The contents of this record have been generated from a legacy data system.
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Legacy System: **LBS**

Sources

Books and journals

Pevsner, N, Wilson, B, The Buildings of England: Norfolk: 1 Norwich and North-East, (2002), 265-269
Sutermeister, H, The Norwich Blackfriars A History and Guide to St Andrews and Blackfriars Halls, (1978)
Elliston Erwood, F C , 'The Norwich Blackfriars' in The Archaeological Journal, , Vol. 106: 1 (Part III), (1949), 90-94

Websites

Virtual Past, Norwich Blackfriars Online, accessed 1 February 2016 from **http://www.norwichblackfriars.co.uk/** *(http://www.norwichblackfriars.co.uk/)*

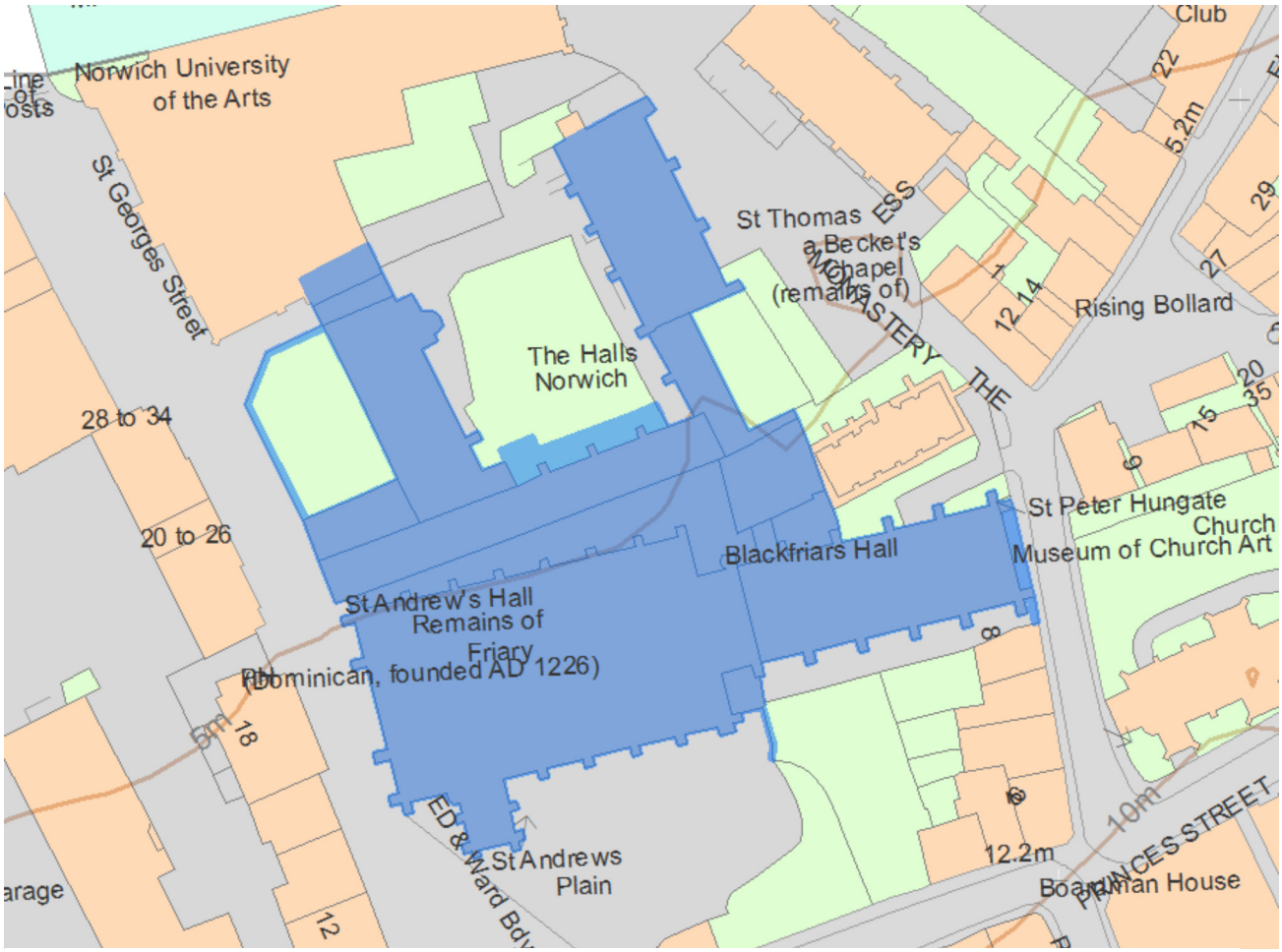
Other

Purcell Miller Tritton, St Andrew's & Blackfriars' Hall: Conservation Management Plan (June 2009)

Legal

This building is listed under the Planning (Listed Buildings and Conservation Areas) Act 1990 as amended for its special architectural or historic interest.

The listed buildings are shown coloured blue on the attached map. Pursuant to s.1 (5A) of the Planning (Listed Buildings and Conservation Areas) Act 1990 ('the Act'), structures attached to or within the curtilage of the listed building (save those coloured blue on the map) are not to be treated as part of the listed building for the purposes of the Act.



Map

This map is for quick reference purposes only and may not be to scale. This copy shows the entry on 23-Dec-2022 at 10:36:13.

End of official list entry

Appendix 4

Drainage Report

Eastern Drainage Services Ltd
Drainage investigations for surveyors, engineers and loss adjusters
Specialists in all drainage renovation techniques including in-situ repairs and sewer connections
6 Drymere, Beachamwell, Swaffham,Norfolk PE37 8AS
Tel Norwich office: 01603 493085 Fax: 01603 493085 Email: info@easterndrains.co.uk
www.easterndrainageservices.co.uk

Drainage Investigation Report

Site Address:

The Halls
St Andrew's Plain
Norwich

Date of Investigation:

6th & 9th December 2022

Client:

Roche

Reference:

E.D.S.5110

Eastern Drainage Services is a registered Limited Company in England and Wales. Company registration No 7170685
Registered office: 6 Drymere, Beachamwell, Swaffham, Norfolk, PE37 8AS

Report Summary and Recommendations

We have attended site to carry out a CCTV survey of all accessible foul and surface water drains. Although the foul and surface water systems are mostly separate some surface water drains have been connected onto the foul system.

The majority of the drains are 100mm and 1500mm diameter constructed from salt glazed clay pipework. There are some uPVC drains and sections of cast iron.

There were a number of manholes we were unable to lift. Some covers are stuck to their frames and others are internal and beneath carpets.

The results of the CCTV survey follows:

1. **Manhole 1 to Gully 1**
The drain is constructed from original 100mm diameter salt glazed clay. The CCTV survey noted a small amount of silt build-up, but the drain is in good condition.

2. **Manhole 1 to Soil & Vent Pipe 1**
The drain is constructed from original 100mm diameter salt glazed clay. A single area of fibrous root ingress visible growing through a joint. This could be covered without excavation by installing a localised patch liner.

3. **Manhole 1 to Manhole 2**
The drain is constructed from original 100mm diameter salt glazed clay. The CCTV survey shows an area with fibrous root ingress and an area with multiple cracks. An unknown drain joins the run which we assume is redundant. The damage could be covered without excavation by installing a localised patch liner.

4. **Manhole 2 Downstream**
The drain is constructed from original 100mm diameter salt glazed clay. The CCTV survey was abandoned at 1.3m because the drain has collapsed. We would recommend a localised excavation to replace the collapse section of pipework. Once repaired the survey can be completed.

5. **Manhole 2 to Gully 2**
The drain is constructed from original 100mm diameter salt glazed clay. The CCTV noted a small amount of debris otherwise the drain is in good condition.

6. Manhole 2 to Manhole 3

The drain is constructed from original 100mm diameter salt glazed clay. The CCTV survey noted a single circumferential crack and a small amount of debris. The crack could be covered without excavation by installing a localised patch liner.

7. SW Rodding Eye Downstream

The drain is constructed from 100mm diameter flexible jointed vitrified clay. The CCTV survey was abandoned at 6.7m due to a large build-up of silt which our camera was unable to pass. Two areas of fibrous root ingress were visible. We recommend the drain is cleared by high pressure water jetting and the CCTV survey completed.

8. Rainwater Pipe 1 to Main Run from Rodding Eye

This 100mm diameter vitrified clay drain is in good condition but partially blocked with debris.

9. Rainwater Pipe 2 to Main Run from Rodding Eye

This 100mm diameter drain is a mixture of uPVC and vitrified clay. The drain joins an unknown drain and then joins onto the drain downstream from the rodding eye. The CCTV survey shows two defective joints meaning it may not be watertight.

10. Internal Manhole 1 downstream to Main Sewer

This 225mm diameter salt glazed clay drain passes through internal manhole 2. The section of drain between the two manholes is in good condition.
The CCTV survey shows an area with multiple cracks approximately 5m downstream from internal manhole 2. This could be covered without excavating by installing a localised patch liner.

11. Internal Manhole 1 to Internal Gully 4

This 100mm diameter drain is a mixture of salt glazed clay and vitrified clay. The drain is in good condition with an unknown junction.

12. Internal Manhole 1 to Internal Manhole 3

This drain is 225mm and 150mm diameter salt glazed clay. The CCTV survey shows a crack close to internal manhole 1 and an area with multiple cracks at 6.75m. There are a number of unknown junctions in addition to a junction from a WC. There is scale through some of the drain and it will require cleaning if it is to be repaired by patch lining.

13. Internal Manhole 2 to Internal Gully 5

This 150mm diameter salt glazed clay drain is in good condition but there is a partial blockage of debris.

14. Internal Manhole 2 to Main Run
This 150mm diameter salt glazed clay drain joins onto the main drain run between internal manholes 1 & 3. It is in good condition but there is a partial blockage of debris.

15. Internal Manhole 3 to Internal Gully 5
This 100mm diameter salt glazed clay drain has a defective joint and a crack close to the gully. If the drain is to be repaired it will need to be replaced.

16. Internal Manhole 3 to Internal Rainwater Pipe
This 100mm diameter drain is a mixture of salt glazed clay and cast iron. The CCTV survey shows a defective joint. This could be sealed without excavating by installing a localised patch liner.

17. Internal Manhole 3 to Urinal Waste Pipe
This 100mm diameter drain is a mixture of salt glazed clay and uPVC. It is in good condition with some minor scaling. There is an unknown junction close to the manhole.

18. Internal Manhole 3 to Internal Manhole 4
This 150mm diameter salt glazed clay drain is in good condition.

19. Internal Manhole 4 to Internal Manhole 5
This 150mm diameter drain has previously been repaired by structural lining. The drain is holding some water which is relatively slow to flow through. There are no signs the drain has been blocked or full recently. The CCTV survey did not find any damage and there are some unknown junctions.

20. Internal Manhole 5 to Internal Manhole 6
This drain is also 150mm diameter salt glazed clay. There are two junctions one of which is redundant. There are two areas with multiple cracks which could be covered without excavating by installing a patch liner.

21. Internal Manhole 6 to Internal Manhole 7
This drain has been repaired by structural liner. There are some lumps to the bottom of the liner but no signs the drain has blocked.

22. Internal Manhole 4 to Internal Gully 2
This 100mm diameter drain is a mixture of salt glazed clay and cast iron. The drain is in good condition but there is some corrosion and debris which could cause intermittent blockages. The drain should be se-scaled.

23. Internal Manhole 5 to WC2
This uPVC drain is mostly 150mm diameter but reduces to 100mm at 5.6m. The drain is in good condition. Several other WC's join onto this drain.

24. Internal Manhole 5 through Run X
The end of the drain has been bunged off meaning it is redundant. It should be sealed off with cement at the manhole.

25. Internal Manhole 5 through Run Y
The end of the drain has also been bunged off meaning and is redundant. It should be sealed off with cement at the manhole.

26. Internal Manhole 6 to WC8
This 100mm diameter uPVC drain is in good condition. A number of other WCs join onto this drain.

27. Internal Manhole 6 to WC12
This 100mm diameter uPVC drain is in good condition. A number of other WCs join onto this drain.

28. Internal Manhole 8 to Internal Manhole 7
This drain is mostly 100mm diameter and constructed from salt glazed clay. There are two cracks, two redundant junctions and an unknown junction possibly from a rainwater pipe. The cracks could be covered by installing two patch liners.

29. Internal Manhole 8 to WC15
This 100mm diameter salt glazed clay drain is in good condition. There is one area where the glaze is deteriorating.

30. Internal Manhole 8 to Internal Gully 8
This 100mm diameter salt glazed clay drain is in good condition

31. Internal Manhole 8 to WC16
The CCTV survey shows this 100mm diameter salt glazed clay drain to be cracked in two places. There is a junction from a rainwater pipe so the cracks would need to be covered by installing two patch liners.

32. Internal Manhole 8 to WC17
This 100mm diameter salt glazed clay drain is in good condition.

33. Internal Manhole 8 to Internal Gully 6
This 100mm diameter salt glazed clay drain is cracked in one places. This could be covered by either lining or patch lining.

34. Internal Manhole 9 to Internal Rest-bend (through manholes 9a and 10)
This 150mm diameter drain is mostly cats iron. There is an obstruction of urinal scale which is has reduced the diameter of the pipe by 60%. There is further hard scale along the drain and some debris. We recommend the drain is cleaned by jetting and chain flailing.

35. Internal Manhole 9 to Internal Gully 10
This short 100mm diameter salt glazed clay drain is in good condition.

36. Internal Manhole 9 to Manhole 3
This drain is constructed from 225mm diameter salt glazed clay. There are three holes in the pipe, a crack and a number of unknown junctions. The damage could be covered by installing patch liners.

37. SW Manhole 1 through Run K
This drain has been capped off. It should be sealed off in the manhole with cement.

38. SW Manhole 1 to Internal Manhole beneath Carpet
This 100mm diameter salt glazed clay is in good condition with one open joint.

39. SW Manhole 1 to Soil & Vent Pipe
This drain is constructed from 100mm diameter salt glazed clay. The CCTV survey shows a hole in the pipe and two cracks, one of which is on the rest-bend. We recommend the drain is repaired by a combination of structural lining and radius patch lining.

40. SW Manhole 1 downstream towards Manhole 4
This drain is 100mm diameter salt glazed clay drain appears to have collapsed at 1.4m from the manhole. We attempted to CCTV survey the drain from the opposite direction via manhole 4 (see survey 41).

41. Manhole 4 upstream towards SW Manhole 1
This 100mm diameter salt glazed clay drain is blocked with silt / soil and stones. We suspect the drain has collapsed close to SW manhole 1 and the stones may be the bedding material for the pipes. We can attempt to remove the silt and stones to hopefully get a clearer picture of what has happened.

42. Manhole 4 to Soil & Vent Pipe
This 100mm diameter salt glazed clay is in good condition with one open joint.

43. Manhole 4 to Gully 4
This drain is partially blocked with silt & stones and requires cleaning.

44. Road Gully 1 to Main Run
This 150mm diameter vitrified clay drain is in good condition. It joins only the main run between manhole 3 and the main sewer manhole. The drain has three junctions, one is redundant, one from rainwater gully B and also from rainwater gully C.

45. Road Gully 2 to Road Gully 1
This 150mm diameter vitrified drain joins onto the drain from road gully 2. The CCTV survey shows a hole in the pipe and an area with multiple cracks. We recommend the drain is repaired by patch lining.

46. Manhole 3 to Main Sewer Manhole
This 150mm diameter salt glazed clay drain has been repaired by structural lining and is in good condition.

47. Manhole 5 upstream to Manhole 5
This drain is 100mm diameter vitrified clay. The section of drain between the two manholes has some hard scale / cement nut is in good condition.
We were not able to lift manhole 6 due to corroded bolts.

48. Manhole 5 to Rainwater Gully 5
This drain is 100mm diameter vitrified clay and the CCTV survey shows some debris and water holding. There is also a crack with an area of roots which could be covered by lining or localised patch lining.

49. Manhole 5 downstream to Main Sewer
This drain is also 100mm diameter vitrified clay. The CCTV survey shows some minor debris and a crack close to the manhole. This could be covered by patch lining.

We trust the foregoing is satisfactory however if we can be of any further assistance please do not hesitate to contact this office.

Manhole Conditions

Manholes

Manhole	Depth in mm	Condition and comments
1	520	Good condition
2	520	Good condition
3		Unable to lift
4	870	Good condition
5	1100	Defective cover
6	-	Unable to lift, screws corroded
Int MH1	730	Good condition
Int MH2	-	No Access - Under Carpet
Int MH3	730	Good condition
Int MH4	710	Good condition
Int MH5	840	Good condition
Int MH6	790	Good condition
Int MH7	-	No Access - Under carpet
Int MH8	500	Good condition
Int MH9	730	Good condition
Int MH10	-	No Access – under floor in gents' toilet
Int MH11	-	Unable to lift
Int MH12	-	Unable to lift
SWMH1	810	Good condition

CCTV Survey

Survey No.	1	**Drain Run:**	Manhole 1 Upstream Towards Gully 1 – Run A		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Manhole 1**	**Start Survey**
0.5	Debris / Silt	10% of pipe diameter
1.5	Misaligned joint Open joint Debris / Silt increases	Medium Slight 20% of pipe diameter
1.7	Misaligned joint Open joint	Slight Slight
3.5	Misaligned joint Open joint	Slight Slight
3.6	**Reaches Gully 1**	**Survey Ends**

CCTV Survey

Survey No.	2	**Drain Run:**	Manhole 1 Upstream Towards SVP1 – Run B		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Manhole 1**	**Start Survey**
0.1	Root through joint	Fibrous
0.2	Bends up	Sharp
0.4	Misaligned joint Open joint	Slight Slight
0.5	**Reaches Soil & Vent Pipe 1**	**Survey Ends**

CCTV Survey

Survey No.	3	**Drain Run:**	Manhole 1 Downstream to Manhole 2 - Run C		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Manhole 1**	**Start Survey**
0.1	Crack Crack Root though joint	Circumferential Longitudinal Fibrous
0.7	Misaligned joint	Slight
0.8	100mm junction at 10 o'clock	Unknown
5.8	**Enters Manhole 2**	**Survey Ends**

CCTV Survey

Survey No.	4	**Drain Run:**	Manhole 2 Downstream – Run D		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Manhole 2**	**Start Survey**
1.3	Debris **No further camera access**	100% of pipe diameter **Drain collapsed** **Survey Ends**

CCTV Survey

Survey No.	5	**Drain Run:**	Manhole 2 Upstream to Gully 2 – Run E		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Manhole 2**	**Start Survey**
0.1	Debris	20% of pipe diameter
0.5	Debris	20% of pipe diameter
3.4	**Reaches Gully 2**	**Survey Ends**

CCTV Survey

Survey No.	6	**Drain Run:**	Manhole 2 Upstream towards Gully 3 – Run F		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Manhole 2**	**Start Survey**
0.4	Debris / Stones	10% of pipe diameter
1.1	Crack on joint	Circumferential
2.7	Bends up	Sharp
3.1	Misaligned joint Open joint Bends level	Slight Slight
3.3	Bends right	Sharp
3.7	**Reaches Gully 3**	**Survey Ends**

CCTV Survey

Survey No.	7	**Drain Run:**	SW Rodding Eye Downstream – Run G		
Diameter:	100mm	**Pipe Material:**	Vitrified Clay	**Drain Type:**	Rainwater

Meter Counter	Observations	Remarks
0.0	**SW Rodding Eye**	**Start Survey**
0.3	Bends level	
0.6	100mm junction at 9 o'clock	Rainwater Pipe 1
0.9	100mm junction at 3 o'clock	Rainwater Pipe 2
1.6	Bends left Debris / Silt	Very slight 10% of pipe diameter
1.9	Debris / Silt increases	30% of pipe diameter
2.7	Debris / Silt continues	30% of pipe diameter
3.4	Root through joint Debris / Silt decreases	Fibrous 10% of pipe diameter
3.5	100mm junction at 3 o'clock	Rainwater Pipe 3
4.2	Root ingress Debris / Silt	Fibrous 50% of pipe diameter
5.2	Debris / Silt continues	50% of pipe diameter
6.2	Debris / Silt continues	50% of pipe diameter
6.7	Debris / Silt increases **No further camera access**	100% of pipe diameter **Survey Ends**

CCTV Survey

Survey No.	8	**Drain Run:**	Rainwater Pipe 1 Downstream – Run H		
Diameter:	100mm	**Pipe Material:**	Vitrified Clay	**Drain Type:**	Rainwater

Meter Counter	Observations	Remarks
0.0	**Rainwater Pipe 1**	**Start Survey**
0.4	Bends level Debris / Silt	 20% of pipe diameter
1.3	**Joins main run**	**Survey Ends**

CCTV Survey

Survey No.	9	**Drain Run:**	Rainwater Pipe 3 Downstream – Run I		
Diameter:	100mm	**Pipe Material:**	uPVC	**Drain Type:**	Rainwater

Meter Counter	Observations	Remarks
0.0	**Rainwater Pipe 2**	**Start Survey**
0.2	Misaligned joint Open joint Pipe material changes	Slight Medium Vitrified Clay
0.5	Joins run Water level	 20% of pipe diameter
1.0	Misaligned joint Open joint Water level Bends left	Slight Medium 20% of pipe diameter Slight
1.5	Bends down Bends right	Medium Slight
2.4	**Joins main run**	**Survey Ends**

CCTV Survey

Survey No.	10	**Drain Run:**	Int Manhole 1 Downstream Towards Main – Run J		
Diameter:	225mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 1**	**Start Survey**
0.1	Misaligned joint Open joint	Slight Slight
0.4	Bends down Bends left	Slight Very slight
1.7	Bends down	Slight
2.4	Bends level Water level	 10% of pipe diameter
2.6	Water level continues	10% of pipe diameter
4.7	**Enters Internal Manhole 1a**	
4.8	Bends left	Slight
5.2	**Exits Internal Manhole 1a**	
10.9	Cracks on joint	Multiple longitudinal
13.3	100mm junction at 1 o'clock	Rainwater Pipe 3
15.3	Misaligned joint	Medium
15.8	**Reaches Main Sewer**	**Survey Ends**

CCTV Survey

Survey No.	11	**Drain Run:**	Int Manhole 1 Upstream to Int Gully 4 – Run K		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole**	**Start Survey**
0.1	Bends up Bends right Pipe material changes	Slight Very slight Vitrified Clay
0.9	Bends level	
1.0	100mm junction at 12 o'clock	Unknown
1.3	Open joint	Slight
1.8	Misaligned joint Open joint Pipe material changes	Slight Slight Salt glazed clay
2.1	**Reaches Internal Gully 4**	**Survey Ends**

CCTV Survey

Survey No.	12	**Drain Run:**	Int Manhole 1 Upstream to Int Manhole 3 - Run L		
Diameter:	225mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 1** Crack	**Start Survey** Circumferential
0.1	Hard Scale	10% of pipe diameter
2.6	100mm junction at 2 o'clock	Internal Gully
3.0	100mm inset connection at 12 o'clock Hard scale	 10% of pipe diameter
3.7	100mm inset connection at 12 o'clock Hard scale continues	 10% of pipe diameter
4.7	100mm junction at 3 o'clock Hard scale continues	 10% of pipe diameter
4.9	Misaligned joint Open joint Pipe diameter changes Hard scale continues	Slight Slight 150mm 10% of pipe diameter
6.3	Bends right Hard scale continues	Very slight 10% of pipe diameter
6.7	Crack Cracks Hard scale continues	Circumferential Multiple longitudinal 10% of pipe diameter
8.0	Water level	10% of pipe diameter
9.1	100mm inset connection at 9 o'clock Hard scale continues	WC 10% of pipe diameter
9.9	Hard scale increases	20% of pipe diameter
10.4	150mm junction at 9 o'clock	
10.8	**Enters Internal Manhole 3**	**Survey Ends**

CCTV Survey

Survey No.	13	**Drain Run:**	Int Manhole 2 Upstream to Int Gully 5 – Run M		
Diameter:	150mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 2**	**Start Survey**
0.4	Debris	20% of pipe diameter
0.9	**Reaches Internal Gully 5**	**Survey Ends**

CCTV Survey

Survey No.	14	**Drain Run:**	Int Manhole 2 Downstream - Run N		
Diameter:	150mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 2**	**Start Survey**
0.3	Debris	20% of pipe diameter
0.5	Open joint	Slight
0.8	**Joins Run**	**Survey Ends**

CCTV Survey

Survey No.	15	**Drain Run:**	Int Manhole 3 Upstream to Int Gully 5 – Run O		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 3**	**Start Survey**
0.1	Bends left	Sharp
1.0	Misaligned joint Open joint	Medium Slight
1.1	Crack **Reaches Internal Gully 5**	11 o'clock longitudinal **Survey Ends**

CCTV Survey

Survey No.	16	**Drain Run:**	Int Manhole 3 Upstream to Int RWP – Run P		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 3**	**Start Survey**
0.8	Misaligned joint Open joint	Slight Slight
2.1	Misaligned joint Open joint	Medium Slight
2.2	Pipe material changes	Cast Iron
2.3	Bends up	Sharp
2.7	**Reaches Rainwater Pipe**	**Survey Ends**

CCTV Survey

Survey No.	17	**Drain Run:**	Int Manhole 3 Upstream to Urinal – Run Q		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 3**	**Start Survey**
0.5	100mm junction at 3 o'clock	
1.0	Soft scale	10% of pipe diameter
2.0	Soft scale continues	10% of pipe diameter
2.3	Misaligned joint Open joint Pipe material changes	Slight Slight uPVC
2.6	Bends right	Sharp
3.0	Soft scale	10% of pipe diameter
3.4	Bends up	Sharp
3.6	**Reaches Urinal Waste Pipe**	**Survey Ends**

CCTV Survey

Survey No.	18	**Drain Run:**	Int Manhole 3 Upstream to Int Manhole 4 – Run R		
Diameter:	150mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 3**	**Start Survey**
0.9	Bends left	Very slight
1.8	Bends left	Very slight
3.7	**Enters Internal Manhole 4**	**Survey Ends**

CCTV Survey

Survey No.	19	**Drain Run:**	Int Manhole 4 Upstream to Int Manhole 5 – Run S		
Diameter:	150mm	**Pipe Material:**	Liner	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 4**	**Start Survey**
0.3	150mm junction at 3 o'clock	
1.1	Hard scale	10% of pipe diameter
1.7	Hard scale continues Bends left	10% of pipe diameter Very slight
2.3	150mm junction at 9 o'clock Hard scale continues	 10% of pipe diameter
5.9	Water level	10% of pipe diameter
6.1	Water level increases	20% of pipe diameter
6.3	150mm junction at 3 o'clock Water level continues	 20% of pipe diameter
6.5	Water level increases	30% of pipe diameter
6.9	Water level decreases	20% of pipe diameter
7.0	Water level decreases	10% of pipe diameter
8.0	Water level continues	10% of pipe diameter
9.0	Water level continues	10% of pipe diameter
9.7	**Enters Internal Manhole 5**	**Survey Ends**

CCTV Survey

Survey No.	20	**Drain Run:**	Int Manhole 5 Upstream to Int Manhole 6 – Run T		
Diameter:	150mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 5**	**Start Survey**
0.9	100mm junction at 3 o'clock	Redundant
1.2	50mm junction at 12 o'clock	Int Gully 7
4.0	Cracks	Multiple longitudinal
4.4	Cracks	Multiple circumferential
4.9	**Enters Internal Manhole 6**	**Survey Ends**

CCTV Survey

Survey No.	21	**Drain Run:**	Int Manhole 6 Upstream to Int Manhole 7 – Run U		
Diameter:	150mm	**Pipe Material:**	uPVC	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 6**	**Start Survey**
0.2	Misaligned joint Open joint Pipe material changes	Slight Slight Liner
1.9	Bends right	Very slight
3.8	Bends right	Very Slight
4.4	Lumps in liner	5 – 7 o'clock
5.4	Bends right	Very slight
6.1	Lumps in liner	6 o'clock
7.6	100mm junction at 9 o'clock	Staff kitchen sink
8.6	**Enters Internal Manhole 7**	**Survey Ends**

CCTV Survey

Survey No.	22	**Drain Run:**	Int Manhole 4 Upstream to Int Gully 6 – Run V		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 4**	**Start Survey**
0.1	Bends left	Slight
1.1	Pipe material changes	Cast Iron
1.4	Bends right Debris	Sharp 20% of pipe diameter
1.7	Bends level	
2.0	Pipe corroded	`30% of pipe diameter
2.8	Pipe corroded **Reaches Internal Gully 6**	40% of pipe diameter **Survey Ends**

CCTV Survey

Survey No.	23	**Drain Run:**	Int Manhole 5 Upstream to WC2 – Run W		
Diameter:	150mm	**Pipe Material:**	uPVC	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 5**	**Start Survey**
1.1	100mm junction at 10 o'clock	WC7
1.6	Bends right	Sharp
2.8	100mm junction at 12 o'clock	WC6
3.9	100mm junction at 12 o'clock	WC5
4.2	100mm junction at 12 o'clock	WC4
4.8	100mm junction at 12 o'clock	WC3
5.6	Pipe diameter changes	100mm
5.9	Bends up	Sharp
6.1	**Reaches WC 2**	**Survey Ends**

CCTV Survey

Survey No.	24	**Drain Run:**	Int Manhole 5 Upstream - Run X		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 5**	**Start Survey**
0.1	Debris	10% of pipe diameter
1.5	Debris	10% of pipe diameter
1.7	Bends up	Sharp
2.0	**Run bunged off**	**Survey Ends**

CCTV Survey

Survey No.	25	**Drain Run:**	Int Manhole 5 Upstream - Run Y		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 5**	**Start Survey**
0.1	Bends right	Slight
0.5	100mm junction at 2 o'clock Debris	Redundant 20% of pipe diameter
2.4	Bends right	Slight
2.9	Bends up	Sharp
3.2	**Run bunged off**	**Survey Ends**

CCTV Survey

Survey No.	26	**Drain Run:**	Int Manhole 6 Upstream to WC 8 - Run Z		
Diameter:	100mm	**Pipe Material:**	uPVC	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 6**	**Start Survey**
0.1	Bends right	Slight
1.4	Bends left	Sharp
1.7	100mm junction at 12 o'clock	WC11
2.6	100mm junction at 12 o'clock	WC10
3.3	100mm junction at 12 o'clock	WC9
3.9	Bends up	Sharp
4.2	**Reaches WC 8**	**Survey Ends**

CCTV Survey

Survey No.	27	**Drain Run:**	Int Manhole 6 Upstream to WC12 – Run A		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 6**	**Start Survey**
0.1	Bends left	Slight
0.9	100mm junction at 12 o'clock	WC14
1.6	Bends right	Sharp
2.3	100mm junction at 12 o'clock	WC13
3.2	Bends up	Sharp
3.4	**Reaches WC12**	**Survey Ends**

CCTV Survey

Survey No.	28	**Drain Run:**	Int Manhole 8 Downstream to Int MH7 - Run B		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 8**	**Start Survey**
0.3	Crack on joint	Circumferential
0.8	100mm junction at 1 o'clock	Redundant
1.5	100mm junction at 3 o'clock	Possible RWP
2.8	100mm junction at 1 o'clock	Capped off
3.4	Crack 100mm junction at 2 o'clock	Circumferential Vent pipe
4.1	Pipe diameter changes	150mm
4.3	**Enters Internal Manhole 7**	**Survey Ends**

CCTV Survey

Survey No.	29	**Drain Run:**	Int Manhole 8 Upstream to WC15 – Run C		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 8**	**Start Survey**
0.2	Bends right	Slight
0.5	Surface spalling / delamination	1 o'clock
2.0	Bends up	Sharp
2.1	**Reaches WC 15**	**Survey Ends**

CCTV Survey

Survey No.	30	**Drain Run:**	Int Manhole 8 Upstream to Int Gully 8 – Run D		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 8**	**Start Survey**
0.3	**Reaches internal Gully 8**	**Survey Ends**

CCTV Survey

Survey No.	31	**Drain Run:**	Int Manhole 8 Upstream to WC16 – Run E		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 8**	**Start Survey**
0.4	Crack	Circumferential
1.1	Misaligned joint Open joint	Slight Slight
2.0	100mm junction at 3 o'clock	Internal Rainwater Pipe
2.2	Misaligned joint Open joint	Slight Slight
2.8	Crack Bends up	Circumferential Sharp
3.1	**Reaches WC16**	**Survey Ends**

CCTV Survey

Survey No.	32	**Drain Run:**	Int Manhole 8 Upstream to WC17 – Run F		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 8**	**Start Survey**
0.9	Bends up	Sharp
1.1	**Reaches WC17**	**Survey Ends**

CCTV Survey

Survey No.	33	**Drain Run:**	Int Manhole 8 Upstream to Int Gully 9 - Run G		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 8**	**Start Survey**
0.3	Bends right	Very slight
0.9	Misaligned joint Open joint	Slight Slight
1.3	Bends left	Very slight
2.4	Crack	7 o'clock longitudinal
3.3	Misaligned joint Open joint	Slight Slight
3.5	**Reaches Internal Gully 9**	**Survey Ends**

CCTV Survey

Survey No.	34	**Drain Run:**	Internal Manhole 9 Upstream Run H		
Diameter:	150mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 9**	**Start Survey**
0.1	100mm junction at 12 o'clock Soft scale	Urinal 60% of pipe diameter
0.4	Bends right	Slight
2.1	**Enters Internal Manhole 9a** Pipe material changes	**Buried** Cast Iron
2.7	**Exits Internal Manhole 9a**	
5.3	100mm junction at 10 o'clock	Rainwater Pipe
5.7	Debris	20% of pipe diameter
6.3	Hard scale	20% of pipe diameter
7.3	Hard scale continues	20% of pipe diameter
7.9	Hard scale decreases	10% of pipe diameter
9.7	**Enters Internal Manhole 10**	
10.0	**Exits Internal Manhole 10** Debris	 20% of pipe diameter
10.8	Debris increases	30% of pipe diameter
11.4	Debris continues	30% of pipe diameter
12.0	Debris increases	40% of pipe diameter
12.7	Debris continues	40% of pipe diameter
13.2	Debris continues Bends right	40% of pipe diameter Slight
14.2	Debris continues	40% of pipe diameter

CCTV Survey

Meter Counter	Observations	Remarks
15.0	Debris decreases Bends right	30% of pipe diameter Medium
15.8	Debris continues Bends up	30% of pipe diameter Sharp **Survey Ends**

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CCTV Survey

Survey No.	35	**Drain Run:**	Int Manhole 9 Upstream to Int Gully 10 – Run I		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 9**	**Start Survey**
0.2	Bends right	Slight
0.8	Misaligned joint Open joint	Slight Slight
0.9	**Reaches internal Gully 10**	**Survey Ends**

CCTV Survey

Survey No.	36	**Drain Run:**	Int Manhole 9 Downstream to Manhole 3– Run J		
Diameter:	225mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Internal Manhole 9**	**Start Survey**
0.2	Misaligned joint Open joint Hole in pipe	Slight Slight 9 o'clock – 3 o'clock
0.7	Bends down	
1.6	Bends level	
2.0	Bends left	Sharp
2.4	Bends right	Medium
2.9	Bends left	Slight
3.0	150mm inset connection at 3 o'clock	
3.9	100mm junction at 3 o'clock	
4.2	Hole in pipe	12 o'clock
5.9	Bends right	Very slight
6.6	Bends right	Very slight
10.0	Hole in pipe	12 o'clock
10.7	Misaligned joint Open joint Bends right	Slight Slight Slight
11.6	Crack	Circumferential
17.0	100mm junction at 3 o'clock	RWG D
25.5	**Enters Manhole 3**	**Survey Ends**

CCTV Survey

Survey No.	37	**Drain Run:**	SW Manhole 1 Upstream Run K		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Rainwater

Meter Counter	Observations	Remarks
0.0	**SW Manhole 1**	**Start Survey**
0.4	Debris / Silt **Run capped off**	30% of pipe diameter **Survey Ends**

CCTV Survey

Survey No.	38	**Drain Run:**	SW Manhole 1 Upstream - Run L		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Rainwater

Meter Counter	Observations	Remarks
0.0	**SW Manhole 1** Water level	**Start Survey** 10% of pipe diameter
0.4	Misaligned joint Open joint	Slight Medium
5.6	**Enters Internal SW Manhole**	**Survey Ends**

CCTV Survey

Survey No.	39	**Drain Run:**	SW Manhole 1 to Soil & Vent Pipe - Run M		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**SW Manhole 1**	**Start Survey**
0.1	Bends right	Very slight
0.4	Crack	Circumferential
0.8	Misaligned joint Open joint	Slight Slight
2.2	Misaligned joint Open joint	Slight Slight
2.4	Misaligned joint Open joint Bends right	Slight Slight Very slight
2.6	Hole in pipe	10 o'clock
4.1	Misaligned joint Open joint	Slight Slight
4.4	Crack Bends up	Circumferential Sharp
4.6	**Reaches Soil & Vent Pipe**	**Survey Ends**

CCTV Survey

Survey No.	40	**Drain Run:**	SW Manhole 1 Downstream – Run N		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**SW Manhole 1** Debris / Silt	**Start Survey** 20% of pipe diameter
1.4	Debris / Silt increases Possible collapse	100% of pipe diameter No further camera access **Survey Ends**

CCTV Survey

Survey No.	41	**Drain Run:**	Manhole 4 Upstream - Run O		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Manhole 4**	**Start Survey**
0.1	Bends left Debris / Silt	Slight 20% of pipe diameter
1.9	Debris / Silt continues	20% of pipe diameter
5.3	Misaligned joint Open joint Debris / Silt	Slight Slight 10% of pipe diameter
7.9	Misaligned joint **Open joint**	Medium **Slight**
9.5	Debris / Stone	30% of pipe diameter
10.5	Debris / stone continues	30% of pipe diameter
11.6	Misaligned joint Open joint Debris / stone continues	Medium Medium 30% of pipe diameter
12.6	Debris / stone increases **No further camera access**	60% of pipe diameter **Survey Ends**

CCTV Survey

Survey No.	42	**Drain Run:**	Manhole 4 Upstream to Soil & Vent Pipe – Run P		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Manhole 4**	**Start Survey**
1.8	Misaligned joint Open joint	Slight Slight
2.1	Misaligned joint Open joint Bends right	Slight Medium Slight
3.1	Misaligned joint Open joint	Slight Slight
3.4	Bends up	Sharp
3.7	**Reaches Soil & Vent Pipe**	**Survey Ends**

CCTV Survey

Survey No.	43	**Drain Run:**	Manhole 4 Upstream to Gully 4 – Run Q		
Diameter:	100mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Manhole 4**	**Start Survey**
0.2	Debris / Silt / Stone Bends right	20% of pipe diameter Slight
0.8	Debris / Silt / Stone continues Bends right	20% of pipe diameter Very slight
2.1	Debris / Silt / Stone increases	50% of pipe diameter
3.9	Debris / Silt / Stone decreases	10% of pipe diameter
4.9	**Reaches Gully 4**	**Survey Ends**

CCTV Survey

Survey No.	44	**Drain Run:**	Road Gully 1 Downstream – Run R		
Diameter:	150mm	**Pipe Material:**	Vitrified Clay	**Drain Type:**	Rainwater

Meter Counter	Observations	Remarks
0.0	**Road Gully 1**	**Start Survey**
0.3	Bends right	Slight
1.7	150mm junction at 10 o'clock	
5.1	150mm junction at 3 o'clock	
5.2	150mm inset connection at 10 o'clock	Road Gully 2
6.5	Bends down Bends right	Slight Very slight
6.9	**Joins main run**	**Survey Ends**

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CCTV Survey

Survey No.	45	**Drain Run:**	Road Gully 2 Downstream – Run S		
Diameter:	150mm	**Pipe Material:**	Vitrified Clay	**Drain Type:**	Rainwater

Meter Counter	Observations	Remarks
0.0	**Road Gully 2**	**Start Survey**
1.7	Hole in pipe	9 o'clock to 1 o'clock
2.0	Cracks Cracks Debris / Silt	Multiple circumferential Multiple longitudinal 10% of pipe diameter
12.6	Bends down	Slightly
13.8	**Joins Road Gully 1 run**	**Survey Ends**

CCTV Survey

Survey No.	46	**Drain Run:**	Manhole 3 Downstream to Main Sewer – Run T		
Diameter:	150mm	**Pipe Material:**	Salt Glazed Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Manhole 3**	**Start Survey**
0.1	Pipe material changes	Liner
2.6	100mm junction at 3 o'clock	RWG C
8.3	150mm junction at 3 o'clock	Road Gullies 1 & 2 & RWG B
11.9	150mm junction at 3 o'clock	Assumed Redundant
18.8	Pipe material changes	Salt Glazed Clay
19.2	Bends right	Slight
26.7	**Enters Main Manhole**	**Survey Ends**

CCTV Survey

Survey No.	47	**Drain Run:**	Manhole 5 Upstream towards Manhole 6 - Run R		
Diameter:	100mm	**Pipe Material:**	Vitrified Clay	**Drain Type:**	Foul

Meter Counter	Observations	Remarks
0.0	**Manhole 5** Water level	**Start Survey** 10% of pipe diameter
0.8	Bends right Water level decreases	Very slight 5% of pipe diameter
15.6	Hard scale / cement	10% of pipe diameter
16.3	Hard scale / cement increases	20% of pipe diameter
17.0	**Enters Manhole 6**	
17.4	Bends right	Sharp
17.5	**Exits Manhole 16** Pipe material changes	 Cast Iron
17.6	Hard scale	20% of pipe diameter
17.7	**No further camera access**	**Bend too sharp for camera to pass** **Survey Ends**

CCTV Survey

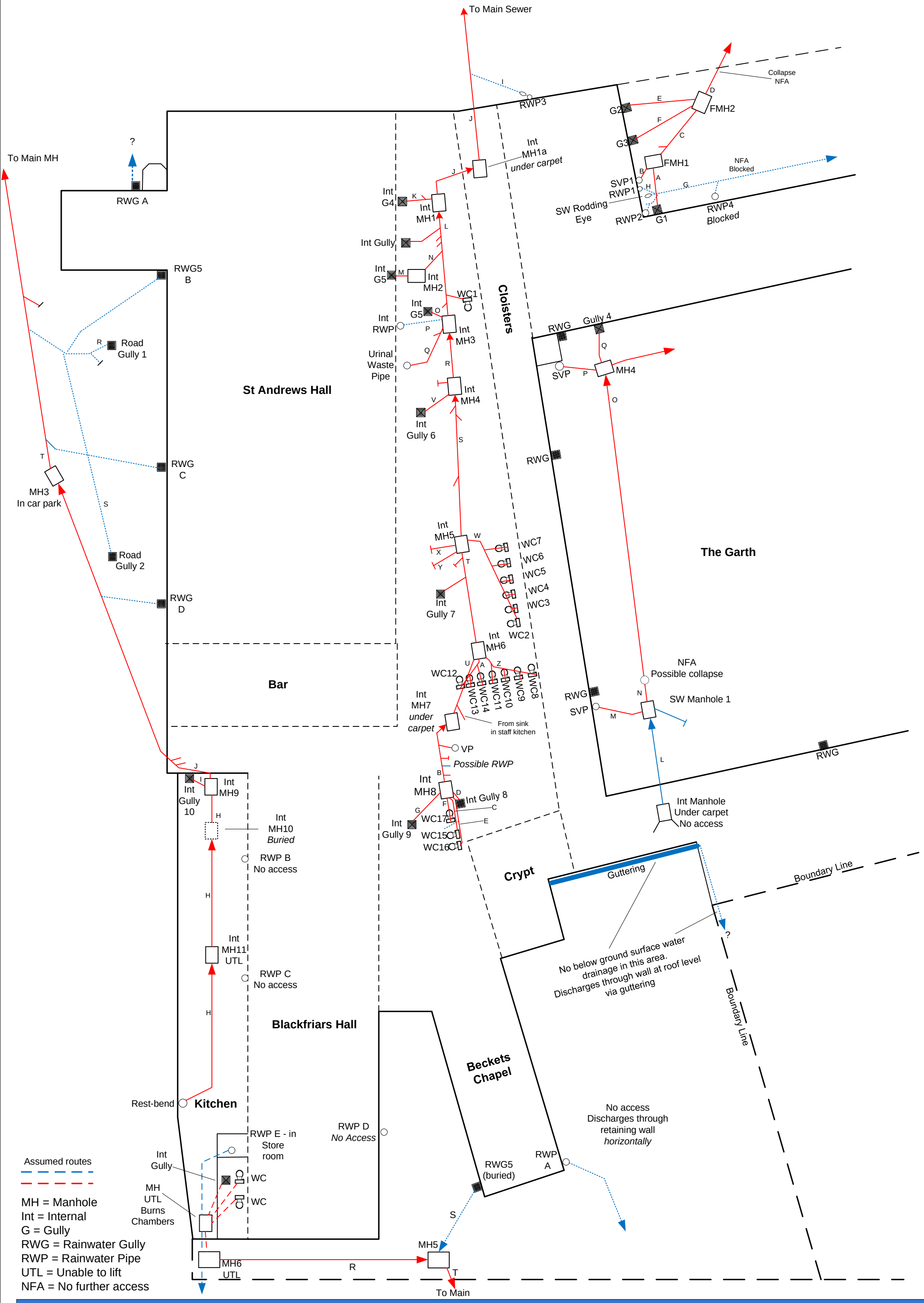
Survey No.	48	**Drain Run:**	Manhole 5 to Rainwater Gully 5 – Run S		
Diameter:	100mm	**Pipe Material:**	Vitrified Clay	**Drain Type:**	Rainwater

Meter Counter	Observations	Remarks
0.0	**Manhole 5**	**Start Survey**
0.1	Debris Water level	10% of pipe diameter 10% of pipe diameter
1.0	Debris Water level	10% of pipe diameter 10% of pipe diameter
2.0	Debris Water level	10% of pipe diameter 10% of pipe diameter
2.4	Water level Crack Root ingress	10% of pipe diameter Circumferential Fibrous
4.6	**Reaches Rainwater Gully 5**	**Survey Ends**

CCTV Survey

Survey No.	49	**Drain Run:**	Manhole 5 Downstream to Main Sewer – Run T		
Diameter:	100mm	**Pipe Material:**	Vitrified Clay	**Drain Type:**	Combined

Meter Counter	Observations	Remarks
0.0	**Manhole 15**	**Start Survey**
0.1	Debris / Stones	10% of pipe diameter
0.4	Debris / Stones Crack	10% of pipe diameter Circumferential
2.4	100mm junction at 3 o'clock	Unknown
3.0	Bends left	Medium
4.2	Bends left	Medium
4.9	Bends down	Medium
5.3	**Main Sewer**	**Survey Ends**



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Appendix 5

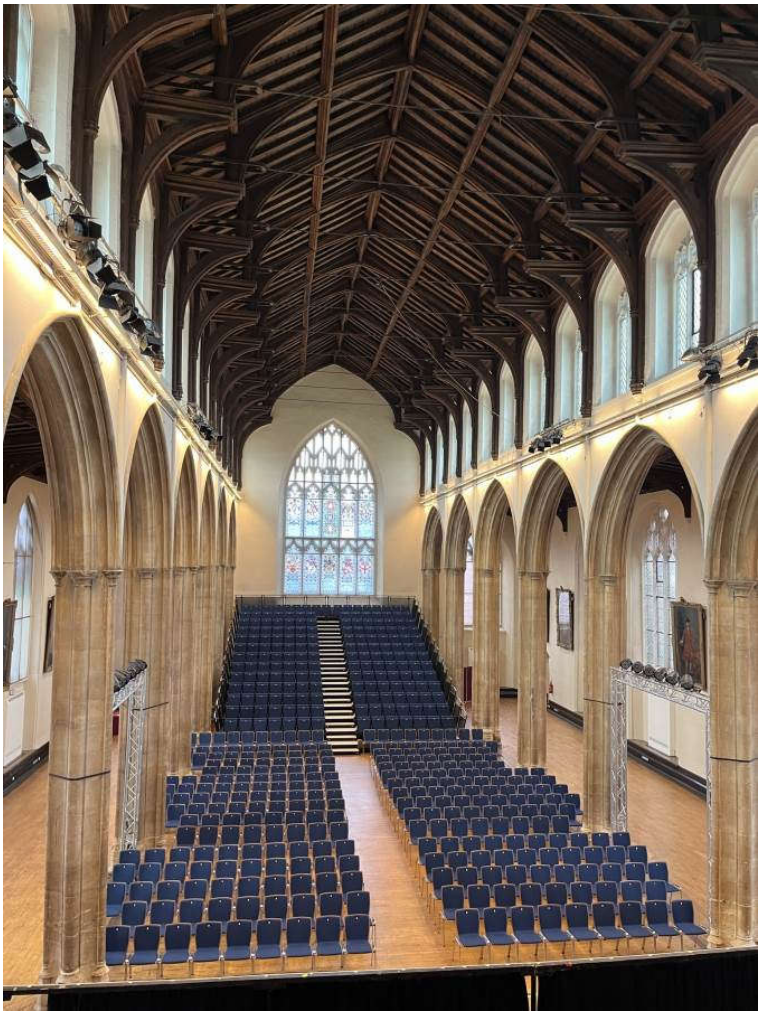
Structural Report

NORWICH CITY COUNCIL

THE HALLS, NORWICH
(ST ANDREW'S & BLACKFRIARS' HALLS, CLOISTERS AND BECKET'S CHAPEL)

Visual Structural Appraisal v02

DECEMBER 2022



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Quality Assurance

Site name: The Halls, St Andrews Plain, Norwich NR3 1AU

Client name: Norwich City Council

Type of report: Visual Structural Appraisal

Prepared by: Josh Halton-Farrow BEng (Hons) MEng CEng MIStructE
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Signed

Date December 2022

Reviewed by: Alan Wright BEng (Hons) CEng FIStructE MICE MCIOB
Conservation Accredited Engineer
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Signed

Date December 2022

Issue Date	Rev	Description
19 December 2022	v01	Issued to client. Missing roof appraisals from H + R.
21 December 2022	v02	Amended to include comments from H + R.

Table of Contents

1. Introduction

1.1. Scope of Works

Wright Consulting were appointed by Mr D Hall of Roche Surveyors on behalf of Norwich City Council to undertake a visual structural appraisal of St Andrew's & Blackfriars' Halls, the Cloisters and Becket's Chapel at The Halls, Norwich. This appraisal was undertaken with a view to understanding the existing condition of the buildings and to recommend any appropriate structural repairs that may need to be undertaken to maintain the buildings' stability. To undertake this brief Josh Halton-Farrow BEng (Hons) MEng CEng MIStructE visited the property on 10, 23 & 24 November 2022 to undertake a visual appraisal from ground level. The weather on the day of our visit was overcast, but dry.

For the purposes of this report, the Halls are set on a North to South axis, with St Georges Street located to the West and St Andrews Street located to the South. Photographs from our visit are included within Appendix A of this report and Hutton + Rostron's report is included within Appendix B.

Limitation of Report

At the time of the visit, the building was in full use and fully furnished. Accordingly, not all of the surfaces and structural finishes were available to view at the time of our visit. It is likely that further structural opening up works will be required to enable the recording of the structural elements, but these are referred to directly within the body of this report.

No trial pits, opening up works or other forms of invasive investigation were carried out as part of this appraisal. Observations made in this report are based on a visual appraisal of the exposed building structure visible from floor level externally and internally. Comments may also be included on non-structural elements, but these should be treated as information only as they are beyond the realm of our professional expertise.

1.2. Report Provisos

Our Appraisal is based on observations made on the date shown in 1.1 above. As some of the defects noted within this appraisal may by progressive, no responsibility can be accepted for defects that were not evident at the date of our visit, or conditions that may have deteriorated since our visit.

This report is not intended to be a full list of defects or conditions, but instead focuses on the most salient structural items considered appropriate to the structural form of the building, the use of the building and its overall structural condition given the purpose of the report. This appraisal is prepared without prejudice and items listed are the most salient points, bearing in mind the purpose of the appraisal. It should therefore not be considered as a 'Full Structural Survey'.

This report is prepared for the sole purpose as mentioned in 1.1 above and is for the sole use of the named Client and their professional advisors only. The use of this report by third parties is not allowed without the written authority of Wright Consulting. No responsibility can be accepted for any consequences of this information being passed to a third party who may act upon its contents/recommendations. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the named Client and Wright Consulting, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the named Client and not for the benefit of any other party. In particular, Wright Consulting does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the named Client. Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the named Client, agrees by virtue of its use to indemnify and hold Wright Consulting harmless from and against all claims, losses and damages, arising out of or resulting from the performance of the work by Wright Consulting.

The recommendations contained in this Report represent Wright Consulting's professional opinions, exercising the reasonable duty of care required of an experienced Structural Engineering Consultant. Wright Consulting does not warrant or guarantee that the property is free of hazardous or potentially hazardous materials or conditions.

2. General Description

2.1. 'The Halls' are a complex of former friary church and convent buildings dating back to the 14th Century. The buildings are of mainly flint and brick construction, with cut timber floors and roofs. The buildings are now used for conferences, weddings, concerts, beer festivals and meetings.

2.2. The Dominican Friary (Blackfriars) Norwich: Becket's Chapel, Chapter House, North Range, standing remains in the East Garth, and buried remains are classed as a Scheduled Ancient Monument noted on the National Heritage List of Great Britain under List Entry Number 1004053. In addition, the former Dominican Friary (Blackfriars) Norwich: St Andrew's Hall and Blackfriars' Hall, The Crypt, the south range, the East Garth and east cloister walk, the West Garth, and west boundary wall are Grade I Listed in their own right as buildings of special historic and architectural interest on the National Heritage List of Great Britain (List Entry Number: 1220456). They are, therefore, protected under the Planning (Listed Buildings and Conservation Areas) Act 1990. For the full listing information, the above List Entry Numbers can be used on Historic England's 'Search the List' web page.

2.3. Given the building's SAM and Listed statuses, any works that alter or change its external appearance or historic building fabric must receive SAM and Listed Building Consent from the Local Conservation Officer and the Secretary of State prior to works commencing. Accordingly, we would recommend an early consultation with the Local Conservation Officer and Historic England to confirm their requirements prior to any recommended repair works being undertaken. It should be noted that archaeologists may need to be employed (at the client's own expense) to record any findings uncovered as part of any future project.

2.4. A detailed historic study of the building and site have not been completed as part of this report. However, it is our recommendation that a detailed study into the development of the site and buildings be undertaken to better understand where the structure has been altered or previously repaired and how this is affecting the buildings as they currently stand. These investigations would likely involve obtaining historic plans and documents from the City's archives to ascertain when and why historic structural repairs have been undertaken. Particular attention should be paid to the works carried out in the last century.

2.5. From the BGS (British Geological Survey) website, the ground conditions under the site are noted to be on a Lewes Nodular Chalk, Seaford Chalk, Newhaven Chalk, Culver Chalk and Portsdown Chalk Formations (Chalk). However, it appears to be on a junction of ground conditions where superficial deposits of River Terrace Deposits (1 - Sand and gravel) may be present. A previously undertaken local borehole notes that there may be a 2m depth of made ground over the 'soft off-white weathered chalk (with occasional flint cobbles). It should be noted that the site slopes from South to North and therefore part of the site/buildings may be sitting on variable ground conditions. A formal ground investigation would need to be undertaken to confirm these assumptions.

2.6. No investigation or recording of the below ground drainage has been completed as part of this appraisal. It is a recommendation of this report that a full CCTV survey be completed of all underground drains with a view to understanding the extent of drainage present, the condition of the drainage and its outfalls.

2.7. According to the Environment Agencies flood zone mapping, the site is classed as Flood Zone 1. Land and property in Flood Zone 1 have a low probability of flooding.

3. Observations

3.1. The following observations should be read in conjunction with our photographs taken during our visit (included in Appendix A) and Hutton + Rostron's 'Condition Investigation of Timber Roof Structures' report (included in Appendix B).

GENERAL

3.2. Although gutters and downpipes are present on the buildings, in many locations, the gutters are blocked, in a poor condition and do not always fall to downpipes. It is not known where the downpipes outfall to, but it is important to ensure they are in a good condition and free flowing. We would therefore recommend a CCTV survey of the RWPs and drains be carried out to allow their condition arrangement to be determined. In addition, it would be prudent to allow for a new formal guttering system with downpipes to be installed. These outfalls should ideally fall to the existing surface water drainage system.

3.3. It is a further recommendation that all vegetation next to the envelope of the buildings should be removed and killed with an appropriate chemical weed killer. Some areas of the building have saplings and ivy growing through their envelopes and these should be treated and removed to minimise the structural impact of their growth.

ST ANDREW'S HALL

3.4. A detailed history and description of the hall can be found on its formal listing as previously mentioned. However, it is worth noting that the building has been altered on an ad-hoc basis to suit the building's change of use or as structural repairs were required.

3.5. St Andrew's Hall currently forms an aisled nave of seven bays. The hall's external walls consist of coursed and random rubble flint, including some knapped flint, with limestone and brick dressings. The nave's pitched roof and the aisles' lean-to roofs are finished in copper. Stepped buttresses are present between each of the aisle windows and a porch has been constructed at the West end of the South elevation using materials to match the hall.

External Observations

3.6. Two large buttresses constructed in a style to match the original slender buttresses have been constructed at the South-East corner of the South aisle. No signs of movement have been observed in this area, so it can be assumed that the buttresses are working. However, small sections of the stonework and mortar are beginning to fail and it is our recommendation that they be repaired.

3.7. Cracking is present in the stone tracery at the apex of many of the aisle window arches. It is our opinion that this has been caused by an overloading of the arches due to the position of the principal rafters internally. Unfortunately, every other principal rafter supporting the aisle roof structure has been located directly over the centre of the window arch. No wall plates are present under the principal rafter bearing position and there is minimal masonry between the arch and rafter to spread the loads into the adjacent areas of wall, so most of the load from the principal rafter is being transferred into the window's stonework. Due to the slender nature of the stone window tracery, many of the stone elements have cracked or slipped out of position. It is our recommendation that a new structural element be installed over each of these windows to spread the load onto the adjacent masonry wall panels to prevent the window tracery becoming overloaded.

3.8. A number of repairs have been made to external elevation's stonework (i.e. window sills, window tracery, stringer courses, etc.) with a cementitious render and these repairs are now failing and allowing rainwater to become trapped behind, thus causing further damage to the stonework. We would recommend that where these cementitious repairs have been undertaken, that the render be removed and the stones be repaired by a specialist stonemason. In addition, there are other areas of stonework that have now failed and require repair. We would recommend a schedule of stone defects/repairs be created by a qualified professional to outline the extent of stone repairs required.

3.9. Diagonal cracking (approximately 5mm in width) extends from the top of the northern ground floor window of the East side of the South porch up to the First Floor window over and from the southern window on the East side of the porch at a 45 degree angle up to the adjacent buttress. The later crack noted extends through the window tracery and down through the flintwork below to ground level. These cracks could be a sign of ground settlement under this historically replaced porch (approx. in the 1860s). We would therefore recommend repointing the crack with a suitable lime mortar and monitoring the crack over the next few years prior to specifying further intrusive repairs.

3.10. Vertical cracks are present above the western most windows of both the North and South aisles. These cracks are approximately 10mm wide and run from eaves level into the stone window tracery. The southern crack also extends through the masonry below the window down to ground level. A mirror image of this crack is present on the West elevation of the South aisle and could be lead us to assume these cracks to be a sign of westerly movement in the West gable. It is our recommendation that these cracks be repointed externally and monitored over an extended period of time. It would also be prudent to carry out a verticality check of the gable to better understand if it is leaning in a westerly direction. There is a change from coursed flintwork below the middle string course to random rubble flintwork above. This could be evidence that the gable has been reconstructed above the middle string course in the past due to a westerly movement that has since been resolved.

3.11. The West gable has four buttresses, one to each corner of the North and South aisles and one to each corner of the nave. The three southern buttresses have fenestrations at their base to create archways for pedestrians to walk through. The buttresses' low level stonework has deteriorated where subjected to weathering. This has caused the stonework to delaminate and erode and it is our recommendation that a stonemason be employed to carry out repairs to prolong the life of the stones. In addition, the cut stone arch in the northern nave buttress has cracked in half. This could be a further sign of the West gable's movement or that this buttress was undermined during adjacent works on St George's Street. There are signs that this crack/movement has been reviewed in the past with 'tell-tales' fixed over the crack. However, these have been removed and we have not been provided with any corresponding data. We would therefore recommend that further monitoring of this stone be undertaken to ascertain if the movement is continuing and if so, it should be noted that investigations into the buttress's foundations/bearing condition will be required to allow a suitable repair to be specified.

3.12. The ends of eight common rafter and two principal rafter sole plates (running parallel to and below the rafters) can be seen to extend through the West end of the nave's external envelope at eaves level. It is clear that this roof structure has substantially dropped vertically in the past and that the ashlar has been cut to suit this change in eaves level. This is a sign that movement in the West gable has been ongoing for many years and could be historic in nature or moving in a very slow manner.

3.13. Although access was not provided to allow for an inspection of the roof finishes, it can be seen from ground level that there are areas that the copper is in a poor condition. It is our recommendation that a specialist be instructed to advise on the roof finishes' condition and whether repairs are required to ensure a weathertight envelope. As a minimum, we would allow for repair flashing and coping details.

Internal Observations

3.14. The floor construction consists of timber floorboards spanning between timber joists sat directly onto the original floor construction below. No trial holes were opened up to allow for an inspection of this structure, but from our visual inspection of the floor and by virtue of its past uses, we concluded that it was sufficient for its continued use as an events venue.

3.15. An internal inspection of the West end of the nave confirms that the North and South upper walls of the final bay have dropped vertically as observed externally. As part of this vertical movement, cracking is present around the adjacent nave windows. We do not know when the last redecoration was undertaken and therefore do not know whether this movement is ongoing. We would recommend that these cracks and the vertical movement be observed over an extended period of time to better understand the movement present.

3.16. There are signs of historic racking in a westerly direction within the nave's roof structure. However, the West gable's alignment does not appear to correspond with this leaning of the roof structure and appears to be straight and true (in vertical alignment). The most western truss lines up with the orientation of the gable masonry and it would appear that the adjacent purlins have been cut short to allow the West gable to be reconstructed straight. As previously noted, metal brackets are located on the external face of the West gable to restrain the gable masonry to the retaining buttresses. As previously noted, it is our recommendation to carry out a verticality check of the gable to better understand if it is leaning in a westerly direction.

3.17. The cracking observed externally above the aisle windows at the West end of the building continue through the external masonry and are visible internally. As previously noted, it is our recommendation that these cracks be repointed externally and monitored over an extended period of time. It should be noted that no fixing or ties are present between the aisle roof structure and the aisles' West elevation. When the building is next reroofed, we would recommend that the roof structure be tied to the West elevations to help restrain the West elevation from moving in a westerly direction.

3.18. A detailed investigation into the condition of the hall's roof structure has been undertaken by Hutton + Rostron Environmental Investigations Ltd. Their report describes the roof structure in detail and highlights any areas of damp, decay or defects. Timber elements, where accessible, were microbore drilled for decay detection and probed for surface/ambient and deep moisture content readings, so as to ascertain the extent of structurally significant or partial decay, and to determine the vulnerability to decay organisms. Thermography and fibre-optic borescope inspection techniques were also utilised to assess inaccessible areas. Generally, the nave and aisle timber roof structures were found to be in a good condition, with decay confined to the extreme bearing ends of the perpendicular plates which supported the bearing ends of common rafter feet. This appeared to be a mixture of historic wet rot and historic wood-boring beetle infestation (Deathwatch beetle – Xestobium rufovillosum). The damp staining visible on the exposed roof timbers and boards were found to be evidence of historic water penetration, with current moisture content readings of 12%. This is below the allowable decay threshold of 20% w/w for fungal growth and 15-16% w/w for wood-boring beetle. It is our recommendation that as part of any reroofing works, allowance should be made for carrying out isolated scarf joint repairs to the historically decayed timbers (highlighted in H+R's report) and for strengthening the connections between principal structural members (i.e. purlin the principal rafter connection, principal rafter ridge connection, principal rafter to hammer beam connection, etc.) with bespoke steel brackets/plates to prevent future failure due to deterioration of the existing mortise and tenon connections.

3.19. The roof structure at the East end of the hall is located over the organ and is of a more modern construction. It is assumed that this is where the (now demolished) historic bell tower was located. The roof structure consists of common rafters spanning from eaves to ridge with two purlins located at third points and a ridge beam. These purlins and ridge beam span between loadbearing walls to the East and West. The West wall has been repaired along its coping and reconstructed at its ridge. Generally, this 'modern' roof structure appears to be in a good order and working structurally. However, most of the timber elements bear into the external masonry and as such are more susceptible to decay due to moisture. This is of particular concern along the East wall that is rendered externally. There are signs of staining on the boards, rafters and purlin ends that are located against or bear onto this wall. It is therefore our recommendation that allowance be made for supplementing or repairing two common rafters and five beam ends if found to be decayed.

3.20. Flaking paintwork and plaster are present on the internal face of the South porch's external walls. This could a sign of leaking roof finishes or a build-up of condensation due to a lack of ventilation in the porch. It is our recommendation that the parapet gutters be inspected to ensure they are clear and in a good condition. In addition, additional ventilation should be installed to allow moisture within the air to leave the porch rather than condensing on the external walls.

BLACKFRIARS' HALL

3.21. A detailed history and description of the hall can be found on its formal listing as previously mentioned. However, it is worth noting that Blackfriars' Hall is said to have been the private chancel for the friars, separated from the nave (St Andrew's Hall) by the cross passage (now bar area).

3.22. The 5-bay hall's external walls consist of coursed and random rubble flint, including some knapped flint, with limestone and brick dressings. The roof is finished with slate tiles. According to our research, refurbishment works were undertaken in the 1970s and 1980s, but the most extensive alterations were likely made after the First World War when a new wooden floor was installed and the roof was repaired.

External Observations

3.23. Currently, access could not be provided to appraise the roof finishes externally. However, from ground level, it is apparent that a number of slipped, broken and missing roof tiles are present. These roof tiles should be refitted/replaced to provide a weathertight envelope and prevent damage to the roof structure below. In addition, where the roof abuts St Andrew's Hall's roof, the render appears to be failing and allowance should be made for the replacement of this render and the re-flashing of the junction between the buildings.

3.24. Extensive repointing has been undertaken in what appears to be a mix of cementitious and hard hydraulic lime mortars. In the most part, this mortar appears to still be in a good condition. However, advice given by SPAB (The Society for the Protection of Ancient Buildings) highlights that one of the highest causes of damage (wood rotting, woodboring insects, corrosion of metals and masonry decay) to historic buildings is excessive dampness. This dampness is usually caused by rain penetration, rising damp and trapped condensation. Rain penetration can be controlled by the repair and maintenance of the building's external envelope. However, to control rising damp and trapped condensation, the building needs to be able to breathe. It is therefore our recommendation that as the cementitious pointing fails over time, it be replaced with a suitable lime based mortar.

3.25. Brick arches are present above the North and South windows and appear to have been altered as part of the window repairs undertaken in the mid-1800s. These arches appear to be in a good condition with no sign of movement. In addition, extensive repairs have been undertaken to the buttresses with brickwork. These buttresses appear to be in a reasonable condition, but where vegetation is growing in mortar joints, it should be removed and any open joints be repointed. The buttress capping stones should also be reviewed and repaired as required to ensure they direct rainwater away from the buttress construction.

3.26. Many of the downpipes from the Hall's main roof either do not reach the ground or expel their rainwater onto the adjacent single-storey infill structures. These downpipes should be repaired/altered to direct their rainwater into the below ground drainage system. In addition, the single-storey infill structure's roofs should be reviewed by a specialist to advise on their condition and whether repairs are required to ensure a weathertight envelope. As a minimum, allowance should be made for repairing/replacing the roof finishes over The Hall's South entrance and the flashing detail between the single-storey infills and the hall's external walls.

Internal Observations

3.27. The visible floor construction consists of timber floorboards (installed in the 1920s) that are assumed to be raised above the original stone floor slabs. No signs of movement or deflection was noted in the floor construction.

3.28. No movement, distortions or cracking was observed in the external walls. Large metal wall brackets have been installed to tie the West wall to the adjacent elevations. No pattress plates or bolts are visible externally, so it is assumed that the brackets have been tied into the core of the wall with bent rods or similar. No movement between these masonry elements was observed.

3.29. A detailed investigation into the condition of the hall's roof structure has been undertaken by Hutton + Rostron Environmental Investigations Ltd. Their report describes the roof structure in detail and

highlights any areas of damp, decay or defects. Timber elements, where accessible, were microbore drilled for decay detection and probed for surface/ambient and deep moisture content readings, so as to ascertain the extent of structurally significant or partial decay, and to determine the vulnerability to decay organisms. Thermography and fibre-optic borescope inspection techniques were also utilised to assess inaccessible areas. Generally, the roof structure was found to be in a good condition, with decay confined to the timber truss posts and non-structural cornicing. This appeared to be a mixture of historic wet rot and historic wood-boring beetle infestation (Deathwatch beetle – Xestobium rufovillosum). The damp staining visible on the exposed roof timbers and boards were found to be evidence of historic water penetration, with current moisture content readings of 12%. This is below the allowable decay threshold of 20% w/w for fungal growth and 15-16% w/w for wood-boring beetle. It is our recommendation that as part of any reroofing works, allowance should be made for carrying out isolated scarf joint repairs to the historically decayed timbers (highlighted in H+R's report) and for strengthening the connections between principal structural members (i.e. purlin the principal rafter connection, principal rafter ridge connection, principal rafter to hammer beam connection, etc.) with bespoke steel brackets/plates to prevent future failure due to deterioration of the existing mortise and tenon connections.

3.30. Our inspection of the roof structure confirmed that the original timber roof structure has been severely altered in the past (1920s?). The original principal timber trusses have been supplemented with new steel rafters on either side. These new rafters have bespoke metal brackets to support the ridge beams, roof purlins and timber principal rafters, thus reducing the forces acting on the original trusses. They have been boxed in with timber boards to allow them to blend in and are tied laterally across the width of the hall with steel rods on every second steel rafter. No structural movement was observed in the roof and it is therefore assumed that this arrangement is works. However, there were signs of minor rusting to the steel rafters where the top flange was exposed. It is therefore our recommendation that as part of any future reroofing works, the steel rafters be exposed to allow their condition to be determined and a new corrosion resistant coating to be applied.

THE CLOISTERS (AND CRYPT)

3.31. This report only includes details regarding the Cloisters' South Range and East Walk. The East and West Garths are only noted where they are pertinent to observations made about the afore mentioned areas.

3.32. The South Range is a two-storey gabled structure rising to three storeys at its West end. The gap between its South elevation and the main halls has been infilled with a single-storey structure to create more usable internal space. The ground floor is the South cloister walk and consists of a 15 bay rib-vaulted brick construction that has been plastered and lime washed. The brick ribs are supported by stone columns embedded in the random rubble flint walls. The new second floor fenestrations, third floor and western stair turret all appear to have been added at the same time and utilise bonded brickwork at the corners and around openings to try and strengthen the connection from internal and external skins of masonry.

3.33. The West end of the South Range has been extended and refaced in a gothic revival style with polychrome brickwork and forms the principal entrance from St Georges Street into the Cloisters.

External Observations

3.34. As noted elsewhere, vegetation has been allowed to grow in difficult to access areas (such as valleys, gable copings, etc.). It is our recommendation that access be provided to allow this vegetation to be removed on a regular basis as required.

3.35. Although in a generally good condition, the brickwork used to face the West end of the South Range has deteriorated near ground level where rainwater has splashed onto the elevation. It is our recommendation that allowance be made for replacing spalled bricks on a like for like basis in a dentistry fashion and eroded mortar joints be repointed in a suitable lime mortar.

3.36. When St Georges Street was resurfaced, the air bricks present on this elevation have been covered over. It is assumed that these were installed to provide an air circulation to the suspended ground floor

to prevent damp and decay. An investigation of the ground floor construction should be undertaken to ascertain if it is still suspended and whether the air bricks are required. If they are, new air bricks should be installed to provide air circulation to the floor void.

3.37. The West gable parapet is capped with a brick header course laid on a tile creasing course. Although this detail will have worked to preserve the condition of the brickwork below as the header course deteriorated, it appears to now be reaching the end of its life and allowance should be made for access to be provided to allow a more detailed inspection of the top of the wall to be made and repaired as necessary.

3.38. As with the low level brickwork, the low level stonework has deteriorated where subjected to weathering. This has caused the stonework to delaminate and erode and it is our recommendation that a stonemason be employed to carry out repairs to prolong the life of the stones.

3.39. Where dormer windows are present, the valley gutters appear to be blocked and as such, it is likely that rainwater is entering the structure behind. Allowance should be made for unblocking and repairing the valley gutters and for inspecting the roof structure behind to allow for any repairs to be specified. It should also be assumed that although not observed, the valley gutter between the two pitched roofs of the West end of the South Range will also need clearing and repairing.

3.40. The East end of the South Range's external structure (visible from within the Cloister) appears to be in a generally good condition. However, it is deteriorating over time with brickwork beginning to spall and mortar joints eroding. It is our recommendation that a regime of repointing and brick replacements be undertaken to ensure the weathertightness of the external walls. In particular, the base of the walls will require repointing where subjected to prolonged damp. Careful thought should be given to taking rainwater away from the building effectively by ensuring the gutters work and by the installation of French drains.

3.41. Bowing is present in the Second Floor window arches of the North Elevation. This has been caused by the overloading of the single-skin arches that have been built in front of rectangular windows. It is our recommendation that where bowed, the brick arches be rebuilt, tying the single skin brickwork back to the structure behind. This tying detail will also need to be replicated on all 6no. rectangular windows on this elevation.

3.42. Some of the previously dismantled historic structure (including the external buttresses and parts of historic walls) are located outside of the footprint of the modern building and are therefore exposed to the weather. Although these flint and brick elements have been previously repointed as part of earlier repair works, the mortar/flaunching is now beginning to fail and allowing water/moisture into the core of the walls below. It is our recommendation that the exposed structure be reflaunched with a suitable lime mortar or other sensible capping material to preserve the core.

3.43. During our inspection, we observed a number of slipped, broken and missing roof tiles. These roof tiles should be refitted/replaced to provide a weathertight envelope and prevent damage to the roof structure below.

3.44. The Cloister's East walk remains as a single storey structure with a mineral felt flat roof and with a reconstructed/heightened East elevation in brickwork. The flat roof has been installed level and is allowing rainwater to pool on the roof. It is our recommendation that the roof and associated flashing details be refinished with an increased slope to ensure any rainwater falls into the eastern gutter. However, this gutter is currently blocked and requires clearing as a priority.

3.45. The Chapter House used to be located to the East of the Cloister's East walk, but now only the base of the North, South and West supporting piers remain above ground level. The Chapter House's footprint is assumed to extend under the current boundary wall and adjacent car park to the East. The boundary wall is approximately 5m tall and acts as a retaining structure for the car park's higher ground level (approx. 3m higher). Although the wall appears to be working currently and does not show signs of lateral movement, many of the bricks and mortar joints are in a very poor condition. This has been exacerbated by previous repairs using cementitious mortars and modern blockwork. It is our recommendation that substantial repairs be undertaken to the wall. These repairs should include the

replacement of spalled bricks, repointing of eroded mortar joints, the installation of a new capping detail (i.e. tile creasing course with brick solider course) and the removal of adjacent vegetation. It is apparent that the wall has previously been underpinned and as such, it is assumed that it is bearing on good ground. However, allowance should also be made for creating lateral ties between the two brick wall panels currently separated by a historic straight joint to further restrain the high retaining wall. Should the wall be found to be moving laterally when further access at high level is provided, a new buttress to resist the horizontal retaining forces may be required.

Internal Observations

3.46. The Cloister's Ground floor is partially submerged below the external Ground level. Damp staining and flaking paint are present on the internal walls and as such, it is assumed that moisture is building up in the wall construction behind. This is most prevalent on the North and South walls. An investigation should be undertaken into the drains and roof finishes at these walls locations to ascertain their condition and if there are any leaks.

3.47. The rib-vaulting over the Ground Floor walkway has been plastered over and as such, the masonry behind could not be appraised in detail. However, there are a number of areas where the plaster has deteriorated and exposed the brickwork behind. In these locations, the mortar joints appear to have eroded. It is our recommendation that all areas of loose/stained plaster be removed and the brickwork behind be inspected to ascertain the cause of the plaster failure prior to a formal repair being specified. As a minimum, any loose/failed mortar joints will require repointing in a suitable lime mortar.

3.48. The construction of the First Floor was not investigated as part of this report, but it is assumed to either bear directly onto the brick vaulting below or be suspended between the external loadbearing walls. No signs of structural movement were present, but as part of any refurbishment works in the future, we would recommend that this floor construction be investigated to ensure it is in a good condition and that partitions are positioned over suitable loadbearing structure below.

3.49. The two-storey element's roof construction was inspected and appeared to be in a good condition. It consisted of common rafters spanning from eaves to ridge with a mid-span purlin that in turn spans between principal trusses at regular centres. Longitudinal restraint is provided by in plane bracing at truss locations. Whilst appraising the roof structure, it was noted that the roof void had a lot of dust and debris that had collected over the lifetime of the building. It is a recommendation of this report that given the nature of timber frames in fire, that the fire separation and fire resistance between floors is assessed and checked. It would also be prudent for the roof void to be cleared of dust and debris as a matter of priority.

3.50. Significant damp staining is present within the staircase at the North East corner of the refaced West end of the Cloister where it abuts the adjacent building. This correlates with the location of an external valley gutter and hopper. As previously noted, this area of roof should be cleared and repaired to ensure a watertight envelope. However, allowance should also be made for inspecting the roof structure below and the repairing it as required.

3.51. A number of fireplaces are present at First Floor level and show signs of damp on the chimney breasts were blocked up. Chimneys of this nature require regular maintenance to ensure the original high-level masonry, cap or flaunching is maintained and the flues are kept clear to prevent the damage of the brickwork through moisture being trapped within the bricks. It is, however, evident that the original brick chimneys have been stable in their own right and have stood the test of time so far. Whilst we have been informed that none of the chimneys are currently in use, it is a recommendation of this report that all of the flues be swept and appraised internally to ensure they are continuous, clear of debris and in a reasonable structural condition. This will require a CCTV appraisal where flues cannot be viewed directly from the hearth or cap. Vents should then be installed to provide a free flow of air to prevent damp build up in the future.

Crypt

3.52. 'The Crypt' is located between Becket's Chapel and South East corner of The Cloisters. It is now a single-storey four bay rib-vaulted structure with a mineral felt flat roof over. The four bays have square-

shaped brick vault structures over, which are supported on a single central stone pier. Brick piers are located around the edges of the room to support the vaulting.

3.53. The brick vaulting appears to have been repointed in the relatively recent past (50 years) with a 'hard' mortar. Although it is currently working structurally and there are no signs of movement in the mortar joints, care should be taken to ensure that the roof finishes are not allowed to leak. Should this happen, the mortar will cause the moisture to become trapped in the 'softer' brickwork, thus causing their accelerated deterioration. Should any of the mortar joints fail, they should be replaced with a more suitable lime mortar.

3.54. The roof finishes appear to be coming to the end of their lifespan and as such, it is our recommendation that they be replaced to ensure moisture does not enter the vault structure. During these reroofing works, we would recommend that the vault structure be inspected from above to ascertain the condition of the rear face of the brickwork and for any repairs (if required) to be specified. Until this inspection is completed, we would recommend that no scaffold is supported on this roof.

3.55. It should be noted that the crypt is at a slightly lower level than Becket's Chapel and as such, is partially submerged below the external Ground level. Damp staining and flaking paint are present on the internal walls and as such, it is assumed that moisture is building up in the wall construction behind. This is most prevalent on the North, South and East walls. An investigation should be undertaken into the drains and roof finishes at these walls locations to ascertain their condition and if there are any leaks. If no problem is found with these elements, thought should be given to installing below ground drainage behind the walls to remove built up water.

BECKET'S CHAPEL

3.56. 'Becket's Chapel' is the remains of a 13th Century chapel located to the North East of Blackfriars' Hall and adjoining the East side of 'The Crypt'. The (approx. 17m x 6m) remains consist of the external brick and rubble core walls (approx. 3m high) that are partially submerged (1m) lower than the external ground levels and have been demolished down to the springing level of the original vault.

3.57. Our research has concluded that the chapel was excavated in the early 1950s and extensive works were undertaken in the 1970s and 1980s to preserve the excavated structure with a view to extending its life. These works included the partial rendering of internal walls in a cementitious render, the laying of concrete patio slabs to form a usable floor space and the heightening of the East and West walls (gables) in modern brickwork to support a new steel framed roof clad in polycarbonate roof sheets. The chapel is now specifically noted within the Scheduled Ancient Monument listing details and protected as such.

External Observations

3.58. The 'modern' polycarbonate roof was found to be nearing the end of its life, with cracks visible in the sheets and a few of the roof sheets had slipped out of line into the gutters. The gutters were blocked and not effectively taking rainwater away from the building. The polycarbonate roof and late 20th Century railings are specifically excluded from the scheduling, and it is therefore our recommendation that the roof be reviewed by a specialist roofer, but that allowance be made for replacing the roof finishes and gutters. As part of these works, it is also our recommendation that the associated drains be cleared and reviewed to ensure they are working to take the rainwater away from the building.

3.59. Where the polycarbonate roof meets the East and West walls, a mastic sealer has been used to prevent rainwater entering the building. This has failed and a gap is now present between the roof finishes and adjacent walling. We therefore recommend that as part of the reroofing works, a new formal flashing detail be installed to prevent rainwater entering the building at these locations.

3.60. Vegetation is growing on or close to all sides of the building and in particular ivy in growing on the East and West walls and onto the roof. This vegetation is causing damage to the structure and should be treated and removed to prevent further damage.

3.61. Some of the original chapel structure (including the external buttresses and parts of the external wall) are located outside of the footprint of the modern roof and are therefore exposed to the weather. Although these flint and brick elements have been previously repointed as part of earlier repair works, the mortar/flaunching is now beginning to fail and allow water into the core of the walls below. It is our recommendation that the exposed structure be reflaunched with a suitable lime mortar or other sensible capping material to preserve the core. In addition, allowance should be made for repointing the walls externally where weathered.

3.62. Where the East and West walls have been heightened, modern bricks and a cementitious mortar have been used. This has created a 'hard' wall panel over the original 'flexible' wall construction. Where this modern construction meets the historic walls at the East end of the building, cracking within the mortar joint is visible in the newer brickwork. This has been caused by the differential movement between the two building materials and is acting as a movement joint. It is our recommendation that this mortar joint be repointed. In addition, the tile creasing course's mortar joint is failing and it is our recommendation that allowance be made for repointing this joint as well.

Internal Observations

3.63. The lightweight steel portal frame roof structure appears to be working with fixed moment connections to resist lateral and longitudinal forces and shows no signs of structural movement. However, due to the deterioration of the roof finishes, rainwater has been allowed to sit on the top face of many of the steel members and signs of surface corrosion are present. This is particularly evident at principal connection locations. It is our recommendation that the entire steel frame be exposed, inspected by a specialist sub-contractor, repaired (if required) and coated with a new corrosion resisting coating. The steel frame has been cast into concrete pads on top of the original walls. Particular attention should be paid to the condition of these embedded steel members.

3.64. Although partially open to the elements, no floor drains are present. This means that any rainwater that does enter the building will build up next to the wall structure until it dries naturally, therefore potentially causing the early deterioration of the walls in this location. It is our recommendation that new floor drains be installed to take any rainwater building up at floor level away from the building. This is particularly prevalent currently given the failing roof finishes, gutters and flashing details.

3.65. The cementitious render on the walls that has been used to 'patch' repair areas of walls in a poor condition is beginning to fail and delaminate from the wall. Where this is happening, moisture could become trapped behind and cause further damage to the original masonry/core behind. It is therefore our recommendation that as the render becomes loose, it be removed and the wall behind be repaired in more commensurate materials (such as lime mortars and soft red brickwork).

4. Conclusions and Recommendations

4.1 It is evident that the buildings have been repaired/altered in an ad hoc manner to suit their changes of use over time and to carry out structural repair/alteration works as required. As such, repair works are now required to remedy areas of disrepair/poor alteration/poor maintenance. Generally, these buildings are in a reasonable state of repair given the limited maintenance that has been ongoing. However, it is now essential that this opportunity be taken to reinstate the weatherproof envelope of the buildings and to ensure that all surface water is discharged of by collection through a working gutter and downpipe surface water system, draining away the outfalls from the footprint of the buildings. Local staining and water ingress is occurring in several areas around the buildings' envelope and efforts should be made to dry these areas out and prevent subsequent dry rot or other detrimental invasive deterioration. Should this overhaul not occur, the extent of structural damage caused by water penetration in the roofs and wall construction could cause localised failure of the building structures.

4.2 Further to H+R's roof timber condition investigation, it has been confirmed that although decay of isolated timber members is present, this does appear to be historic in nature. However, as noted above, if the building is not kept weathertight, this further decay of the roof structure could occur. We would therefore advise that as part of any future reroofing works, allowance be made for the specialist repair or supplementation of the existing decayed timbers and the strengthening of connections between principal structural members with bespoke steel brackets/plates to prevent future failure due to deterioration of the existing mortise and tenon connections.

4.3 In addition, there are signs that the West gable of St Andrew's Hall is or has previously moved in a westerly direction. Further monitoring is required to ascertain whether this movement is ongoing or historic. In addition to this monitoring, we would recommend a detailed study into the historic development of the site and buildings be undertaken to better understand where the structure has been altered or previously repaired and how this is affecting the buildings as they currently stand.

4.4 It is our recommendation that prior to the creation of a detailed schedule of works document, the next phase of work should be the production of a full historical study and Conservation Management Plan, recording and analysing the existing construction and determining the significance of the elements present. It is our view that if a full historical and archaeological review is completed, much of the minor structural repairs and maintenance works would be of low significance, although we are sure there is significant archaeological interest on the site and care would be needed in preparing any Schedule of Repairs.

4.5 Below we have tabulated and prioritised our recommendations which should be read alongside those above. The priorities are as follows:

I	Immediate
S	Short Term (2 – 5 Years)
M	Medium Term (5 – 10 Years)
L	Long Term (10 years +)

Paragraph Number	Item Description	Priority
	GENERAL	
2.3	Early consultation with the Local Conservation Officer and Historic England should be sought to confirm their requirements prior to any recommended repair works being undertaken.	**-**
2.4 & 4.4	A detailed study into the development of the site and buildings (i.e. the production of a full historical study and Conservation Management Plan, recording and analysing the existing construction and determining the significance of the elements present) be undertaken to better understand where the structure has been altered or previously repaired and how this is affecting the buildings as they currently stand. These investigations would likely involve obtaining historic plans and documents from the City's archives to ascertain when and why historic structural repairs have been undertaken.	**I - S**
4.4	A detailed Schedule of Works document for the proposed structural monitoring and repairs should be produced to allow permission to be obtained and a definitive price for the works to be determined.	**I - S**
3.2	A CCTV survey of the gutters, RWPs and drains should be carried out to allow their condition to be determined and to allow for a formal guttering system with downpipes to be installed. These outfalls should ideally fall to an existing surface water drainage system.	**I**
3.3	All vegetation next to the envelope of the buildings should be removed and killed with an appropriate chemical weed killer.	**I**
	ST ANDREWS HALL	
3.6 & 3.11	Most of the external buttresses require small sections of the stonework and mortar to be repaired on a like for like basis.	**S**
3.7	A new structural element be installed over each of the aisle windows to spread the load from the roof trusses onto the adjacent masonry wall panels to prevent the window tracery becoming overloaded.	**S - M**
3.8	A schedule of stone defects/repairs should be created by a qualified professional to outline the extent of stone repairs required.	**S**

Paragraph Number	Item Description	Priority
3.9	The cracking present of the South Porches East elevation should be repointed with a suitable lime mortar and monitoring of the crack over the next few years should be undertaken prior to specifying further intrusive repairs.	**I – S**
3.10	The external cracks related to the West Gable's westerly movement should be repointed externally and monitored over an extended period of time. It would also be prudent to carry out a verticality check of the gable to better understand if it is leaning in a westerly direction.	**I**
3.11	Further monitoring of the West Gable's cracked buttress arch stone should be undertaken to ascertain if the movement is continuing and if so, it should be noted that investigations into the buttress's foundations/bearing condition will be required to allow a suitable repair to be specified.	**I**
3.13	A specialist should be instructed to advise on the roof finishes' condition and whether repairs are required to ensure a weathertight envelope. As a minimum, we would allow for repair flashing and coping details.	**I**
3.15	In addition to the cracks noted in 3.11, the internal cracking and the vertical movement related to the West gable should be observed over an extended period of time to better understand the movement present.	**I**
3.17	The roof structure should be tied to the West elevations to help restrain the West elevation from moving in a westerly direction.	**S**
3.18	As part of any reroofing works, allowance should be made for carrying out isolated scarf joint repairs to the historically decayed timbers (highlighted in H+R's report) and for strengthening the connections between principal structural members (i.e. purlin the principal rafter connection, principal rafter ridge connection, principal rafter to hammer beam connection, etc.) with bespoke steel brackets/plates to prevent future failure due to deterioration of the existing mortise and tenon connections.	**S - M**
3.19	Allowance be made for supplementing or repairing two common rafters and five beam ends if found to be decayed within the Organ Loft.	**S**
3.20	The South Porch's parapet gutters should be inspected to ensure they are clear and in a good condition. In addition, additional ventilation should be installed to allow moisture within the air to leave the porch rather than condensing on the external walls.	**I**

Paragraph Number	Item Description	Priority
	BLACKFRIARS' HALL	
3.23	Allowance should be made for the replacement of the render on St Andrew's East gable, as well as the re-flashing of the junction between the buildings.	**I - S**
3.24	As the cementitious pointing used on the external elevations fails over time, it be replaced with a suitable lime based mortar.	**S - M**
3.25	The buttress capping stones should also be reviewed and repaired as required to ensure they direct rainwater away from the buttress construction.	**S - M**
3.26	The single-storey infill structures' roofs should be reviewed by a specialist to advise on their condition and whether repairs are required to ensure a weathertight envelope. As a minimum, allowance should be made for repairing/replacing the roof finishes over The Hall's South entrance and the flashing detail between the single-storey infills and the hall's external walls.	**I**
3.29	Allowance should be made for carrying out isolated scarf joint repairs to the historically decayed timbers (highlighted in H+R's report) and for strengthening the connections between principal structural members (i.e. purlin the principal rafter connection, principal rafter ridge connection, principal rafter to hammer beam connection, etc.) with bespoke steel brackets/plates to prevent future failure due to deterioration of the existing mortise and tenon connections.	**S - M**
3.30	As part of any future reroofing works, the steel rafters should be exposed to allow their condition to be determined and a new corrosion resistant coating to be applied.	**S - M**
	THE CLOISTERS (AND CRYPT)	
3.35	Allowance should be made for replacing spalled bricks on a like for like basis in a dentistry fashion and eroded mortar joints be repointed in a suitable lime mortar.	**S**
3.36	An investigation of the ground floor construction should be undertaken to ascertain if it is still suspended and whether the air bricks are required. If they are, new air bricks should be installed to provide air circulation to the floor void.	**I - S**

Paragraph Number	Item Description	Priority
3.37	Allowance should be made for access to be provided to allow a more detailed inspection of the top of the West gable parapet wall to be made and repaired as necessary.	**S**
3.38	A stonemason should be employed to carry out repairs to prolong the life of the external stonework.	**S**
3.39	Allowance should be made for unblocking and repairing the valley gutters and for inspecting the roof structure behind to allow for any repairs to be specified. It should also be assumed that although not observed, the valley gutter between the two pitched roofs of the West end of the South Range will also need clearing and repairing.	**I**
3.40	A regime of repointing and brick replacements be undertaken to ensure the weathertightness of the external walls. In particular, the base of the walls will require repointing where subjected to prolonged damp.	**I – S**
3.41	It is our recommendation that where bowed, the brick arches over the 1st Floor windows on the North Elevation be rebuilt, tying the single skin brickwork back to the structure behind. This tying detail will also need to be replicated on all 6no. rectangular windows on this elevation.	**I - S**
3.42	The previously dismantled historic structure (including the external buttresses and parts of historic walls) should be reflaunched with a suitable lime mortar or other sensible capping material to preserve the core.	**I - S**
3.43	The loose/damaged roof tiles should be refitted/replaced to provide a weathertight envelope and prevent damage to the roof structure below.	**I**
3.45	Substantial repairs should be undertaken to the boundary wall within the Chapter House remains. These repairs should include the replacement of spalled bricks, repointing of eroded mortar joints, the installation of a new capping detail (i.e. tile creasing course with brick solider course) and the removal of adjacent vegetation. Should the wall be found to be moving laterally when further access at high level is provided, a new buttress to resist the horizontal retaining forces may be required.	**I - S**
3.47	All areas of loose/stained plaster within The Cloisters rib-vaulting should be removed and the brickwork behind be inspected to ascertain the cause of the plaster failure prior to a formal repair being specified. As a minimum, any loose/failed mortar joints will require repointing in a suitable lime mortar.	**S**

Paragraph Number	Item Description	Priority
3.48	This 1st floor construction be investigated to ensure it is in a good condition and that partitions are positioned over suitable loadbearing structure below.	-
3.49	The fire separation and fire resistance between floors should be assessed and checked. It would also be prudent for the roof void to be cleared of dust and debris as a matter of priority.	I - S
3.50	Allowance should be made for inspecting the roof structure over the staircase at the North East corner of the refaced West end of the Cloister where it abuts the adjacent building as part of any reroofing works and for repairing it as required.	I
3.51	All of the flues should be swept and appraised internally to ensure they are continuous, clear of debris and in a reasonable structural condition. This will require a CCTV appraisal where flues cannot be viewed directly from the hearth or cap. Vents should then be installed to provide a free flow of air to prevent damp build up in the future.	I – S
3.53	Should any of the Crypt's brick vaulting mortar joints fail, they should be replaced with a more suitable lime mortar.	S - M
3.54	When the roof structure is replaced, the vault structure should be inspected from above to ascertain the condition of the rear face of the brickwork and for any repairs (if required) to be specified. Until this inspection is completed, we would recommend that no scaffold is supported on this roof.	S - M
	BECKET'S CHAPEL	
3.58	The roof finishes should be reviewed by a specialist roofer, but allowance should be made for replacing the roof finishes and gutters. As part of these works, it is also our recommendation that the associated drains be cleared and reviewed to ensure they are working to take the rainwater away from the building.	I
3.59	As part of the reroofing works, a new formal flashing detail be installed to prevent rainwater entering the building at these locations.	I - S
3.61	The exposed structure located outside of the protected roofing should be reflaunched with a suitable lime mortar or other sensible capping material	S

Paragraph Number	Item Description	Priority
	to preserve the core. In addition, allowance should be made for repointing the walls externally where weathered.	
3.62	The cracked mortar joint should be repointed. In addition, the tile creasing course's mortar joint is failing and it is our recommendation that allowance be made for repointing this joint as well.	**S**
3.63	The entire steel frame should be exposed (brushed back), inspected by a specialist sub-contractor, repaired (if required) and coated with a new corrosion resisting coating. The steel frame has been cast into concrete pads on top of the original walls. Particular attention should be paid to the condition of these embedded steel members	**S - M**
3.64	New floor drains should be installed to take any rainwater building up at floor level away from the building.	**S - M**
3.65	As the internal cementitious render becomes loose, it should be removed and the wall behind be repaired in more commensurate materials (such as lime mortars and soft red brickwork).	**S**

Appendices

Appendix A – Photographs taken by Wright Consulting

PHOTOGRAPHS TAKEN 10 NOVEMBER 2022

St Andrews Hall

Photograph 1 – South Elevation

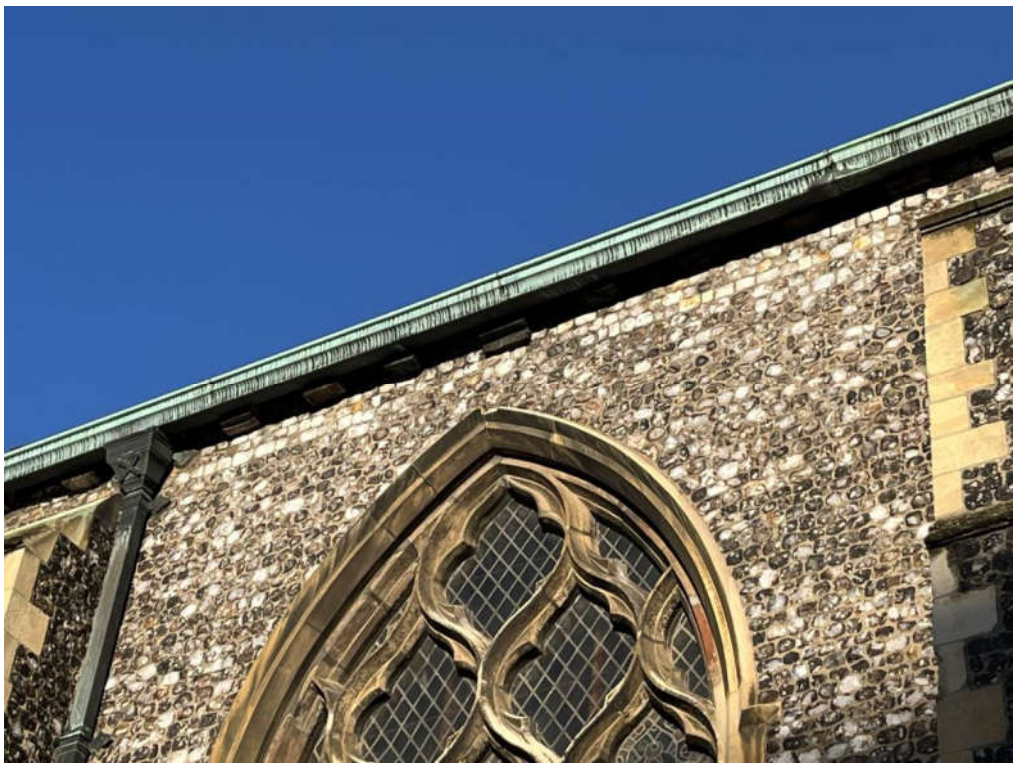
Photograph 2 – Porch (South Elevation)

Photograph 3 – West gable

Photograph 4 – East end of North Elevation

Photograph 5 – North Elevation

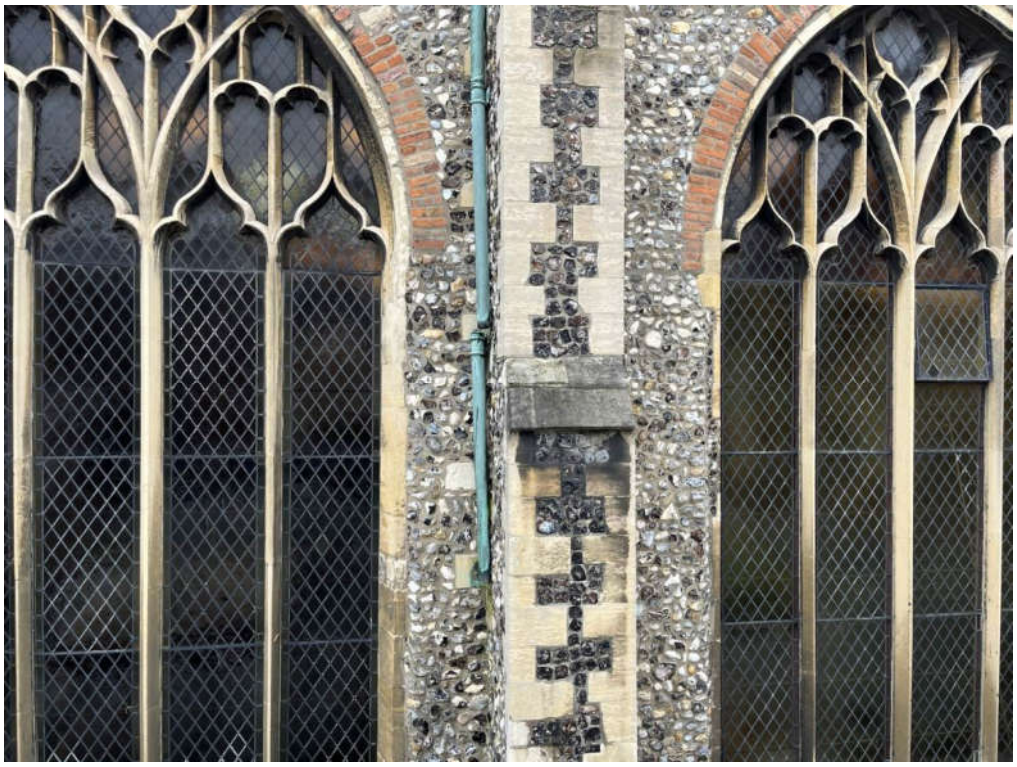
Photograph 6 – West end of North Elevation



Photograph 7 – Roof structure visible at eaves externally

Photograph 8 – Cracking over window arch (western window on North Elevation)

Photograph 9 – Brickwork exposed around North Elevation arches



Photograph 10 – Downpipe broken and missing

Photograph 11 – Vertical crack below and above South porch window

Photograph 12 – Vertical crack below and above western most South Aisle window

Photograph 13 – Vertical crack below southern West gable window

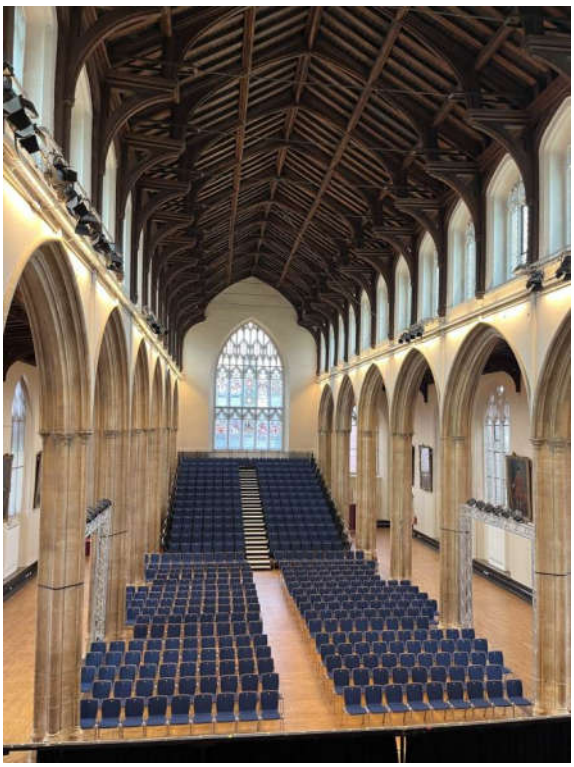
Photograph 14 – Eroded stonework to base of West gable buttresses

Photograph 15 – Large metal bracket tying West gable construction to end buttresses

Photograph 16 – Garage Wing northern brickwork built on top of original wall brickwork

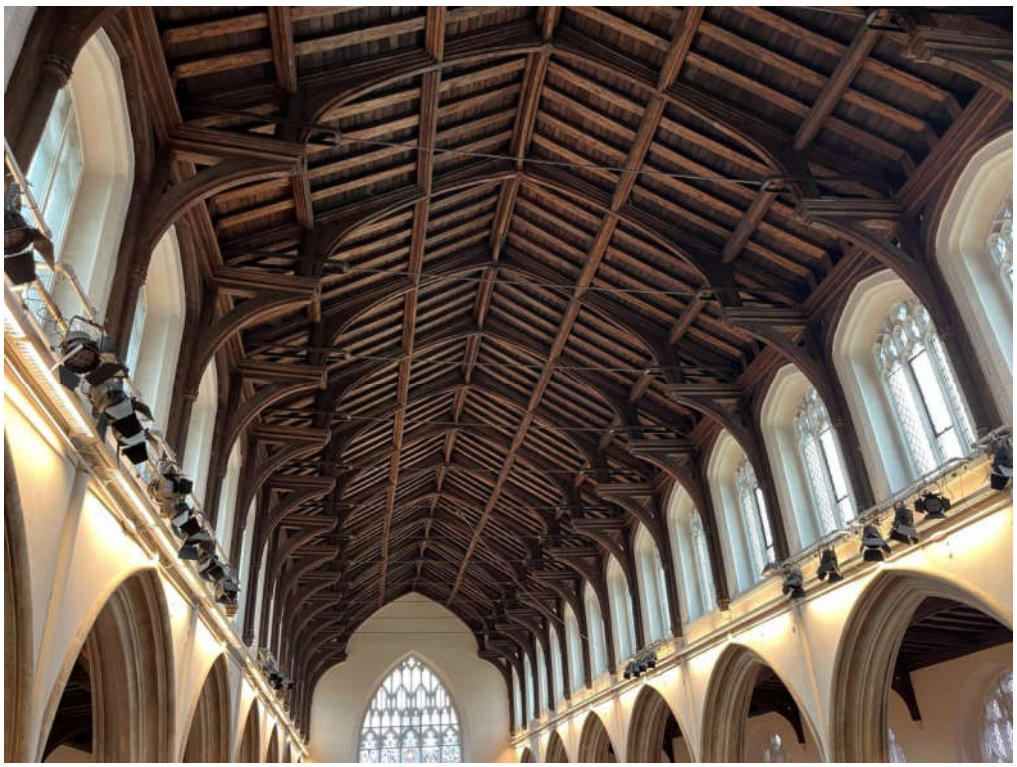
Photograph 17 – Trial pit showing foundation at North Gable and North Extension junction

Photograph 18 – Trial pit at South East corner



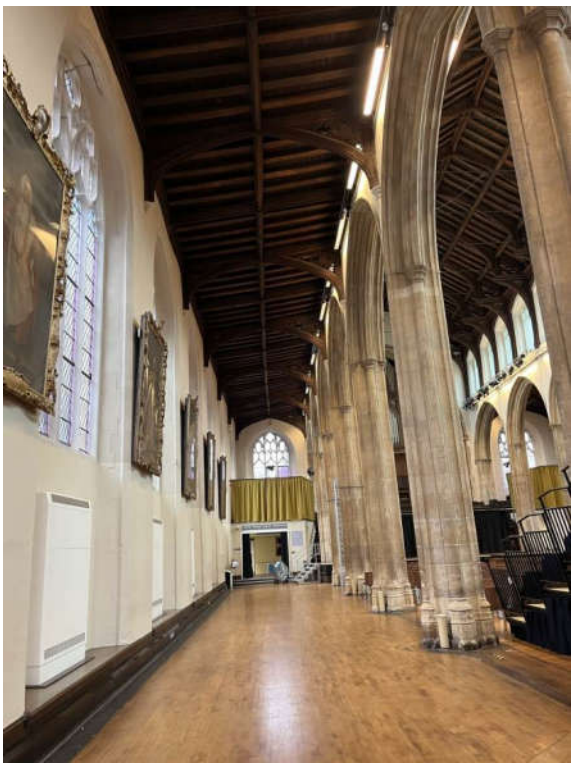
Photograph 19 – Internal view of nave looking West

Photograph 20 – Internal view of nave looking East



Photograph 21 – Nave roof structure looking West

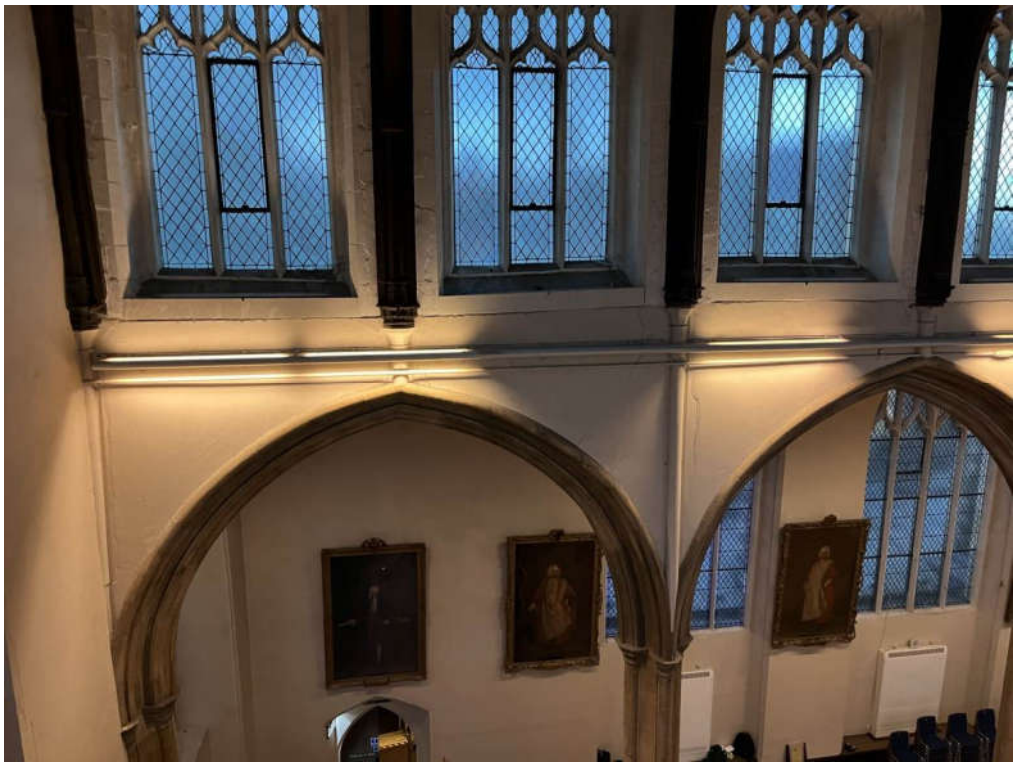
Photograph 22 – South aisle looking East



Photograph 23 – North aisle looking East

Photograph 24 – Signs of historic damp to East end of South aisle roof structure

Photograph 25 – Cracking to West end of South aisle's South wall



Photograph 26 – Signs of historic movement to West end of nave at aisle roof level (window sills sloping/dropped)

Photograph 27 – Typical common rafter support detail

Photograph 28 – Signs of decayed timber at eaves level (common rafter end and plate)

Photograph 29 – 'Modern' roof structure over organ

Photograph 30 – 'Modern' brickwork infill between nave and organ loft

Photograph 31 – Damp timber elements where North purlin extends into East wall (organ loft)

Photograph 32 – Damp common rafter against North Wall in organ loft

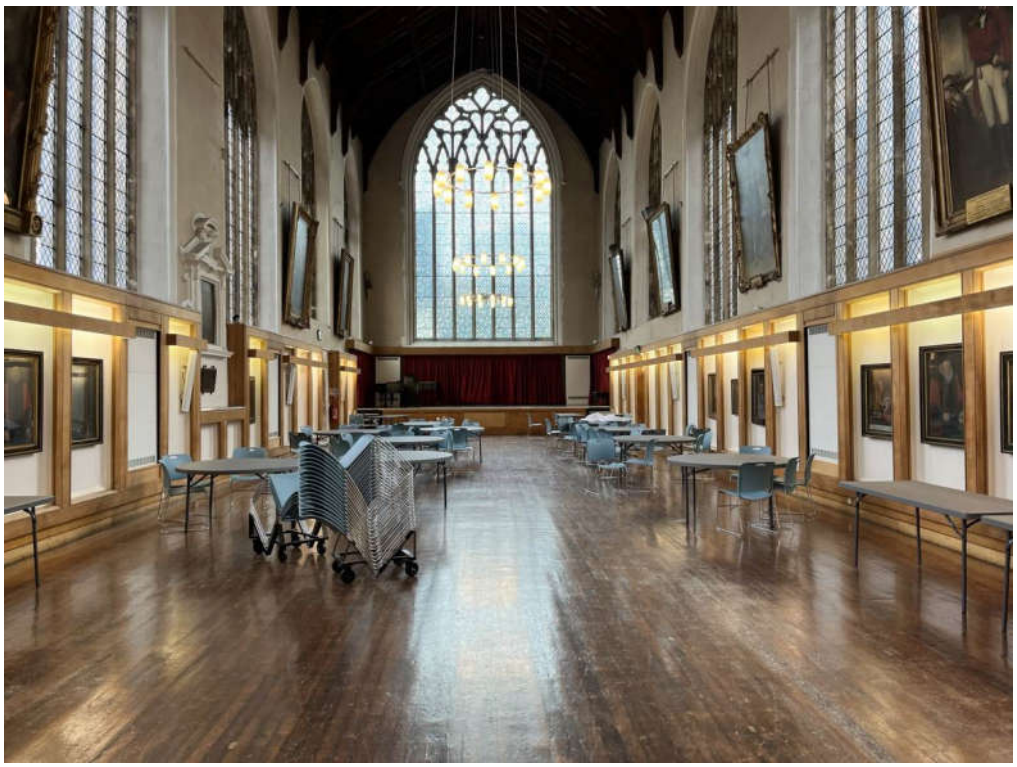
Blackfriars' Hall

Photograph 33 – North East corner

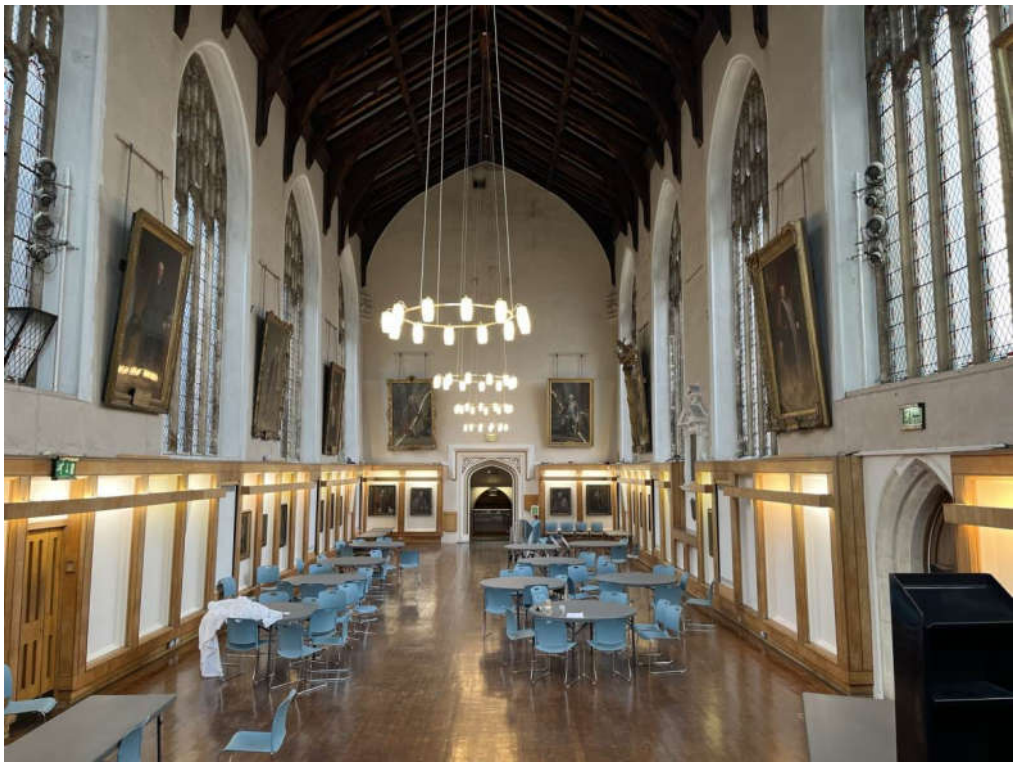
Photograph 34 – North Elevation

Photograph 35 – South Elevation

Photograph 36 – Single storey infill between South elevation and boundary wall

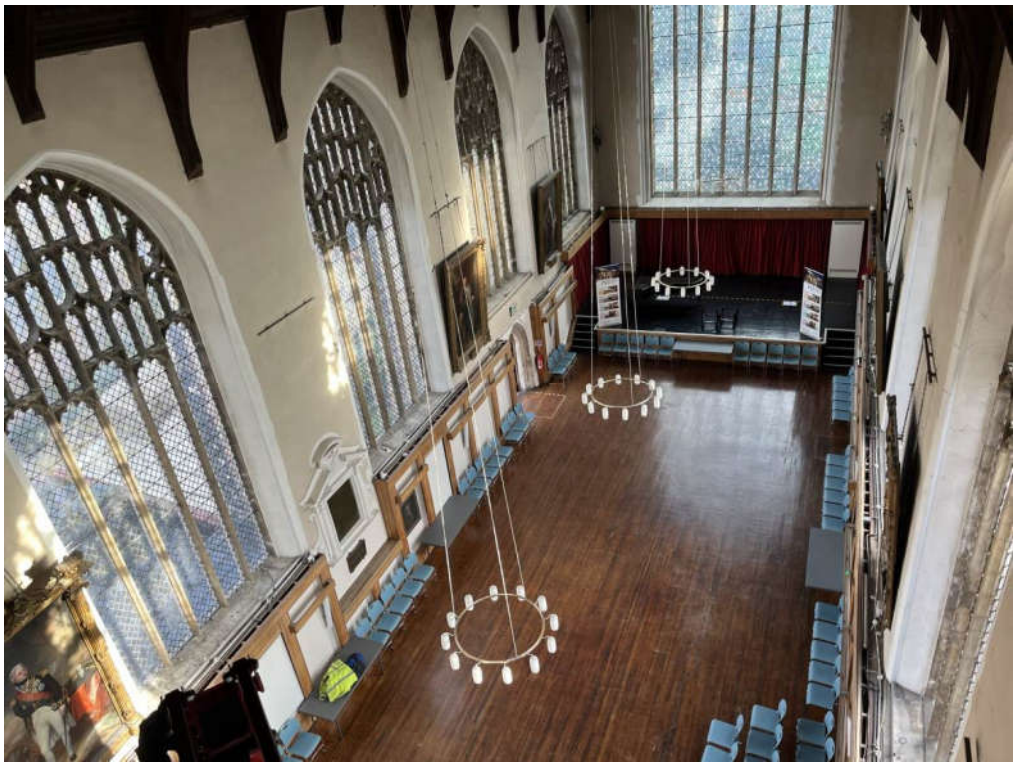


Photograph 37 – Main Hall looking East

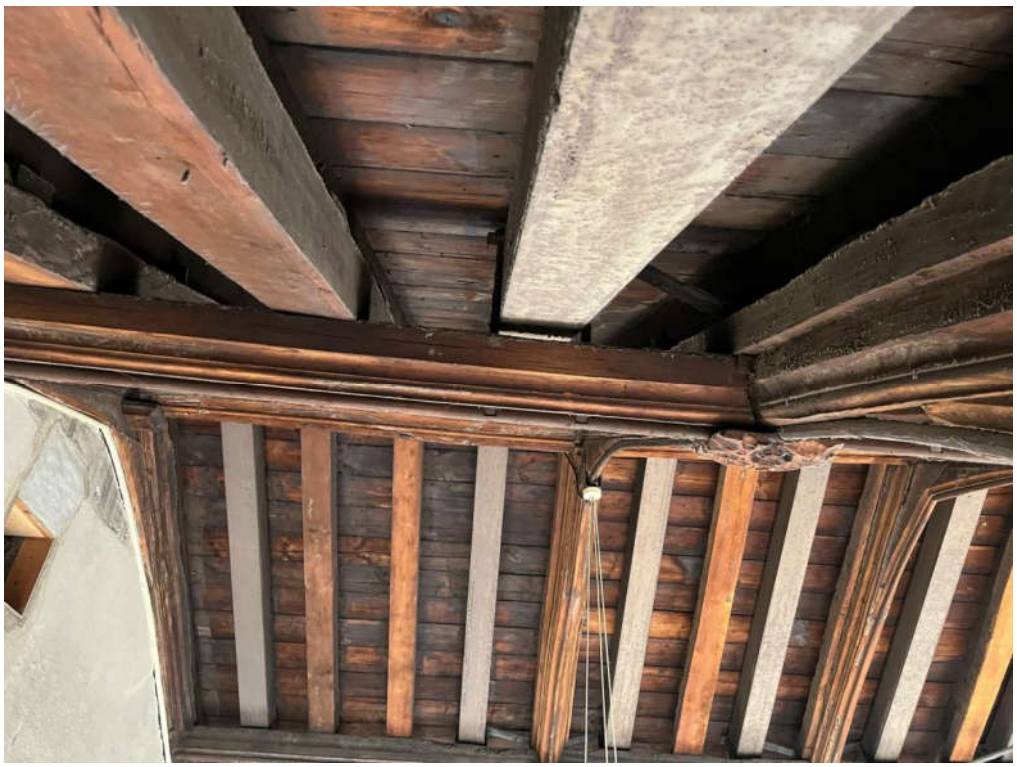


Photograph 38 – Main Hall looking West

Photograph 39 – Roof structure looking East



Photograph 40 – Aerial view of hall looking East



Photograph 41 – Bracket behind rafters assumed to support historic timber truss from new steel trusses either side

Photograph 42 – Typical eaves detail (concrete eaves beam/infill present)

Photograph 43 – Top flange of steel rafter showing signs of rust

Photograph 44 – Metal restraint brackets present on West wall mimicking brackets on West elevation of St Andrew's Hall

The Cloisters

Photograph 45 – West gable/entrance

Photograph 46 – North Elevation

Photograph 47 – North Elevation

Photograph 48 – West elevation of Chapter House link

Photograph 49 – East elevation above roof level

Photograph 50 – South elevation of roof

Photograph 51 – East elevation and flat roof of Chapter House Link

Photograph 52 – Exposed flint wall remains

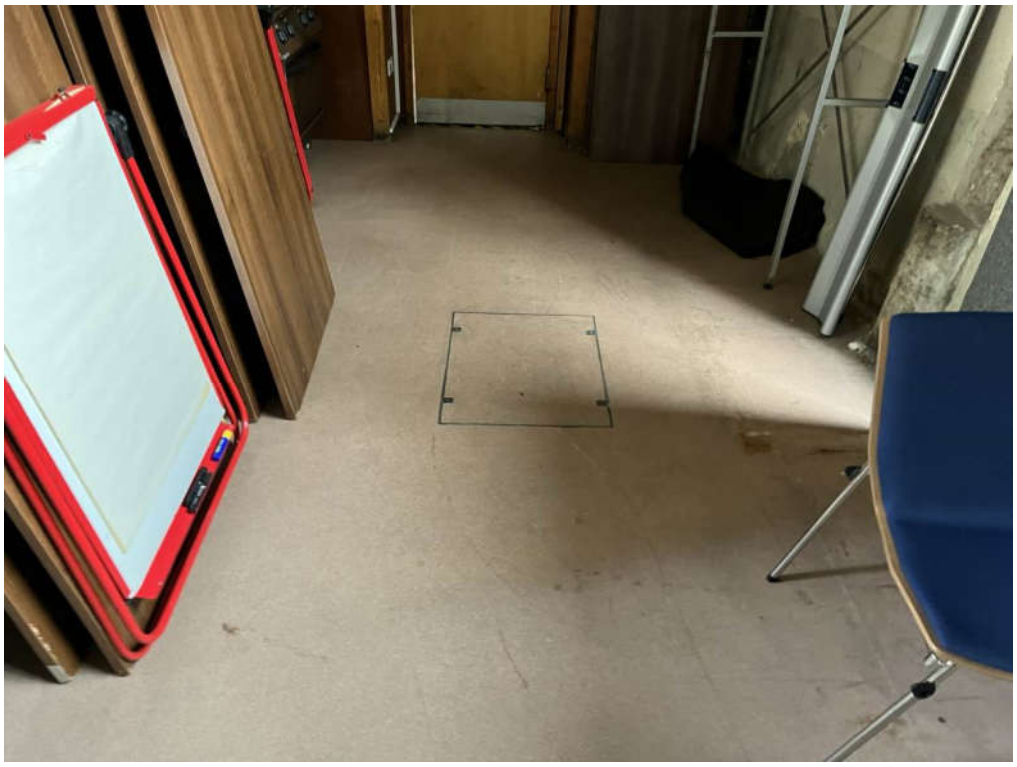
Photograph 53 – Brick window arch bowing out

Photograph 54 – Bowed and cracking window arch brickwork

Photograph 55 – Former Chapter House East wall

Photograph 56 – Former Chapter House South Wall

Photograph 57 – Chapter House link looking North



Photograph 58 – Drain covers with Chapter House Link

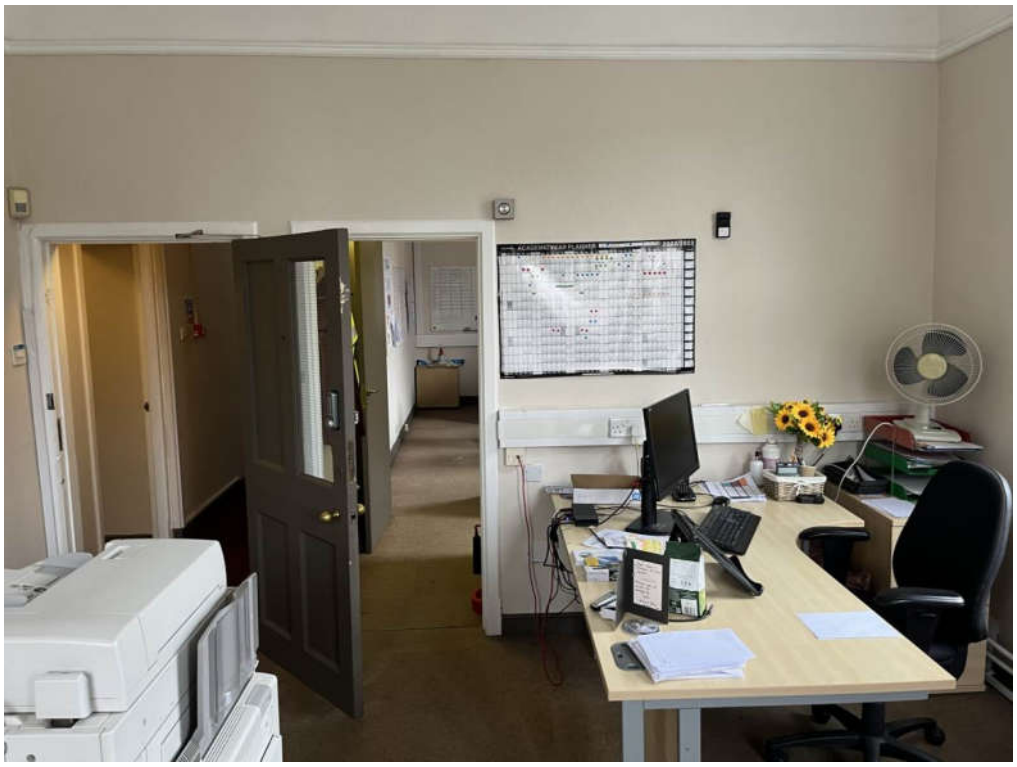
Photograph 59 – Cloisters looking West (Ground Floor)

Photograph 60 – Cloisters looking East (Ground Floor)

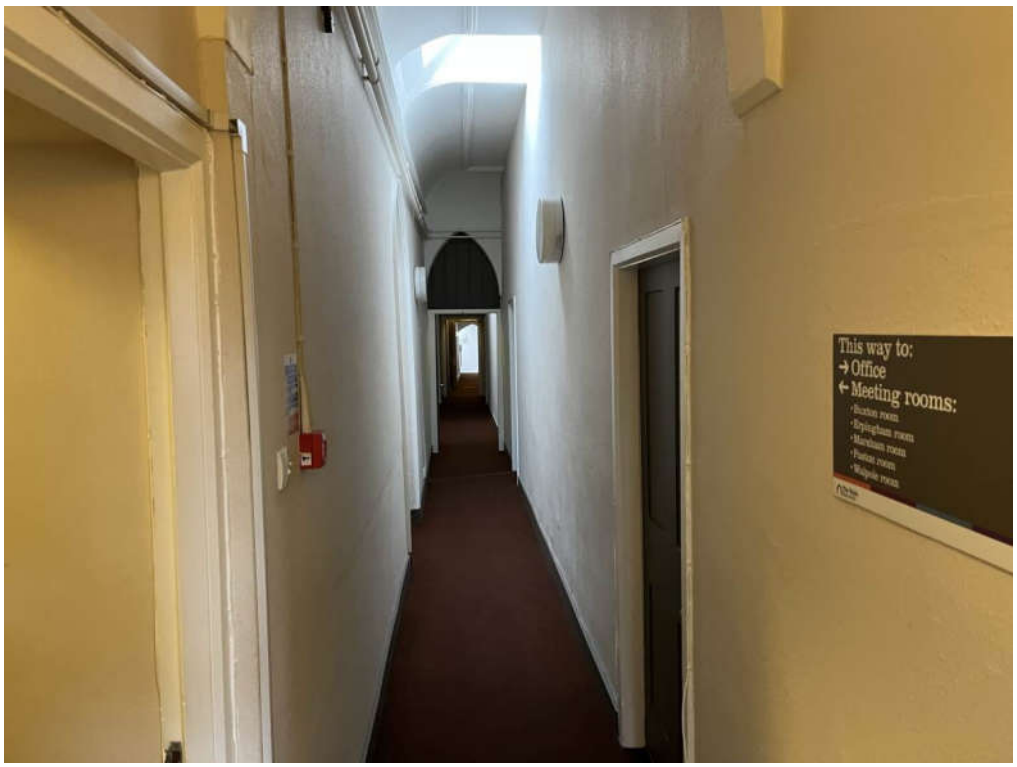
Photograph 61 – Brickwork deteriorated where plaster has fallen away

Photograph 62 – Signs of damp in Ground Floor walls

Photograph 63 – East wall at First Floor



Photograph 64 – First Floor offices looking West

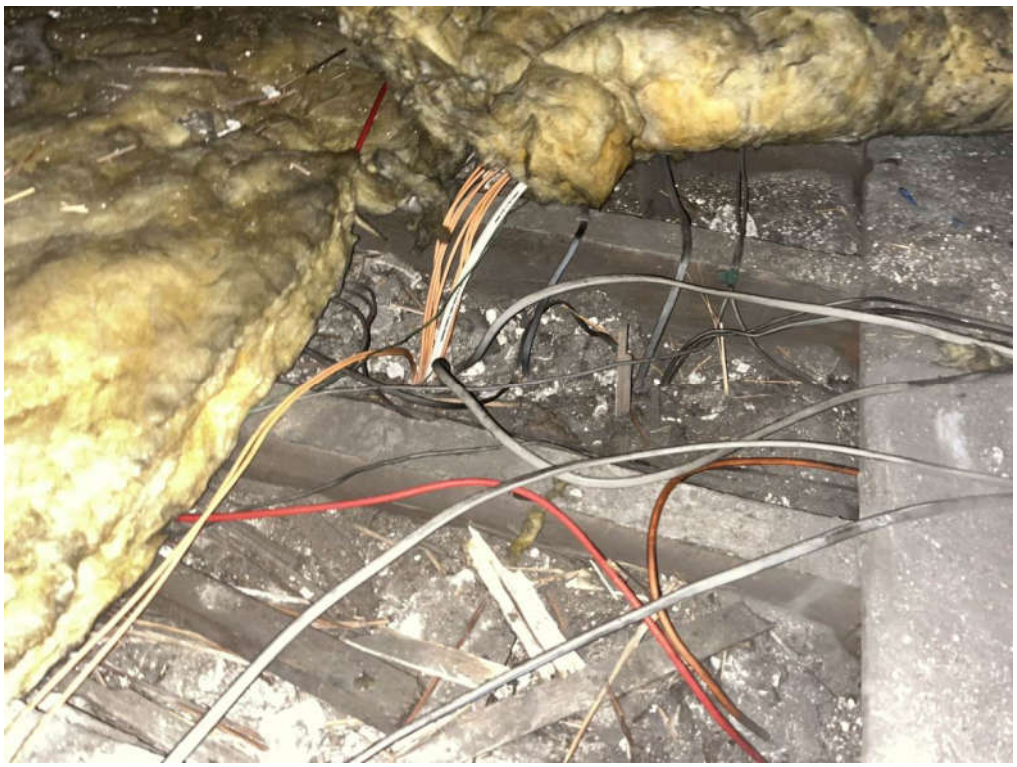


Photograph 65 – First Floor corridor looking West

Photograph 66 – First Floor offices looking East

Photograph 67 – Typical roof structure in two-storey section of Cloisters

Photograph 68 – In plane bracing



Photograph 69 – Debris in ceiling void

Photograph 70 – Roof structure dry where entering East gable

Photograph 71 – Meeting rooms in West end of First Floor

Photograph 72 – Meeting rooms in West end of First Floor

Photograph 73 – Fireplace blocked and signs of damp on chimney breast

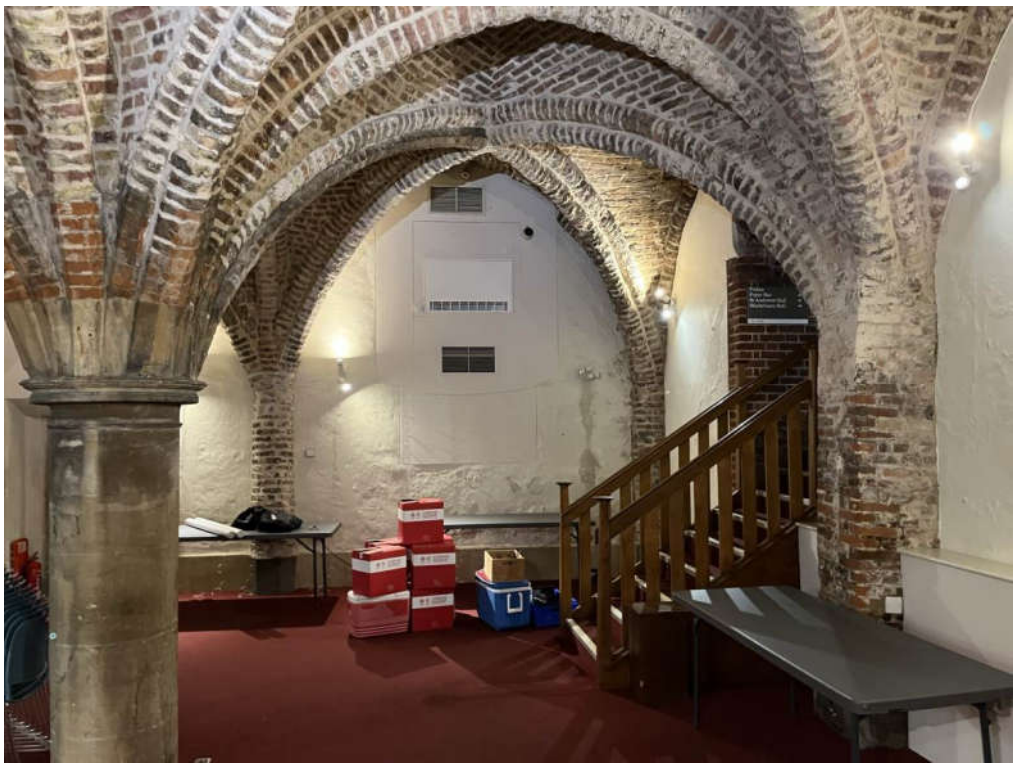
Photograph 74 – Staircase within West end of Cloisters

Photograph 75 – Extensive water ingress through roof structure over staircase

Photograph 76 – Cracking present in ceiling plaster

The Crypt

Photograph 77 – Crypt looking West



Photograph 78 – Crypt looking East

Photograph 79 – Masonry arches repointed in the last century

Photograph 80 – Masonry repointed with a hard mortar

Photograph 81 – Signs of damp in walls

Photograph 82 – Signs of damp in walls

Becket's Chapel

Photograph 83 – North Elevation

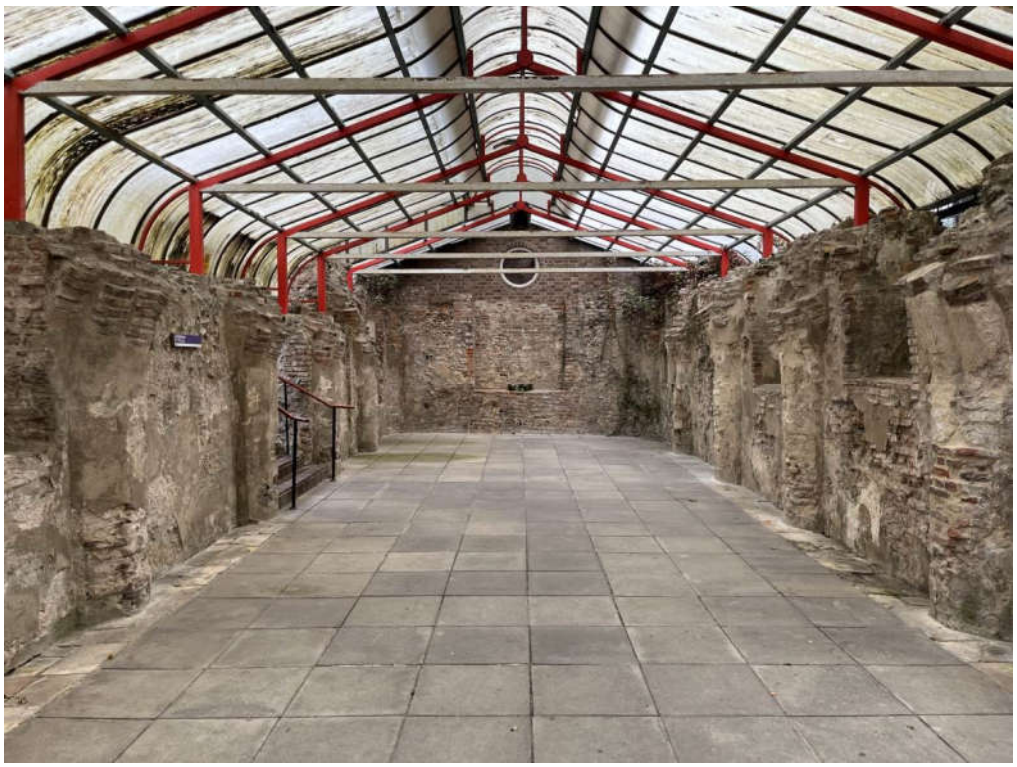
Photograph 84 – South Elevation

Photograph 85 – No flashing where West gable meets adjacent roof

Photograph 86 – Cracking to East gable brickwork

Photograph 87– Exposed remains of flint wall

Photograph 88 – Dropped roof sheet and blocked gutters



Photograph 89 – Internal looking East

Photograph 90 – Internal looking West

Photograph 91 – Steelwork embedded in concrete pad cast onto wall

Photograph 92 – Cementitious render on walls

Photograph 93 – Vegetation growing into building

Photograph 94 – Signs of water ingress

Appendix B – Hutton + Rostron's Condition Investigation of Timber Roof Structures

CONDITION INVESTIGATION OF TIMBER ROOF STRUCTURES

ST ANDREW'S AND BLACKFRIARS' HALL, NORWICH

JOB NO. 157-54

NORWICH CITY COUNCIL

22-24 NOVEMBER 2022

Prepared by:	Technical review by:	Administration by:
Joe Lovelock *BSc (Hons)* Patrick Hughes *MSc*	-	Jess Doherty *BA (Hons)*

CONTENTS

Hutton+Rostron Environmental Investigations Ltd, Netley House, Gomshall, Surrey, GU5 9QA,
Tel: 01483 203221 Email: ei@handr.co.uk Web: www.handr.co.uk

1 INTRODUCTION

1.1 AUTHORITY AND REFERENCE

Hutton+Rostron Environmental Investigations Limited carried out a timber decay survey at St Andrew's Hall and Blackfriars' Hall on 22-24 November 2022 in accordance with instructions received from Josh Halton-Farrow by email dated (date) on behalf of Norwich City Council. Reference was made to drawings created by NPS Group and supplied by Josh Halton-Farrow for the identification of structures. For the purpose of orientation in this report, the building was taken as being aligned along an east-west axis, with the main entrance to the south

1.2 AIM

The aim of this investigation was to identify damp and decay problems relating to the timber roof structures, or relevant building defects and to give recommendations on any remedial works required to correct such problems and prevent damp or decay problems in the future using environmental means

1.3 LIMITATIONS

This survey was confined to the accessible structures. Concealed timbers and cavities have been investigated where necessary by the use of high-powered fibre optics. The condition of concealed timbers may be deduced from the general condition and moisture content of the adjacent structure. Only demolition or exposure work can enable the condition of timber to be determined with certainty, and this destroys what it is intended to preserve. Specialist investigative techniques are therefore employed as aids to the surveyor. No such technique can be 100 per cent reliable, but their use allows deductions to be made about the most probable condition of materials at the time of examination. Structures were not examined in detail except as described in this report, and no liability can be accepted for defects that may exist in other parts of the building. We have not inspected any parts of the structure which are covered, unexposed or inaccessible and we are therefore unable to report that any such part of the property is free from defect or in the event that such part of the property is not free from defect it will not contaminate and/or affect any other part of the property. Any design work carried out in conjunction with this report has taken account of available pre-construction or construction phase information to assist in the management of health and safety risks. The sample remedial details and other recommendations in this report are included to advise and inform the design team appointed by the client. The contents of this report do not imply the adoption of the role of Principal Designer by H+R for the purposes of the Construction (Design and Management) (CDM) Regulations 2015. No formal investigation of moisture distribution was made

1.4 H+R STAFF ON SITE

Joe Lovelock
Patrick Hughes

1.5 PERSONNEL CONTACTED

Josh Halton-Farrow – Wright Consulting
Halls staff members

2 EXECUTIVE SUMMARY

2.1 OBSERVATIONS AND RECOMMENDATIONS

1 General: Timber elements where accessible were drilling for decay detection and probed for surface/ambient and deep moisture content readings so as to ascertain the extent of structurally significant or partial decay, and to determine the vulnerability to decay organisms before, during, and after any refurbishment/repair works. Thermography and fibre-optic borescope inspection techniques were also utilised to assess inaccessible areas

2 Timber decay: Isolated areas of decay were identified in St Andrew's Hall and Blackfriars' Hall during the investigation which were generally in vulnerable eaves locations where there had been historic issues with water penetration. The historic decay was in all cases a result of historic wet rot and subsequent wood-boring beetle infestation. Active decay was identified in the organ loft roof structure where moisture was penetrating the gable end and raising the moisture content of timbers in contact with or embedded in the masonry above the decay threshold. No dry rot (*Serpula lacrymans*) fungal growth was noted or identified anywhere in the building at the time of survey. This was attributed to the predominance of oak wood as structural timber, which is generally invulnerable to the dry rot organism

3 Moisture content readings: All moisture content readings taken from structural and non-structural timber elements at the time of survey from St Andrew's Hall and Blackfriars' Hall were all well below the level that could sustain fungal decay organisms or wood-boring beetle infestation. There were indications that water was actively penetrating the east gable wall of the roof structure over the organ loft; moisture content readings from timbers embedded in or in contact with the masonry in this location were generally above the decay threshold of ~20 per cent w/w. This was suspected to be a result of cracking and deterioration in the cementitious render applied to the external face of the exposed section of the gable wall, allowing entrapment of moisture

No chemical treatment required in relation to fungal decay organisms or wood-boring beetle infestation. Decayed timber should be cut back to sound material and repaired/replaced using timber to match existing. New timber should be fully isolated from damp or potentially damp masonry using a damp-proof material, through-ventilated air gap, or cut back and re-supported on hangers and brackets. All repairs should be directed by the Structural Engineer and in consultation with the Conservation Officer

3 OBSERVATIONS AND *RECOMMENDATIONS*

3.1 ROOF CONSTRUCTION

3.1.1 St Andrew's Hall

1 Aisles: Rafters spanned north-south and were supported on masonry walls at both bearing ends. The purlin at midspan of the rafters was supported along the length of the aisles by intermediate trusses. Cementitious in-fill was noted between rafters preventing determining whether a timber plate was below the rafter feet; however, this was considered likely but may have been positioned at the outermost edge of the masonry wall. The roof finishes consisted of 2no. layers of timber boarding, with a small void between layers of roofing materials. Purlins did not appear to be embedded into masonry at east and west ends but were supported on the outermost truss in each case, which was fully isolated from the masonry by an ~100mm gap

2 Nave: The roof was constructed using hammer-beam trusses spanning north-south across the internal space of the nave. These supported 2no. purlins per-pitch which in turn supported common rafters. Rafters were supported at eaves onto masonry wall heads with additional perpendicular timbers spanning north-south below the rafters. Decorative carved timber posts supported bearing ends of trusses and were housed into the wall finishes and likely secured to grounding timbers. Roof finishes were assumed to be as per the aisles described above

3 Organ loft roof structure: The organ loft roof structure was located at the eastern end of St Andrew's Hall and was accessible via the spiral stone stairway in the lobby area. Rafters spanned north-south and were supported on purlins at midspans and masonry walls at eaves. Timber plates were noted below rafters at eaves, and purlins were fully embedded into the internal masonry wall to the west and the gable wall to east. Timber pads were noted below purlin bearing ends. Sarking boards provided the roof finish with copper sheeting over as per the main roof structures to the west. Additional smaller-section timbers had been fixed to the upper edges of the rafters, presumably during re-roofing refurbishment works in the past

4 Material: All structural timbers of St Andrew's Hall were preliminarily identified on-site as being of oak timber (*Quercus spp*.). The organ loft roof structure was primarily formed using softwood timber, likely of the *Pinus* genus; however, upper purlins were noted to be of oak

5 History of remediation:

- St Andrew's - There was clear signs of hand shaping of the primary structural timbers, although there were occasional signs of replacement and/or repair using newer timbers. Newer timbers showed evidence of machine conversion (circular and bandsaw markings). All sarking boarding visible internally was noted to have been converted using mechanised circular saw suggesting widespread remedial intervention since original construction, likely during the early C19th. Additionally, there was widespread use of resin for in-filling gaps,

filling of dead knots, and consolidating timbers

- Organ loft roof structure – The primary use of softwood in this roof structure suggested wholescale removal of original historic material and replacement. Machine markings and general condition and patina of timber elements were consistent with early C20th manufacture

6 Relevant dimensions, St Andrew's:

– Aisle:

Common rafter	-	~175 x 120mm at ~520mm centres
Sarking board	-	~155 x 20-25mm
Bracing	-	~290mm wide, ~80mm thickness
Truss post	-	~135mm wide
Capping	-	~100 x 50mm

– Nave:

Principal rafter	-	~350 x 130mm
Common rafter	-	~185 x 110 at ~515mm centres
Purlins	-	~260 x 210mm
Sarking board	-	~145 x 15mm
Ashlar posts	-	~185 x 80mm
Moulded ashlar plate	-	~225 x 200mm
Sole plates	-	~195 x 145mm
Hammer beams	-	~300 x 230mm
Truss posts	-	~300x 270mm
Arch braces	-	~360 x 135mm
Hammer post	-	~270 x 250mm

Organ loft roof:

Common rafters	-	~105 x 90mm at ~420mm centres
Additional timbers	-	~90 x 75mm
Softwood purlin	-	~225 x 100mm
Oak purlin	-	~170 x 200mm

3.1.2 Blackfriars' Hall

1 Construction: Hammer-beam roof trusses again supported rafters and the one purlin per-pitch. Rafters were supported at eaves onto masonry wall heads. Timber rafters were accompanied by steel I-beam elements boxed-in to give the appearance of timber, with large amounts of cementitious mortar encapsulating the feet of common rafters. Purlins were not embedded into masonry at bearing ends, but were supported on the outermost trusses which were isolated from the walls by an ~100mm air gap

2 Materials: All structural timbers were preliminarily identified as being of oak (*Quercus spp.*)

3 History of remediation: The inclusion of steel elements between rafters suggested relatively recent and significant repairs to the roof in the past. Additionally, there were significant timber repairs identified to trusses, particularly to truss posts below the principal rafters. Further to this, rafter spacings had been in-filled with cementitious render/mortar

4 Relevant dimensions:

Principal rafters	-	~300 x 290mm
Common rafters	-	~190 x 110mm
Steel common rafters	-	~200 x 200mm
Ashlar posts	-	~180 x 95mm
Sling-braces	-	~430 x 80mm
Truss post	-	~300 x 250mm
Purlin	-	~300 x 200mm
Ridge beam	-	~300 x 200mm
Sarking board	-	~250mm x N/A
Softwood batten	-	~80 x 75mm

3.2 CONDITION

3.2.1 St Andrew's Hall

1 Timber decay: The investigation was confined to the eaves of the aisles and nave, in areas that were considered vulnerable to issues with damp and decay either from defective roof coverings above, or from defective guttering resulting in overcharging and saturation of facades. In these locations structural timber, where accessible, were inspected using decay detection microbore drilling, and surface and deep moisture content probing. A number of potential issues were revealed during the survey: (bays and trusses numbered from west to east)

- Bay 1, nave, north side – partial decay detected affecting the westernmost perpendicular timber sole plate at the bearing end. Localised wet rot and wood-boring beetle decay although moisture content readings too low for further decay to occur
- Bay 3 – nave, north side – diagonal fissure to perpendicular sole plate timber which may be structurally significant
- Truss 4, nave, south side – historic decay to bearing end of hammer beam. Cavities extending for ~600mm in length have been in-filled with cementitious mortar. Historic structural movement has resulted in slight separation of cornice, and dropping of arched brace – moisture content readings too low for decay
- Bay 4, nave, south side – partial decay to moulded cornice. Moisture content readings too low for further decay to occur
- Bay 5, nave, south side – Potential decay to moulded cornice tenon connection to hammer beam – bearing end of perpendicular plate decayed ~80mm, not structurally significant – moisture content readings too low for further decay to occur
- Bay 6, nave, north side – bearing end of perpendicular plate element decayed ~50mm, large dead knot in 4th rafter from west which may be structurally significant
- Bay 6, nave, south side – 1st sole plate section from west decayed at south bearing end ~80mm and at centre location
- Bay 9, nave, north side – bearing end of perpendicular plate decayed at north bearing end ~80mm

Generally, decay was confined to the extreme bearing ends of the perpendicular plates which supported the bearing ends of common rafter feet. This appeared to be a mixture of historic wet rot and historic wood-boring beetle infestation (Deathwatch beetle – *Xestobium rufovillosum*). It was not clear whether this was structurally significant; however, may result in slight downward movement of common rafters if crushing of the plate occurs over time, and places further loadings onto the decorative ashlar plate directly over the overhang

2 Water penetration: There was evidence of historic water penetration that had resulted in the decay described above, although moisture content readings were for the most

part recorded at well below the decay threshold of ~20 per cent w/w for fungal growth, and 15-16 per cent w/w for wood-boring beetle. Moisture content readings in general were returned at ~12 per cent w/w or lower indicating no ongoing issues moisture ingress from defective roof coverings or roof drainage, despite reports from Hall members of staff to the contrary. Decay was generally accompanied by localised bleaching and staining of timber elements, and localised wood-boring beetle flightholes

General repairs: No chemical remedial treatment required in relation to fungal decay organisms or wood-boring beetle infestation. Decayed timber should be cut back to sound material and replaced with new to match existing. New timber should be fully isolated from damp or potentially damp masonry using a continuous strip of damp-proof material, using a through-ventilated air gap, or cut back and supported on hangers/brackets. All repairs to be overseen by the Structural Engineer and in consultation with the Conservation Officer

Plate repairs: The decayed sections of plate should be exposed and repaired using new material scarfed-in to suit. DPC should be placed below during works

Structural concerns: The Structural Engineer should comment on the large dead knot affecting the rafter in bay 6 and the diagonal fissure through the plate in bay 3

Decayed cornicing: Decayed cornicing may not be structurally significant and therefore may not require immediate repairs; however, if tenon connections to truss posts are decayed then this should be rectified, potentially using brackets to re-connect to posts

3.2.2 Blackfriars' Hall

1 Timber decay: As in St Andrew's Hall above, the investigation was confined to the eaves of the Hall and to the western end, in areas that were considered vulnerable to issues with damp and decay either from defective roof coverings above, or from defective guttering resulting in overcharging and saturation of facades. In these locations structural timber, where accessible, were inspected using decay detection microbore drilling, and surface and deep moisture content probing. A number of potential issues were revealed during the survey: (bays and trusses numbered from west to east)

- Truss 3, south side – potential decay to top of truss post below moulded cornice on west side – moisture content readings too low for decay to occur – evidence of historic wood-boring beetle flightholes
- Bay 3, south side – eastern end of moulded cornicing decayed for ~50mm by historic Deathwatch beetle activity – moisture content readings at 12 per cent w/w, too low for further decay to occur
- Truss 9, north side –truss post decayed for ~800mm in length – moisture content readings too low for further decay to occur – combination of historic wet rot fungal decay and wood-boring beetle
- Truss 10, north side –truss post decayed for ~1m in length – moisture content readings too low for further decay – combination of historic wet rot fungal decay and wood-boring beetle
- Bay 12, south side – superficial and non-structurally significant transverse splitting to western end of moulded cornicing
- Truss 13, north side – truss post partially decayed at head for ~630mm. decay on the border between structurally significant and non-structurally significant – potential decay to timber elements hidden by cementitious mortar – moisture content readings too low for further decay to occur

2 Water penetration: As with St Andrew's Hall described in 3.2.1 (2) above, there was evidence of historic water penetration that had resulted in the decay described above,

although moisture content readings were for the most part recorded at well below the decay threshold of ~20 per cent w/w for fungal growth, and 15-16 per cent w/w for wood-boring beetle. Moisture content readings in general were returned at ~12 per cent w/w or lower indicating no ongoing issues moisture ingress from defective roof coverings or roof drainage, despite reports from Hall members of staff to the contrary. Decay was generally accompanied by localised bleaching and staining of timber elements, and localised wood-boring beetle flightholes

General repairs: No chemical remedial treatment required in relation to fungal decay organisms or wood-boring beetle infestation. Decayed timber should be cut back to sound material and replaced with new to match existing. New timber should be fully isolated from damp or potentially damp masonry using a continuous strip of damp-proof material, using a through-ventilated air gap, or cut back and supported on hangers/brackets. All repairs to be overseen by the Structural Engineer and in consultation with the Conservation Officer

Truss posts: The decayed truss posts should be cut back to sound material and replaced with new timber to match existing (oak – Quercus spp.). If possible, new timber should be isolated from the masonry using strips of dpc. Any wedges used to level or plumb the post during replacement should be of plastic, with plywood/hardboard or other wood-based products avoided

Decayed cornicing: Decayed cornicing may not be structurally significant and therefore may not require immediate repairs; however, if tenon connections to truss posts are decayed then this should be rectified, potentially using brackets to re-connect to posts

3.2.3 Organ loft roof

1 Timber decay: Due to significant issues with penetrating moisture through the gable, moisture content readings taken from timbers in contact were generally recorded at above the decay threshold of ~20 per cent w/w, occasionally reaching the fibre saturation int (over 30 per cent w/w). One length of embedded timber to the north side of the east side wall, was found to be decayed on drilling, and wet rot fungal growth and staining were identified on timbers in this area. Purlins bearing ends were found to be sound on inspection, although deep moisture content readings were high enough at the time of survey for decay to occur. No decay was detected in bearing ends of rafters despite being in contact with the masonry wall at the north and south eaves, and perforations in the brickwork in-fill between rafter feet enabled probing and drilling of the plate which was also found to be sound on inspection. Purlin ends and pads below were occasionally affected by wood-boring beetle flightholes, although no structural decay as a result

2 Water penetration: Across the gable wall there was widespread hygroscopic salt efflorescence indicating a history of ongoing issues with water penetration, likely due to the cementitious render that had been applied externally, entrapping moisture and forcing it inwards towards the roof structure. As described above, moisture content readings were for the most part well in excess of the decay threshold

General repairs: No chemical remedial treatment required in relation to fungal decay organisms or wood-boring beetle infestation. Decayed timber should be cut back to sound material and replaced with new to match existing. New timber should be fully isolated from damp or potentially damp masonry using a continuous strip of damp-proof material, using a through-ventilated air gap, or cut back and supported on hangers/brackets. All repairs to be overseen by the Structural Engineer and in consultation with the Conservation Officer

Timber isolation: Due to the elevated moisture content readings revealed during the survey, consideration should be given to isolating all timbers in contact with the saturated masonry wall to the east side. This could be achieved by cutting back purlins and re-supporting on

brackets/hangers. The decayed embedded timber should be removed and the resulting void in-filled with brickwork. Embedded purlin pads would subsequently become redundant and should be removed and in-filled

3.3 THERMAL IMAGERY

Thermal imagery was undertaken throughout the building so as to determine any differential in temperature of the masonry walls that may suggest issues with active moisture penetration. For the most part, there was no differential identified that would suggest ongoing issues with moisture ingress that would affect structural timbers, despite reports from members of staff at the time of survey relating to occasional liquid water collecting at the base of the walls of the aisles during inclement weather. Slight temperature changes were noted however, in Blackfriars' Hall at the approximate mid-point which suggested an elevated level of retained moisture within the masonry masses, although no structural timbers were in direct contact with masonry in this location, and decorative and secondary timber elements below were generally isolated with air gaps. No differential in temperature was noted at the east end of the south aisle where previous reports had suggested dry rot (*Serpula lacrymans*) fungus may have been affecting timber elements, and although there was superficial staining to timber in this area, no structural decay or fungal growth was identified on inspection

3.4 DRONE IMAGERY

Drone images indicated significant build-up of biological growth within gutters of Blackfriars' Hall which would likely be resulting in significant overcharging during periods of heavy rainfall and leading to saturation of masonry below, leaving any timbers embedded into masonry in this location vulnerable to issues with damp and decay. In addition, one roof slate was noted to have slipped down onto the north pitch gutter, which may not only be allowing direct water penetration into the roof structure (albeit localised) but may also lead to further blockage of the gutter. Potentially significant roofing defects to the east end of the south aisle of St Andrew's Hall were also noted; the cement render retaining the roofing edge flashing had failed, although as described in 3.3 above, this did not appear to be resulting in internal issues with damp and timber decay. Cracking in the east rendered gable between the two main halls was also noted during the drone investigation, which was considered likely to be causing the raised moisture content readings taken from timbers of the organ loft roof structure, especially those embedded into the masonry wall such as the purlins and purlin pads

3.5 ACCESS

Access was via ladders in the aisles of St Andrew's Hall and using a MEWP (mobile work elevating platform) for the Nave of St Andrew's Hall and for Blackfriars' Hall. This enabled physical and close-up visual inspection, and probing for deep and surface/ambient moisture content readings to assess vulnerability to decay

4 GENERAL RECOMMENDATIONS

All new and refurbishment detailing should be assessed for its effect on environmental and structural health. General principles are set out below. Special care is required when introducing new materials, moisture sources or heating and ventilation systems, for example air conditioning

4.1 ROOF AND SURFACE DRAINAGE

4.1.1 Maintenance

All guttering, hopperheads and outlets should be regularly checked and cleared to keep them free of debris, especially during the autumn months

4.1.2 Protection

Hopperheads, gutter outlets and ground gullies should be protected with metal mesh cages so as to prevent blockage and overflow. These should extend higher than the expected water level to reduce the tendency to block and should be easily removable to allow cleaning and maintenance

4.1.3 Overflows

Hopperheads, parapet gutter outlets and valley gutter outlets should be fitted with overflow pipes to drain water clear of the structure in case of blockage. These should be at a level below that at which water would overflow the roof flashings

4.1.4 Roof drainage calculations

Roof drainage calculations should be made to check the adequacy of gutters, drains and downpipes so that their capacities may be increased if necessary during refurbishment. H+R can carry out these calculations if required

4.1.5 Monitoring

The installation of an automatic monitoring and alarm system should be considered to give warning of blockage or overflow in the roof drainage system

4.1.6 Access

Safe and convenient access ladders, safety points and walkboards should be installed to all roof areas to allow proper inspection and maintenance

4.2 VENTILATION

4.2.1 Structural voids

All structural voids within the building should be provided with adequate through ventilation so as to prevent moisture build-up. This must be done with regard to the applicable fire regulations

4.2.2 Chimneys

All chimneys not in use should be capped so as to minimise water ingress but so as to allow maximum ventilation of the flues. Flues should be cleared and cleaned to remove blockages. Fireplaces and chimney breasts should be opened or vented to allow through-ventilation of the flues. This prevents moisture build-up in the flues and helps interior ventilation by the stack effect

4.2.3 Bathrooms and kitchens

All bathrooms and kitchens should be fitted with adequate extractor fan systems. These should run for at least fifteen minutes after occupancy to prevent condensation. The installation of floor drains should be considered in these rooms in case of overflow

4.2.4 Roof spaces

All roof spaces, including flat roof areas and gutter soles, should be provided with adequate through-ventilation. This may occur via the gaps between slates in unsarked pitched roofs. However, flat roofs and pitched roofs with sarking or insulation will require the installation of vents through the roof surfaces or at the eaves and ridges. Insulation material in roof spaces should be kept clear of external walls, gutter soles or timbers in contact with damp or potentially damp masonry

4.2.5 Windows

Windows should be refurbished so as to allow easy and convenient opening and closing by occupants in order to encourage proper ventilation of the building. This is important both for environmental and structural health. Windows should be fitted with security locks so as to allow secure locking in a partially opened position

4.3 STRUCTURAL DETAILING

4.3.1 New timbers

New timbers should be isolated from any damp or potentially damp masonry with a damp proof material or ventilated air gap

4.3.2 Timber repairs

Structurally decayed timbers should be removed or cut back to sound timber unless required for aesthetic reasons. Timbers should then be partnered or spliced as in section 4.3.1 above. If steel plates or hangers are used, they should be detailed so as to allow sufficient ventilated air gaps and drainage to prevent moisture build-up due to condensation. No timber

preservation or remedial treatments should be required

4.3.3 Paint finishes

Moisture vapour permeable or 'microporous' paint finishes should be preferred for internal and external surfaces and woodwork. This is especially important on window timbers. To take advantage of the properties of such paints, the complete removal of old alkyd paint systems is recommended. Health and Safety: Special precautions should be taken during surface preparation of pre 1960's paint surfaces as they may contain harmful lead or other toxic materials

Appendix A

REMEDIAL BUILDING WORKS AND ENVIRONMENTAL CONTROL

The most critical factors for the environmental control of decay organisms are available moisture and temperature. The former is dependent on such factors as moisture content, relative humidity, micro-ventilation, and salt content. In simplistic terms it is necessary to correct building defects leading to high moisture contents in timber and to increase ventilation around timber at risk

In practice there are two problems; first it is necessary to identify the significant building defects and then the best techniques must be chosen to control the environment at each point. This may be achieved by analysing the building in terms of moisture sources, moisture reservoirs and moisture sinks

It is not possible to prevent moisture entering a building entirely and often attempts to block the movement of moisture through a building structure using impermeable materials are ineffective. They may also be counter-productive as they can prevent moisture being dissipated, resulting in high moisture levels and decay in adjacent materials. The more effective and robust approach is that used in traditional buildings. Here, porous materials are preferred, and every moisture source is balanced by a moisture sink. Thus ground water may penetrate masonry but is evaporated off before it reaches timber structures. Similarly, water vapour is introduced by occupation, but is ventilated out via windows, chimneys and other passive and active forms of ventilation. Failure to balance a moisture source with an appropriate sink may result in moisture moving into vulnerable materials and eventually causing decay and other problems

Moisture reservoirs occur when a moisture 'source' has not been balanced by a 'sink' and water has accumulated in a porous material. Typical examples of this are to be found when thick masonry walls have been soaked by persistent leaks or when chimney breasts have been filled with rain water from uncapped chimneys. Such reservoirs may take years to dry out, even when the source has been dealt with. As a result, they can act as a source of moisture for recurrent timber decay over a long period. A special case of this phenomenon occurs when large quantities of water have been used in fighting a fire

In practice then, each area of decay is associated with a building defect, resulting in an increased moisture source, a blocked or inappropriate moisture sink or a moisture reservoir. The appropriate building measures should then be specified to correct that defect

A common example might be the bridging of a damp proof course by raised ground levels. This will act as a moisture source and may result in decay of timbers in an adjacent floor space. Reducing the ground level will cut off this source and will also provide a sink of moisture by allowing evaporation from the exposed wall. The sub-floor moisture level might also be controlled by increasing the other available moisture sinks. Cleaning pre-existing airbricks or inserting additional sub-floor ventilation would be a common measure. In general, it is important to increase evaporative surfaces and avoid obstructing them during refurbishment

Another common example would be a blocked and overflowing parapet gutter acting as a moisture source. This could wet up gutter soles, joist ends and wall plates as well as any other structure in an expanding cone extending from the leak down through the building. Preventing this moisture source may require a number of measures such as increasing the capacity of down pipes, re-lining the gutters and fitting thermostatically controlled trace heating tape to increase free flow of snow melt water

Any failure in a roof finish, gutter or coping will generally result in significant water penetration into the masonry wall beneath, which will then act as a moisture reservoir. Any timber in contact with this reservoir will be at risk of decay as it will tend to 'wick' moisture from the masonry. Steps must therefore be taken to isolate in-contact timber from the masonry using such measures as DPC membranes or joist hangers producing an air gap. It will also be necessary to ensure the timbers are adequately ventilated so that any moisture that is absorbed can be breathed off. Closed cavities or water-impermeable layers over timbers at risk must therefore be carefully searched out and rectified using knowledge of historic methods of construction. Bricked-in lintels and sealed up emulsion-painted sash windows are typical examples of structures at risk in this way

Having cut off the moisture source to a moisture reservoir and protected the 'at-risk' timbers it is next necessary to provide safe 'sinks' for the moisture. This will ensure that the reservoir is dried out in the long term. In some cases, the reservoir can be removed entirely, for example damp pugging can be dug out and replaced. In most cases it is a matter of promoting ventilation around a wicking surface on the reservoir and ensuring that the moisture-laden air can be vented to the outside. Dry lining systems can be useful for this purpose as can the good old-fashioned chimney. Raising the temperature will promote the process of wicking and evaporation. General house heating can help but care must be taken to ensure that water vapour is not being 'pulsed' into other parts of the building by a sequence of evaporation and condensation down a temperature gradient. Heating can be especially useful if it is possible to heat the reservoir material itself. We have devised special systems for heating large section timbers and masonry for this purpose but again the old-fashioned fire-place and chimney is very useful

In some cases, dehumidifiers can be used in the short to medium term, but care must be taken. They often require special 'tenting' and monitoring so that moisture is removed from the appropriate material and not from the world at large. They also require high air temperatures and high RH's to extract moisture efficiently

In all cases most of the remedial building works that may be required are quite within the capacity of the general contractor. Most are traditional repairs though some may take advantage of new materials or techniques such as dry lining, joist hangers and tanking. New and potentially useful products are coming into the building market all the time, for example, time controlled automatic fans, hollow ventilating plastic skirting boards, plastic masonry drains, roof space ventilating systems and moisture permeable paints. All such products and techniques can be used to help in making the environmental control of timber decay even more efficient and economical. All that is required is careful analysis of each situation and a little scientific understanding

Appendix B

MAINTENANCE AND MONITORING

The investigation and building works described in the previous appendices should put a building back into a state of structural and environmental health. The environmental control approach will also mean that a building is less likely to develop problems in the future. This is because the effect of minor building failures should be 'buffered' by the robustness of the systems established. Fortunately, most traditional systems are robust in this way. This is why older buildings may tolerate a considerable amount of neglect and abuse before developing severe problems. However, the long-term health of the building will always depend on adequate maintenance. This is no less true of buildings treated with timber preservatives

A detailed investigation carried out as part of an environmental control policy provides an excellent basis on which to plan the most cost-effective maintenance program. Indeed, the building works required for environmental control are often best integrated into such a program. Short-term 'emergency' measures can be taken to simply halt further decay and measures to replace damaged structures or prevent future problems can be delayed to fit into a longer term plan of works. This flexibility in scheduling work as a result of the environmental approach allows further saving of costs and inconvenience

A maintenance program must also include provision for the routine inspection of all significant parts of the building at appropriate intervals. This should aim to detect and correct problems developing before they cause significant damage. Again the information gained in the investigation can be used to decide on the most cost effective inspection interval

In many cases remote monitoring systems can be very useful in increasing the efficiency and reducing the cost of maintenance programs. They can be especially useful for checking the moisture content of inaccessible timbers in roof spaces, behind decorative finishes and in walls. H+R have developed the Curator building monitoring systems for this proposal

Sensors can be placed at all critical points after the investigation or after the remedial building works. Areas can then be closed up and finishes re-applied, for example sensors may be placed in lintels, joist ends, valley gutter soles or in damp walls to monitor drying. It is important to use enough sensors and to place them with an understanding of the moisture distribution processes because conditions can vary even in a small area. It is these local variations in conditions that produce the environmental niches which decay organisms exploit

If more than 30 sensors are deployed, taking the readings can become onerous and this may result in human error or negligence. In these situations automatic monitoring systems become desirable. H+R have developed a number of specialised 'Curator' data logging systems to do this. With larger systems, the wiring of sensors can also become a problem. For systems requiring 100 or more sensors we can use a 'Curator A' unit working via a single 4-core main cable connecting up any number of nodes, each supporting 4 sensors. This system can be programmed with logging intervals and alarm limits for each sensor and can be read via the telephone system via its own modem. Data from the system can then be analysed using CAD and programs for statistical interpretation on a remote computer

Appendix C

Fig 1:

St Andrew's Hall, internal; showing a general view looking east of the structural arrangement of the timber roof and that of the overall building. Note the presence of aisles along the north and south sides, these were served by separate, lower roof structures than the Nave

Fig 2:

St Andrew's Hall, internal; showing a general view looking west of the structural arrangement of the timber roof and that of the overall building

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Fig 3:

St Andrew's Hall, internal; showing a general view of the masonry gable wall at the west of the north aisle. This was reported to have possibly been rebuilt during the 19th century

Fig 4:

St Andrew's Hall, internal; showing a focused view of timber truss elements forming the north side of the first truss adjacent to the internal face of the masonry gable wall at the west of the north aisle. Several elements displayed conversion marks indicating they were of contemporary origin

Fig 5:

St Andrew's Hall, internal; showing a focused view of timber components forming the roof structure at eaves level of the north aisle. Note the presence of mechanised conversion marks on the sarking board, indicating the sarking had been relatively recently replaced

Fig 6:

St Andrew's Hall, internal; showing a focused view of historic common rafters forming the roof structure over the north aisle. Note the use of modern resin 'filler' materials. The use of this was identified throughout the entire roof structure

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Fig 7:

St Andrew's Hall, internal; showing the condition of the north wall head and eaves of the roof structure over the north aisle. Note masonry had been positioned over and between each pair of rafters likely to provide lateral rigidity, as well as further strength the embedded ends. This prevented access to the feet of the rafters as well as any additional timber elements

Fig 8:

St Andrew's Hall, internal; showing the typical jointing arrangement of the moulded cornices along the north side of the north aisle. Note 2 no. locations where timber pegs had been used to provide further security to the joint

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Fig 9:

St Andrew's Hall, internal; showing a focused view of the joint interface between a section of moulded cornice and a principal rafter on the north side of the north aisle. Note the joint type was a housed mortise and tenon

Fig 10:

St Andrew's Hall, internal; fracturing was identified to the centre of the masonry window arch and tracery beneath. This had not visibly affected the structural integrity of the roof at the time of survey

St Andrew's and Blackfriars Hall
Photographs
22-24 November 2022
Not to scale

Fig 11:

St Andrew's Hall, internal; showing a build up of masonry atop the wall head on the north side of the north aisle. Note the presence of red brick and a likely cementitious render, indicating that this had been recently laid or added to. Also note the presence of a contemporary damp proof membrane beneath the common rafter, likely installed during previous widespread refurbishments

Fig 12:

St Andrew's Hall, internal; showing a gap at the joint between a truss post and moulded cornice. Note the presence previous patch repairs, suggesting the joint had possibly moved since their installation

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Fig 13:

St Andrew's Hall, internal; showing a section of moulded cornice that displayed evidence of decay by 'wet' rot and wood-boring beetle. Note that moisture levels at the time of survey were below the threshold required for the onset and growth of biological decay organisms, therefore the decay was deemed to be historic and no longer active

Fig 14:

St Andrew's Hall, internal; showing a videoscope of the type and condition of the materials used to form the subsequent roof layers above the internal hardwood sarking board. Note the sarking board within the void was visually identified as softwood. Also note the presence of localised moisture staining to the edges of the sarking board. This was likely due to a build up of humidity causing interstitial condensation within the roof void

Fig 15:

St Andrew's Hall, internal; showing a principal rafter in close proximity to the masonry gable wall at the east end of the south aisle. Note widespread moisture staining to the timber elements, likely caused by excessive moisture ingress from external sources through the masonry

Fig 16:

St Andrew's Hall, south aisle; showing a videoscope image of the principal rafter forming the truss at the east end of the south aisle, pictured in fig. 15 above. Note the further extent of the moisture staining. No decay or mycelial growth was visibly identified at the time of survey

Fig 17:

St Andrew's Hall, Nave; showing the structural arrangement of a typical bay within the roof structure of bay 1, at the west end of the hall

Fig 18:

St Andrew's Hall, Nave; showing a focused view of the interface between the hammer beam, moulded cornice and principal rafter on the north side of bay 1

Fig 19:

St Andrew's Hall, Nave; showing a focused view of the hardwood sarking board used throughout the Nave. Note the visible mechanised conversion marks, indicating the sarking board was of contemporary origin

Fig 20:

St Andrew's Hall, Nave; showing the typical construction design of partially embedded bearing ends of common rafters and sole plates within the Nave. Note the use of red brick was considered to possibly be a later addition and the presence of likely cementitious render could prevent the evaporation of moisture trapped in close proximity or contact with the timber elements

Fig 21:

St Andrew's Hall, Nave; showing a general view of the arrangement and condition of sole plates as well as their connections to the back side of the moulded inner plate within the north side of bay 1. Note the presence of high levels of dust and debris at eaves level, this could present a health hazard to occupants of the building, as well as construction and maintenance personnel carrying out works

Fig 22:

St Andrew's Hall, Nave; showing the lower section of a common rafter, ashlar and sole plate within the north side of bay 3. Note the presence of an elongated mortise indicated alterations had previously taken place

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Fig 23:

St Andrew's Hall, Nave; showing significant localised moisture staining to the structural timber elements, as well as the internal face of the brickwork, on the north side of bay 3. Note this had likely been caused by a failure to previous roofing materials allowing moisture ingress. Moisture readings were below the threshold for the onset and growth of biological decay organisms

Fig 24:

St Andrew's Hall, Nave; showing a large dead knot located on the underside of the 4th common rafter on the north side of bay 6. Size and position of knot was deemed to likely be a strength reducing characteristic. Structural Engineer to comment

Fig 25:

St Andrew's Hall, Nave; showing a section of decay to the end of partially embedded sole plate on the north side of Bay 6. Moisture readings were below the threshold required for the onset and growth of biological decay organisms, indicating the instance of decay was historic

Fig 26:

St Andrew's Hall, Nave; showing a section of partial decay to the end of partially embedded sole plate on the north side of bay 9. Moisture readings were below the threshold required for the onset and growth of biological decay organisms, indicating the instance of decay was historic

Fig 27:

St Andrew's Hall, Nave; showing the general condition and structural arrangement of timber elements on the south side of bay 9. Note the embedded end of the hammer beam underwent decay detection drilling. No decay was identified at the time of survey

Fig 28:

St Andrew's Hall, Nave; showing a further image of the general condition and structural arrangement of timber elements on the south side of bay 9. Note no decay was detected upon investigation, however contemporary cementitious materials had been used to encapsulate the feet of the rafters which could prevent the evaporation of any trapped moisture, increasing the likelihood of the onset of biological decay organisms

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Fig 29:

St Andrew's Hall, Nave; showing a sole plate on the south side of bay 6 that was identified as having a decayed partially embedded end and further decay to the centre for ~300/350mm

Fig 30:

St Andrew's Hall, Nave; showing a general image depicting the extent deflection to masonry forming the aisle, on the south side, at the west end. This deflection had not appeared to have caused any critical damaged to the timber roof structure above

Fig 31:

St Andrew's Hall, Nave; showing a series of common rafters on the south side of bay 5 that display significant racking westward. Investigations did not identify any further issues and the common rafters appeared to be structurally sound at the time of survey

Fig 32:

St Andrew's Hall, Nave; showing a focused view of the west end of the moulded cornice on the south side of bay 5. Note the joint had separated ~45mm and the tenon appeared to have been decayed. Joint should likely undergo further strengthening using contemporary mechanical fixings

Fig 33:

St Andrew's Hall, Nave; showing the partially embedded end of a sole plate on the south side of bay 5, that had been partially decayed on the left hand side, in close proximity to the joint interface with the common rafter

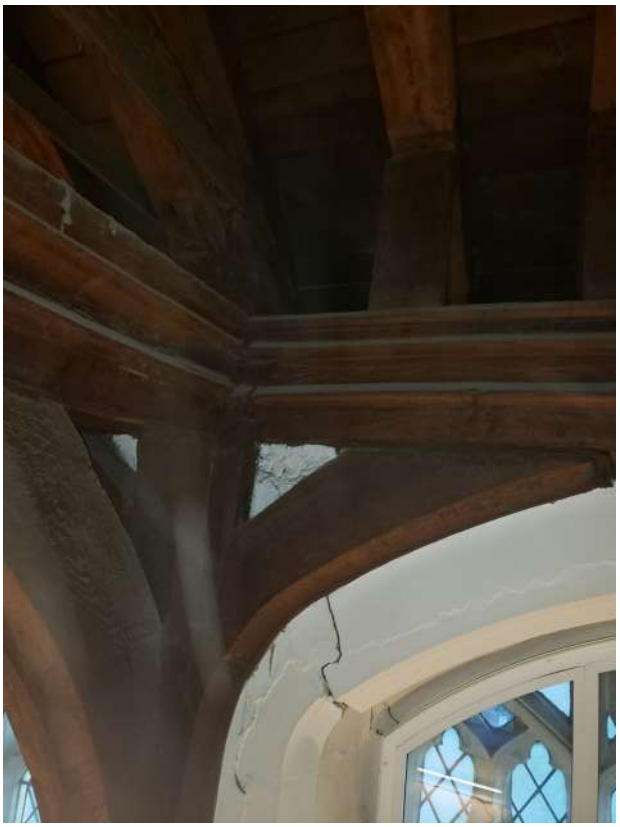

Fig 34:

St Andrew's Hall, Nave; showing fracturing to the masonry window arch beneath the timber roof structure on the south side of bay 5. Further investigations deduced that this had led to partial joint separation in certain areas, however no areas of significant concern were identified

St Andrew's and Blackfriars Hall
Photographs
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Not to scale

Fig 35:

St Andrew's Hall, Nave; showing the embedded bearing end of the hammer beam on the south side of bay 3 and the joint interface between the principal rafter and hammer beam. Note a large pocket of historic decay had been filled with a likely cementitious material. Further decay detection drilling ascertained the presence of further cavities in close proximity to the mass of cementitious material. The overall area of decay throughout the section of the hammerbeam meant that it was considered to be structural. Moisture readings were below the threshold for the onset and growth of biological decay organisms, therefore the decay was considered to be historic. Structural Engineer to comment

Fig 36:

St Andrew's Hall, Nave; showing a focused view of a contemporary metal 'L' bracket used to strengthen a joint between a purlin and principal rafter on the south side of bay 3. Note that the widespread use of contemporary metalwork had likely been installed during recent, previous phases of refurbishment to the roof structure

Fig 37:

St Andrew's Hall, Nave; showing a general view of the condition and type of contemporary metal tie bar used throughout the Nave roof

Fig 38:

St Andrew's Hall, Nave; showing a focused view of a sapwood band to the underside of a common rafter that had been historically decayed by a 'wet' rot fungal organism. Localised areas of historic decay to the sapwood on structural elements was seen throughout the roof structure. Moisture readings were below the threshold for the onset and growth of biological decay organisms

Fig 39:

St Andrew's Hall, Nave; showing movement to the ashlars on the south side of bay 1, resulting in partial separation of both upper and lower joints

Fig 40:

St Andrew's Hall, Nave; showing truss elements on the south side of bay 1. Note the hammer post and other elements appeared to be of recent origin, possibly replaced during refurbishment works to the roof structure, or after the rebuilding of the west gable wall which likely happened during the 19th century

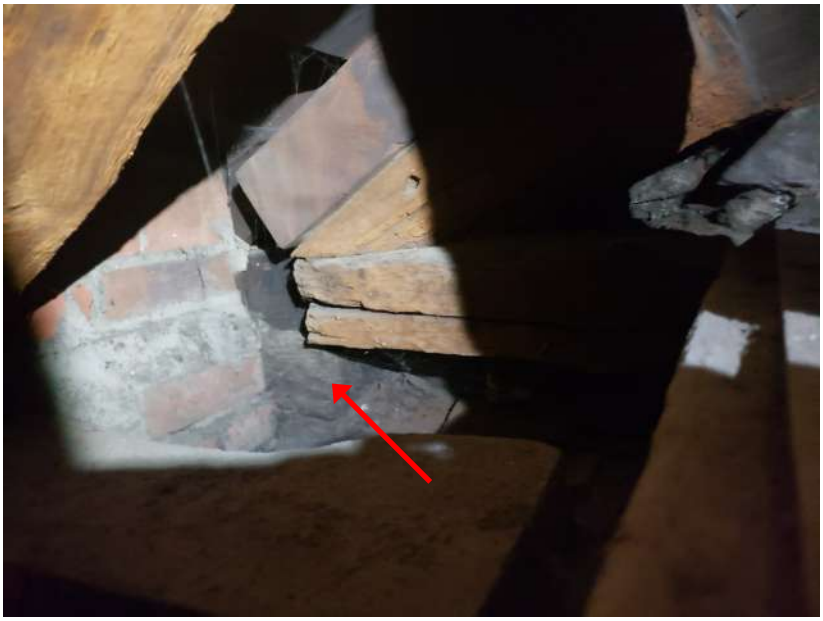

Fig 41:

St Andrew's Hall, Nave; showing a docked structural element, possibly a hammer beam on the south side of bay 1. Condition and quality of subsequent structural elements could only be partially inspected due to limited access. The use and quality of any mechanical fixings could not be ascertained at the time of survey

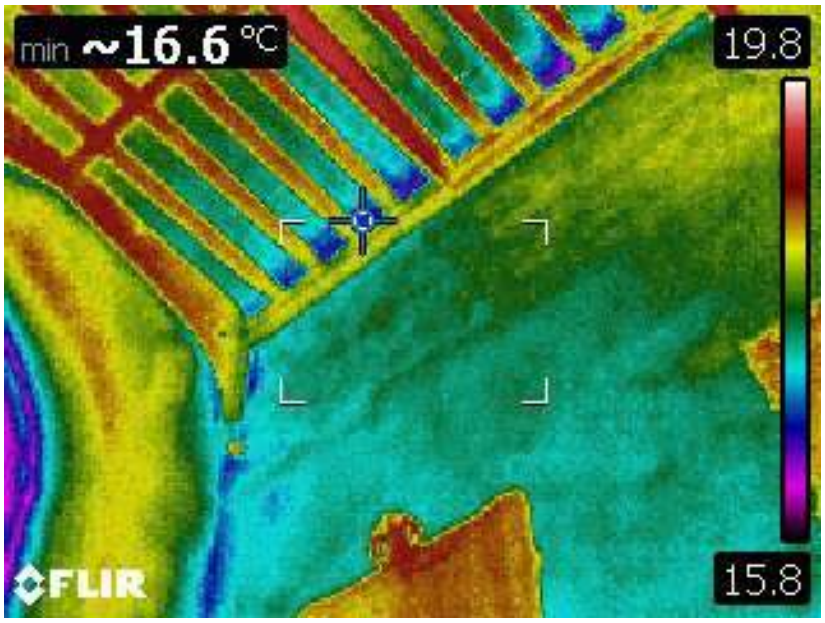

Fig 42:

St Andrew's, north aisle, west end; showing thermal image and slight indications of temperature differential at roof level, although no direct evidence of water penetration in this location

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Fig 43:

St Andrew's, north aisle; showing thermal image and no suggestion of ongoing issues with water penetration that would result in temperature differential in masonry masses at high level

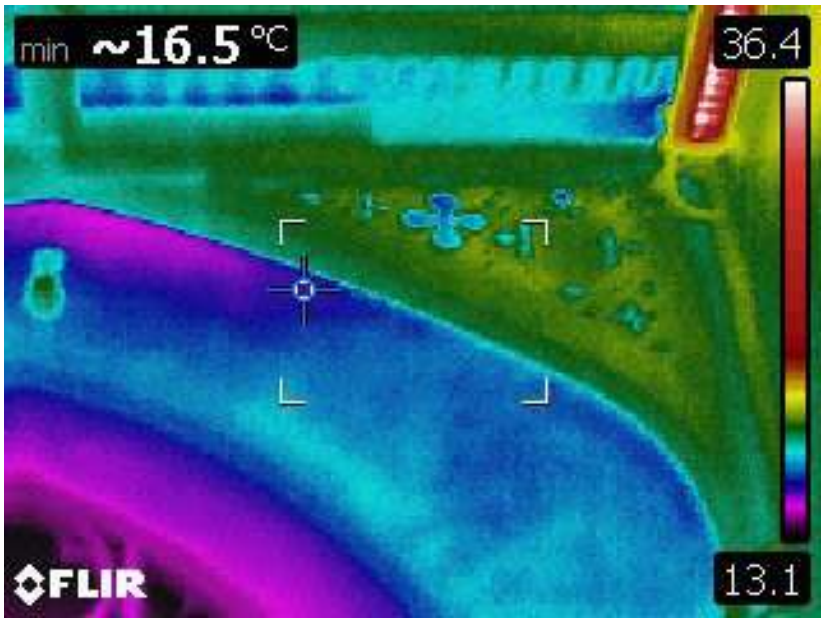

Fig 44:

St Andrew's, north aisle, east end; showing thermal image at extreme east end. Temperature differential well within 'normal' parameters

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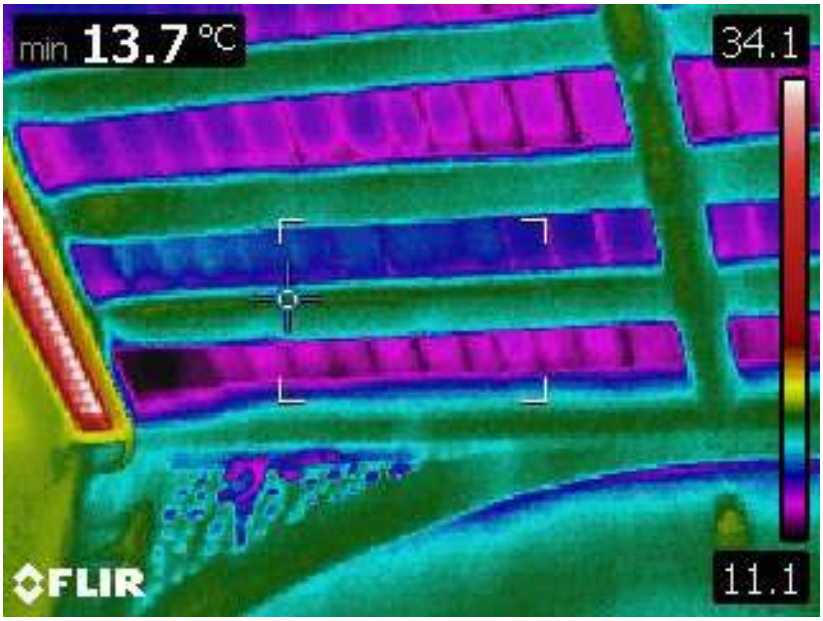

Fig 45:

St Andrew's, south aisle, east end; showing location of previously recorded suspicions of dry rot (*Serpula lacrymans*). Thermal imagery did not indicate issues with water penetration despite defects noted to roof finishes above

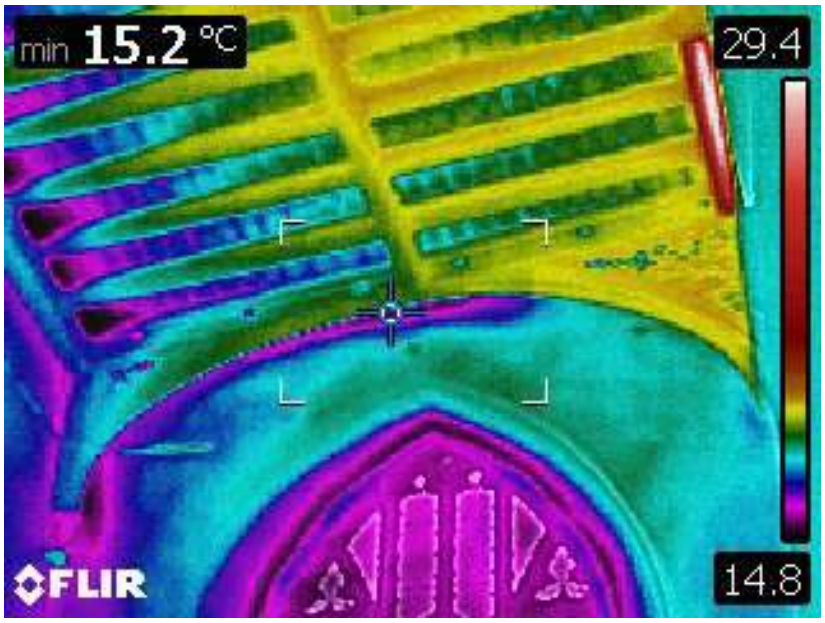

Fig 46:

St Andrew's, south aisle, east end; showing location of previously recorded suspicions of dry rot (*Serpula lacrymans*). Thermal imagery did not indicate issues with water penetration despite defects noted to roof finishes above

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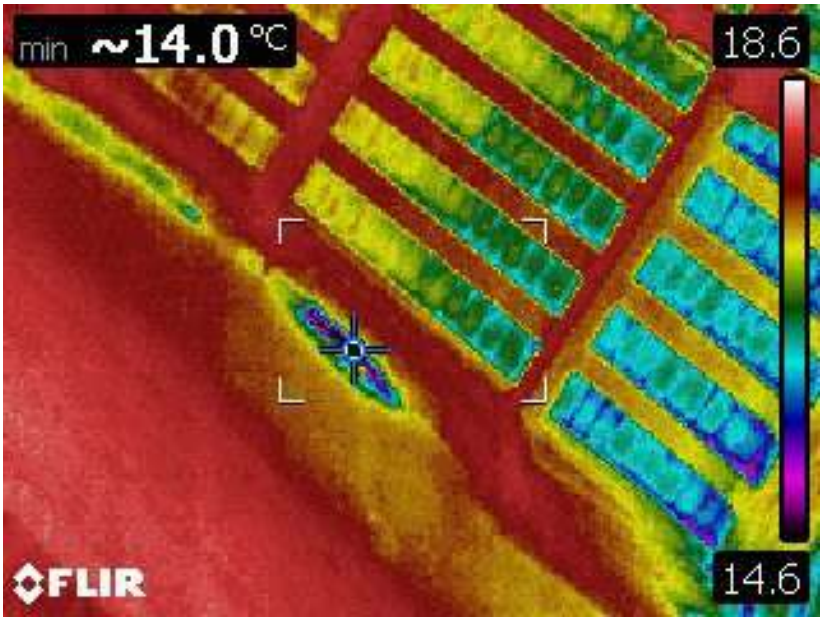

Fig 47:

Nave, east end, showing thermal image of area of potential dampness directly above organ. No evidence of water penetration on coverings below, and patch may be a result of hygroscopic salt efflorescence from historic water penetration causing plaster to fail locally

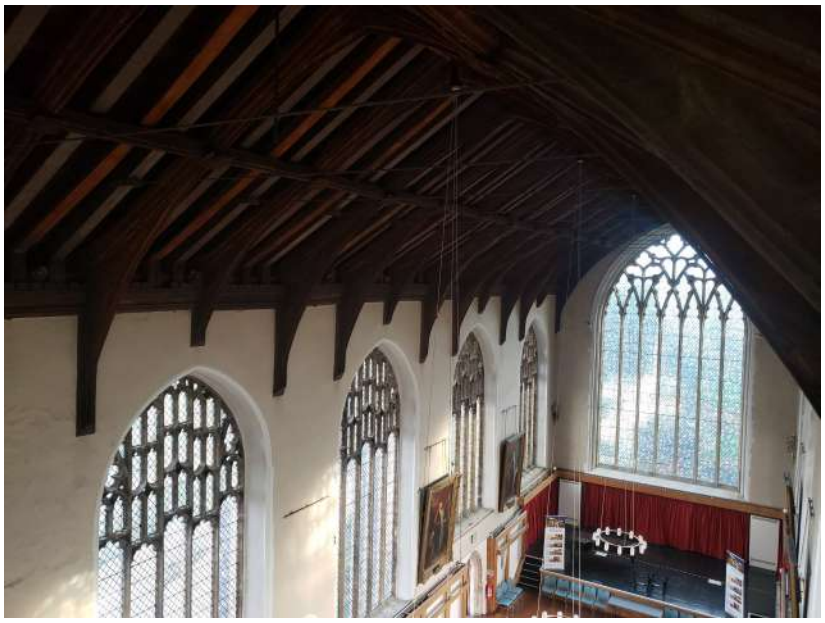

Fig 48:

Blackfriars' hall, bay 1; showing the general condition and structural arrangement of the roof structure, looking east

Fig 49:

Blackfriars', bay 1; showing the general condition and structural arrangement of truss no. 1, which was abutted against the west internal gable wall. Historic moisture staining to the wall was identified, however drill probing and investigations of the condition of the timber indicated only minor decay to structural elements at the time of survey. Moisture readings where below the threshold for the onset and growth of biological decay organisms

Fig 50:

Blackfriars', bay 1; showing what appeared to be replacement sections of boarding within the cavity between the brace, principal rafter and truss post on the south side. These were seen to be of contemporary origin due to the mechanised conversion marks on their surface

Fig 51:

Blackfriars', bay 1; showing the presence of contemporary cementitious material atop the wall head, encapsulating the feet of rafter elements on the south side. This contemporary addition was noted on both sides of the hall throughout it's length. The presence of cementitious materials would likely trap moisture in close proximity or contact with vulnerable timber elements, as well as hinder the ability for repairs to take place

Fig 52:

Blackfriars', bay 1; showing the further condition and structural arrangement of common rafters at this location. Note the ashlars had been secured at their top mitred butt joints to timber common rafters using metal mechanical fixings

Fig 53:

Blackfriars', bay 1; showing the presence of a contemporary softwood timber batten positioned atop packers, on the upper face of a common rafter. This had been used to fractionally raise the height of the roof so that it was in line with the contemporary steel common rafters. This detail was seen throughout the entire roof structure

Fig 54:

Blackfriars', bay 1; showing a contemporary common rafter that was formed of a steel 'I'-beam and the metalwork connecting it to the adjacent historic principal rafter and purlin. Again this detail was seen throughout the roof structure

Fig 55:

Blackfriars', bay 1; showing the connection detail at the apex between two contemporary steel common rafters

Fig 56:

Blackfriars', bay 1; showing the connection detail at the apex between two historic common rafters. Note the surface corrosion to the ferrous metal strap suggests that their were fluctuating levels of high humidity within the hall

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Fig 57:

Blackfriars', bay 3; showing the general condition and arrangement of structural roof members on the north side. Note the use of softwood sarking board, likely installed during recent refurbishment works

Fig 58:

Blackfriars', bay 3; showing the presence of contemporary resinous 'fillers' being used on structural elements. The use of these could prevent the evaporation of trapped moisture, increasing the likelihood of the onset and growth of biological decay organisms. The use of such materials was also deemed to be detrimental to the historic aesthetic of the hall, as well as contravening further principles of building conservation

Fig 59:

Blackfriars', bay 3; showing partial separation of the moulded cornice/ inner plate on the north side. This was not deemed to be critical. Also note the presence of frass beneath the joint, moisture readings taken at the time of survey indicated levels were below the threshold for the onset and growth of biological decay organisms

Fig 60:

Blackfriars', bay 3; showing the use of ferrous metal fixings to secure the moulded cornice/plate to the masonry on the south side. The chronology of the fixing could not be ascertained however it's condition was deemed to possibly indicate it was of a similar age to the original roof structure

Fig 61:

Blackfriars', bay 3; showing the east end of the moulded cornice/plate on the south side, which was found to be partially decayed due to 'wet' rot and Death watch beetle (*Xestobium rufovillosum*). Moisture readings were below the threshold for the onset and growth of biological decay organisms, indicating that the decay was likely historic and no longer active

Fig 62:

Blackfriars', bay 3; showing the further use of a cementitious materials as a 'filler' between the historic timber truss post and the internal face of the masonry, on the south side. The use of such materials could prevent the evaporation of any trapped moisture, accelerating the onset and growth of biological decay organisms that would lead to decay of the structural timber component

Fig 63:

Blackfriars', bay 6; showing the arrangement of historic and contemporary common rafters, this arrangement was typical throughout the roof structure

Fig 64:

Blackfriars', bay 6; showing the presence of contemporary roofing felt visible between contemporary sarking board elements on the north side. This further indicated recent refurbishment works had taken place

Fig 65:

Blackfriars', bay 6; showing the presence of historic superficial 'wet' rot decay to the sapwood on the historic structural elements on the north side, as well as the use of poorly applied and unsuitable contemporary resinous 'filler' materials

Fig 66:

Blackfriars', bay 6; showing the further use of improper resinous 'filler' materials throughout the roof structure. These were deemed to be detrimental to the historic aesthetic, as well as increase the likelihood of moisture becoming trapped in contact with structural timber elements, accelerating the onset of biological decay organisms

Fig 67:

Blackfriars', bay 6; showing the interface between the bottom of the moulded cornice/inner plate element and the internal masonry on the south side. Note the plate was not embedded into the masonry, however the internal plaster and paintwork was built-up above the timber by a matter of millimetres. This had likely prevented historic moisture build-up from escaping and led to the instance of minor decay to the timber at the point of contact with the masonry

Fig 68:

Blackfriars', bay 6; showing the presence of hardwood boarding covering the aperture formed between the principal rafter, truss post and brace, on the south side. This suggested that this had been a feature of the roof structure prior to the recent refurbishment works, where modern timber boarding had been used in certain areas

Fig 69:

Blackfriars', bay 9; showing the west end of the moulded cornice/inner plate that had been historically affected by both 'wet' rot decay and wood boring beetle, on the north side. The element was deemed to possibly be at risk of failure due to it's contact with a decayed truss post

Fig 70:

Blackfriars', bay 9; showing the top of the north truss post of truss no. 9. The post had been structurally decayed by 'wet' rot that continued down its length for ~800mm

Fig 71:

Blackfriars', bay 9; showing the top of the north truss post of truss no. 10. The post had been structurally decayed by 'wet' rot that continued down its length for ~1m. This decay was likely affecting the integrity of the metal strapping and mechanical fixings

Fig 72:

Blackfriars', bay 9; showing the east end of the moulded cornice/inner plate on the south side. Note previous patch repairs had taken place where damage/decay had historically occurred

Fig 73:

Blackfriars', bay 9; showing the continued, excessive use of cementitious material atop the wall head on the south side of the bay, as well a significant build-up of dust at eaves level and on structural elements. This could present a health hazard to occupants of the hall

Fig 74:

Blackfriars', bay 12; showing the approximate location of partial decay to the top end of the post of truss no. 13, on the north side. Moisture readings were below the threshold for the onset and growth of biological decay organisms at the time of survey

Fig 75:

Blackfriars', bay 12; showing the approximate location of a timber element behind the truss post of truss no. 13 on the north side. The additional timber element could likely be an outer plate. Upon decay detection drilling the outer plate was found to be likely partially decayed due to the density of the timber and the amount of resistance displayed by the drill

Fig 76:

Blackfriars', bay 12; showing the north side of truss no. 13. The truss post was found to be decayed from the top down for ~630mm. The severity of the decay was deemed to be on the threshold between partial and structural. Moisture readings were below the threshold for the onset and growth of biological decay organisms at the time of survey

Fig 77:

Blackfriars', bay 12; showing minor transverse cracking to west end of moulded cornice, on south side of bay 12

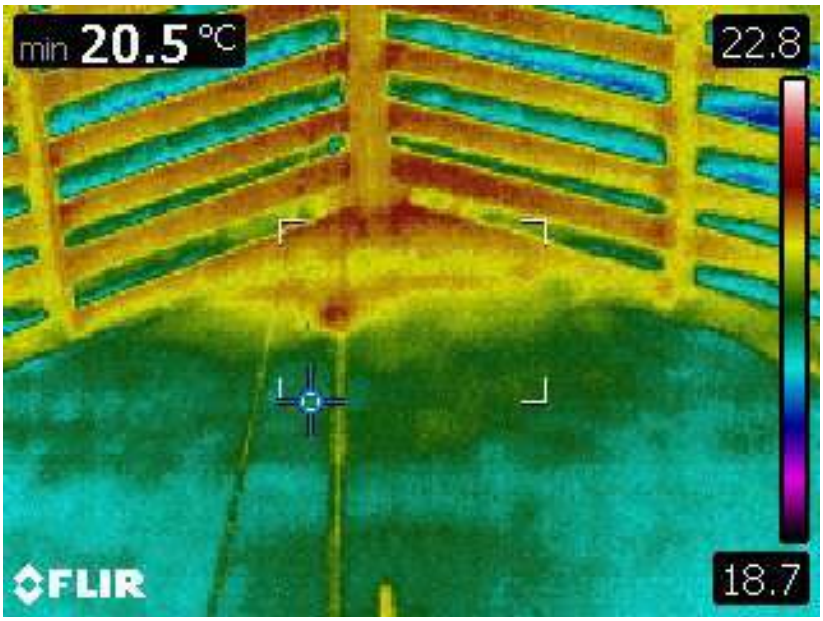

Fig 78:

Blackfriars', West gable end; showing slight temperature differential at high level, although no evidence of issues with water penetration

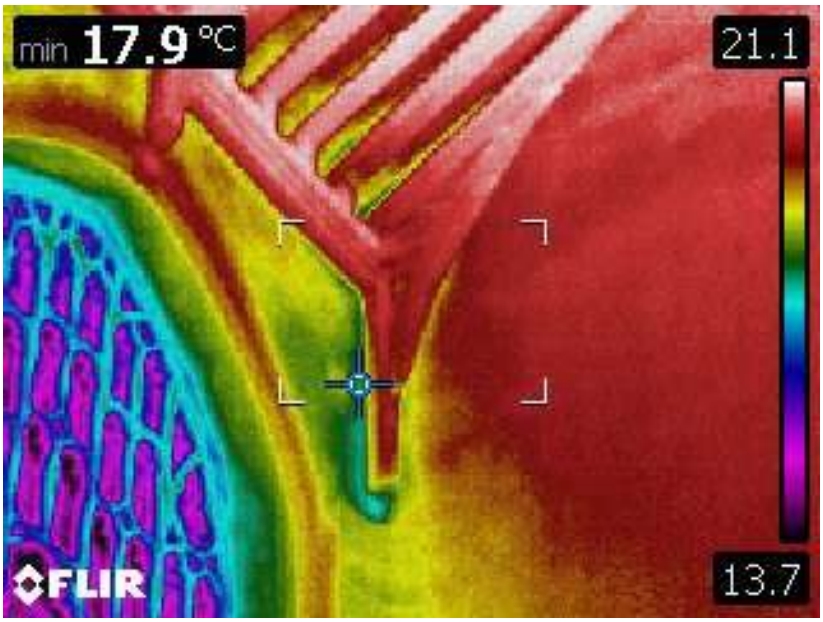

Fig 79:

Blackfriars', South-west corner; showing thermal image and temperature differential well within 'normal' parameters

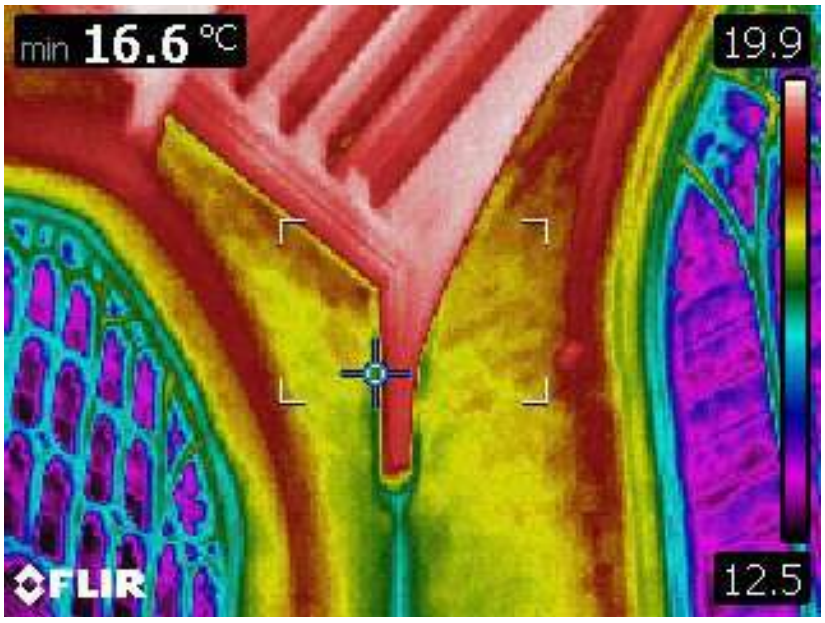

Fig 80:

Blackfriars', North-east corner; showing thermal image and temperature differential well within 'normal' parameters

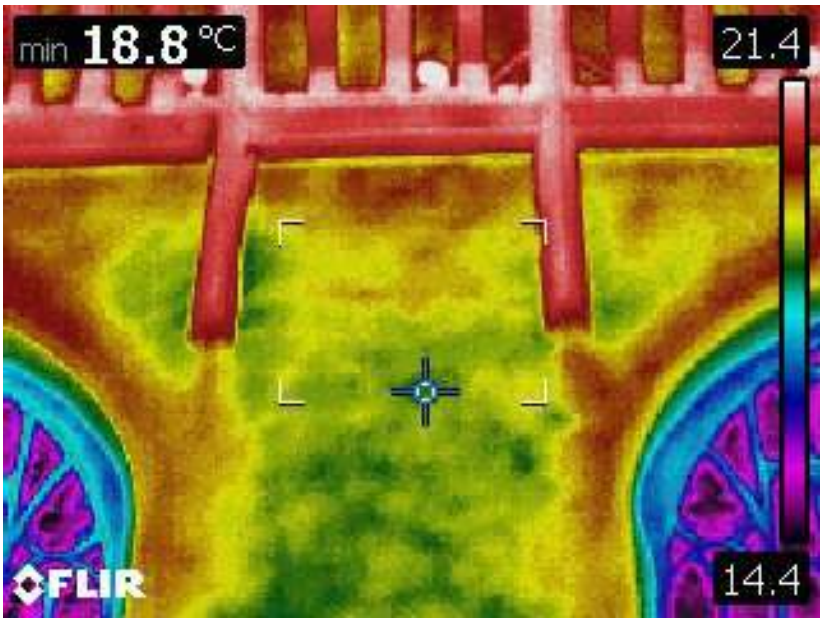

Fig 81:

Blackfriars', Central elevation, north side; showing slight temperature differential suggesting increased levels of moisture within masonry masses

Fig 82:

Central roof structure over organ loft; showing general view of south pitched roof

Fig 83:

Central roof structure over organ loft; showing water-staining and hygroscopic salt efflorescence on timbers and masonry directly over head of spiral stairway. No structural decay to timbers detected at roof leel, and moisture content readings too low for decay to occur

Fig 84:

Central roof structure over organ loft; showing section of decayed embedded timber at landing of stone spiral stairway

Fig 83:

Central roof structure over organ loft; showing localised wood-boring beetle decay to embedded timber. Moisture content readings at surface below decy threshold, although deep moisture content at level high enough to sustain wood-boring beetle activity and fungal decay

Fig 84:

Central roof structure over organ loft; showing rafters embedded into masonry at south side. Plate section also fully embedded although no decay detected, and moisture content readings below decay threshols

Fig 85:

Central roof structure over organ loft; showing purlin embedded into masonry to east. No decay detected to purlin bearing end, although elevated moisture content readings of timber pad below suggest issues with penetrating dampness through gable wall

Fig 86:

Central roof structure over organ loft; showing upper purlin embedded into masonry. No safe access for inspection although elevated moisture content readings throughout area suggest issues with dampness penetrating masonry wall to east side

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Fig 87:

Central roof structure over organ loft; showing extreme north-east corner and extent of staining

Fig 88:

Central roof structure over organ loft; showing moisture content readings from timber pad below lower purlin on south pitch at over the decay threshold of ~20 per cent w/w

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Fig 89:

Central roof structure over organ loft; showing iron strengthening in south-east corner, likely implemented due to decay of historic embedded timbers

Fig 90:

Central roof structure over organ loft; showing small openings in relatively modern brick infill between rafter feet, allowing inspection (drilling and probing) of the timber plate. Decay detected at the time of survey

Fig 91:

Central roof structure over organ loft; showing conversion markings on undersides of rafters consistent with mechanised circular saw suggesting late 19th onwards manufacture

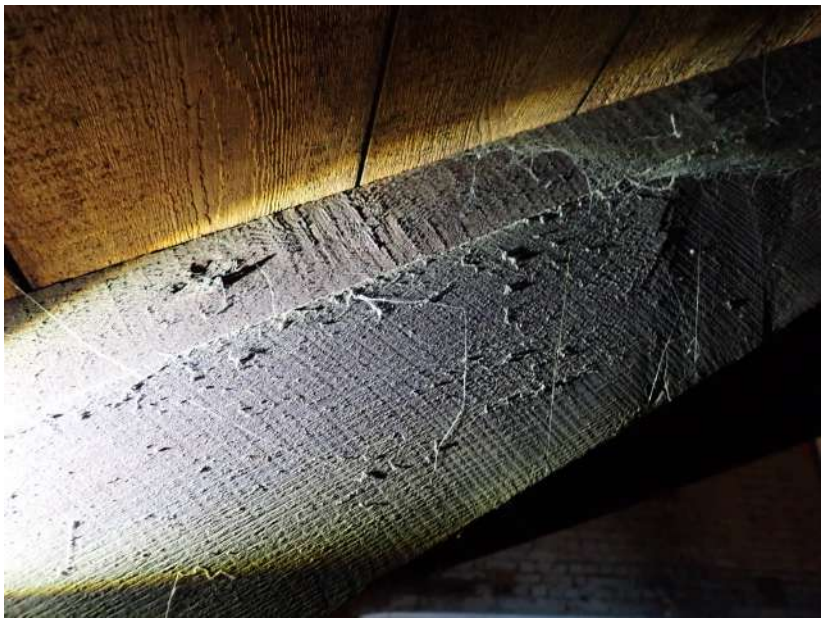


Fig 92:

Central roof structure over organ loft; showing conversion markings on face of rafters consistent with mechanised circular saw and bandsaw markings on additional timber over, suggesting late 19th onwards manufacture

Fig 93:

Drone image; showing roof defects at east end of south aisle. No evidence of recent water penetration internally; however, historic water-staining indicated this area was vulnerable. It was unclear at the time of survey the cause of the discolouration, although likely connected to access provisions

Fig 94:

Drone image; showing exposed gable wall of roof structure between St Andrew's and Blackfriars Halls. Cementitious render likely to be retaining moisture within masonry masses, raising moisture content readings of timbers embedded

Fig 95:

Drone image; showing further cementitious render to exposed gable masonry between the two halls. Noticeable cracking to the north side

Fig 96:

Drone image; showing gutter blockage at south-east corner of Blackfriars roof, likely resulting in chronic overcharging and saturation of masonry below

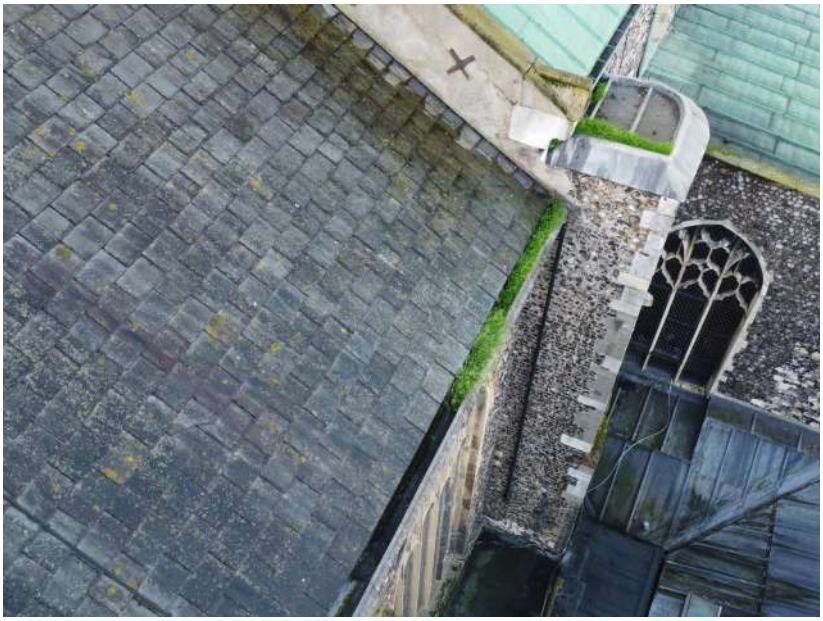


Fig 97:

Drone image; showing significant blockage of rainwater guttering at west end of north side of Blackfriars Hall, again, likely saturating masonry below during periods of heavy rain

Fig 98:

Drone image; showing again blockage of rainwater goods at west end of north pitch of Blackfriars Hall. Also note significant plant growth on head of spiral stone stairway section indicating inadequate drainage in this lcoation

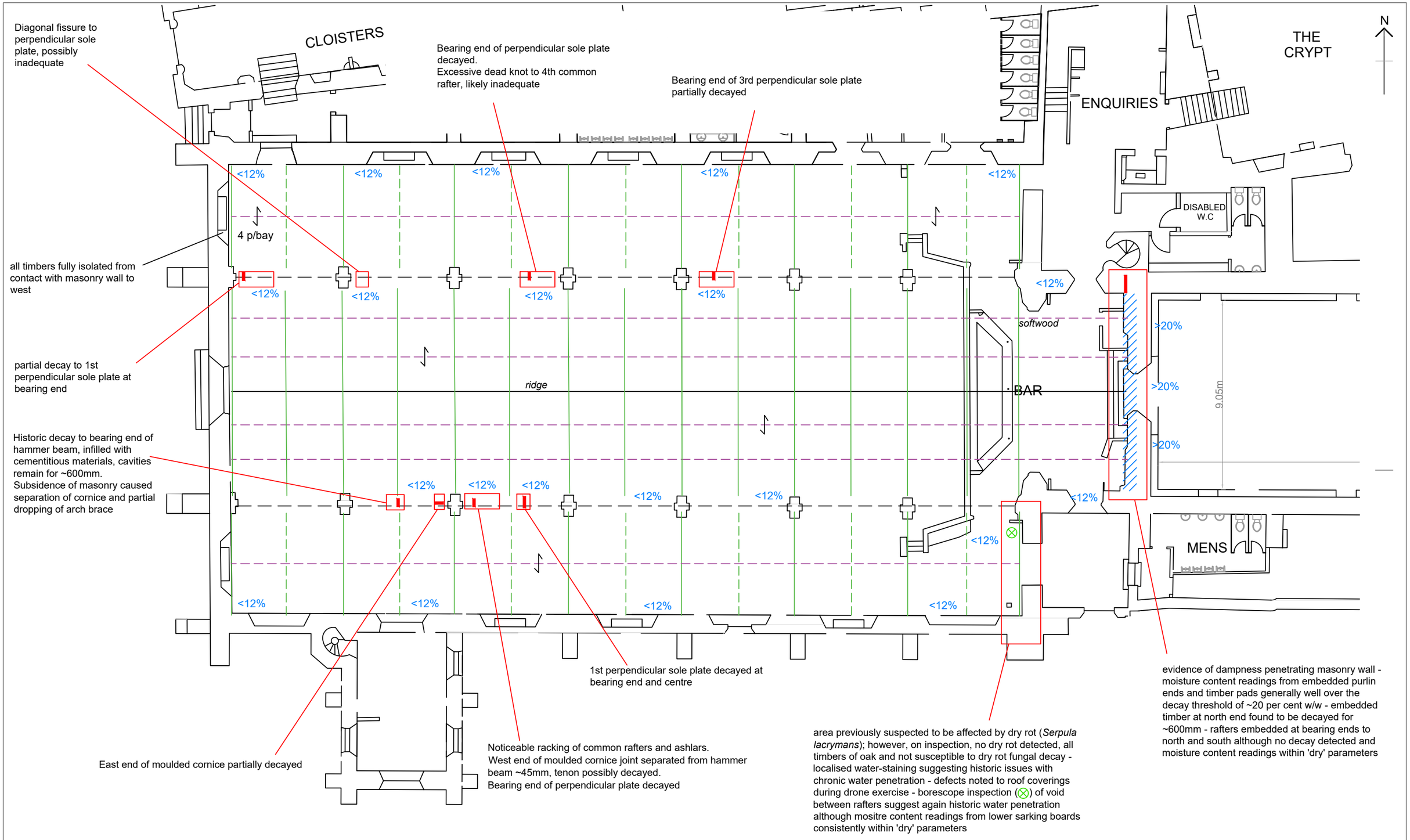
Fig 99:

Drone image; showing slipped slate on north pitch of Blackfriars Hall, likely reducing drainage capabilities of guttering. Also note clear algal/ biological growth centrally of roof coinciding with location of temperature differential internally noted during thermography

Fig 100:

Drone image; showing closer view of slipped slate and localised exposure of roof to direct water ingress

Appendix D



St Andrew's and Blackfriars' Hall - St Andrew's plan view

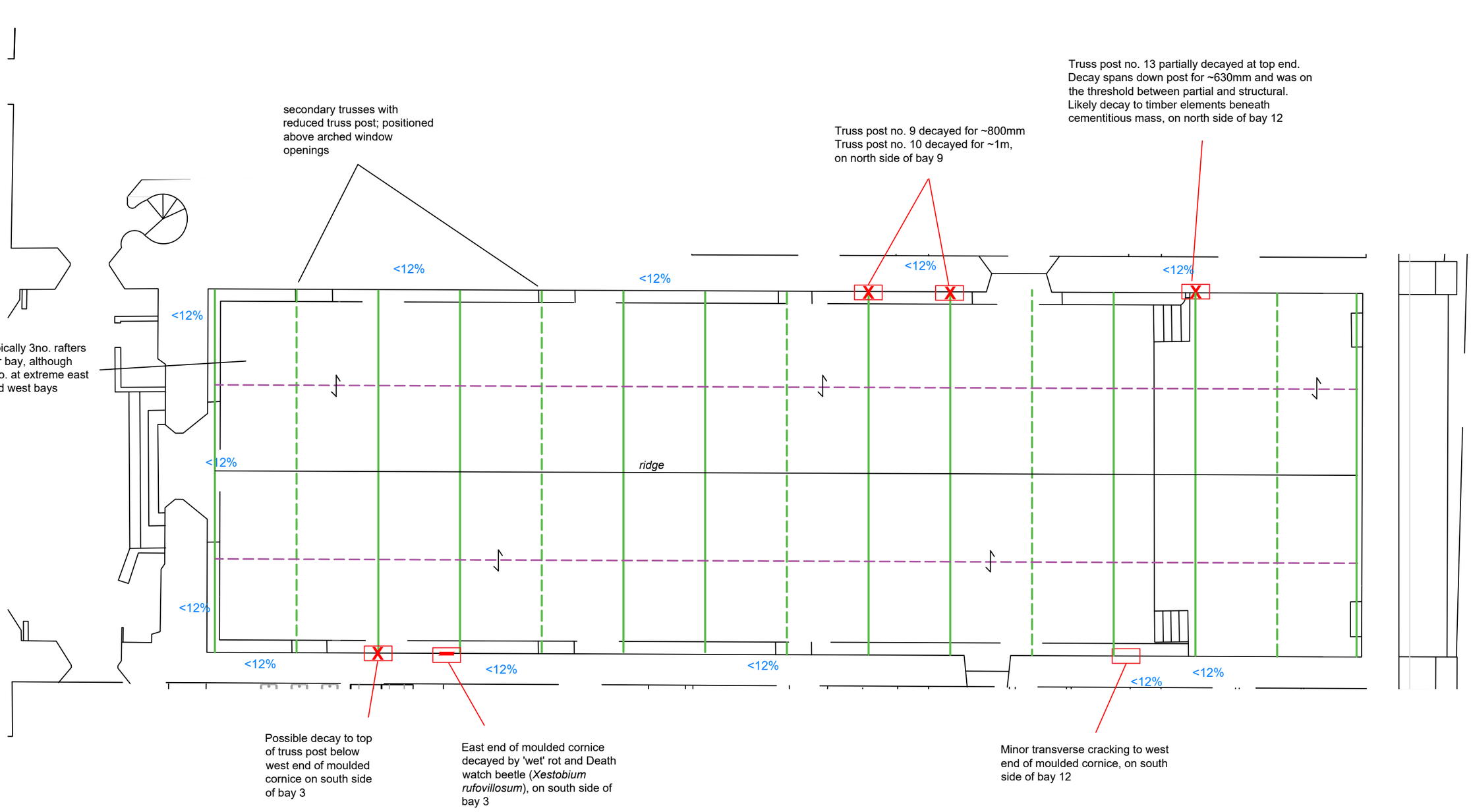
Condition investigation of timber roof structures

22-24 November 2022

Hutton + Rostron Environmental Investigations Ltd
Netley House, Gomshall, Surrey, GU5 9QA Tel: 01483 203221

Key:

- X — Decayed bearing end of timber element
- Area subject to water penetration
- <10% — Deep moisture content reading (w/w%)
- Rafter direction
- Primary timber truss
- Secondary timber element
- Purlin
- Area of concern

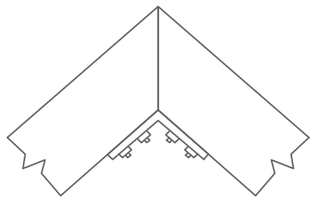


St Andrew's and Blackfriars' Hall - Blackfriars' plan view
Condition investigation of timber roof structures
22-24 November 2022

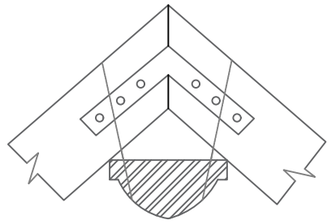
Hutton + Rostron Environmental Investigations Ltd
Netley House, Gomshall, Surrey, GU5 9QA Tel: 01483 203221
157-54 Report -Not to scale-

Key:
- X — Decayed bearing end of timber element
- Area subject to water penetration
- <10% — Deep moisture content reading (w/w%)
- Rafter direction
- Primary timber truss
- Secondary timber element
- Purlin
- Area of concern

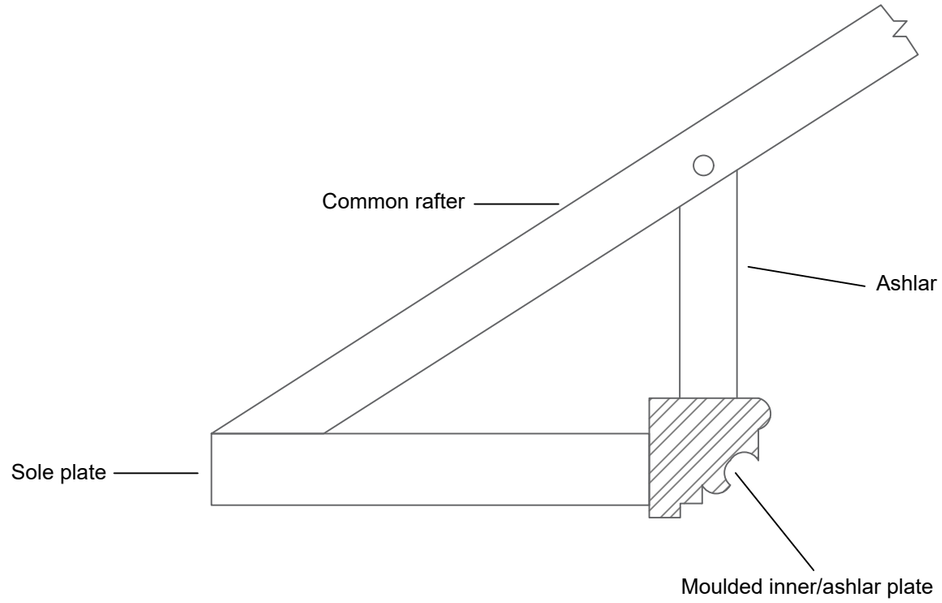
Blackfriars' Hall:
Apex joint of timber common rafters



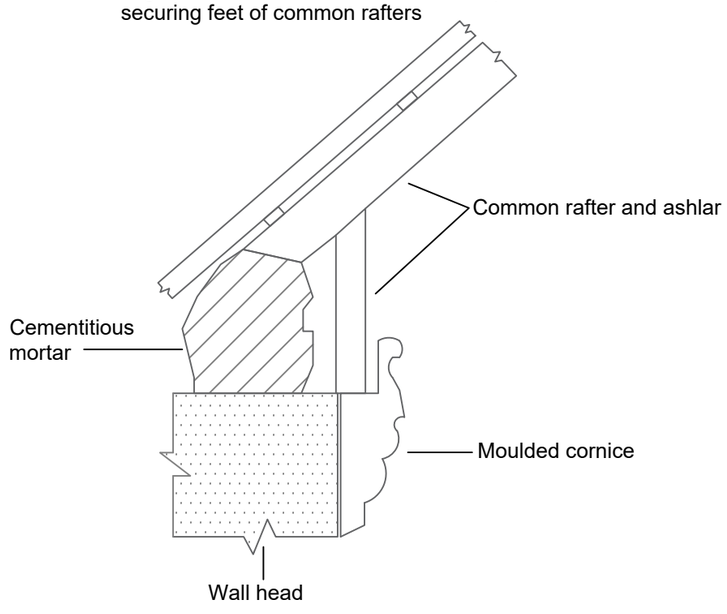
Blackfriars' Hall:
Apex joint of Steel 'I-beam' common rafters. Note coach bolts securing common rafters to the ridge beam



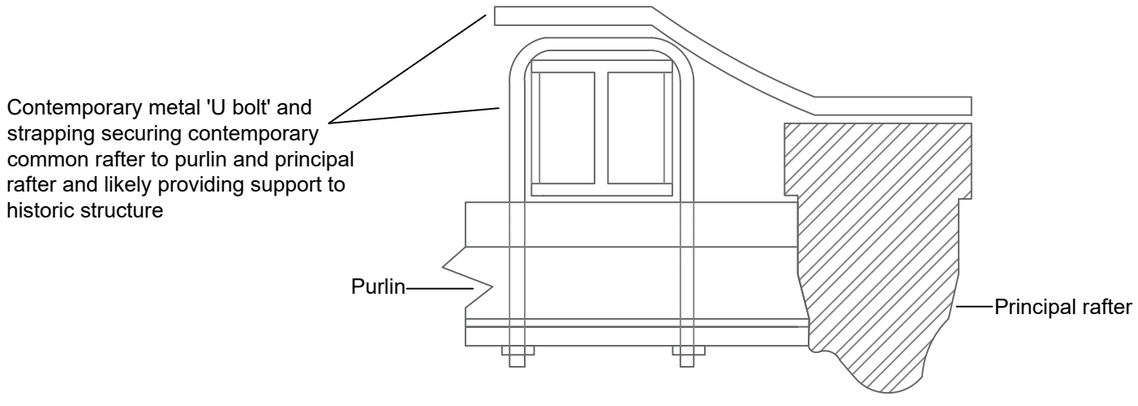
St Andrew's Hall:
Showing a cross sectional detail of the eaves



Blackfriars' Hall:
Cross-sectional detail of the eaves. Note the presence of a large amount of cementitous mortar atop the wall head, securing feet of common rafters



Blackfriars' Hall:
Showing a cross section detail of the historic principal rafter and adjoining purlin, with the contemporary common rafter and metal work



Key:

St Andrew's and Blackfriars' Hall - structural detailing
Condition investigation of timber roof structures
22-24 November 2022

Hutton + Rostron Environmental Investigations Ltd
Netley House, Gomshall, Surrey, GU5 9QA Tel: 01483 203221
157-54 Report -Not to scale-

ROCHE