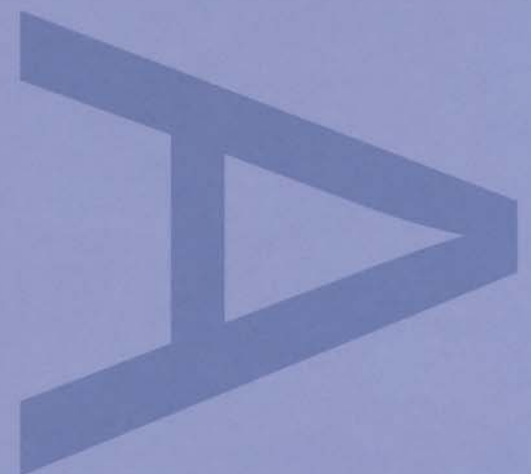
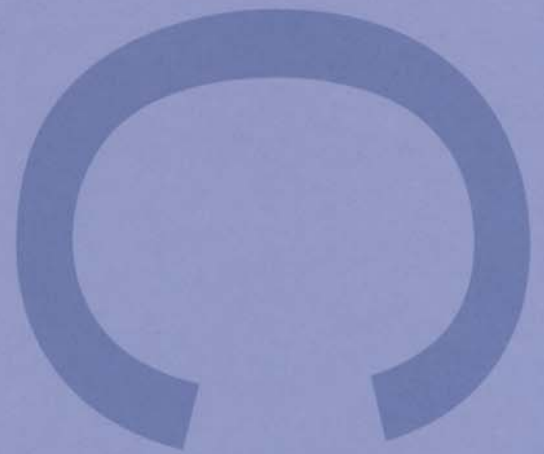
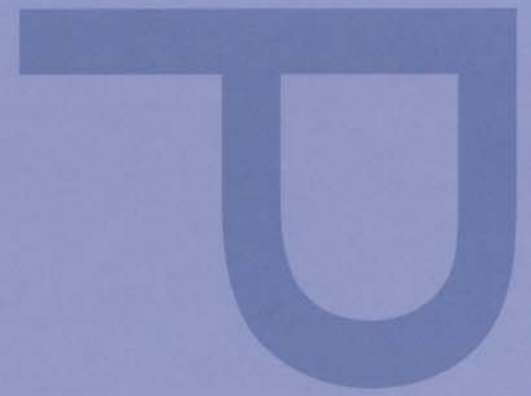


**AN ARCHAEOLOGICAL EXCAVATION AT  
SANDS ROAD, SWALWELL,  
GATESHEAD, TYNE AND WEAR**

**Post-Excavation Assessment Report**



**PRE-CONSTRUCT ARCHAEOLOGY**

**An Archaeological Excavation at Sands Road, Swalwell, Gateshead,  
Tyne and Wear**

**Central National Grid Reference: NZ 2020 6225**

**Site Code: SRS 05**

**Commissioning Client:**

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March 2007**

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***PART A: PROJECT SUMMARY***

## 1. NON-TECHNICAL SUMMARY

- 1.1 An archaeological excavation was undertaken by Pre-Construct Archaeology Limited at Sands Road, Swalwell, Gateshead, Tyne and Wear. The central National Grid Reference for the site is NZ 2020 6225. The project was commissioned by Lidl UK GmbH, ahead of the construction of a new retail outlet, following closure and demolition of a cement works. The archaeological fieldwork was undertaken between July 5th and August 19th 2005.
- 1.2 At the time of the archaeological project, the former cement works site was a parcel of land covering c. 7,800 square metres, off Sands Road on the north side of the village of Swalwell, lying south of the River Tyne and east of the River Derwent. It is bounded by Front Street/Hexham Road to the south, Sands Road to the north and east and an access road to the west.
- 1.3 An earlier desk-based assessment concluded that the site had particularly good potential for industrial archaeology. Cartographic evidence demonstrated that the site was formally occupied by Sir Ambrose Crowley's Ironworks. A pioneer in the late 17th century Black Country steelmaking industry, Crowley transferred his large-scale manufactory to Sunderland in 1683, moving his operations to Winlaton in 1690 and then buying out the operations of a rival partnership at Swalwell by 1707. Crowley's Ironworks at Swalwell became one of the largest and most important such works in Britain in the 18th century, the majority of its activity being concerned with finishing iron goods such as nails, anchors, salt pans and hoes, rather than primary production of iron or steel. An artificial watercourse, the Derwent Gut, served the ironworks and joined the River Derwent north of the village of Swalwell. The watercourse still runs through the site, now largely culverted. By the second half of the 19th century, the Swalwell works were in use as an engineering company and, by c. 1890, the site was occupied by the Northumberland Paper Mills.
- 1.4 Following on from the desk-based research, a phased programme of archaeological investigations was conducted at the site. The initial fieldwork comprised a trial trenching evaluation and standing building recording, undertaken in February-March 2005 by Pre-Construct Archaeology Limited. The building recording provided an archive record of early structural elements in standing buildings. The evaluation comprised three trial trenches, sited to test for buildings, structures and features associated with earlier phases of occupation of the site. In summary, the evaluation identified the presence of significant archaeological remains of the industrial era, including structural remains in the southern part of the site that were interpreted as part of a building annotated as the '*Grand Warehouse*' on a 1718 map of Crowley's Ironworks.
- 1.5 Accordingly, open area archaeological excavation was required across part of the proposed development footprint in order to record fully sub-surface remains ahead of the construction programme. The excavation area was rectangular in shape, with maximum dimensions of 31m NW-SE x 24m NE-SW. Archaeological remains across the remainder of the site were preserved *in situ*, since the construction programme required ground levels to be raised to create a car park.

- 1.6 The excavation recorded significant structural remains relating to 18th-20th century industrial usage of the site. The full extent of a building, shown on the 1718 map as a '*wharf building*' and on a map from 1870 as an '*iron warehouse*', with cartographic evidence indicating that it was still extant as recently as the 1960s, was exposed within the excavation area. The external dimensions of the brick-built Wharf Building were 25.60m NW-SE by 6.30m wide. The latest surviving internal floor was of concrete, but investigative trenches excavated through this floor at each end of the building revealed cobbled surfaces and layers of cemented iron slag, probably representing successive floor levels associated with late 18th-early 19th century usage. The sandstone foundations of the building were exposed in the trench at the southern end of the structure.
- 1.7 To the north and east of the Wharf Building, the southern edge of a former water channel, annotated on the 1718 map as a '*corn mill race*', was exposed, associated with a section of retaining wall some 13.50m in length. The Retaining Wall had been subject to considerable rebuilding and repair, with a wide range of materials having been utilised, including several substantial grinding stones, presumably derived from the ironworks. Cartographic evidence indicates that the Retaining Wall and this part of the watercourse survived up to the 1960s.
- 1.8 To the west of the Wharf Building, the eastern side of an inlet from the watercourse was exposed. This feature is labelled '*Pool A*' on the 1718 map, where it is annotated '*The pool for Boats or Keels to come into*' and is labelled as '*Water Course*' on the 1870 map. Three wide openings in the west wall of the Wharf Building would have functioned as loading bays, allowing goods to be loaded and unloaded from keels on the watercourse inlet. The bays were infilled with bricks, with several structural phases demonstrating a gradual narrowing and heightening of the entranceways. Cartographic evidence suggests that the inlet was infilled some time between 1897 and 1919, and disuse of the loading bays presumably dates to the same period.
- 1.9 To the east of the Wharf Building was a brick and sandstone structure which measured 16.40m NW-SE by 7.50m NE-SW. Its south-eastern wall was of similar construction to the Wharf Building and it was probably derived from the 18th century ironworks, although the remaining walls were of later date, probably mid to late 19th century. The 1718 map shows a rectangular building in this location annotated as '*Half Forge*' and this also appears on a map from 1802. The 1870 plan of the ironworks shows a similar layout to the excavated remains, with a building narrower at its northern end. This Forge Building was still extant until 1919, and was demolished sometime between this date and the 1960s.



- 1.10 Within the Forge Building were the remains of a furnace, probably the chimney end of a puddling furnace, as invented by Peter Onions and patented by Henry Cort in 1783-4 in order to create wrought iron from pig iron produced in a blast furnace. The remains of the chimney comprised a main outer skin of bricks with several inner brick skins representing repairs to the structure over time. As with the building within which it was situated, the Furnace Chimney was located in a similar position to a furnace shown on the 1718 map, but the structure recorded probably dates to the mid to late 19th century. Although the Forge Building was demolished some time between 1919 and 1960, the chimney was still extant on the Ordnance Survey map of 1960, although the precise date of demolition is not known.
- 1.11 Several cemented slag deposits were located in a corridor between the Wharf Building and Half Forge Building, these likely to represent external surfaces constructed with debris from the ironworks. Cartographic evidence shows that this area was an open space from at least the time of the 1718 map, where it is annotated as '*a passage between Wharf B and the ½ forge*', until at least the 1960s. Within this corridor a capped well was recorded, comprising a square structure with brick and sandstone walls and a sandstone slab capping.
- 1.12 The artefactual material recovered from the excavation included a brick assemblage dominated by firebricks, with four maker's stamps identified. The dates of operation of the named makers spanned 1830-1925, although none of the examples can be confidently dated earlier than 1850. Therefore, this material is likely to derive from building or rebuilding activity between c. 1860 and the early 1900s, including construction and use of the Furnace Chimney within the Forge Building. Hand-moulded bricks used in the construction of the earliest phases of the Wharf and Half Forge Buildings are not closely dateable, and while they are closer in character to brick types of the period c. 1750-1800 in the region, cartographic evidence suggest that these structures were in existence by c. 1718. Several stone samples were collected, including samples taken from the grinding stones reused in the watercourse retaining wall, with geological assessment showing that all stone utilised at the site had been sourced from local exposures.
- 1.13 A range of materials was also submitted for archaeometallurgical assessment, including metal artefacts, slag from the furnace structure, slag from external floor surfaces in the corridor between the Wharf and Forge Buildings, and slag from deposits internal to the Wharf Building. Quantities of fuel ash slag were adhered to the refractory bricks of the Furnace Chimney and metalliferous slag was also recovered, preliminary analysis suggesting that this may have been produced by the 'puddling' process.
- 1.14 In summary, the data recovered from the site warrants publication in an appropriate outlet. The site is certainly of regional significance in terms of industrial archaeology and of local and regional significance in terms of the history and development of Swalwell and of the local and regional brick industry.

- 1.15 This Post-Excavation Assessment Report is divided into three parts (Parts A, B and C). Part A, the Project Summary, begins with an introduction to the site, describing its location, geology and topography, and setting out the planning and archaeological background to the project, and then continues with a full description of the methodologies employed during the investigations. Part A concludes with a section detailing the archaeological remains representing each of the main phases of activity.
- 1.16 Part B, the Data Assessment, quantifies the written, graphic and photographic elements of the project archive and contains specialist assessments of each class of material, with recommendations for further analysis for each category, with discussions of the significance of the project data in local, regional and national terms.
- 1.17 Part C contains the references and acknowledgements. The report has three appendices.

## 2. INTRODUCTION

### 2.1 General Background

- 2.1.1 This report details the results of an archaeological excavation undertaken July 5th-August 19th 2005 by Pre-Construct Archaeology Limited (PCA) at Sands Road, Swalwell, Gateshead, Tyne and Wear. The central National Grid Reference of the site is NZ 2020 6225 (Figure 1). The archaeological investigations were commissioned by Lidl UK GmbH, ahead of construction of a retail outlet at the site.
- 2.1.2 The site lies off Sands Road on the north side of the village of Swalwell, in Gateshead and is bounded by Hexham Road/Front Street to the south, by Sands Road to the north and east and by an access road to the west. Immediately prior to the archaeological excavation, the site was occupied by the premises of Bespoke Concrete Products Limited.
- 2.1.3 The archaeological excavation was preceded by an archaeological desk-based assessment.<sup>1</sup> On the basis of the assessment findings, the Tyne and Wear Archaeology Officer (TWAO), recommended to the Local Planning Authority, Gateshead Metropolitan Borough Council, that a trial trenching evaluation should be undertaken at the site, as well as recording of historic standing buildings. Separate specifications for the trial trenching evaluation and standing building recording were prepared by the TWAO.<sup>2</sup> These pieces of work were undertaken by PCA in February-March 2005.<sup>3</sup> The evaluation identified the presence of significant post-medieval industrial remains in the three trenches investigated, including structural remains probably associated with 18th century ironworks operated by Sir Ambrose Crowley.
- 2.1.4 The TWAO therefore required a final phase of archaeological intervention, comprising an open area excavation within the footprint of the proposed supermarket to record archaeological remains prior to construction and a specification for this work was prepared.<sup>4</sup> The excavation area was rectangular in plan and measured a maximum of 31m NW-SE x 24m NE-SW, covering an area of just over 700 square metres, located in the central southern portion of the site (Figure 2).
- 2.1.5 This Post-Excavation Assessment Report follows English Heritage guidelines set out in '*Management of Archaeological Projects (2<sup>nd</sup> edition)*' (MAP2).<sup>5</sup> The completed project archive, comprising written, drawn, and photographic records and artefacts will be deposited at The Museum of Antiquities, Department of Archaeology, Newcastle University, under the site code SRS 05. The Online Access to the Index of Archaeological Investigations (OASIS) reference number is: preconst1-23887.

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<sup>1</sup> Williams 2004.

<sup>2</sup> NCC 2004a and b.

<sup>3</sup> PCA 2005.

<sup>4</sup> NCC 2005a.

<sup>5</sup> English Heritage 1991.

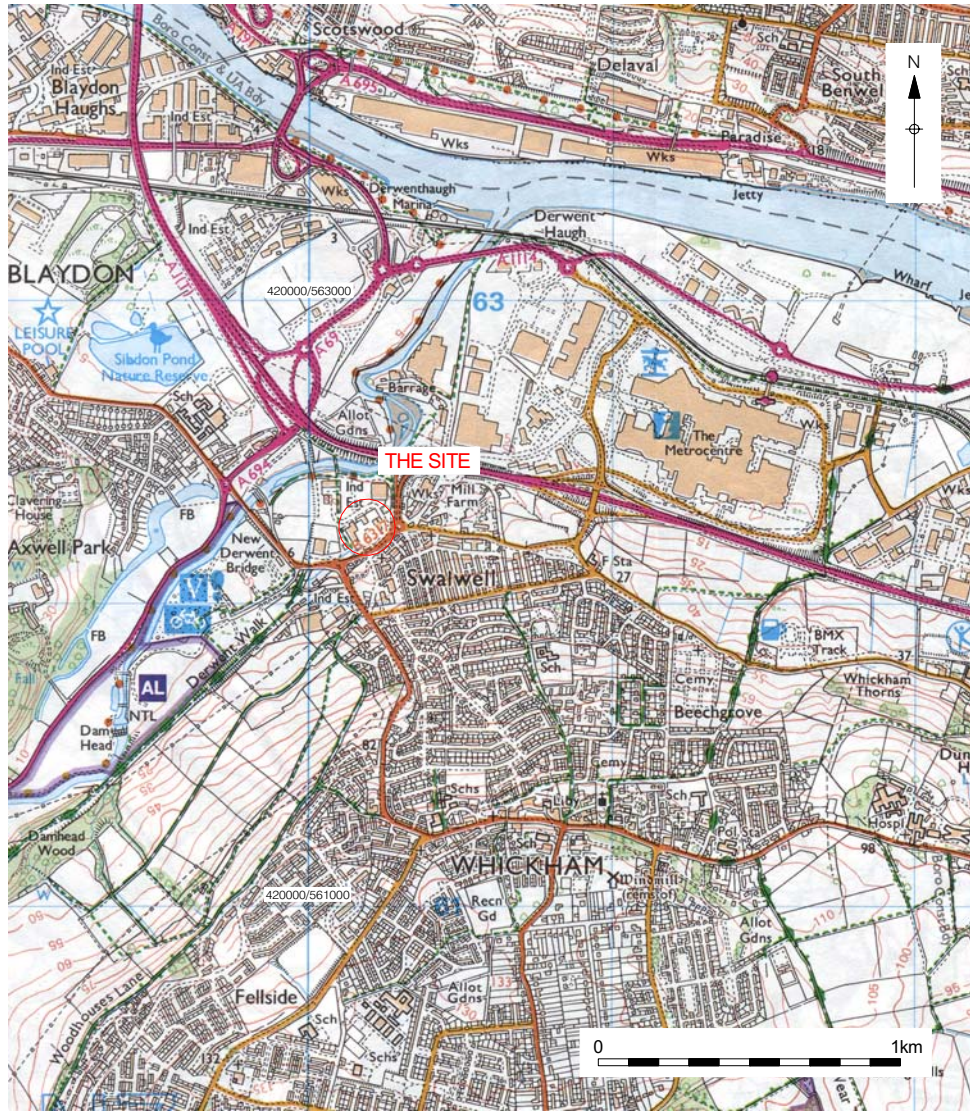


Figure 1. Site location  
Scale 1:25,000

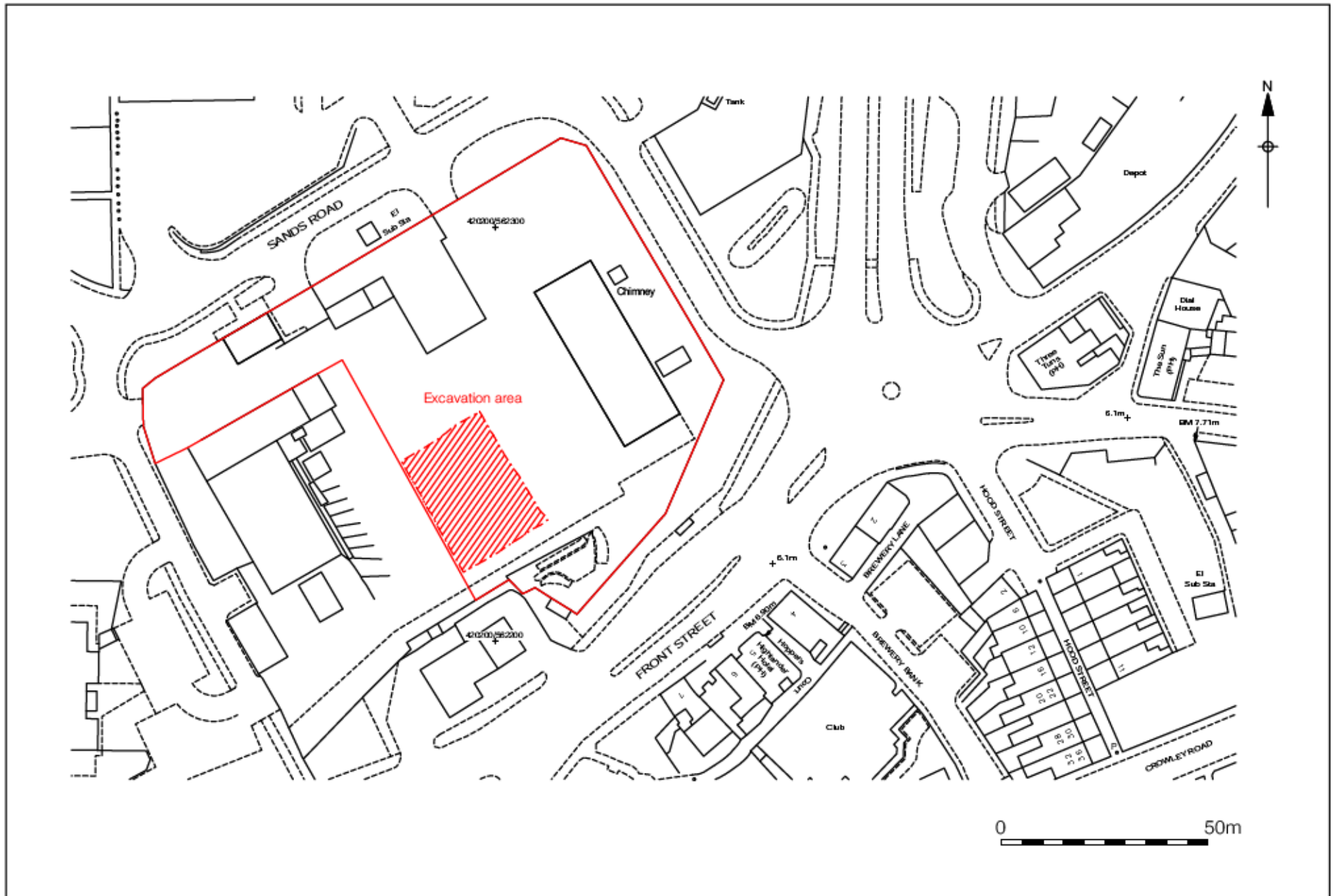


Figure 2. Location of excavation area  
Scale 1:1250

## **2.2 Site Location and Description**

- 2.2.1 The site is located off Sands Road, on the north side of the village of Swalwell, in the Metropolitan Borough of Gateshead, Tyne and Wear. The A1 western bypass skirts the village to the north, with numerous branch roads running from this trunk road into the village. Lying south of the River Tyne and east of the River Derwent, the central National Grid Reference of the site is NZ 2020 6225 (Figure 1).
- 2.2.2 The overall development site was a parcel of land c. 7,800 square metres in size, occupied immediately prior to the work by the premises of a concrete manufactory. Within this plot, open area archaeological excavation was undertaken in a rectangular trench measuring up to 31m NW-SE x 24m NE-SW, with a total surface area of just over 700 square metres. The excavation area was located in the central southern portion of the overall development site, covering most of the southern half of the proposed building footprint (Figure 2).
- 2.2.3 At the time of the archaeological excavation, the site had been recently vacated by the concrete company, with the majority of the standing buildings having been demolished to ground level. Hard surfaces – mostly concrete – remained across much of the site, with demolition debris piled up in places. Within the western portion of the site, one or two 19th century buildings remained in place, while, to the east, a 19th century brick chimney was also extant, this in the process of being consolidated for retention as part of the redevelopment scheme. The southern margin of the site was covered in trees and other vegetation shrubs, effectively screening the site from Front Street/Hexham Road to the south.

## **2.3 Geology and Topography**

- 2.3.1 The 'solid' geology of the site is Carboniferous Coal Measures, which includes sandstone and limestone strata. The 'drift' geology of the site is varied, as it lies within an area of deposited sediments from the River Derwent, which have been formed and reworked since the last Ice Age. Borehole evidence from the site suggests that the drift geology comprises sands and gravels with substantial deposits of alluvial material also present, these deposited by watercourses that formerly ran across the site.
- 2.3.2 The development site lies to the south of the River Tyne and on the east bank of the River Derwent, close to the valley bottom, at approximately 5m OD. To the south-east, the land rises steeply past Swalwell village and towards the now conjoined village of Whickham further up the valley side. An artificial watercourse, known as the Derwent Gut, served the former ironworks on the site and joined the River Derwent north of Swalwell village. Although the watercourse still runs through the site, it is now largely culverted, with the only visible trace of its former course being an amorphous depression in the southern portion of the site. Water was visible flowing through the open culvert at one location in this depression, to the east of the excavation trench and towards the southern boundary of the site.



## 2.4 Planning Background

2.4.1 In 2004, a planning application (DC/04/01851/FUL) was submitted by Lidl UK GmbH to Gateshead Borough Council proposing demolition of the buildings of the former concrete works on Sands Road, followed by erection of a large supermarket with associated car parking. The supermarket building was to occupy the western portion of the site, with associated car parking to the east. A 19th century brick chimney on the eastern margin of the site is a local landmark and on the local list of buildings of architectural and historic value, and, therefore, was to be subject to remedial works and retention within the redevelopment scheme.

2.4.2 It is the role of the TWAO attached to the Historic Environment Section at Newcastle City Council to identify proposed development schemes in Tyne and Wear that may have archaeological implications and to provide archaeological advice to Local Planning Authorities, in this case Gateshead Metropolitan Borough Council.

2.4.3 The need for early consultation in the planning process in order to determine the impact of development schemes upon the archaeological resource is identified in '*Planning Policy Guidance Note 16: Archaeology and Planning*' (PPG16).<sup>6</sup> That document provides guidance for planning authorities, property owners, developers and others on the preservation and investigation of archaeological remains. Local guidance on heritage issues is set out in Unitary Development Plan (UDP)<sup>7</sup> of Gateshead Borough Council.

2.4.4 In the Gateshead UDP, Policy E19 states:

*Where archaeological sites and monuments of local importance are affected by proposed development, consideration will be given to whether they should be preserved. Where the physical preservation of remains in the original situation is not feasible, excavation for the purposes of recording will be sought.*

In addition, Policy E20 states:

*Planning applications for development in Areas of Potential Archaeological Importance should normally be accompanied by an archaeological field evaluation. The physical preservation of remains in the original situation, or excavation for the purpose of recording, or a combination of the two, will be sought as appropriate to the importance of the remains.*

2.4.5 The site lies within such an '*Area of Potential Archaeological Importance*', as defined by the UDP. In particular, the site was formerly occupied by the historically important 18th century ironworks of Sir Ambrose Crowley, and remained in use for industrial purposes until the present development. Therefore, the TWAO determined that archaeology would be a material consideration in the determination of the planning application for re-development of the site. In this instance, the TWAO advised that a programme of archaeological assessment and evaluation should follow submission of the planning application, in order to inform the planning decision.

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<sup>6</sup> Department of the Environment 1990.

<sup>7</sup> Adopted in 1998 and available online at [www.gateshead.gov.uk](http://www.gateshead.gov.uk)

- 2.4.6 A desk-based assessment of the archaeological potential of the site concluded that there was a high probability of significant archaeological remains from the industrial era at the site. Any remains of Ambrose Crowley's 18th century ironworks would be of particular significance, although later phases of structural development would also be of interest. The assessment also identified – as well as the aforementioned brick chimney – several extant historic standing structures derived from 19th century industrial occupation of the site.
- 2.4.7 Archaeological investigation, comprising trial trenching evaluation, was required, pre-determination of the planning application, in order to determine the extent, nature, date and degree of preservation of any archaeological remains at the site. For the purposes of archaeological development control, the aim of the evaluation was to assess the potential of the archaeological resource at the site in order to inform a decision regarding an appropriate mitigation strategy. In addition, a programme of historic building recording was required to provide a permanent record of historic structural remains at the site.
- 2.4.8 The TWAO prepared separate specifications for the standing building recording and the trial trenching evaluation. The evaluation specification required six trial trenches, although only three could be investigated during the fieldwork, due to site usage at that time. This fieldwork was undertaken by PCA in February-March 2005. The evaluation identified the presence of significant post-medieval industrial archaeological remains in the southern part of the site, including structural remains likely to be associated with the 18th century ironworks of Ambrose Crowley.
- 2.4.9 A tertiary phase of archaeological investigation was therefore required and a specification for an archaeological excavation was prepared by the TWAO. This specification required open area excavation across the footprint of the proposed supermarket building, an area of 25m x 65m, to record any archaeological remains before construction work began. Following discussions between Lidl UK GmbH, the TWAO, the Tyne and Wear Industrial Archaeologist and Gateshead Borough Council, an agreement was reached in May 2005 to reduce the size of the excavation area to 25m x 30m, covering the southernmost portion of the proposed building footprint.

## **2.5 Archaeological and Historical Background**

- 2.5.1 A summary of the archaeological and historical background to the site is set out below, using information gathered during the archaeological desk-based assessment in 2004. PCA gratefully acknowledges the research of those responsible.
- 2.5.2 There are no known prehistoric or Roman sites or finds within the immediate vicinity of the site. While the nearby rivers and their periphery would have provided an ideal habitat for fishing and wildfowling during prehistoric, and indeed later, periods, no evidence has as yet come to light to indicate early occupation at this particular location.



- 2.5.3 Swalwell is first mentioned in documentary records in 1183, when the Boldon Book records William Swalwell as having 120 acres of intake. However, there is no evidence for the existence of a settlement at this time. There was, however, certainly a settlement at Swalwell by the time of Bishop Hatfield (1345-81); his survey notes that there was a mill at Swalwell, presumably a water mill, and also a fishery. The layout of the medieval settlement is not known, Front Street possibly being the main thoroughfare at the time.
- 2.5.4 Swalwell was a significant industrial area from the 17th century. The Hollinside Way, constructed in 1692 and the earliest known waggonway on the east side of the River Derwent, took a route through Swalwell towards the future site of Crowley's Ironworks. The exact route of the waggonway in the vicinity of the site is uncertain.
- 2.5.5 Ambrose Crowley opened his ironworks in Swalwell c. 1707-1709, opting for a site on land beside the Derwent Gut, east of an existing corn mill race, where there was already a small ironworks. Crowley, born in Stourbridge, Worcester in 1658, was a pioneer of the Black Country steelmaking industry of the time. He transferred his large-scale manufactory to Sunderland in 1683, before moving his operations to Winlaton in 1690 and then buying out the operations of a rival partnership at Swalwell by 1707. The works at Swalwell specialised in the production of finished iron goods, particularly nails, hoes, frying pans and anchors, although '*blistered, German and cast steel*' were also manufactured. A map of the works dated 1718 shows that the complex included a plating forge, a blade mill, an iron forge, a slitting mill, steel furnaces and warehouses (Figure 17). By the second quarter of the 18th century, Crowley's Ironworks had become the biggest ironworks on Tyneside and one of the biggest in Europe.
- 2.5.6 In 1782 the business became known as Crowley, Millington and Company. A map of the Clavering Estates in Swalwell, dated 1802, (not reproduced here, but transcribed in the 2004 desk-based assessment) shows the works had extended to the north-east beyond the area bounded by the corn mill race. Several buildings are shown in the vicinity of the works on this map.
- 2.5.7 The ironworks began to decline in the mid 18th century due to technical advantages and competition both locally and elsewhere and the rise of canal transport, which favoured new centres of production further south. This led to the eventual closure of the ironworks in 1853. The works were sold in 1863 to Powe and Fawcus of North Shields for £780 and were auctioned in 1870, and later leased to Ridley and Company who, in 1893, established a steel foundry on the site, with forges, hammers, smiths' shops and machine shops. These works closed in 1911. A brick chimney survives on the site from this period. The paper mills of William Grace and Company, later known as the Northumberland Paper Mills, occupied part of the former Crowley Ironworks site in the late 19th and early 20th century.
- 2.5.8 The Ordnance Survey 1st edition map (Figure 18), dated 1865, shows '*Crowley's Works (Iron)*' (*sic*), with a similar layout of buildings to the 1802 map. A plan of the ironworks from 1870 shows the works, which were to be offered for sale by auction in Newcastle in June of that year (Figure 19). This plan shows the same layout as the slightly earlier Ordnance Survey 1st edition, but shows far more detail, with, for example, each building annotated.

- 2.5.9 The Ordnance Survey 2nd edition map, c. 1890, shows a radical change at the site, with buildings that had not altered significantly for more than 100 years having been replaced by the buildings of the Northumberland Paper Mills (Figure 20).
- 2.5.10 The 1960s Ordnance Survey map shows the Northumberland Paper Mill complex as disused (Figure 22). After this date, the main building of the complex was largely demolished, with smaller warehouses being built. At the time of the investigations herein described, the site had recently been vacated by Bespoke Concrete Products Limited.

### **3. AIMS AND OBJECTIVES**

- 3.1 In broad terms, the archaeological excavation at Sands Road, Swalwell was required to record archaeological remains surviving within the southern portion of the development footprint, prior to the commencement of construction work.
- 3.2 The specific research objective of the archaeological excavation was to investigate structural remains associated with industrial use of the site since the early 18th century. Of particular interest were the former buildings from Crowley's Ironworks, as well as the artificial watercourse, the Derwent Gut. The main aim of the excavation was therefore to uncover and record structural remains of Crowley's Ironworks industry, the watercourse and any associated archaeological features and structures.
- 3.3 The archaeological excavation was essentially to comprise careful exposure of structural remains and any associated features, with subsequent recording in plan and elevation and by photography. Since development groundworks were not to involve grubbing-out of sub-surface structures, archaeological remains would thereafter largely remain preserved *in situ*, following infilling of the archaeological excavation area. Ground levels across the eastern portion of the site, *i.e.* beyond the footprint of the proposed building, were to be raised to create a car parking area.

## 4. ARCHAEOLOGICAL METHODOLOGY

### 4.1 General Fieldwork Methodology

- 4.1.1 The methodology adopted for the open area excavation was initially outlined in the specification prepared by the TWAO in advance of the work. The excavation was confined to the southern portion of the footprint of the proposed new supermarket building. The excavation area therefore comprised a rectangular trench sited in the southern central part of the site, with maximum dimensions of 31m NW-SE x 24m NE-SW and covering c. 700 square metres. The excavation fieldwork took place between July 5th and August 19th 2005.
- 4.1.2 The modern concrete surface was broken out using a hydraulic breaker fitted to a tracked 360° mechanical excavator and the machine then proceeded to remove overburden with a wide blade 'ditching' bucket. This work was conducted under archaeological supervision. Broken concrete and 'spoil' was removed by dumper-truck and mounded to the east of the excavation area. The majority of the walls representing former structures – the Wharf and Forge Buildings - survived just below the concrete surface. Modern backfill of the interior of the Wharf Building was removed by machine to the level of a concrete floor surface, revealing walls surviving to a maximum height of 1.60m. Elsewhere, modern overburden was removed to the level of the first significant archaeological horizon. The eastern and northern sides of the excavation area were 'battered-back' for Health and Safety reasons, due to the depth of modern overburden.
- 4.1.3 As described above, it was not anticipated that the structural archaeological remains would have to be removed, so the excavation principally involved exposure of structural remains and any associated features, with recording in plan, elevation/section and by photography. Limited excavation was undertaken by hand to examine floor surfaces and foundations of structural remains. Two investigative sondages were excavated by hand across the interior of the Wharf Building at its northern and southern ends; these measured a maximum of 5.60m and 3.50m in length, respectively. 'Trash' pumps were used to remove water from these sondages as they extended below the level of the water table. Following careful cleaning and recording, limited hand excavation of the Furnace Chimney in the Forge Building was also undertaken.
- 4.1.4 Detailed cleaning by hand of structural remains was undertaken by the archaeological team. All subsequent excavation and recording was carried out in accordance with recognised archaeological practice and following the methodology set out on PCA's *'Field Recording Manual'*.<sup>8</sup>

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<sup>8</sup> PCA 1999.

## **4.2 Site Recording**

- 4.2.1 *Pro forma* recording sheets were used to compile a full record of all written, graphic and photographic work undertaken. Detailed written records were made of all archaeological features, structures and deposits encountered, comprising both factual data and interpretative elements. Drawings were executed on polyester-based drawing film, at a scale of 1:10 or 1:20, and were related to a site survey grid that was established across the excavation area using electronic surveying equipment. A unique site code, SRS 05, was used throughout the excavation phase of work.
- 4.2.2 Elevations of walls were drawn at a scale of 1:10. Long stretches of wall of uniform construction were drawn in outline, with representative sections 1-2m in length to show brickwork detail. All non-uniform structural fabric and features of architectural note within the walls was also drawn in full detail. All elevations of the Furnace Chimney, along with two walls in the Forge Building, were drawn in full detail, as was the Retaining Wall for the Derwent Gut. All elevations of structural remains have been digitised as drawn.
- 4.2.3 Outline plans of all structural remains were compiled using electronic surveying equipment. These were printed out a scale of 1:20, and returned to site for the addition of detail. The Derwent Gut Retaining Wall, the Furnace Chimney in the Forge Building, a well and the north-eastern wall of the Forge Building were all fully digitised. A representative area of the early cobbled surface revealed within the Wharf Building was also drawn and digitised.
- 4.2.4 A Temporary Bench Mark (TBM) was established on the site from the Ordnance Survey Bench Mark (value 6.90m OD) located on the Highland Hotel Public House, Hoppers Court, to the south of the site. The value of the TBM was 4.52m OD. The elevation of all principal strata, structures and features was calculated in metres above Ordnance Datum (m OD) and the values indicated on the appropriate plans and section drawings.
- 4.2.5 'Harris Matrix' stratification diagrams were compiled to record stratigraphic relationships during all stages of the fieldwork.
- 4.2.6 Detailed photographic records of all stages of the fieldwork were compiled utilising SLR cameras. The records included monochrome prints and colour transparencies (on 35mm film), illustrating the principal features and finds discovered in detail and in general context. All photographs of this nature included a clearly visible, graduated metric scale. The photographic record also included 'working shots' to illustrate more generally the nature of the archaeological operation mounted. In addition, a digital colour photographic record of the excavations was compiled.

## **4.3 Artefacts and Archaeometallurgical Remains**

- 4.3.1 All artefacts recovered from the investigations were treated in an appropriate manner and were exposed, lifted, cleaned, marked, conserved, bagged, packaged, boxed and stored, as appropriate and in accordance with recognised guidelines.<sup>9</sup>
- 4.3.2 Specialist assessment was undertaken on all categories of finds (*e.g.* brick, stone, *etc.*).

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<sup>9</sup> UKIC 1983 and RESCUE 1988.

- 4.3.3 All processing of artefacts was undertaken away from the site. Subsequent assessment of artefactual material was undertaken by suitably qualified personnel. For each category of artefact, an assessment report has been produced including a basic quantification of the material and a statement of its potential for further analysis and recommendations for such work.
- 4.3.4 Brick samples were taken from each structural feature encountered at the site and, where practical, a complete brick was collected from every type of fabric utilised in each structural feature. In addition, the entire range of stamped bricks utilised at the site was also collected, along with specialised forms such as 'closers' and 'wedges'. A specialist examined all bricks; the results are detailed in Section 8.
- 4.3.5 Stone samples for geological assessment were also taken from stone used in the construction of the walls and structures at the site as well as the grinding stones. In total, 12 stone samples were collected and all were examined by a specialist; the results are detailed in Section 9 of this report.
- 4.3.6 Several slag deposits likely to represent floor surfaces, some of which were extensive, were encountered between the Wharf and Forge Buildings. A one-metre grid was established across the extent of these deposits and a spot sample was taken from each one-metre square. A total of 79 samples were collected from 14 separate deposits. Of these samples, a minimum of 10% of the samples collected from each deposit was processed which involved drying, sorting and bagging the material for future analysis. Three of these spot samples were examined by an archaeometallurgist as part of the post-excavation assessment; the results are detailed in Section 10 of this report.
- 4.3.7 Within the remains of the Furnace Chimney, a slag deposit was adhered to the bricks that formed the latest inner skin of the structure on the slope that led up to the chimney. This deposit was extensively sampled and a total of 25 spot samples were taken from this material. All of these samples were appraised by an archaeometallurgist and five samples were selected to be subject to preliminary analysis as part of this post-excavation assessment; the results are detailed in Section 10 of this report.
- 4.3.8 In total, seven bulk samples were collected during the open area excavation. These were taken from deposits such as floor and make-up deposits that contained large quantities of metallurgical debris. All samples were washed, sieved and dried in order to recover all archaeometallurgical debris. It was not necessary to process these samples for the recovery of palaeoenvironmental material. Sub-samples of fragments of metallurgical debris from three of these bulk samples were subject to preliminary analysis as part of this post-excavation assessment; the results are detailed in Section 10 of this report.
- 4.3.9 Artefactual material recovered from the excavation comprised an assemblage of metal objects encountered in the vicinity of the Furnace Chimney. A catalogue of these objects is included in Section 10 of this report. All of these objects were appraised by an archaeometallurgist and two objects were selected for preliminary analysis; the results are detailed in Section 10 of this report.

#### **4.4 Post-Excavation Assessment**

- 4.4.1 This report sets out the findings of the archaeological investigations at the site. It includes a post-excavation assessment of the stratigraphic, artefactual and archaeometallurgical data recovered, in accordance with the guidelines of English Heritage, as set out in MAP2. Following MAP2 guidelines, the site data collected during the fieldwork has been assessed for its potential for further analysis in relation to the project's research aims and any additional questions that came to light during post-excavation analysis. This post-excavation assessment report, enumerating the different kinds of evidence (stratigraphic, artefactual and archaeometallurgical) from the site and their potential for further analysis, has been prepared as the first phase of that process.
- 4.4.2 Assessment of each category of artefactual and archaeometallurgical material was undertaken by suitably qualified archaeological specialists as soon as possible following the completion of the fieldwork.
- 4.4.3 Survival of all materials recovered during or generated by archaeological projects depends upon suitable storage. The complete project archive, comprising written, drawn, and photographic records (including all material generated electronically during post-excavation) and all recovered materials will be packaged for long-term curation according to relevant guidelines.<sup>10</sup> An acceptable standard for archives generated by archaeological projects has been defined in MAP2. The archive will be quantified, ordered, indexed, and internally consistent. The depositional requirements of the receiving body, in this case Tyne and Wear Museums Service, will be met in full.
- 4.4.4 Data will be prepared for accession to the Tyne and Wear HER.
- 4.4.5 Unless overridden by National Law, any artefacts and ecofacts recovered from the site belong to the landowner, which is urged to donate these to an appropriate body. PCA will, with the agreement of the landowner, arrange for deposition of the material with a suitable repository, in this case Tyne and Wear Museums Service.

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<sup>10</sup> UKIC 1990.



Figure 3. Phased plan  
Scale 1:100



## **5. PHASED SUMMARY OF THE ARCHAEOLOGICAL SEQUENCE**

### **5.1 Phase 1: Alluvium**

- 5.1.1 A deposit, [39], comprising soft mid yellowish brown clayey silt was observed in the base of a sondage on the north side of Test Pit 1, which was excavated towards the southern end of the Wharf Building (Figure 3). The deposit was exposed over an area measuring 2.70m x 2.0m, continuing beyond all limits of excavation, and had a maximum excavated thickness of 0.20m, although further excavation was hindered by ingress of water. The highest level at which it was encountered was 2.48m OD.
- 5.1.2 Deposit [39] has been interpreted as being of alluvial origin, presumably having been deposited by a watercourse that formerly ran through the site, possibly even a former channel of the River Derwent, however the date of deposition is uncertain.

### **5.2 Phase 2: Buildings of Early 18th Century Origin**

#### **5.2.1 The Wharf Building**

- 5.2.1.1 The remains of a substantial rectangular structure, annotated as the '*Wharfe on the east side of Pool A*' on the 1718 plan, occupied the majority of the western central quarter of the excavation area (Figure 3; Plates 1 and 7). Four brick walls, [2], [3], [4] and [5], formed the external walls (these being described in detail below), giving internal dimensions of the building of 24.50m long (NW-SE) x 4.80m wide. To the east of the structure, it was not possible to expose the external ground surface contemporary with its earliest phase, since this lay below the lowest limit of excavation practicable. What was probably the original main pedestrian entrance into the building was situated in the northern half of the east wall. Although having been infilled with concrete steps, this entrance was exposed down to a height of 3.70m OD. The base of the entrance could not be reached, but it can be reasonably surmised that original external ground level probably lay below this level.
- 5.2.1.2 In stratigraphic terms, the earliest recorded element of the Wharf Building was a linear cut, [102], which cut through the aforementioned Phase 1 alluvium in Test Pit 1. Detailed examination was not possible due to the rate of water ingress, but this was the linear construction cut for a sandstone foundation, [101]. This structure, exposed in the western side of Test Pit 1 (Figure 5, internal elevation), was constructed with roughly hewn sandstone blocks that ranged in size from 500mm x 250mm to 330mm x 170mm. Two regular courses were exposed within the sondage, maximum thickness 0.45m, but it was not possible to establish the full thickness of the foundation. Only the eastern face of the masonry could be exposed, over a distance of c. 1.80m, at a maximum height of 2.64m OD. This sandstone structure is interpreted as part of the foundation for the brick walls of the Wharf Building.

- 5.2.1.3 Wall [10] was located at the south-western corner of the Wharf Building, on the same alignment as the main west wall, [3], but projecting beyond the building (Figures 3 and 5). Wall [10] was built with roughly hewn and roughly squared sandstone blocks (400mm x 350mm x 280mm to 220mm x 150mm x 70mm) bonded with lime mortar. Only a small section of this structure, c. 1m in length, was visible adjacent to the southern limit of excavation, continuing to the south, and this was 0.72m wide x 0.62m high. In the exposed portion, wall [10] appeared to be built to courses although its western elevation had been rendered with concrete at a later date, which limited investigation. It is possible that brick wall [3] had been built upon wall [10], although whether or not its purpose was specifically as a foundation within the Wharf Building is uncertain.
- 5.2.1.4 The aforementioned west wall, [3], of the Wharf Building extended 25.60m NW-SE on its external face and 24.50m internally (Figure 3). With a thickness of 0.72m, it was constructed with handmade, unfrogged red bricks (240mm x 110mm x 60mm) bonded with greyish white lime mortar and with flush pointing. For the most part, the wall was laid in an English bond, although in at least two locations, English garden wall bond was evident in lower elements of the brickwork (Figure 5). The external face had been rendered in concrete at a later date.
- 5.2.1.5 Across the majority of the Wharf Building, the west wall, [3], was exposed for a height of c. 1.55m with the rubble infill of the structure removed down to the level of the latest internal concrete floor surface. In Test Pit 1, towards the southern end of the building, brickwork of the west wall survived to a maximum height of 2.40m and the base of the structure was exposed at a level of 2.64m OD. In Test Pit 2, towards the northern end of the Wharf Building, a trench excavated through the concrete floor exposed wall [3] for a height of c. 2.0m, although its base was not revealed in this area. Along its entire length, the west wall survived at a maximum level of 5.24m OD.
- 5.2.1.6 Three interruptions were recorded in wall [3], all partially infilled at a later date, as described in due course. These interruptions represented original entranceways of varying width, 2.0m, 2.80m and 2.70m, from north to south, allowing access from 'Pool A' to the west (Figures 3 and 5). The features were also unequally spaced, with the sections of brickwork in the west wall being 3.40m, 4.60m, 5.0m and 3.90m wide, from north to south. Test Pit 1 demonstrated that the southernmost entrance originally continued to the depth of the sandstone foundation of the building, at 2.64m OD. It was not possible to examine the base of the entrance to the north, in Test Pit 2, but it was exposed to a lowest level of 2.76m OD, suggesting that this also originally extended down to the sandstone foundation. No evidence was recorded for an internal floor surface associated with this earliest phase of building, but it was presumably located at a similar level to the sandstone foundations. Later infilling of the entranceways had had the effect of raising the level of each.

- 5.2.1.7 The east wall, [5], of the Wharf Building was of similar construction to wall [3], again in handmade, unfrogged red bricks (240mm x 110mm x 60mm) bonded with lime mortar (Figures 3 and 7). The brickwork was mostly English bond, with the occasional use of English cross bond. The highest level at which the wall survived was 5.34m OD and the maximum height of the exposed brickwork was 1.75m, although on this side of the building there could be no excavation below the level of the internal concrete floor surface, so the base of the wall was not exposed. The upper part of the wall was 0.60m thick, stepping out to 0.72m wide on the external face only, at a level of 4.45m OD (Figure 7). There were two interruptions in the brickwork of the east wall, the first a 2.40m wide entranceway located towards northern end of the building, the second a 1.20m wide entranceway at the southern end.
- 5.2.1.8 The north wall, [4], of the Wharf Building, was built with handmade red bricks (230mm x 120mm x 60mm) bonded with lime mortar (Figures 3 and 6). It was 0.48m wide and was exposed for a maximum height of 1.60m, although the lowermost portion and base could not be examined. It measured 4.70m NE-SW internally and 5.80m externally with a 1.10m wide opening placed approximately centrally. To the west of this opening, the brickwork of the internal face was in English garden wall bond, while to the east it was English bond. Externally, the uppermost portion of the structure was in English bond, with the lower courses a mixture of English garden wall bond and English bond. At its eastern end, wall [4] was fully keyed into wall [5], while, to the west, only the six uppermost surviving courses were keyed into wall [3], with all visible courses below abutting the brickwork of the west wall.
- 5.2.1.9 The south wall, [2], of the Wharf Building, comprised handmade red bricks (230mm x 110mm x 60mm) bonded with lime mortar. Internally it was 4.70m in length, while externally it was more than 7.0m in length, projecting to the east beyond the building for a distance of c. 1.0m beyond which point it had been truncated (Figures 3 and 4). Wall [2] was 0.61m wide and was exposed to a maximum height of 1.37m, although its lowermost portion and base could not be exposed. For the most part, the brickwork was English bond. A 1.05m wide entranceway was located roughly centrally in the wall, this had been blocked in the 20th century with brickwork, [107], (Phase 9). At the south-western corner of the building, walls [2] and [3], were fully keyed in, while, to the east, only the uppermost portion of the brickwork above the concrete floor surface was keyed in to east wall [5].

## 5.2.2 The Half Forge Building

- 5.2.2.1 Fragments of several brick walls, [15], [16], [27], [50] and [106], located to the east of the Wharf Building, were similar in construction techniques and materials utilised to walls [2]-[5] of the Wharf Building, indicating that these walls probably derive from the same phase of construction. These fragments of wall are interpreted as representing parts of the external walls of the structure shown on the 1718 plan of the ironworks as '*½ forge*' (Figure 17). The internal dimensions of the structure thus formed by these walls was c. 15.50m NW-SE x 6.50m NW-SE (Plates 2 and 8). Although the full width was probably not exposed within the limits of excavation, the excavated evidence indicates that the full length of wall [15] was identified and the structure is therefore likely to have been close to the exposed dimensions.

- 5.2.2.2 A NW-SE orientated wall, [16], was located 3.50m east of the Wharf Building and running parallel to it (Figure 3). It comprised handmade red bricks (230mm x 110mm x 70mm), bonded with lime mortar, the materials being very similar to those used in the earliest surviving brickwork of the Wharf Building. For the most part, the brickwork was in English bond with an excess of stretchers at the lowest level exposed. The northern end of this wall comprised sandstone blocks (470mm x 200mm x 200mm to 250mm x 190mm x 180mm) probably indicating the position of a former entrance (Figure 9). Two patches of brickwork within the wall represent later repairs, with yellow firebricks having been utilised for these. The wall was 4.92m NW-SE in length and 0.52m wide, with a maximum surviving height of 1.0m, continuing below the base of excavation. The highest level at which it survived was 4.65m OD.
- 5.2.2.3 Wall [15] formed a right-angled return from the southern end of wall [16] and these walls were keyed into each other (Figure 3). Wall [15] was of very similar construction to wall [16] with the same materials and bonding utilised (Figure 10). It extended 7.85m NE-SW in length and was 0.64m wide, with a maximum surviving height of 1.43m, the lowermost portion not being revealed. Later repairs utilising yellow firebricks were also evident within this wall.
- 5.2.2.4 The external face of a short length of a brick wall, [27], was recorded at the eastern end of wall [15], with the two structures keyed in. Wall [27] was only visible in elevation being exposed for a distance of 0.65m NE-SW, continuing to the east. It was 1.20m high, although its lowermost portion could not be exposed within the limits of the excavation (Figure 10). Built with handmade red bricks (230mm x 120mm x 70mm) bonded with lime mortar, no coursing pattern could be discerned, as the only section of the wall visible was the area where it had been keyed into wall [15] and its external face had been truncated or damaged. The 1718 plan shows a wall projecting beyond the south-eastern corner of the building, on the same alignment as the south wall, and this could represent wall [27].
- 5.2.2.5 Another fragment of brick wall, [106], was recorded c. 10m to the north of wall [16] (Figure 3). Its surviving dimensions were 1.52m NW-SE x 0.58m NE-SW, continuing to west below a later structure, wall [19], which had been largely built over it (Figure 12; Figure 13, North-west facing elevation). Wall [106] was exposed for a height of only 0.27m, with its lowermost portion not visible within the limits of excavation. The handmade red bricks within the structure measured 230mm x 110mm x 60mm and were bonded with lime mortar.
- 5.2.2.6 Wall [50] was located a few metres to the north-east of wall [106], again comprising handmade red bricks. Only one course could be exposed within the limits of excavation, this having an external face built with stretchers and an internal face with headers (Figure 3). The fragmentary structure extended 2.66m NE-SW, continuing to the east beyond the limit of excavation, and was 0.40m wide.

### 5.3 Phase 3: Infilling of Openings in Wharf Building and Raising of Floor

- 5.3.1 The threshold of each of the three openings in the west wall of the Wharf Building was raised, these events possibly being undertaken contemporaneously. The catalyst for this work may have been increasing water levels in 'Pool A'. The southernmost opening was infilled with brickwork, [6], comprising red handmade bricks (240mm x 120mm x 60mm) bonded with lime mortar and laid, for the most part, in English bond, flush pointed (Figures 3 and 5). This brickwork, however, did not infill the full width of the opening, instead a 1.05m wide central gap remained. The infilling was 0.60m wide, lying flush to the external line of the main wall and surviving to a highest level of 3.98m OD. The central gap had been subsequently infilled with additional brickwork, [24], to a similar height. This comprised red handmade bricks (230mm x 110mm x 65mm), laid in English bond, flush pointed.
- 5.3.2 Test Pit 1, at the southern end of the Wharf Building, recorded a deposit, [30], to the east of brickwork [6], which appeared to post-date construction of the infill. It comprised soft, clayey sandy silt with very occasional brick, mortar and sandstone fragments and gravel pebbles throughout. Up to 0.19m in thickness and recorded at a highest level of 2.84m OD, deposit [30] was exposed for a distance of 3.90m x 3.50m, continuing beyond the limit of excavation to all directions except the west (Figure 3). Interpretation of this deposit cannot be certain, although it could represent ground raising material deliberately dumped ahead of the raising of the internal floor of the Wharf Building.
- 5.3.3 In the north-west facing section of Test Pit 1, deposit [30] was overlain by a thin layer of gravel, [38] (Figure 8, Section 1). This is interpreted as the bedding layer for a substantial sandstone block, [37], which measured 1.24m in length x 0.21m thick and was recorded at a maximum height of 3.04m OD (Plate 11). This block could represent the lowermost step in a flight of steps leading down from the entrance through the southern wall of the Wharf Building, although this interpretation is not certain.
- 5.3.4 The central opening in the west wall of the Wharf Building was infilled with brickwork, [7], which comprised an assortment of bricks, mostly handmade red bricks of the same type as those utilised in the original brick walls of the structure, but with several examples of frogged bricks and firebricks (Figure 3; Figure 5, North-east elevation). The firebricks date to the 18th century, but the frogged bricks are likely to be of c. mid-19th century date. Flush pointed in stretcher bond, the brickwork was 0.50m wide, again built in line with the external wall line, and the highest level at which it was recorded was 3.90m OD.
- 5.3.5 The northernmost opening in the west wall had been subject to several phases of infilling. The earliest of these, represented by brickwork [63], spanned the full width of the opening and comprised handmade red bricks (230mm x 110mm x 60mm) bonded with lime mortar laid in stretcher courses (Figure 5). The upper portion of this brickwork was rather fragmentary, with a maximum recorded height of 0.34m, continuing below the limit of excavation recorded at a highest level of 3.13m OD.

- 5.3.6 A group of deposits recorded in Test Pits 1 and 2 have been interpreted as representing waste material derived during ironworking operations in the vicinity. Some were probably deliberately dumped for ground raising, whilst others may have formed actual floor surfaces. The raising of the floor level would have been necessary following infilling of the entrances into the structure from the watercourse to the west.
- 5.3.7 The earliest such deposit exposed in section in Test Pit 2 was a 0.11m thick layer, [59], of cemented iron slag, recorded at a highest level of 2.89m OD (Figure 8, Section 2). It was overlain by a similar deposit, [58], up to 70mm thick. The overlying deposit, [57], comprised mid grey clayey silt up to 0.11m thick, in turn overlain by another iron slag deposit, [47], up to 0.15m thick. Deposit [47] was overlain to the east by another iron slag deposit, [46], with a maximum recorded thickness of 20mm, continuing below the limit of excavation (Figure 3; Figure 8, Section 3). Fragments of two large sandstone grinding stones, SF 5 and SF 6, were contained in this deposit. The combined maximum excavated thickness of these deposits was 0.40m. The highest level of the uppermost deposit was 3.18m OD.
- 5.3.8 In Test Pit 1, the aforementioned sandstone block [37], was overlain by a slag-rich layer, [29], up to 0.12m thick and recorded at a highest level of 3.18m OD (Figure 3; Figure 8, Section 1; Plate 11).
- 5.3.9 Slag was a frequent component of this group of deposits in the Wharf Building and as mentioned above, this was probably waste material derived from the ironworks. Archaeometallurgical assessment of a sub-sample of layer [29] has revealed that it comprised 'soil', coal slack, hammerscale, soot and clinker. Such a composition is typical of compacted floor deposits found on industrial sites where ferrous metals have been manufactured. The presence of hammerscale suggests the presence of iron/steel forging, whilst the high proportion of cinders, coal dust and clinker suggests the presence of fossil fuelled furnaces and/or hearths on the site. Samples of layers [29] and [57] also contained small ferrous metal pieces, the size and shape of which are indicative of scrap from the production of iron or steel castings.

#### **5.4 Phase 4: Wharf Building Floor Surfaces**

- 5.4.1 In Test Pit 1, at the southern end of the Wharf Building, slag layer [29] was overlain by a 0.20m thick deposit, [36], comprising yellowish brown sand (Figure 8, Section 1). This was overlain to the west by a 0.17m thick deposit, [35], comprising brownish grey silty sand with moderate small brick, sandstone and slag fragments throughout. These deposits are interpreted as bedding layers for an overlying cobble surface, [28], constructed with rounded and sub-rounded river cobbles, well-sorted with the majority being less than 200mm in width (Plate 11). This surface was 0.16m thick and was exposed over an area that measured 4.90m NE-SW x 3.50m NW-SE, continuing beyond the limits of excavation to the north and south; within Test Pit 1, the surface spanned the width of the Wharf Building and it was recorded at a maximum height of 3.42m OD.

- 5.4.2 A flight of sandstone steps, [12], was exposed in the south-western corner of the Wharf Building, leading up from cobble surface [28] and probably contemporary with it (Plate 11). To the east, it reached an opening in the east wall of the Wharf Building, giving access to a corridor (Figure 3; Figure 7, North-east elevation; Figure 8, Section 1). The upper step comprised a single block of sandstone spanning the full width of the threshold and recorded at a maximum height of 4.54m OD. This stone was punctuated by a square aperture towards its southern end, possibly representing the setting for a door post (Figure 3). Below the upper step were four sandstone steps leading down from the opening, each comprising two or three distinct sandstone blocks and underlain by a brick foundation of handmade red bricks. The lowest step had a maximum height of 3.73m OD. Overall, the structure was 1.20m high, projecting 1.40m from wall [5] into the interior of the Wharf Building, and 1.20m wide.
- 5.4.3 At the north end of the Wharf Building, a deposit, [45], comprising sandy silt with frequent small fragments of brick and mortar throughout was recorded within Test Pit 2 (Figure 3). It was recorded over an area measuring 4.28m NE-SW x 1.25m NW-SE, continuing to the north and east beyond the limits of excavation, and was 0.16m thick. This is interpreted as the bedding layer for an overlying cobble surface, [40], which was very similar in construction to the previously described surface [28], to the south (Plate 12). Again, this surface spanned the width of the Wharf Building and was exposed for a length of 2.36m, continuing to the south (Figure 3), and recorded at a maximum height of 3.47m OD. The similarities in height and composition between this and surface [28] are considered good indicators that these were parts of the same extensive surface.
- 5.4.4 A deposit, [56], of the same composition as previously described bedding layer [45] was recorded in section in Test Pit 1 (Figure 8, Section 2). This is also interpreted as a bedding layer, on this occasion for an overlying brick surface, [55], which extended 1.62m NE-SW in section, continuing to the south beyond the limit of excavation. The highest level at which this surface was recorded was 3.28m OD; it has been interpreted as an extensive area of repair to the internal cobble floor within the Wharf Building, as described above.
- 5.4.5 To the east of brick surface [55], a 0.15m thick slag deposit, [54], was recorded over an area measuring 3.78m NW-SE, continuing to the south, x 4.74 NE-SW, and the highest level at which it was recorded was 3.30m OD. This deposit abutted both brick floor [55] and cobble surface [40] and possibly represents an area of further repair. Ongoing repair to internal floor surfaces was probably likely due to the presence of openings in both the west and east walls, allowing access to the watercourse to the west and the corridor to the east, which probably resulted in heavy wear to the internal floor surfaces of the building.
- 5.4.6 Brickwork infill [63] to the northernmost opening in the west wall of the Wharf Building was overlain by a layer, [62], of iron slag, which appeared to be a consolidation and/or levelling dump (Figure 5, North-east elevation). Overlying this was a thin layer of sand, [64], clearly a bedding layer for a brick surface, [61], recorded in elevation at a maximum height of 3.29m OD. This brick surface has been interpreted as being probably contemporary to the previously described brick floor [55], to the south-east.

## **5.5 Phase 5: Further Infilling of Openings in Wharf Building**

- 5.5.1 At the northernmost opening in the west wall of the Wharf Building, brick surface [61] was overlain by a rubble deposit, [60], a foundation layer for the overlying brickwork infill, [8], which raised the level of the opening by more than 1.0m, presumably effectively blocking access through this opening (Figure 3; Figure 5, North-east elevation). The brickwork was 0.85m high x 0.44m wide, flush with the external face of the building, and was built with red bricks (230mm x 110mm x 60mm) laid in stretcher bond.
- 5.5.2 At the northern end of the Wharf Building, the opening in wall [4] was infilled with brickwork, [104], up to a level of 3.62m OD. The brickwork was 0.38m wide, flush with the external face of the building; only the upper surviving course of bricks could be exposed within the limit of excavation (Figure 3).

## **5.6 Phase 6: Structures Derived from the Second Half of the 19th Century**

### **5.6.1 The Forge Building**

- 5.6.1.1 Structural evidence indicates that the 18th century Half Forge Building was probably extensively rebuilt in the second half of the 19th century; the majority of the walls forming the western side of the structure probably date from this period. A plan of the ironworks dated 1870 shows a building annotated 'FORGE' in this location.
- 5.6.1.2 A NW-SE aligned sandstone wall, [17], was located to the north of Phase 2 wall [16] and this extended 2.60m in length, truncated to the south, and was 0.38m wide (Figure 3). It was built to courses, random roughly hewn blocks in the external elevation and squared blocks in the internal elevation (Figure 9; Plate 13). The wall was exposed for a maximum height of 1.90m, its lowermost portion not revealed below the limit of excavation. Abutting wall [17] was a short length, 1.10m NW-SE, of brick wall, [105], which was 0.50m wide and was exposed for a maximum height of 2.0m (Figures 3 and 9). The vestige of a semi-circular brick arch survived on the north side of this wall, presumably indicating the position of a former entrance into the building. The wall was built with a mixture of handmade red bricks, presumably reused from earlier structures, along with firebricks dating from the second half of the 19th century; laid in English garden wall bond.
- 5.6.1.3 A small fragment of brick wall, [90], was recorded to the north of wall [105] and this measured 0.78m NW-SE x 0.26m wide and was exposed for a maximum height of 0.80m (Figure 3; Figure 9, South-west elevation). The bricks measured 110mm x 60mm thick and all appeared to have been cut to a standard length of 160mm.
- 5.6.1.4 To the north, wall [90] was tied into wall [18], which extended 4.68m NW-SE with a perpendicular return in the north, this surviving for a length of 1.68m (Figures 3 and 9). The wall was 0.60m wide and was exposed for a height of 0.95m, the base was not revealed within the limits of excavation. It was built with a mixture of handmade red bricks and firebricks with occasional squared sandstone (up to 140mm x 150mm x 300mm) also utilised. The longer stretch of wall was mostly constructed in English garden wall bond whilst the return was laid in stretcher bond.



- 5.6.1.5 Wall [19] was located to the north of wall [18] and extended 2.57m SE-NW towards the corner of the building. The brickwork was 0.37m wide and was exposed for a maximum height of 0.90m, although the lowermost portion was not revealed (Figures 3 and 9). The lowest part to be exposed was constructed in sandstone, probably a foundation, with a large grinding stone incorporated. The upper part of the wall was constructed with a variety of brick types, including reused handmade red bricks and firebricks, the latter included stamped examples dated to the second half of the 19th century. The bricks were bonded with lime mortar and laid with no regular bonding pattern.
- 5.6.1.6 Wall [20] was keyed into the northern end of wall [19] and formed a perpendicular return extending for a distance of 1.16m SW-NE (Figure 3). It was 0.24m wide and exposed for a maximum height of 0.85m, although the lowermost portion was not revealed (Figure 9). It was built in brick (240mm x 110mm x 70mm) bonded with lime mortar with no regular bonding pattern.
- 5.6.1.7 The building represented by walls [17], [105] and [18] have been interpreted as the structure shown as a Forge Building on the 1870 plan, this was basically rectangular in plan, but narrower at the northern end, with the north-western corner 'missing' (Figure 19). This Forge Building probably represents a partial rebuild of the Half Forge Building, with the south wall and the remaining parts of the north and west walls probably still defined by the original 18th century walls, although with some 19th century repair evident. Therefore, having been built upon essentially the same footprint as the earlier structure, the overall dimensions of the Forge Building were probably the same as those of the earlier building. None of the east wall was exposed, lying entirely beyond the eastern limit of excavation. The 'missing' north-western corner of the Forge Building on the 1870 plan, may be represented by wall [18], although the drawing suggests a more extensive feature than that indicated by the excavated remains.

## **5.6.2 The Retaining Wall**

- 5.6.2.1 The remains of a wall, [48], were recorded running approximately east-west from the eastern limit of excavation, towards the north-east corner of the Wharf Building (Figures 3 and 15; Plate 9). It was of varied construction, with the lowest course to be exposed, visible only to the west, constructed in yellow brick. This was overlain by two courses of sandstone blocks and then two-three courses of squared sandstone (ranging in size from 80mm x 130mm to 170mm x 490mm) incorporating some red brick. The uppermost surviving portion of the wall comprised three courses of red brick laid in stretcher bond (Figure 16). The masonry of the north elevation was relatively well-dressed and more regular, representing the external face of the structure, whilst that forming the south elevation was less regular. The wall extended 9.70m, curving slightly to the south at its eastern end. It was exposed for a maximum height of 0.54m, although at no point could the base be exposed due to water ingress, and its maximum width was 0.43m. The westernmost portion was narrower in construction, only 0.32m wide over a distance of 2.80m. The highest level at which the wall was recorded was 4.26m OD.

- 5.6.2.2 To the west, wall [48] abutted wall [22], which continued the same line for a distance of 3.35m (Figures 3 and 15). This section of wall was noteworthy in that it contained many reused grinding stones, examples of which were recorded in two separate courses. The lowermost course contained three adjacent grinding stones (SFs 8-10), which measured 530mm-580mm east-west x 610mm-630mm north-south x 160mm-185mm thick (Plate 10). Rather than having simply being amalgamated into the structure, the north face of each stone had been fashioned to form a relatively smooth face to the wall. The remainder of the lowermost course to be exposed comprised squared sandstone of varying dimensions, along with a reused L-shaped sandstone fragment, SF 11.
- 5.6.2.3 The uppermost surviving course of wall [22] also contained reused grinding stones, with SF 3 and SF 4 being the most complete examples, these measuring 620mm east-west x 580mm x 180mm thick and 650mm east-west x 630mm x 180mm thick, respectively. To the west, fragments of two other grinding stones, SF 1 and 2, were recorded (Figure 15). Overall, this section of wall was exposed for a maximum height of 0.32m, although the lowermost portion could not be exposed, and it was 0.86m wide. The highest level at which it was recorded was 3.85m OD. It was not possible to determine a stratigraphic relationship between the Wharf Building and wall [22] due to the poor survival of the remains in this area due to water erosion and demolition.
- 5.6.2.4 Walls [22] and [48] are interpreted as elements of a Retaining Wall for the south side of a watercourse which ran to the north of the Wharf and Forge Buildings.

## **5.7 Phase 7: Late 19th Century Furnace Chimney**

### **5.7.1 Furnace Chimney, external walls**

- 5.7.2.1 The remains of a three-sided brick chimney were recorded towards the north-western corner of the Forge Building, internal to the structure (Figures 3, 12-14; Plates 3-6). By design, its west wall, [41], also formed a section of the west wall of the Forge Building, linking walls [18] and [19], but continuing to the south beyond the end of the former. Wall [41] extended 1.78m NW-SE and was 0.34m wide, with a maximum exposed height of 1.67m, continuing below the lower limit of excavation.
- 5.7.2.2 The north wall of the chimney was defined by wall [42], which measured 1.76m NE-SW x 0.24m high and was exposed for a maximum height of 1.65m. The central portion of this wall incorporated a 0.42m wide opening, with the remnants of an associated semi-circular arch, c. 1m high, recorded (Plate 5). The east wall of the chimney was defined by wall [43], which measured 1.77m NW-SE x 0.34m wide and was exposed for a maximum height of 2.05m (Plate 3). The lowermost part of the east wall to be exposed was a large sandstone block, which suggested that the brickwork had been constructed upon a sandstone foundation (Figure 13, North-east facing elevation).

5.7.2.3 All three walls of the Furnace Chimney were built with yellow firebricks of varying dimensions, with very occasional reused handmade red bricks also noted. The majority of the brickwork was laid in English garden wall bond, although there were also areas in irregular bonding patterns. Open to the south (Plate 4), the chimney had internal dimensions of c. 1.40m NW-SE x 1.10m NE-SW and external dimensions of 1.80m square. The highest surviving level of the structure was 5.22m OD and the lowest that could be reached was 3.23m OD, this on the putative sandstone foundation of the east wall. Iron fittings were noted on the external face of the structure along with iron staining which may have marked the position of removed iron brackets which would have supported the structure during heat expansion. Several stamped firebricks were recovered from the structure and these date from the second half of the 19th century.

#### **5.7.2 Furnace Chimney, primary skin**

5.7.2.1 The internal face of north wall [42] had been deliberately lined with an inner 'skin' of brickwork, wall [49], for the purposes of strengthening the chimney structure. Constructed to respect the arched opening within the outer wall, wall [49] measured 1.08m NE-SW x 0.11m wide and was visible for a height of 0.92m, extending below the base of excavation.

#### **5.7.3 Furnace Chimney, secondary skin**

5.7.3.1 A secondary inner 'skin' of brickwork, [44], lined all three sides of the chimney and this was 0.24m wide (Plates 4 and 6). It comprised yellow firebricks of the same type as in the external walls, and all of the stamped examples were of the '*Hannington*' maker, dating to the second half of the 19th century.

5.7.3.2 This secondary inner skin of brickwork was built with columns of stretchers that were not keyed into the outer walls, possibly to provide stability during heat expansion. Much slag had adhered to the inner surface of the brickwork, making identification of a bonding pattern difficult, but the bricks appear to have been laid on bed with headers pointing inwards. The overall internal dimensions of the secondary skin of bricks were c. 0.80m NE-SW x 1.30m NW-SE. The north side of this secondary skin of bricks extended upwards beyond the opening in north wall [42] and this portion was exposed for a maximum height of 1.38m. All the bricks in this skin displayed varying degrees of heat damage, with those in the east wall showing the most degradation.

#### **5.7.4 Furnace Chimney, tertiary skin**

5.7.4.1 A tertiary inner 'skin' of brickwork was represented by wall [51], this only one brick (110mm) wide built in yellow firebricks some of which belonged to the aforementioned Hannington manufactory. Again, this lined all three sides of the structure, leaving an internal space measuring only 1.0m NW-SE x 0.40m NE-SW (Plates 4 and 6).

5.7.4.2 The west side of the tertiary skin projected beyond the chimney structure for a distance of 1.20m NW-SE and this portion was of relatively more substantial construction, being up 0.25m wide (Plate 4).

5.7.4.3 Within the chimney, the tertiary skin was exposed for a maximum height of 0.58m and the highest level at which it survived was 4.10m OD. The bonding pattern in the brickwork could not be identified due to a covering of iron slag residue, [23], as well as the partial collapse of the upper part of the structure. As with the secondary skin of brickwork, there was greater degradation by heat damage on the eastern side.

### **5.7.5 Furnace Chimney, internal deposits**

5.7.5.1 The internal area of the chimney structure, within the tertiary brick skin, was infilled with brickwork, [92], which was exposed for a maximum height of 0.52m and for a maximum distance of 0.88m NW-SE. This probably represents the internal base of the Furnace Chimney.

5.7.5.2 South of brickwork [92] was a deposit, [91], comprising firmly cemented slag, and although this was not excavated, brick infill [92] possibly continued beneath it. The slag extended c. 1.75m NW-SE and was 0.52m wide, with a maximum thickness of 0.10m, continuing below the base of excavation. Furnace Chimney base [92] was overlain by a mixed deposit, [66], of fuel ash slag, slagged refractory brick and possible metalliferous slag. It was recorded over an area measuring 1.08m NW-SE x 0.68m NE-SW and was up to 0.40m thick.

5.7.5.3 Within the Furnace Chimney, the latest slag deposit, [23], overlay deposit [66] and also comprised a mixture of fuel ash slag, slagged refractory brick and possible metalliferous slag. It extended over an area measuring 1.40m NW-SE x 0.90m NE-SW (Plate 3). Although mostly 0.35-0.40m thick, it was considerably thinner to the south, where it was only 70mm thick.

5.7.5.4 A silty deposit, [89], was recorded between the corner of wall [18] in the west wall of the Forge Building and wall [41], the west wall of the Furnace Chimney. This deposit contained a quantity of iron objects and scrap metal (SFs 14-28).

## **5.8 Phase 8: External Features**

5.8.1 Several deposits of slag, [68-82], some of which were extensive, were revealed in plan in the area between the Forge and Wharf Buildings (Figure 3; Plates 2 and 7). Preliminary assessment of spot samples from three of these contexts has identified the presence of iron oxide, small fragments of coal, coal slack, hammerscale, soot and clinker. These deposits, comprising waste material from the ironworks, were presumably dumped to raise the ground level in the area between the Wharf Building and the Forge Building, a necessity when the floor levels of the Wharf Building were raised. As with the slag deposits encountered within the Wharf Building, these deposits are typical of compacted floor deposits found on industrial sites where ferrous metals are being manufactured. The presence of hammerscale suggests iron/steel forging, while a high proportion of cinders, coal dust and clinker in the material, suggests the presence of fossil fuelled furnaces and/or hearths on the site. No dateable material was recovered, but some of the deposits were dumped after the construction of the Phase 6 furnace in the late 19th century, and, in the absence of any dateable material, all the technological residues deposits in this area have been allocated to the same broad phase of activity.

- 5.8.2 A sub-square feature, [95], truncated the slag deposits in the southern part of the corridor between the Forge and Wharf Buildings (Figure 3). Lying directly adjacent to walls [17] and [105] of the Forge Building, this was the construction cut for a brick and sandstone structure, [94], interpreted as a well. Its external dimensions were 2.40m NW-SE x 1.80m NE-SW. The structure was evidently of rather piecemeal construction, with various sizes and shapes of sandstone block having been utilised and it had been capped with sandstone slabs, [93], including a squared grinding stone, SF 30 (Plate 14). No excavation of the well was possible due to Health and Safety considerations.
- 5.8.3 A short distance to the north of well [94], the slag deposits in the corridor between the Forge and Wharf Buildings had also been truncated by a sub-rectangular construction cut, [103], for a brick structure, [85] (Figure 3). Constructed with red and yellow bricks (240-260mm x 120mm), this measured 1.84m NW-SE x 0.90m NE-SW and abutted wall [90], part of the west wall of the Forge Building, to the east. Further investigation of the structure could not be undertaken and its purpose was not ascertained.

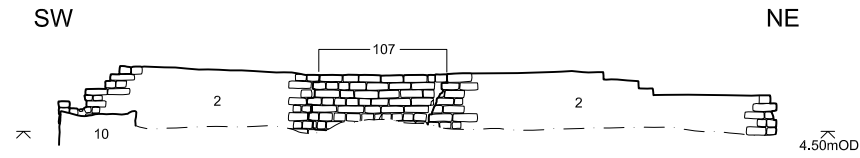
## **5.9 Phase 9: Latest (20th Century) use of the Wharf Building**

- 5.9.1 At the southern end of the Wharf Building, cobble surface [28] was overlain by a 50mm thick deposit, [34], of clayey sandy silt (Figure 8, Section 1). This was overlain by a 0.43m thick deposit, [33], comprising sand, mortar and brick rubble. The overlying deposit, [32], comprised clayey, sandy silt with frequent brick and sandstone rubble up to 0.21m thick. This was overlain by a slag and brick rubble deposit, [31], up to 0.10m thick.
- 5.9.2 At the northern end of the Wharf Building, the brick floor, slag floor and cobble surfaces were overlain by a 0.29m thick deposit, [52], comprising sandy silt with brick rubble and mortar (Figure 8, Sections 2 and 3).
- 5.9.3 The deposits described above have been interpreted as ground raising, levelling and make-up deposits for the most recent surface within the Wharf Building, a concrete floor, [13]. This was exposed across the full extent of the building and was 80mm thick, occurring at highest and lowest levels of 3.73m OD and 3.59m OD, respectively (Plates 1 and 7). Fourteen roughly square slots were recorded in the concrete floor (Figure 3), corresponding with a series of beam slots, which measured 70m x 90mm, in the east wall, [5]. There were no corresponding beam slots in the west wall, [3], and these features probably housed racking, while maintaining access along the western side of the building. Circular iron stains were noted on the concrete floor, possibly representing where iron barrels had stood.
- 5.9.4 A flight of three poured concrete steps, [11], had been constructed within the northernmost opening in the east wall of the building (Figures 3 and 7). These spanned the width of the entranceway and gave access to the level of concrete surface [13] and, accordingly, are considered certainly contemporary with the most recent floor.
- 5.9.5 The entrance through the south-western wall of the Wharf Building [2] had been completely blocked and infilled with bricks, [107]. A variety of bricks had been utilised for this, including some reused 19th century firebricks, but the majority of the infill was constructed with yellow bricks (230mm x 115mm x 75mm) dated to the early 20th century.

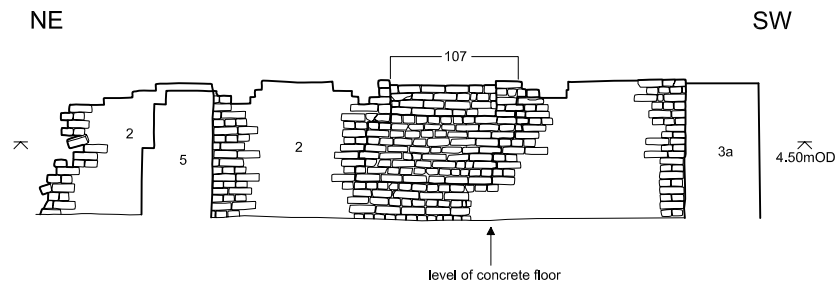
- 5.9.6 The external face of the east wall, [3], of the Wharf Building was rendered in a 20mm thick layer of concrete, [25] (Figure 5, South-west elevation). This render was continuous along the length of the wall and covered the infilling brickwork of each opening. The render did not extend to the full height of the wall at any point and, in fact, was not present higher than 0.85m from the lowermost exposed portion of the wall; the highest level at which the render was present was 4.41m OD.
- 5.9.7 An L-shaped concrete wall, [9], was situated at the north-western corner of the Wharf Building (Figure 3). This measured 5.0m NE-SW, continuing to the west beyond the limit of excavation, and turned at right angles in the east to run 1.06m NW-SE, immediately adjacent to west wall [3], ending flush with north wall [4]. It was 0.76m wide and was exposed for a maximum height of 0.60m, at a highest level of 4.34m OD. This feature is interpreted as a dam, inserted in the 20th century to block off the western watercourse from the water channel to the north. This western watercourse (formerly Pool A) was still extant on the Ordnance Survey 2nd edition map of 1897, but by 1919 was no longer present, suggesting that dam [9] dates from between 1897 and 1919.

## **5.10 Phase 10: Modern Deposits**

- 5.10.1 Rubble deposits, [26], of recent origin comprising mixed demolition rubble (concrete, brick, roof tile, cinder and glass) extended across the entire site, backfilling the Wharf Building at the onset of the excavation. These deposits were up to 2.25m thick. Other discrete deposits of rubble were encountered across the site, although since these are not considered to be of any archaeological significance they are not discussed here. All these deposits are catalogued in the site matrix and context index (see Appendices A and B).
- 5.10.2 Modern service trenches, [99] and [97], truncated rubble deposits.
- 5.10.3 The latest concrete surface, [100], that was recorded formed the ground surface at the onset of the work. It varied in thickness from 0.15m to 0.40m and was recorded at a highest level of 5.57m OD, sloping down to 4.98m OD.



Wharf Building. South-east elevation, external face. Wall [2].



Wharf Building. North-west elevation, internal face. Wall [2].



Figure 4. Wharf Building. Wall [2], elevations  
Scale 1:75

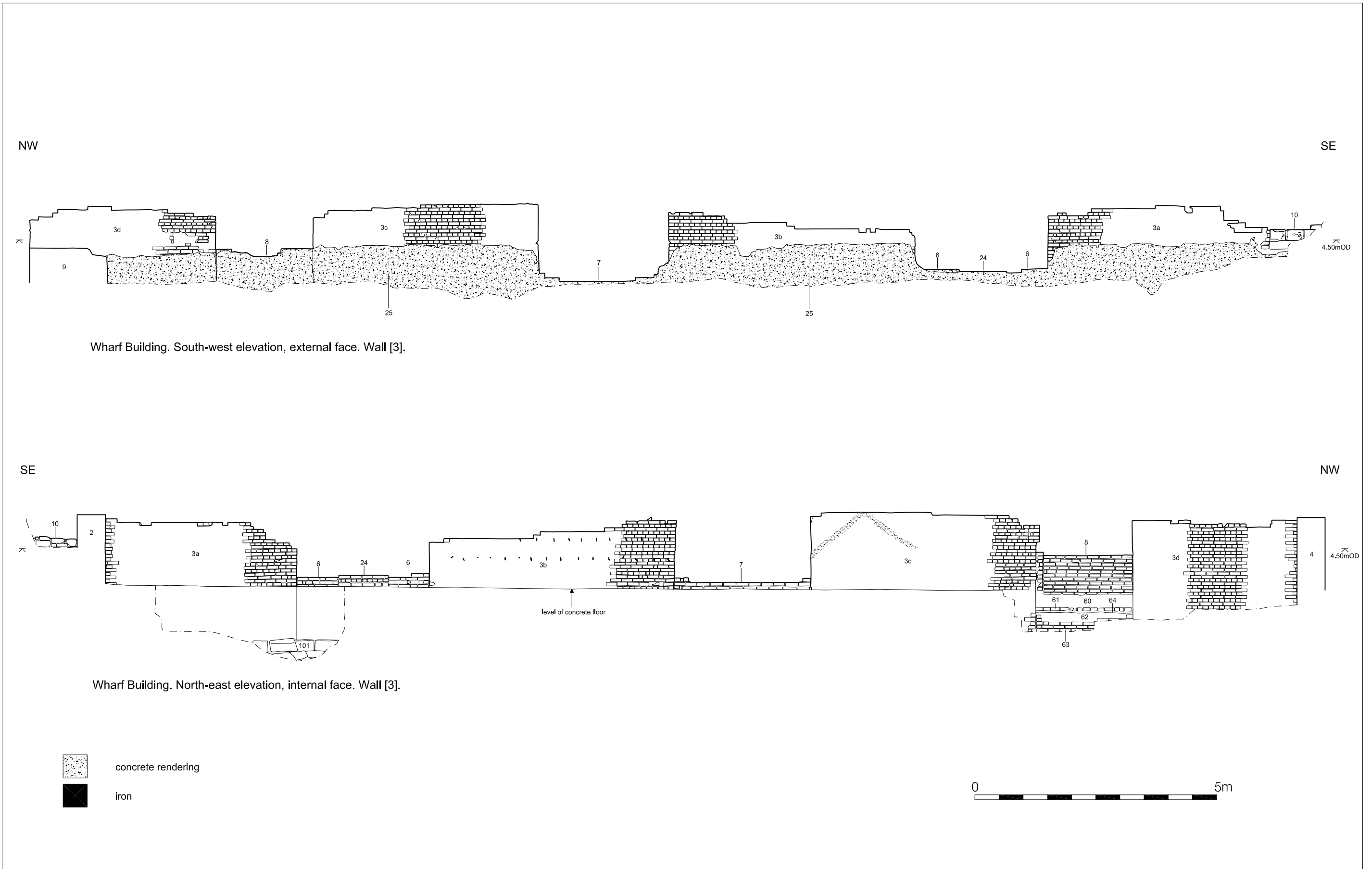
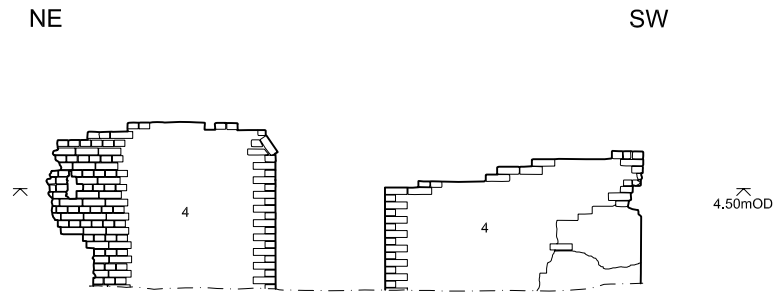
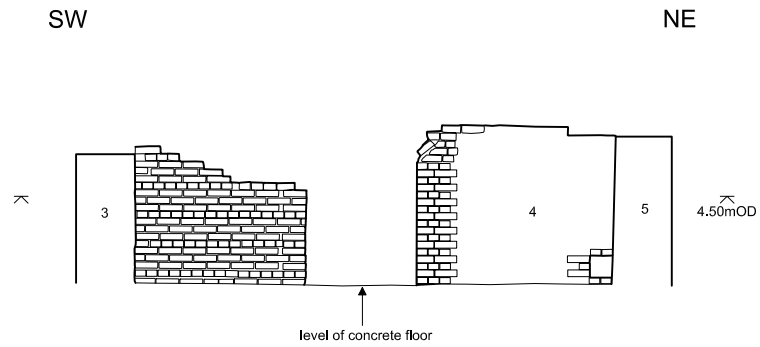


Figure 5. Wharf Building. Wall [3], elevations  
Scale 1:75





Wharf Building. North-west elevation, external face. Wall [4].



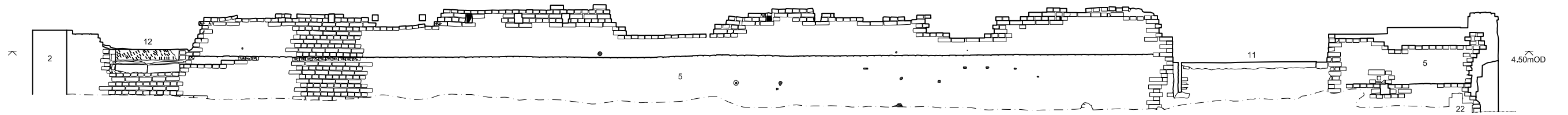
Wharf Building. South-east elevation, internal face. Wall [4].



Figure 6. Wharf Building. Wall [4], elevations  
Scale 1:75

SE

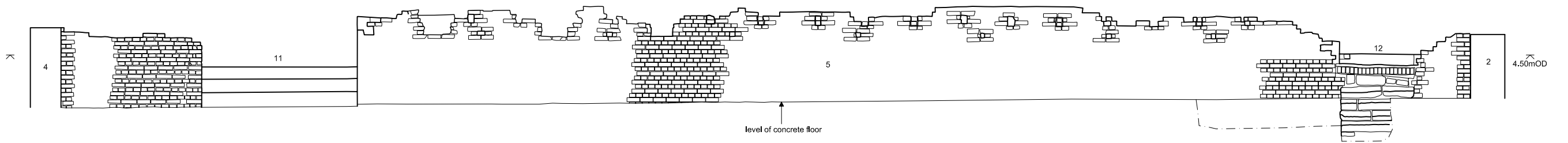
NW



Wharf Building. North-east elevation, external face. Wall [5].

NW

SE



Wharf Building. South-west elevation, internal face. Wall [5].



Figure 7. Wharf Building. Wall [5], elevations  
Scale 1:75

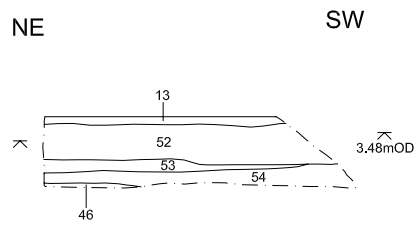
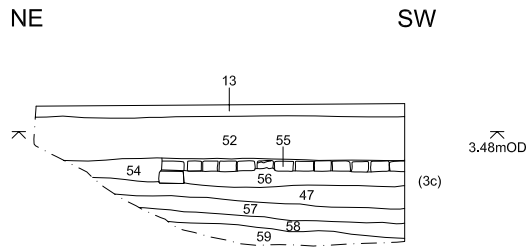
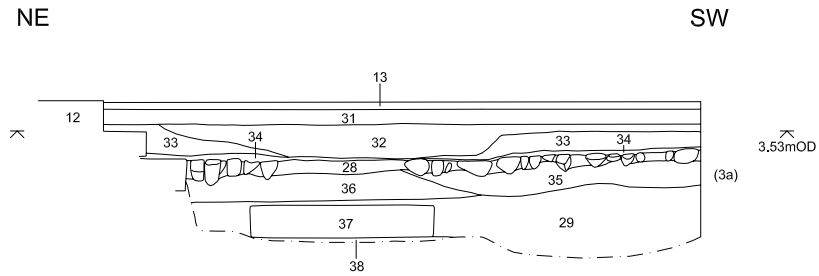
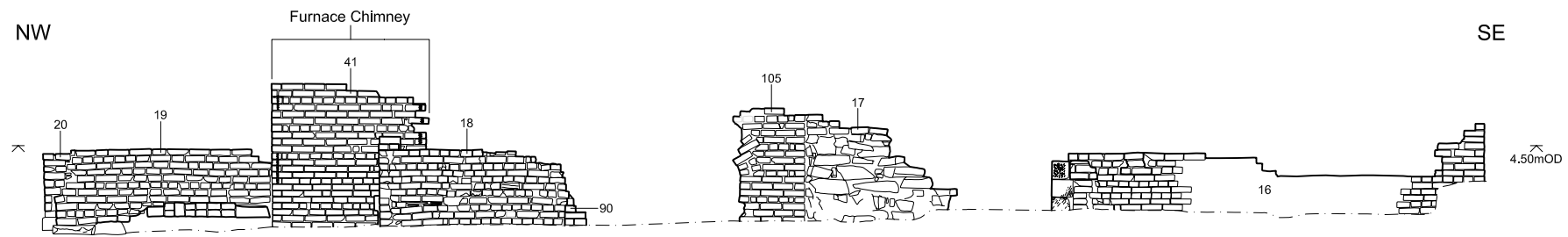
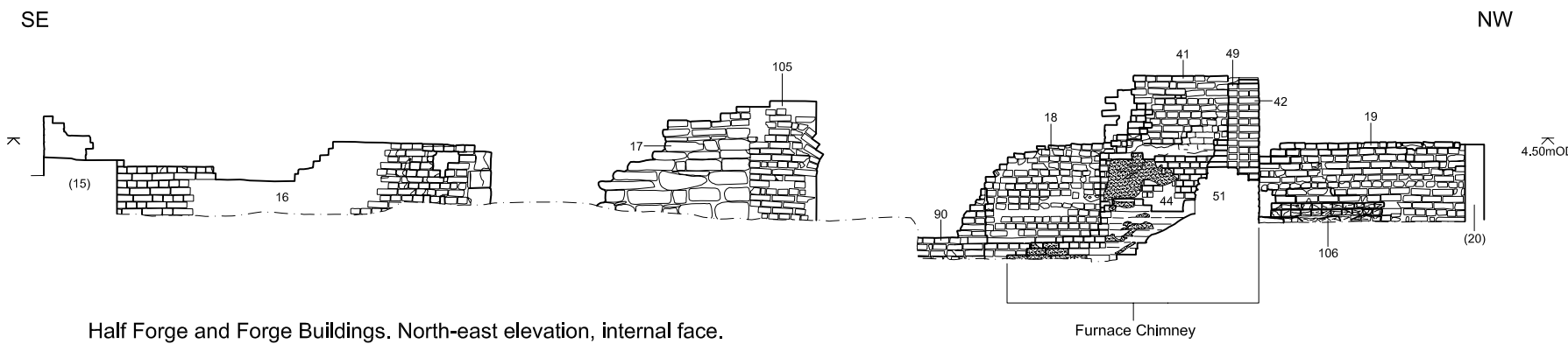


Figure 8. Wharf Building. Test Pit sections  
Scale 1:50



Half Forge and Forge Buildings. South-west elevation, external face.

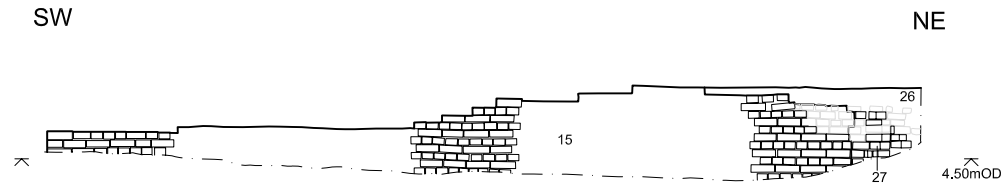


Half Forge and Forge Buildings. North-east elevation, internal face.

 slag deposits



Figure 9. Half Forge and Forge Buildings. South-west wall, elevations  
Scale 1:75



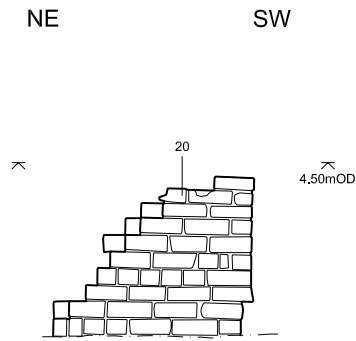
Half Forge and Forge Buildings. South-east elevation, external face. Wall [15].



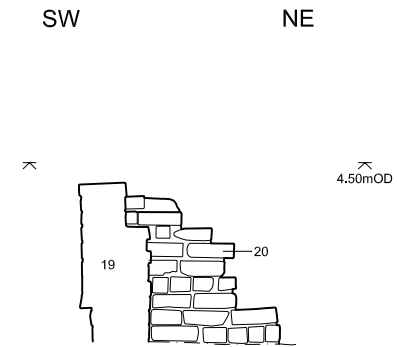
Half Forge and Forge Buildings. North-west elevation, internal face. Wall [15].



Figure 10. Half Forge and Forge Buildings. Wall [15], elevations  
Scale 1:75



Half Forge and Forge Buildings.  
North-west elevation, external face. Wall [20].



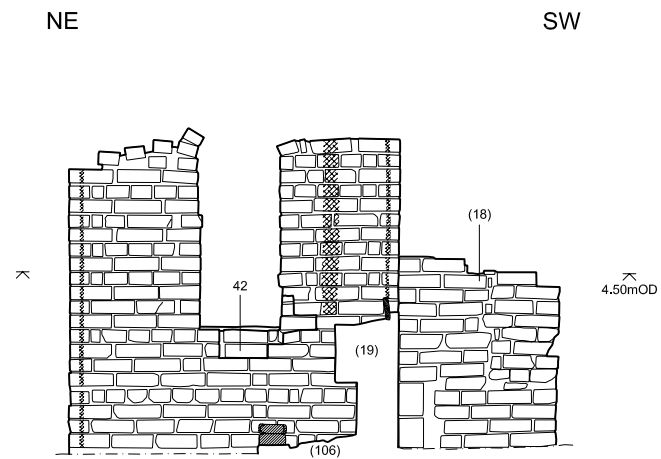
Half Forge and Forge Buildings.  
South-east elevation, internal face. Wall [20].



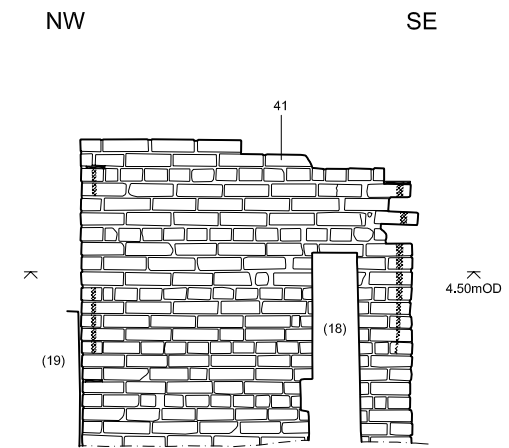
Figure 11. Half Forge and Forge Buildings. Wall [20], elevations  
Scale 1:40



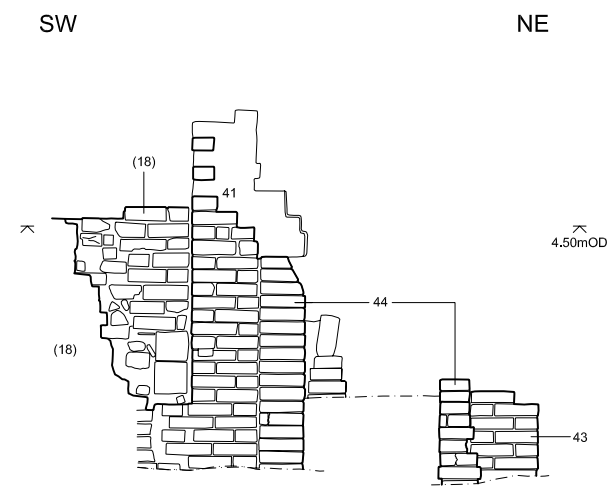
Figure 12. Furnace Chimney, detail plan  
Scale 1:50



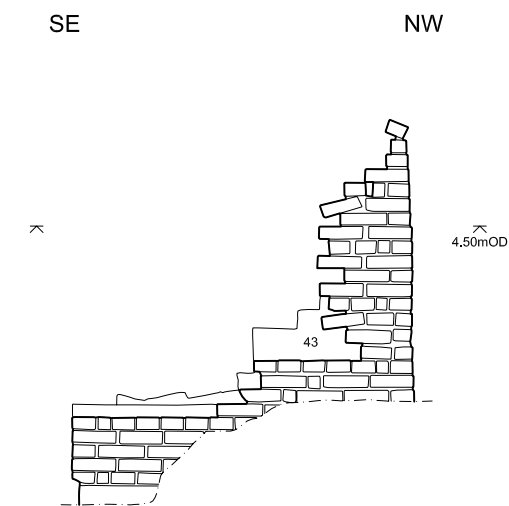
Furnace Chimney. North-west facing elevation.



Furnace Chimney. South-west facing elevation.



Furnace Chimney. South-east facing elevation.



Furnace Chimney. North-east facing elevation.

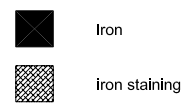
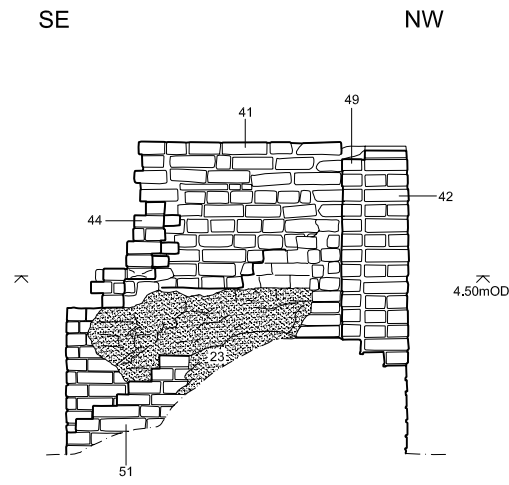
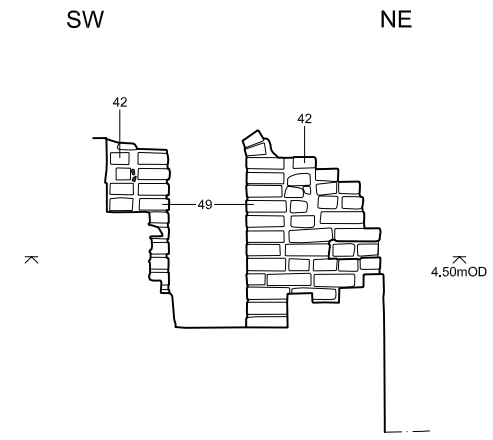


Figure 13. Furnace Chimney, external elevations  
Scale 1:40

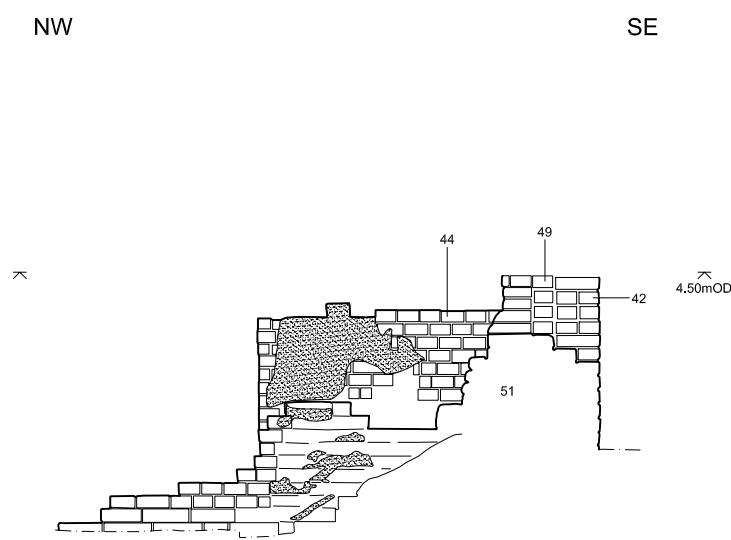




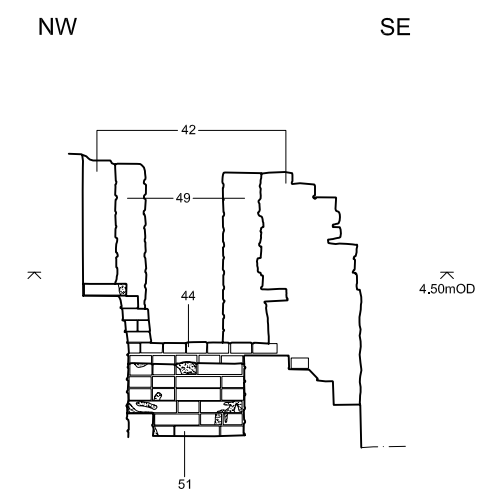
Furnace Chimney. North-east facing internal elevation.



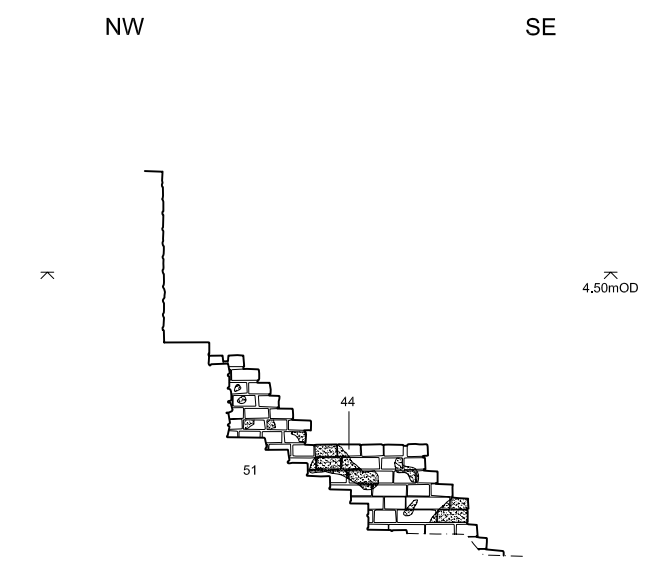
Furnace Chimney. South-east facing internal elevation.



Furnace Chimney. North-east facing internal elevation, after further excavation.



Furnace Chimney. South-east facing internal elevation, after further excavation.



Furnace Chimney. South-west facing internal elevation, after further excavation.

 slag deposits



Figure 14. Furnace Chimney, internal elevations  
Scale 1:40

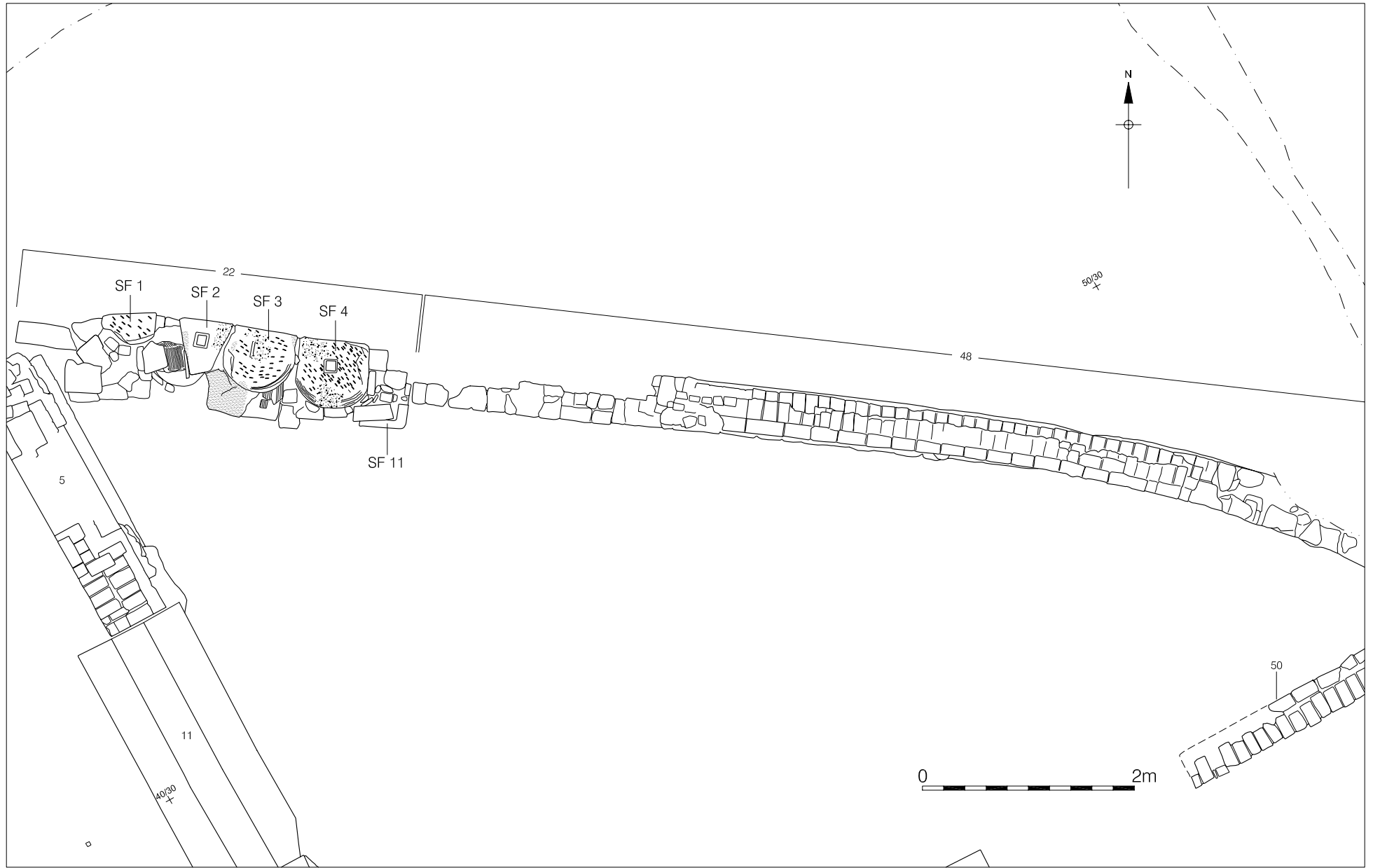
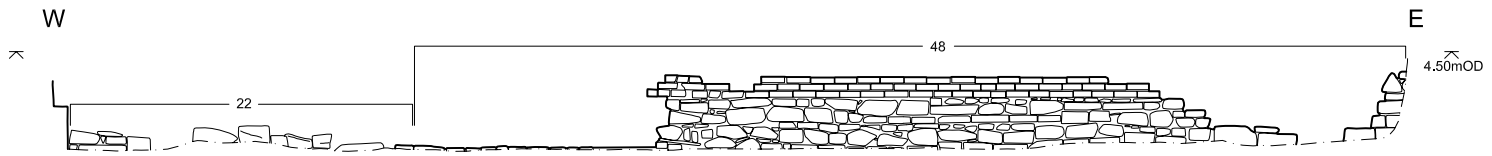
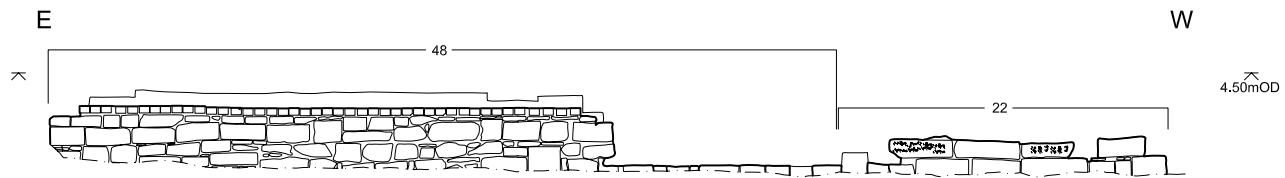


Figure 15. Retaining Wall, detail plan  
Scale 1:50



Retaining Wall, [22] and [48]. South elevation.



Retaining Wall, [22] and [48]. North elevation.



Figure 16. Retaining Wall, elevations  
Scale 1:75

## 6. DISCUSSION

### 6.1 Historical Development of Crowley's Ironworks

- 6.1.1 The first Ambrose Crowley was born in the village of Rowley Regis in the heart of the Black Country in the early years of the 17th century. Described in his will in 1680 as a 'nailer', Crowley was probably one of many in the region to combine light industry with an agricultural small-holding. His son, Ambrose Crowley (the second) was baptized in 1635 and married in 1657, having moved to Stourbridge, Worcestershire some time before. When married he too was described as a 'nailer', although later descriptions have him as a 'blacksmith' and an 'ironmonger'. His first son, also Ambrose (the third), was born in 1658 in Stourbridge.
- 6.1.2 By the 1670s, the Stourbridge-based ironworking business of the second Ambrose Crowley was thriving. Primarily involved with purchasing iron and steel at various stages of processing, as well as buying from ironmasters and forgemasters and selling to slitters, blacksmiths, nailers or merchants, some manufacturing processes were also undertaken.<sup>11</sup> Between 1680 and 1700 Crowley acquired interests in several branches of manufacture and operated two iron forges in the Stourbridge area. Pig iron was processed in these forges and bar iron was produced for local slitters to make into rod iron for nail making. Crowley also began to purchase Swedish bar iron, of superior quality to the English material and used in steel-making.
- 6.1.3 Apprenticed at the age 15 to a London merchant, the third Ambrose Crowley was soon to follow closely in his father's footsteps. He had established a nail making factory in Sunderland by 1685 and in 1691 acquired the lease of a disused corn mill in Winlaton with the intention of setting up an iron manufactory, used for the final stages of nail manufacture from rod or bar iron. Frustrated at his dependence on slitters in the Midlands for the supply of rod iron to his Winlaton factory, Crowley determined to set up his own slitting and rolling mill. The factory at Winlaton was unsuitable for such a development as it lacked water-power, but the swift flowing River Derwent was an ideal source of power.
- 6.1.4 Other factors contributed to the suitability of the Derwent Valley for an ironworks. The growth of coal mining in the area in the 17th century had led to the construction of wooden waggonways, the most important of which followed the valley of the Derwent for some distance to reach coal workings in the Pontop area. In the late 17th century other resources began to be exploited, including lead and iron deposits, and coal and charcoal were easily obtainable for fuel. Staithes on the Tyne at Blaydon and Derwenthaugh and on the lower Derwent at Swalwell provided easy access by keel to the major port at Newcastle. Crowley set up his ironworks in c. 1697 about a mile east of Winlaton, two miles above the confluence of the Derwent with the Tyne, and these became known as Winlaton Mill. Documents from 1701 refer to a furnace, probably a cementation steel furnace, and a warehouse. Records show that Crowley decided to switch to the use of brick from stone as a cheaper alternative. The works at Winlaton Mill became a substantial and important iron and steel works. Crowley built a warehouse in 1701 at Blaydon and it was here that the bar iron was landed and the finished goods exported on keels to transport goods down river to Newcastle.

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<sup>11</sup> Flinn 1962, 11.

- 6.1.5 In 1702 Edward Harrison, William Bayliss and John Wood acquired property at Swalwell with a view to setting up an ironworks and they took lease of three corn mills at Swalwell, including two from the Clavering Estate.<sup>12</sup> This indicates an intention to operate at least three water wheels and the ironworks may have been operational by 1704, since in that year Crowley was told that '*many of his nailers and pattern-ring makers had left his service at Winlton and gone to work for Mr. Edward Harrison*'.<sup>13</sup> The works at Swalwell occupied a more advantageous position than Winlton, lying on the east bank of the Derwent, less than a mile from its confluence with the Tyne, and with the river navigable for this distance.
- 6.1.6 Ambrose Crowley acquired the lease for the property from his rivals in 1707 and between this date and 1728 Crowley and his son, John, developed the business considerably, so much so that it became their principal centre of manufacture. It is not certain how much construction work was needed, as the previous occupiers probably undertook some such work, but a Swedish engineer who visited Swalwell in 1719 wrote that the works had been built by Crowley some 10 or 12 years earlier.<sup>14</sup> By 1728 the works at Swalwell included a '*plating-forge, a blade mill, an iron forge, a slitting-mill two steel furnaces, air furnaces, three warehouses, nine shops for 'odd ware', two 'houses for straitning and bundling of hoops', eight 'double hand nailers and frying pan shops', four large shops for anchors, five hoe-makers shops, one 'large paten shop' and four unspecified shops*'.<sup>15</sup>
- 6.1.7 A high proportion of nails made in Britain in the late 17th century was consumed in the shipbuilding industry and Crowley knew that the principal markets lay between Sunderland and Exeter, on the east and south coasts of England. By the early years of the 18th century, the main structure of the Crowley organisation, as it was to remain for over a century, was established, comprising three factories in Winlton and Swalwell, a warehouse in Blaydon and five warehouses in London. Crowley secured the bulk of the naval contracts by the early 18th century and stocks of material were kept at each of the six principal naval yards on the Thames Estuary and at a chain of warehouses in Ware, Wolverhampton, Walsall and Stourbridge.
- 6.1.8 R. R. Angerstein was an 18th century industrial expert who travelled extensively collecting information on advances in technology and trade for the Swedish government. He travelled throughout England and Wales in 1753–1755 and a translation of his works was published in 2001.<sup>16</sup> This work includes an account of '*Mr Crowley's bar-iron forges and iron-fabricating works called Swalwell*'. The topographical location of the works was noted as being of particular importance:
- 'Swalwell is located by the river Derwent, where it flows out into the Tyne, so that above it there are waterfalls that provide power and below there is a channel that is navigable when the tide is high. The ships that come from Newcastle and Shields, the former 3 miles away and the latter 11 miles, can discharge their cargo inside the storehouse and load up again at the works.'*

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<sup>12</sup> Flinn, 1962, 52-53.

<sup>13</sup> *ibid.*

<sup>14</sup> *ibid.*, 54.

<sup>15</sup> *ibid.*

<sup>16</sup> Berg and Berg 2001.

- 6.1.9 Angerstein's account describes the Swalwell works as comprising:
- 'a bar-iron forge with two hearths, a plating forge making various sheets for pans, a slitting mill, two steel furnaces, a foundry with two furnaces and a grinding mill with three stores. There are also 22 workshops for the forging of hoes for the West Indian tobacco plantations, with three workmen in each; three anchor forges with six workmen in each; three shops for screws and rods for beds; one shop for iron for bolts and screwbars, etc; three shops with three people each for harpoons and other equipment for catching whales; one shop for balances and lifting jacks; two for machetes or fascine knives to cut sugar canes; two for fire-irons, consisting of pokers, fire-tongs and shovels; three for 'Capucher' for sugar mills or the gudgeons for sugar crushing rolls; one shop for braziers to place on the table and other such articles; two for ship's nails; ten for smaller nails and also many for hammers and other blacksmiths' tools.'*
- 6.1.10 Angerstein noted that pig iron for the works was transported from London and originated from England and America. At the time of his visit there were three steel furnaces that utilised Swedish and Russian iron. The iron foundry made all sorts of small castings such as pots, and door knockers and the cast iron used for such things consisted of old cannon and other old iron purchased in Holland and occasionally Sweden. The grinding mill had six stones and items such as files, axes, flat irons, hoes, mattocks and carpenter's and shipwright's tools were fashioned there.
- 6.1.11 The account also provides detailed information about the wages paid to each type of worker, and for most classes of job workers were paid by the quantity of goods they produced rather than a set wage. The workers who lived in the factory compound paid for coal, tools and lodgings and also paid money for the support of widows, children and the poor, such contributions being made by everyone in employment at the factories of Ambrose Crowley.
- 6.1.12 As a result of bequests in Crowley family wills, the Crowley business became known as Crowley, Millington and Company and the Millingtons administered the business from 1782 to 1863. The company continued to be of major importance in the North East in the later 18th century. The Winlaton factory was closed in 1816, but the Swalwell, Teams and Winlaton Mill factories continued in use. The early 19th century witnessed the growth of local competition, including the Hawks family who established an extensive business manufacturing ironware for the Navy and the East India Company. The Swalwell and Winlaton Mills did not survive, due to technical advantages and competition both locally and elsewhere, as well as the rise of canal transport, which favoured new centres of production further south. The Swalwell works were taken over by Messrs Ridley and Co., as discussed above, who operated the site until 1911.

## 6.2 The Wharf Building

- 6.2.1 The Wharf Building is shown on the 1718 map of Crowley's Ironworks, annotated as '*Wharf B*' with '*Pool A*' to the west, the latter annotated as '*The pool for Boats or Keels to come into*' (Figure 17). The walls of the structure are annotated on the 1718 map as '*Walls on the ? of Wharf B to support Ground floor*'. Angerstein's mid 18th century description of the ironworks notes that vessels '*can discharge their cargo inside the storehouse*'.<sup>17</sup> Thus, the three wide openings in the west wall would have functioned as loading bays where materials could be unloaded from shallow draught vessels on the watercourse. Indeed, the openings are annotated on the 1718 map as '*Openings between the walls to Land Goods on Wharf B*'. Other documentary evidence tells us that iron bars arrived at the Wharf Building, transported on flat-bottomed keels the short distance from staithes at Blaydon or Swalwell.<sup>18</sup>
- 6.2.2 The area to the east of the Wharf Building is annotated on the 1718 map as '*Passage between Wharf B and the ½ forge*'. The wide entranceway in the eastern side of the Wharf Building would have allowed easy ingress and egress of workers and materials between that building and the Half Forge Building. This entrance is shown on the 1718 map and annotated '*Opening from Wharf B to the ½ forge*'. The opening in the northern end of the Wharf Building was probably a doorway for pedestrian access. The 1718 map annotates this as '*Opening into the Water from Wharf B*', although the map shows that the northern end of the building does not front directly onto the water, with a small area of land between the building and the watercourse. The area beyond the southern end of the building is shown on the 1718 map as '*Road Q*' with '*the high Wharf or Road Way so called*'. The width of the opening at the southern end of the building is indicative of a pedestrian entrance and this opening is also shown on the 1718 map annotated '*A ?wall to support Road Q and an Opening between there and Wharf B*'.
- 6.2.3 Bricks associated with the earliest phase of construction of the Wharf Building were hand-moulded, varying slightly in size and appearance, and are not closely datable. The material examined for the assessment was closer in character to brick types that, in this region, date from the period c. 1750-1800 (see Section 8). In the absence of a comprehensive regional brick type series from closely dated buildings for the 18th century, this possible anomaly could be due to later 18th century rebuilding of the Wharf Building on the earlier footprint or it could simply reflect differences in technique and quality among local brickmakers of the period. In general, there is excellent concordance between the excavated remains of the Wharf Building and '*Wharf B*' as shown on the 1718 map. The building shown on the map has openings in the north, south and east walls, in the same position as those identified as the earliest phase of construction of the excavated Wharf Building. Precise details of the west wall are difficult to decipher on the map, but entrances into the building from Pool A are annotated along the length of this wall. Therefore, the preferred interpretation is that the Phase 2 Wharf Building is of early 18th century date rather than being a rebuild on the same footprint from later in the 18th century. The supposed date range for the earliest handmade bricks in the structure should, therefore, be extended back to the first quarter of the 18th century.

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<sup>17</sup> Berg 2001, 260.

<sup>18</sup> Flinn 1962, 123.

6.2.4 The Wharf Building is shown on the 1870 plan as an '*iron warehouse*' with the watercourse to the west (Figure 19) and is still extant by the time of the Ordnance Survey 2nd edition from 1897, by which date the site had been taken over by the Northumberland Paper Mills (Figure 20). The Wharf Building was still shown on the 1960 Ordnance Survey map, by which time the Northumberland Paper Mills were disused (Figure 22), being demolished soon after this date. The most recent changes to the internal floor levels of the Wharf Building, *i.e.* the latest concrete floor, along with evidence of an internal racking/storage system, almost certainly date from the 20th century, but pre-1960. Brick samples taken from the infilling of an opening in the west wall date from the early 20th century.

### **6.3 The Half Forge and Forge Buildings**

6.3.1 The earliest structural elements of the structure to the east of the Wharf Building concord closely, in terms of both construction techniques and materials, with the earliest structural phase of the Wharf Building. This suggests that these elements derive from the same phase (Phase 2) of early 18th century construction and, accordingly, they have been interpreted as representing parts of the external walls of a structure, the Half Forge Building, annotated on the 1718 plan as the '*½ forge*' (Figure 19). An entrance into the building from the west may be represented by the fragmentary remains of an arch in its west wall.

6.3.2 The 19th century (Phase 6) brick walls of the Forge Building represent a rebuild of the Phase 2 Half Forge Building. Materials from the earlier structure appear to have been utilised for this rebuild, with the southernmost portion of the structure evidently remaining largely intact. The Ordnance Survey 1st edition of 1865 shows a rectangular building in this location (Figure 18). The 1870 plan of Swalwell Ironworks shows a larger building annotated '*FORGE*' in this location, this being rectangular but missing its north-western corner (Figure 19), and with a very similar layout as the excavated structure. The indication, therefore, is that the Forge Building was rebuilt between 1865 and 1870. Stamped firebricks utilised in the construction of its walls date to the period 1850-1906. The Forge Building was still extant on the 1919 Ordnance Survey map (Figure 21), but had been demolished by the time of the 1960 edition (Figure 22).

### **6.4 The Furnace Chimney**

6.4.1 The Phase 7 Furnace Chimney has been interpreted as the chimney end of a 'puddling furnace'. This was the 18th century invention of Peter Onions, patented by Henry Cort in 1783-4, with the first example being founded in Wortley, Yorkshire. It was designed to create wrought iron from pig iron produced in a blast furnace. Since pig iron contains carbon and other impurities it is brittle, so the puddling furnace was designed to burn off these impurities to produce malleable, low-carbon steel. The important design detail pulled hot air over the pig iron, without the iron coming into direct contact with the fuel. The fire was situated in a chamber at the opposite end of the structure to the chimney and the iron was placed in a second chamber on a grate, separated from the fire by a bridge. The structure had an arched roof so that the heat bounced off the ceiling and was directed onto the iron. The chimney had a damper at the summit to regulate the draught that pulled the heat over the pig iron.



- 6.4.2 Puddling furnaces were prepared for use by painting the grate and the enclosing walls with iron oxides, typically hematite. The iron was placed in the grate and allowed to melt there, mixing with the oxides, and the mixture was then stirred with a 'rabbling bar', a long iron rod with a hook at one end. The oxygen from the oxides reacted with the impurities in the pig iron to form gases that were removed via the chimney. More fuel was then added to raise the temperature and melt the iron completely, causing the carbon to start to burn off and slag to rise to the surface. Eventually, after most of the carbon had burned off, iron formed as spongy plastic material. The hook on the end of the rabbling bar was used to pull out large 'puddle-balls' of this material. The iron would then be reheated and rolled into flat bars or round rods.
- 6.4.3 Firebricks used in the construction of the Furnace Chimney at Swalwell all post-date 1850, with the majority in the range 1850-1906. One stamped example, from the external wall of the structure, post-dates 1869. Documentary evidence demonstrates that Swalwell Ironworks were in decline by the mid 19th century, closing in 1853. The works were sold to Powe and Fawcus in 1863 and were auctioned in 1870 and later leased to Ridley and Company who established a steel foundry, incorporating forges, hammers, smiths' shops and machine shops, on part of the former ironworks site in 1893. These works finally closed in 1911. It is probable that the Furnace Chimney recorded at the site may have been constructed during the use of the site by Ridley and Company, therefore dating to the period 1893-1906.

## **6.5 The Retaining Wall**

- 6.5.1 The Retaining Wall for the south side of the watercourse that formerly occupied the northern portion of the excavation area is interpreted as being of 19th century origin. The watercourse is known to have been in existence during earlier periods; for example, it is annotated on the 1718 map as '*Corn Mill Race*'. It was, therefore, originally associated with a 17th century mill known to have been sited to the west of the area of investigation (Figure 17). However, the excavated remains are demonstrably of later origin, as evidenced firstly by the materials utilised in their construction and, secondly, by cartographic evidence. The 1718 plan (Figure 17) and the 1802 Clavering plan show a retaining wall further to the north, leaving a small strip of land to the between the watercourse and the Wharf and Forge Buildings.
- 6.5.2 By the time of the Ordnance Survey 1st edition map of 1865 and the detailed plan of 1870, the watercourse had been widened, with the Retaining Wall as recorded, in place to the south of its former line (Figures 18 and 19). By this stage, the structure ran from the north-east corner of the Wharf Building to the north-east corner of the Forge Building. Thus the Phase 6 Retaining Wall was constructed in the period 1802-1865. The plan from 1870 shows a bridge crossing the watercourse in the area between the Wharf Building and the Forge Building, approximately in the location of the narrow section of Retaining Wall [48] (Figure 19).
- 6.5.3 Although no absolute dating or stratigraphic evidence can confirm a relationship between the 19th century rebuilding of the Forge Building and the Retaining Wall, it is considered probable that they were undertaken broadly contemporaneously, since both represent significant structural alterations in this part of the site. For this reason, the two episodes have been placed in the same broad phase of activity dated to the second half of 19th century.

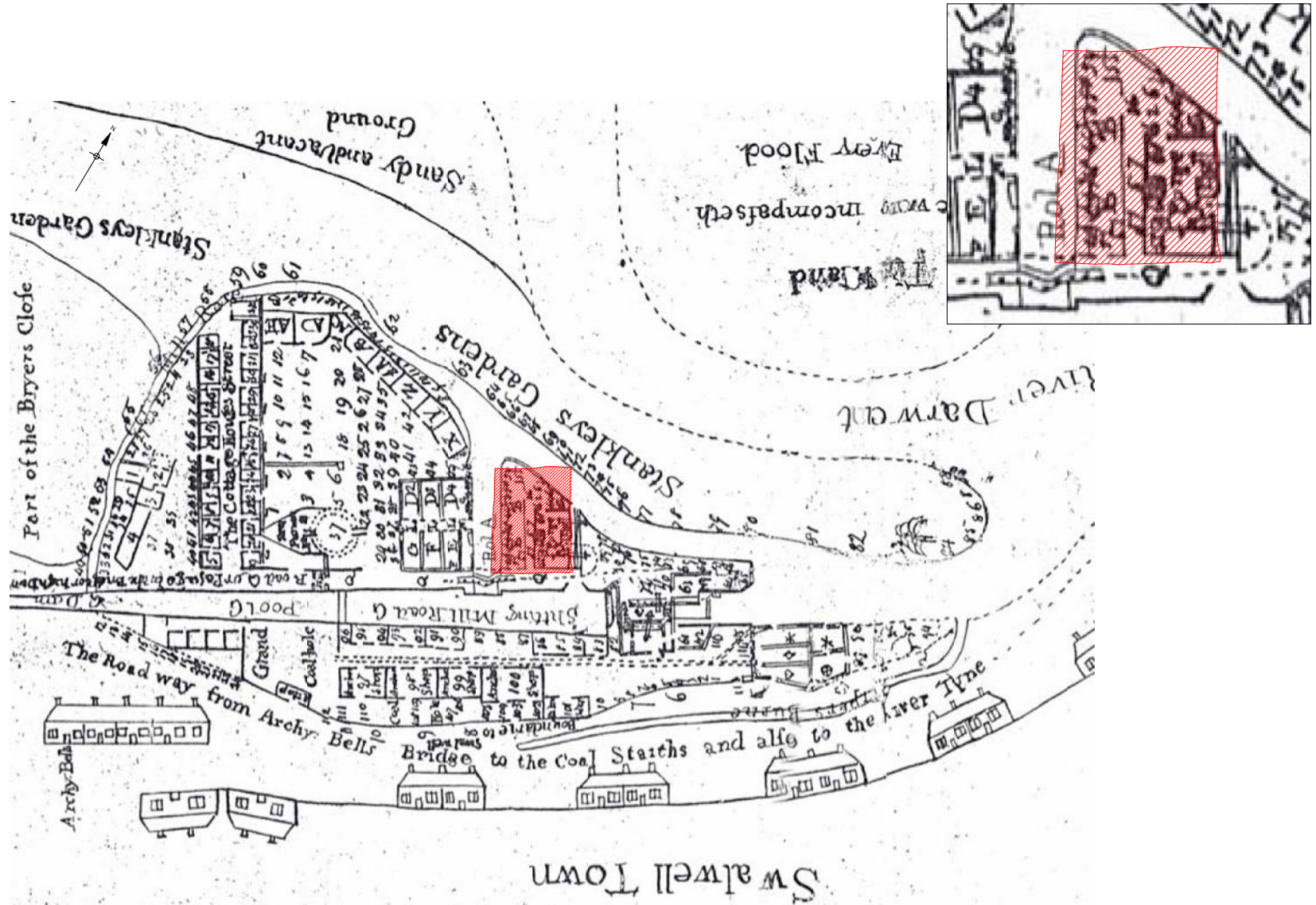


Figure 17. Map of Crowley's Ironworks, c. 1718

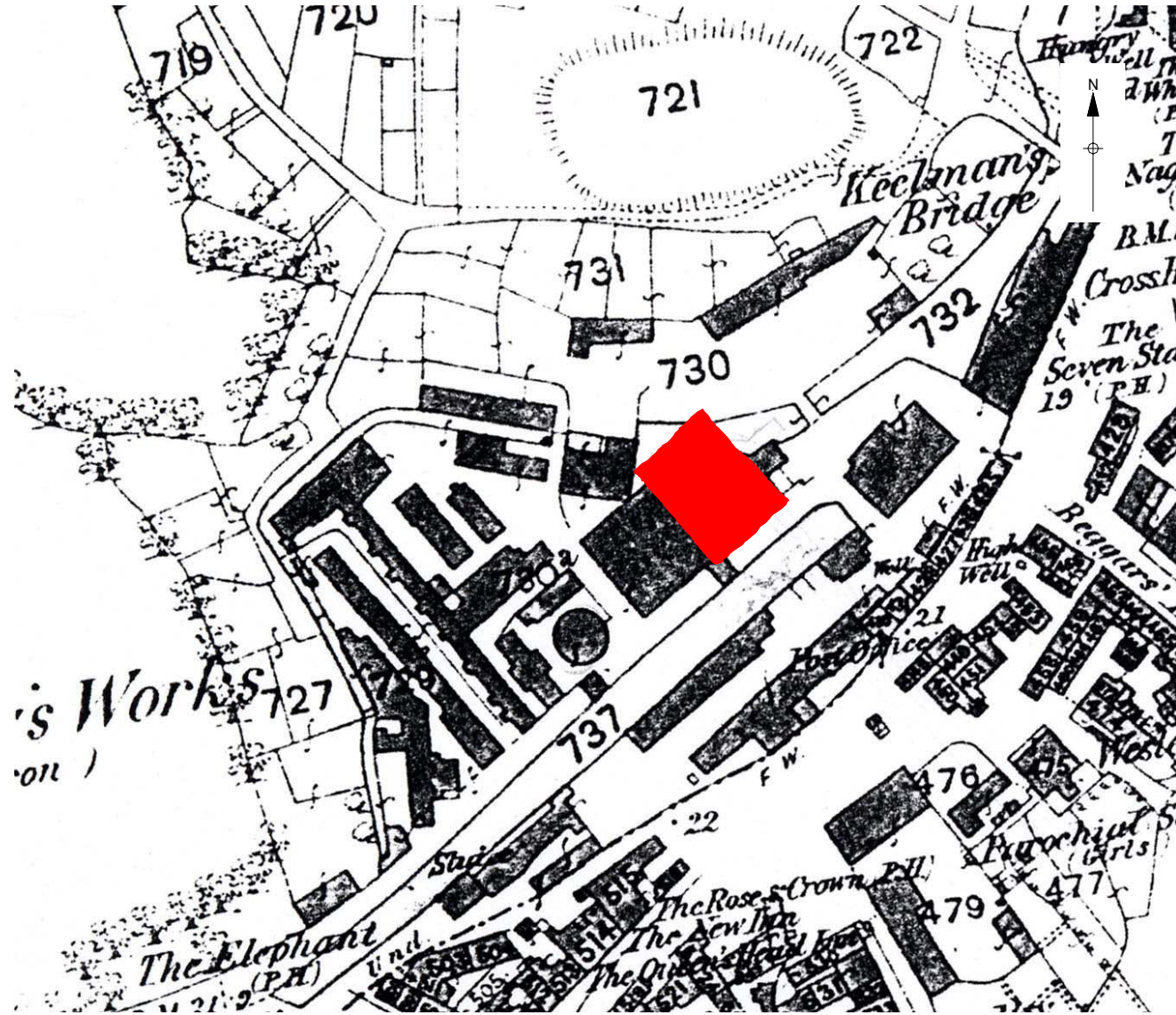


Figure 18. Ordnance Survey 1st Edition, 1865



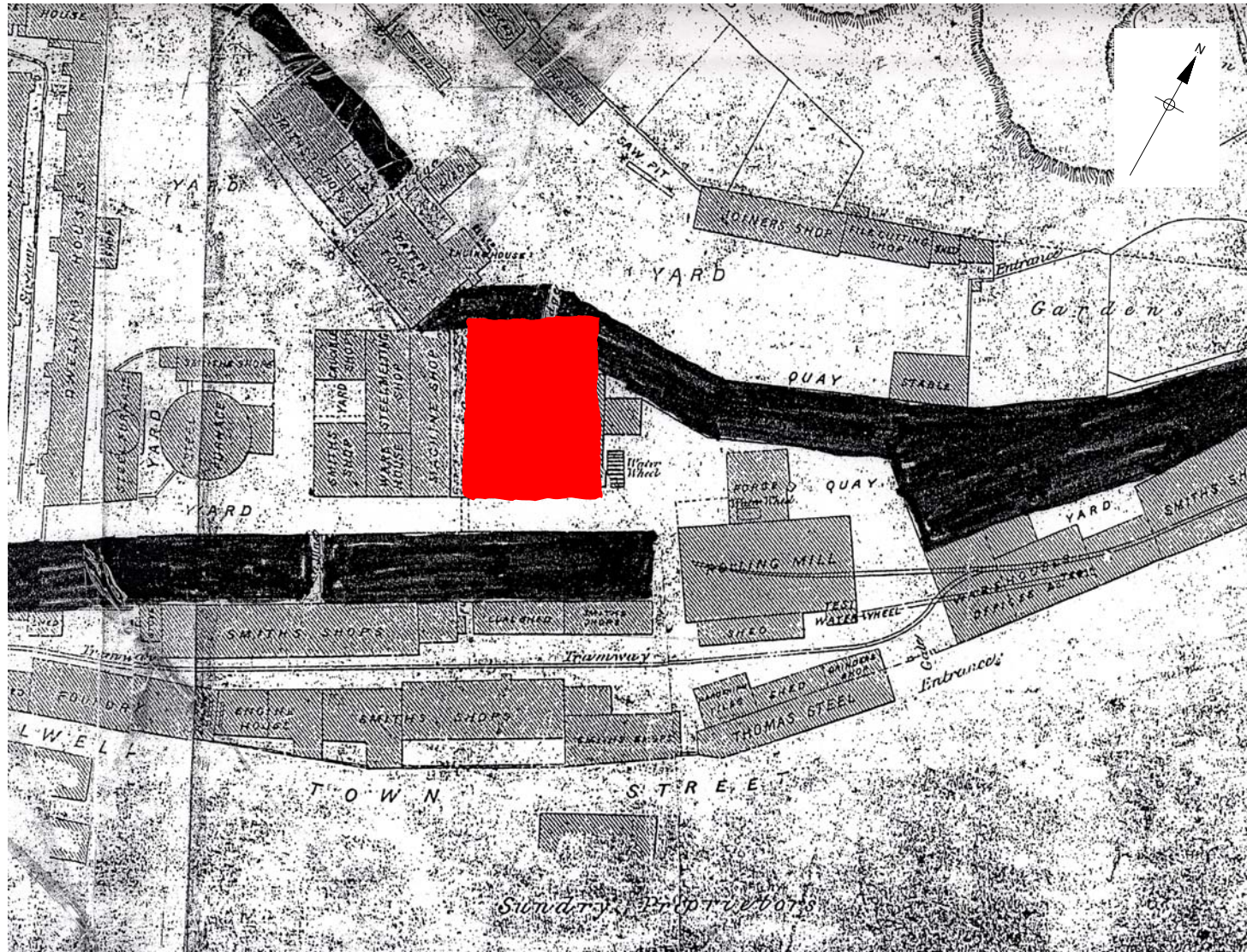


Figure 19. Plan of Swalwell Ironworks, 1870



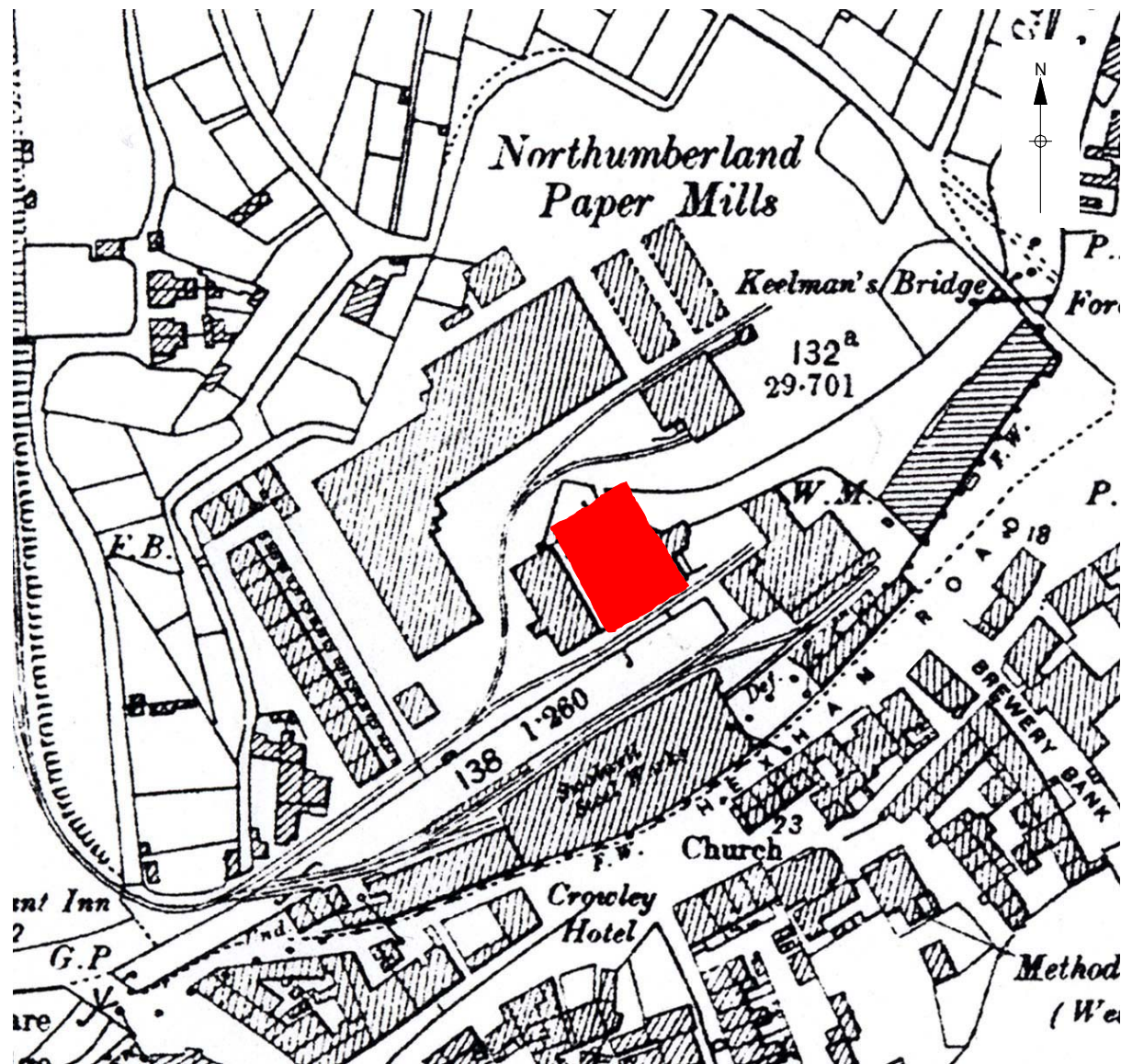


Figure 20. Ordnance Survey 2nd Edition, 1897

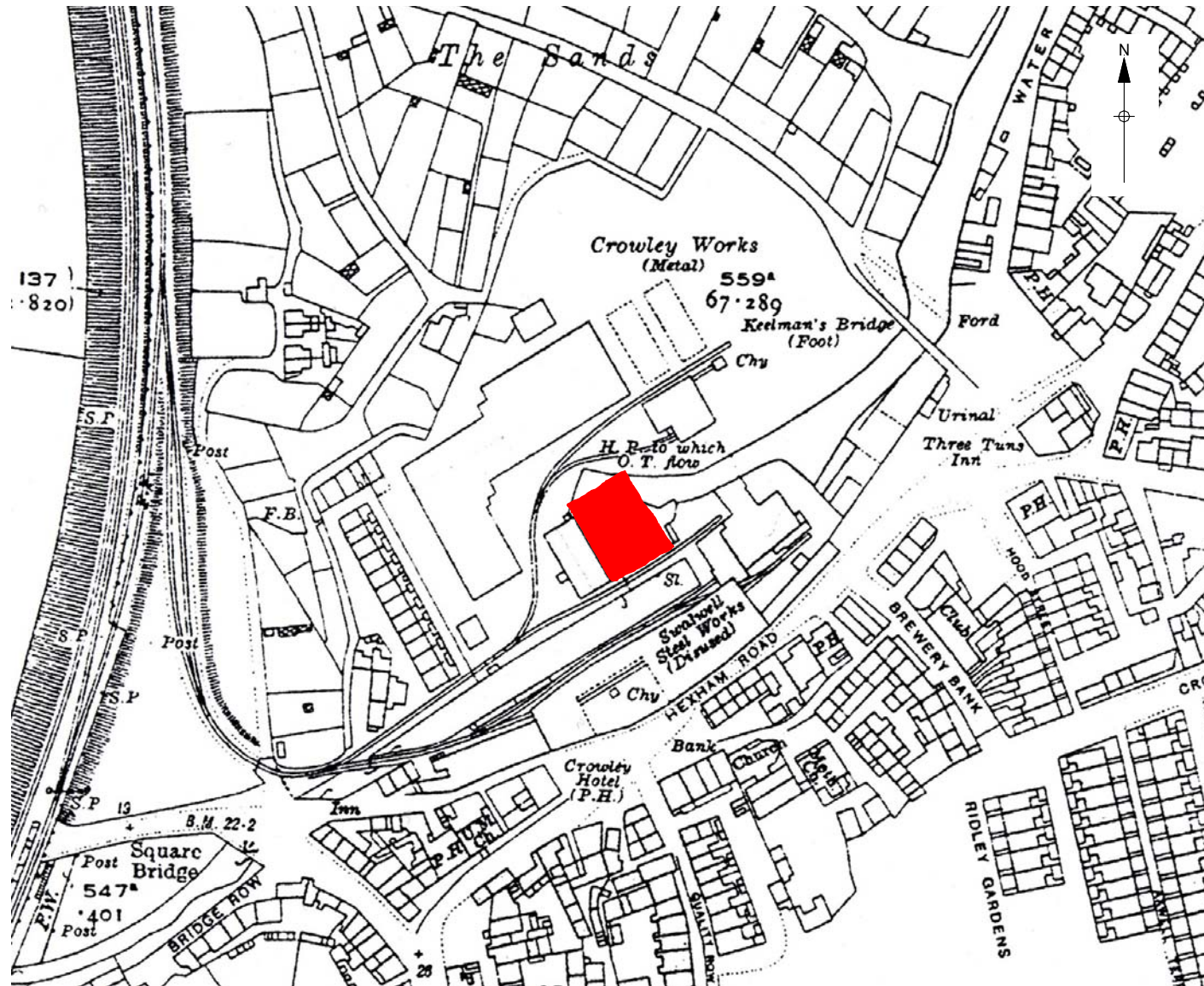


Figure 21. Ordnance Survey 3rd Edition, 1919



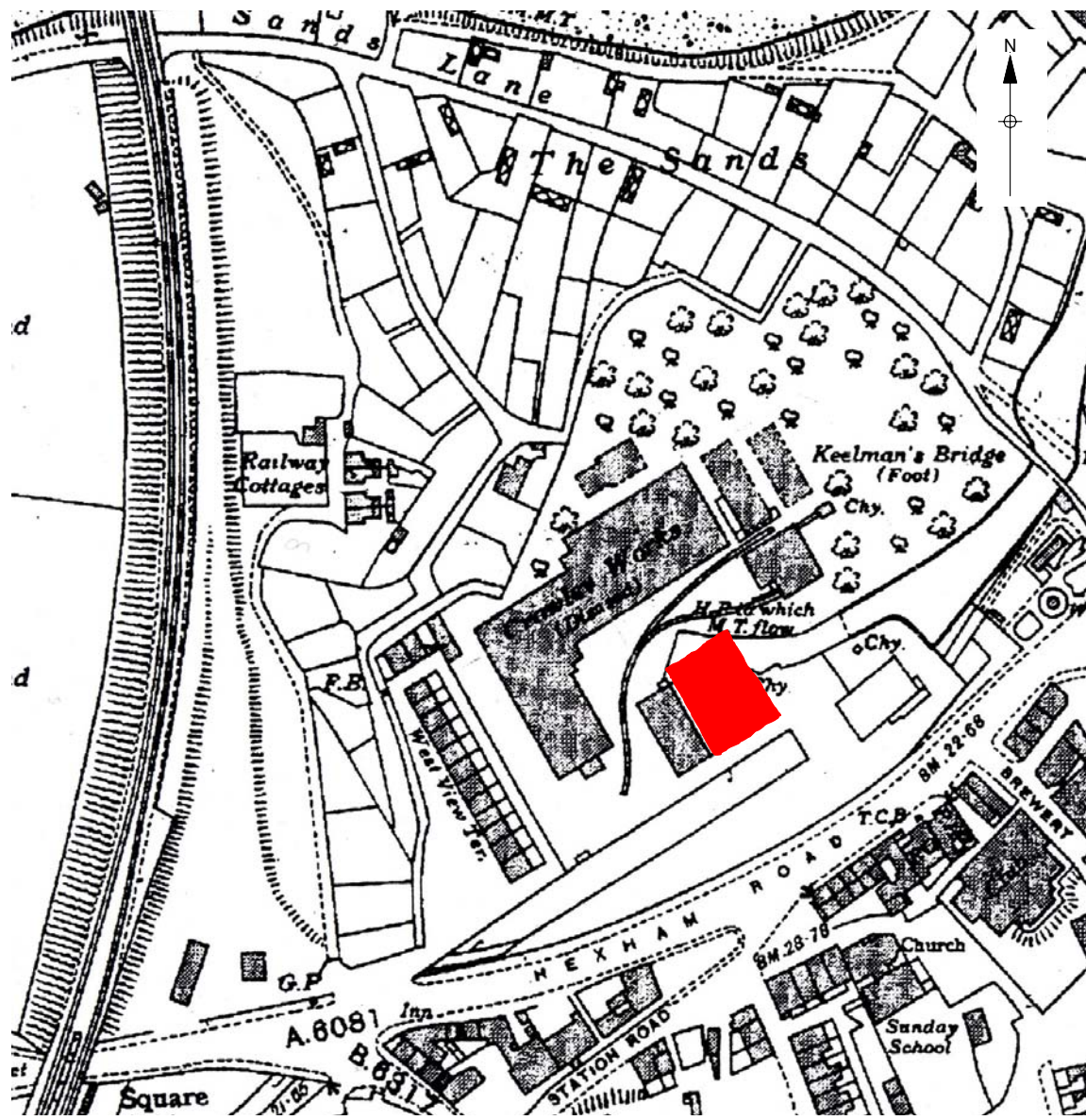


Figure 22. Ordnance Survey, 1960

***PART B:***  
***DATA ASSESSMENT***



## 7. STRATIGRAPHIC DATA

### 7.1 Written and Graphic Records

7.1.1 The contents of the paper archive are set out in Table 7a.

<i>Item</i>	<i>No.</i>	<i>Sheets</i>
Context Register	1	3
Context/Masonry Sheets	106	106
Elevation/Section Register	1	2
Elevation/Section Drawings	53	119
Plans	12	81
Sample Register	1	5
Sample Sheets	89	89
Small Finds Register	1	1

*Table 7a: Quantification of paper records*

### 7.2 Photographic Records

7.2.1 The contents of the photographic archive are set out in Table 7b.

<i>Item</i>	<i>No.</i>	<i>Sheets</i>
Colour Slide Register	6	12
Colour Slides	212	12
Monochrome Print Register	6	12
Monochrome Prints	212	29
Monochrome Negatives	212	12
Digital Colour Register	1	1
Digital Colour	40	n/a

*Table 7b: Quantification of photographic records*

### 7.3 Project Archive

7.3.1 The paper and photographic archive is currently housed at the Northern Office of Pre-Construct Archaeology Limited.

7.3.2 The complete project archive, comprising written, drawn, and photographic records (including all material generated electronically during post-excavation) and all 'finds' (see the following sections) will be packaged for long-term storage according to relevant guidelines.<sup>19</sup> The archive will be deposited with Tyne and Wear Museums Service for permanent curation. The depositional requirements of the receiving body will be met in full.

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<sup>19</sup> UKIC 1990.

## 8. BRICK ASSESSMENT

By: *John Nolan (NCAS)*

### 8.1 Introduction

- 8.1.1 During the excavation, 55 whole or partial bricks were collected as brick 'samples', along with 15 slag samples (Samples 9, 10, 13–18) adhering to brick. For this assessment, the combined assemblage, which comprised 62 actual brick fragments, has been examined. The samples came principally from standing structures.
- 8.1.2 Most of the material was press-moulded firebrick, some with stamps of makers operating in the period 1830-1920. There were also some common bricks, mostly hand-moulded, and of sizes and appearance which could span the mid 17th-mid 19th centuries. A few pressed common bricks were probably of late 19th-early 20th century date.
- 8.1.3 Most of the samples were complete bricks, though others were recovered having been broken and reused. Two samples (Brick Samples 9 and 14) from context [23] comprised lumps of mortared brickwork fragments, showing coursing that mixed firebricks and closers.

### 8.2 Methodology

- 8.2.1 All samples were individually visually examined, described and, where meaningful dimensions survived, measured. Details are shown in Table 8a, below. Firebricks with maker's stamps were identified using the lists in '*Brickworks of the North East*'.<sup>20</sup> Common handmade bricks were compared with examples from dated structures elsewhere on Tyneside, using the reference collection held by NCAS.

### 8.3 Range and Variety

- 8.3.1 Firebricks formed the bulk of the samples (45 examples). All appeared to be press-moulded. A range of forms were represented, including a quarl, a split or half-thick brick, and wedges and closers for building kiln arches. Four firebrick manufacturers were represented by maker's stamps.
- 8.3.2 The most common brick stamp represented in the assemblage with 14 examples was '*Hannington*', made by Hannington and Company of Swalwell, operating from 1850-1906.<sup>21</sup> One brick of this type was recovered from contexts [15], [17], [19], [23], [42], [43], [51], and [105] with six examples recovered from context [44] (Brick Samples 9, 10, 13, 16, 58, 105, 109, 123, 128, 131, 201, 202, 204, 205). Most stamps were on square bricks, but there were also two 'crowns' or 'closers' and a side wedge.
- 8.3.3 There were three '*Ramsay*' stamps, products of G.H. Ramsay and Company's works beside Derwent Gut, Swalwell, operating from 1830-1920.<sup>22</sup> These were recovered from contexts [19], [23] and [42] (Brick Samples 14, 124, 129). One stamped brick, from context [42], was a 'bull-head'.

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<sup>20</sup> Davison 1986.

<sup>21</sup> *ibid*, 131.

<sup>22</sup> *ibid*, 132; 138.

- 8.3.4 There were two ‘*Snowball*’ stamps, from the firebrick works of J. Snowball and Sons established at Swalwell in 1875 and operating until 1925.<sup>23</sup> These were recovered from contexts [2] and [48] (Brick Samples 45, 115). One stamp, that from context [2], was on a wedge.
- 8.3.5 The assemblage contained one firebrick brick stamped ‘*Walbottle*’, a product of the Walbottle Coal and Firebrick Company, working from 1869-1906.<sup>24</sup> This was recovered from context [42] (Brick Sample 126).

## 8.4 Dating

- 8.4.1 The dates of operation of the named makers spanned 1830 to 1925, though none of the brick could be confidently dated earlier than the 1850s. The date ranges suggest these bricks derive from building/rebuilding activity on the site between c. 1860 and the early 1900s, including construction and use of the Furnace Chimney and its linings, and substantial repair or rebuilding of wall contexts [15]-[19] of the Forge Building.
- 8.4.2 Most of the common bricks (17 samples) were apparently hand-moulded, varying slightly in size and appearance, and not closely datable. One form appeared closest to excavated examples from Gateshead dated to c. 1650, but could be a broadly second half of the 17th century to mid 18th century type. Another was closely paralleled by brick from Lemington Glass Cone, built c. 1787. Interestingly, the sample material from the walls of the Wharf Building, which is thought from cartographic sources to have been in existence by at least c. 1718, is closer in character to brick types of the period c. 1750-1800 (Brick Samples 47, 174 from walls [2] and [5]). In the absence of a comprehensive regional brick type series from closely dated buildings for the 18th century, this apparent anomaly could be due to a later 18th century rebuilding of Wharf Building on the earlier footprint, or, perhaps more likely, simply reflects differences in technique and quality among local brickmakers of the period.
- 8.4.3 There was evidence for reuse of brick within the site. The Retaining Wall (context [48]) flanking the Derwent Gut incorporated a range of types dating from the 18th century (Brick Sample 114) to possibly the early 20th century (Brick Sample 117), and wall [16] within the Forge Building incorporated firebrick with traces of vitrification (Brick Samples 61 and 62).

## 8.5 Recommendations

- 8.5.1 Documentary research may help to identify rebuilding and alterations not identifiable from the plan or excavation record, and provide firmer dating for the unmarked common bricks.
- 8.5.2 The handmade common brick in the assemblage has the potential, if the structures from which they derive can be closely enough dated, to add to knowledge of local post-medieval brick forms and their development.
- 8.5.3 *Ex-situ* thermoluminescence dating is unlikely to significantly refine the broad dating of the handmade common brick, and there is a possibility that the sample material could have been affected by processes involving high temperatures during the lifetime of the works, affecting the results of such scientific dating.

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<sup>23</sup> *ibid.*, 132; 136.

<sup>24</sup> *ibid.*, 89.

## **8.6 Storage and Curation**

- 8.6.1 The bricks are archivally stable and require no conservation treatment.
- 8.6.2 It is recommended that the most complete examples of each brick form are retained, and that the retained assemblage contain at least one example of each maker's stamp.
- 8.6.3 It is desirable that examples of each brick form and maker's stamp should ultimately be represented in a regional brick type series.

<b>Context</b>	<b>Phase</b>	<b>Sample</b>	<b>Type</b>	<b>Quantity</b>	<b>Maker</b>	<b>Dimensions</b>	<b>Comments</b>	<b>Date Range</b>
2	2	47	housebrick	1		230x115x65mm	moulded?, mid red, wiped upper surface, white mortar with coal incls., faint combed frog	1750-1800?
5	2	174	housebrick	1		232x115x63mm	handmade?, mid red, yellow/buff 'wash', dimpled upper surface, faint combed frog on underside, one end sooted, others white mortar with coal flecks. Size and appearance like brick from Lemington Glass Cone, cc.1787.	1750-1800?
6	3	49	housebrick	1		241x113x60mm	handmade, orange-red, shell imp on bottom, upper surface dimpled, one side slightly sooted, others have grey mortar with coal & lime flecks	1750-1800?
6	3	50	housebrick	1		238x124x67mm	handmade, dk red with some s/stone incls, one side sooted, others with grey mortar and coal & lime flecks. No frog.	1750-1800?
7	3	52	firebrick	1		240x111x74mm	stained orange-brown, one face slightly sooted, others have grey mortar with lime flecks, frog with two 'screwhead' imps	1700-1750?
8	5	53	housebrick	1		232x112x62mm	mid red, some lge s/stone inclusions, one side clean, others with grey mortar with coal and lime flecks. Faint combed frog	1750-1850?
15	2	56	firebrick	1		0x72x52mm	crown or closer, gritty white disc. Yellow buff, white mortar all but one end.	post-1850
15	2	58	firebrick	1	Hannington?	0x0x0mm	gritty white but discoloured, sooted one side, others with grey-white mortar with coal & lime flecks.	1850-1906
15	2	59	housebrick	1		225x110x61mm	handmade, one side clean, others with grey mortar flecked with coal and lime, upper surface dimpled. Faint combed frog.	1750-1800?
15	2	60	housebrick	1		230x113x63mm	handmade, mid red with reduced core, sooted one side, others with grey white mortar with coal & lime flecks	1750-1800?
16	2	61	firebrick	1		230x117x70mm	gritty white, broken end has purplish disc. And some glassy bubbled vit; one side has heavy dk purple encrustation perhaps to inside of furnace?	post-1850
16	2	62	firebrick	1		230x115x69mm	gritty white, sooting on one side, grey/white mortar with coal flecks other faces. Some vit under mortar suggests reuse.	post-1850
16	2	63	housebrick	1		0x105x67mm	broken, handmade, dk red, sooted on all faces with white mortar with coal & lime flecks.	1750-1800?
16	2	64	housebrick	1		228x110x62mm	handmade, red with grey reduced core, slight sooting one side, others have white mortar. Faint combed frog.	1750-1800?
17	6	105	firebrick	1	Hannington	0x116x63mm	broken, gritty white, one side clean, others with grey/white mortar with coal and lime flecks.	1850-1906
18	6	122	housebrick	1		235x112x60mm	handmade, mid red, sooted sides, other faces have white mortar, mouldmarks on upper face (wiped), faint combed frog on underside.	1750-1800?
19	6	129	firebrick	1	Ramsay	232x116x63mm	sooted one side, others with white mortar with coal & lime flecks	1830-1920
19	6	130	housebrick	1		235x100x62mm	handmade, red, as sample 59, slight sooting one side, others have white mortar.	1750-1800?
19	6	131	firebrick	1	Hannington	234x115x60mm	gritty white disc yellow, slight distortion	1850-1906
19	6	132	firebrick	1		0x145x105mm	quarl, broken, gritty white, discoloured by heat to grey with purple discoloration, white mortar with coal flecks on all sides.	post-1850
23	7	14	firebrick	5	Ramsay?	0x110x70mm	fused/ mortared together, gritty white, dk. dull purple vitrified coating.	1830-1920

<b>Context</b>	<b>Phase</b>	<b>Sample</b>	<b>Type</b>	<b>Quantity</b>	<b>Maker</b>	<b>Dimensions</b>	<b>Comments</b>	<b>Date Range</b>
23	7	15	firebrick	1		0x112x65mm	gritty white disc. pink/buff, broken end has purple/brown vit, other faces have sandy mortar.	post-1850
23	7	16	firebrick	1	Hannington	0x114x60mm	gritty white disc. yellow/buff, heavy purple vit on broken end, sandy mortar on all other faces.	1850-1906
23	7	17	firebrick	1		0x116x63mm	gritty white, broken end has purplish disc. and some vit. Other faces have sandy mortar.	post-1850
23	7	18	firebrick	1		0x114x63mm	gritty white/buff, sooting one side, soft white mortar on others part vit on broken end.	post-1850
24	3	51	housebrick	1		230x110x65mm	dk red, handmade, sooting on one end other faces white lime mortar, faint combed frog.	1700-1750?
41	7	203	firebrick	1		228x117x65mm	gritty white, disc. yellow/pink, textile imp. on underside, white mortar on all faces, one end struck to a bevel ?springer for arch.	post-1850
42	7	123	firebrick	1	Hannington	228x113x60-45mm	wedge, white mortar with coal & lime flecks.	1850-1906
42	7	124	firebrick	1	Ramsay	230x112-87x65-87mm	bull-head, gritty white disc. yellow/buff with some orange/pink.	1830-1920
42	7	125	firebrick	1		236x64x64mm	crown or closer, gritty white, sooted one side and one end.	post-1850
42	7	126	firebrick	1	Walbottle	232x120x65mm	gritty white, disc. yellow buff, sooted one end and one side.	1869-1906
42	7	127	housebrick	1		230x109x60mm	red, handmade, distorted, dark streaks on one face, others with soft white mortar in places vit. to a glassy green-brown.	1750-1800?
43	7	128	firebrick	1	Hannington	230x61x61mm	crown or closer, one end has rustication and is sooted, all other faces have white mortar.	1850-1906
44	7	9	firebrick	3	Hannington	0x0x0mm	bonded together, gritty buff/yellow, broken end with dk brown/black vit. probably from mortar lining, some soft sandy orange mortar.	1850-1906
44	7	10	firebrick	1	Hannington	0x118x58mm	gritty white/yellow buff, broken face discoloured purple with slight vit., others have buff sandy mortar.	1850-1906
44	7	13	firebrick	2	Hannington?	0x112x58mm	gritty white, disc to yellow/buff, sandy mortar vit. on broken faces and one side.	1850-1906
44	7	202	firebrick	1	Hannington?	0x118x32mm	split or half-thick, yellow/buff, broken end has purple discoloration and slight vit other face and sides have traces of mortar. Stamped h on one side.	1850-1906
44	7	204	firebrick	1	Hannington?	0x65x60mm	crown or closer, gritty white, disc. Orange/pink, broken, sooted one end and one side	1850-1906
44	7	205	firebrick	1	Hannington	0x110x60mm	gritty white, disc by heat to buff with purple-black at broken end, mortar on all faces.	1850-1906
48	6	113	firebrick	1		0x125x72mm	gritty white, light grey mortar with coal and lime partly overlies dull purple vit as 14, so probably re-used.	post-1850
48	6	114	housebrick	1		210x108x61mm	dk red with occ buff incls, handmade, slight sooting to one side, others mid grey mortar with coal flecks.	1750-1800?
48	6	115	firebrick	1	Snowball	0x111x60mm	gritty white, half, one side sooted, some purple vit.	1858-1885
48	6	116	firebrick	1		0x0x70-72mm	lump, broken, gritty white with pink margins, some black mortar on one face	post-1850
48	6	117	housebrick	1		227x103x76mm	moulded, heavy dk red, no frog, grey mortar with lime flecks on all but one e	l.19C-20C
51	7	201	firebrick	1	Hannington	0x112x66mm	gritty white disc. to yellow/buff, broken end disc. Purple with some vit. Traces of mortar on all faces.	1850-1906

<b>Context</b>	<b>Phase</b>	<b>Sample</b>	<b>Type</b>	<b>Quantity</b>	<b>Maker</b>	<b>Dimensions</b>	<b>Comments</b>	<b>Date Range</b>
105	6	106	firebrick	1		226x60x57mm	crown or closer, one end clean, other faces with grey/white mortar with coal and lime flecks.	post-1850
105	6	107	firebrick	1		229x115x63mm	gritty white, sooted one side, others have white mortar with coal flecks.	post-1850
105	6	108	firebrick	1		230x110x66mm	gritty white, disc by heat to buff/orange, heavy sooting one side, white mortar on all others, corners abraded.	post-1850
105	6	109	firebrick	1	Hannington?	232x109x70mm	discoloured by heat to an orange colour internally, sooted one side, white mortar on other faces.	1850-1906
105	6	110	housebrick	1		230x113x67mm	handmade, mid red, one end and one side clean, others have mortar i.e. a corner brick.	1750-1800?
105	6	111	housebrick	1		236x115x55mm	handmade, dk red, one end slightly sooted, other faces have white mortar with lime flecks, wiped upper surface, no combed frog. In size and external appearance this is similar to MCG99/590, thought to be c.1650.	1750-1800?
107	9	43	firebrick	1		233x114x76mm	white, disc. yellow/buff, frog on upper and lower surfaces, one with two dots and two circles, one end clean, other faces have grey mortar with coal and lime flecks	e.20C?
107	9	44	firebrick	1		230x113x78mm	As sample 43	e.20C?
107	9	45	firebrick	1	Snowball	231x117-74x60mm	wedge, gritty white, grey mortar with coal & lime flecks on all faces	1858-1885
107	9	46	firebrick	1		230x113x62mm	gritty buff, thin purplish vit on one side, others have grey mortar with coal & lime flecks	post-1850

Table 8a: Brick catalogue

## **9. GEOLOGICAL ASSESSMENT**

*By: Trevor Morse*

### **9.1 Introduction**

9.1.1 During the excavation, 12 samples were submitted for geological analysis. These comprised samples of stone removed from several grinding stones and from masonry features within buildings investigated at the site.

### **9.2 Methodology**

9.2.1 The fossil assessment was made on what could be seen without magnification (macrofossils).

9.2.2 No assessment was made re microfossils.

9.2.3 All samples were subjected to a number of drops of dilute HCl (10%), this helps to determine the presence of Calcite  $\text{CaCO}_3$ . This presence helps in the diagnosis of Limestones, Calcareous (cement) Sandstones. Also the presence of calcareous soils or cements (mortar) covering the artefact, this was noted on most of the small find artefacts from the Swalwell site.

### **9.3 Geology of the Swalwell Area**

9.3.1 Broadly, the geology of the Swalwell area falls into three distinctive zones vertically. The upper zone being the soil and vegetation horizon of the Holocene/Recent age. The underlying zone is the drift/glacial horizon of Pleistocene age. Underlying the above two horizons is the Solid Geology of the Carboniferous Coal Measures, which in turn overlies unconformably older deposits of the Lower Palaeozoic (termed the Basement), these are rocks of ?Devonian, Silurian, Ordovician and Cambrian in age (in descending order of age).

9.3.2 With respect to the Solid Geology of Northern England, the sediments young towards the East, so exposures of the Carboniferous are overlain in the east by the younger rocks of Permian age. The Carboniferous is split into three major horizon groupings and they are in descending order of age (old terminology used), Coal Measures, Namurian (Millstone Grit) and Carboniferous Limestone Series.



## 9.4 Results

<b>Sample Number</b>	178
<b>Context Number</b>	[22]
<b>Feature Type</b>	Grinding stone
<b>Description</b>	Sandstone sample from SF 2
<b>Colour</b>	Fresh face – orange brown
<b>External Geological Structure</b>	Bedding plane or dressed surface
<b>Internal Geological Structure</b>	Nothing noted
<b>Fossil Content</b>	Nothing noted
<b>Reaction to dilute HCl (10%)</b>	Nothing noted
<b>Composition</b>	Quartz, Limonite, Carbonaceous (?woody) material (dirty appearance)
<b>Any non-geological markings</b>	Dressed surface
<b>Possible Source</b>	This is a typical Carboniferous medium-grained 'Dirty' sandstone, sourced locally
<b>Comments</b>	Moderately to well cemented porous and medium-grained sandstone. Angular quartz grains + limonite = water lain deposit. Carbonaceous material (dirty in appearance) = near terrestrial to terrestrial environment of deposition
<b>Type Lithology</b>	Typical of a delta top fluvitile (river) sandstone Possibly sourced locally from the Carboniferous sediments (top of the Namurian to Coal Measures)

<b>Sample Number</b>	179
<b>Context Number</b>	[22]
<b>Feature Type</b>	Grinding stone
<b>Description</b>	Sandstone sample from SF 3
<b>Colour</b>	Fresh face - dirty cream to light orange brown
<b>External Geological Structure</b>	Nothing noted
<b>Internal Geological Structure</b>	Nothing noted
<b>Fossil Content</b>	Nothing noted
<b>Reaction to dilute HCl (10%)</b>	No reaction noted on a fresh rock surface, however, on a weathered surface, a very positive reaction was noted. This could have been caused by calcitic rich ground waters (geologically) or the application of cement as a bonding agent (human activity)
<b>Composition</b>	Quartz, Limonite, Carbonaceous (?woody) material (dirty appearance), Muscovite Mica
<b>Any non-geological markings</b>	Dressed weathered faces
<b>Possible Source</b>	This is a typical Carboniferous fine-grained 'Dirty' sandstone, sourced locally
<b>Comments</b>	Moderately to well cemented porous and fine-grained sandstone. Angular quartz grains + limonite = water lain deposit. Carbonaceous material (dirty in appearance) = near terrestrial to terrestrial environment of deposition
<b>Type Lithology</b>	Typical of a delta top fluvitile (river) sandstone. Possibly sourced locally from the Carboniferous sediments (top of the Namurian to Coal Measures)

<b>Sample Number</b>	180
<b>Context Number</b>	[22]
<b>Feature Type</b>	Grinding stone
<b>Description</b>	Sandstone sample from SF 8
<b>Colour</b>	Fresh face - cream to light brown
<b>External Geological Structure</b>	Nothing noted
<b>Internal Geological Structure</b>	Nothing noted
<b>Fossil Content</b>	Nothing noted
<b>Reaction to dilute HCl (10%)</b>	No reaction noted on a fresh rock surface, however, on a weathered surface, a very positive reaction was noted. This could have been caused by calcitic rich ground waters (geologically) or the application of cement as a bonding agent (human activity)
<b>Composition</b>	Quartz, Limonite, very small amounts of Black Specs (?biotite mica or ?carbonaceous remains)
<b>Any non-geological markings</b>	Grooves in weathered surface
<b>Possible Source</b>	This is a typical Carboniferous fine-grained sandstone, sourced locally. Appears to be relatively clean, free from carbonaceous material
<b>Comments</b>	Moderately to well cemented porous and fine-grained sandstone. Angular quartz grains + limonite = water lain deposit. Carbonaceous material (dirty in appearance) = near terrestrial to terrestrial environment of deposition
<b>Type Lithology</b>	Typical of a delta top fluvatile (river) sandstone. Possibly sourced locally from the Carboniferous sediments (top of the Namurian to Coal Measures)

<b>Sample Number</b>	181
<b>Context Number</b>	[22]
<b>Feature Type</b>	Grinding stone
<b>Description</b>	Sandstone sample from SF 10
<b>Colour</b>	Fresh face – dirty orange brown
<b>External Geological Structure</b>	?Bedding plane or ?dressed surface
<b>Internal Geological Structure</b>	Nothing noted
<b>Fossil Content</b>	Nothing noted
<b>Reaction to dilute HCl (10%)</b>	No reaction noted on a fresh rock surface, however, on a weathered surface, a very positive reaction was noted. This could have been caused by calcitic rich ground waters (geologically) or the application of cement as a bonding agent (human activity)
<b>Composition</b>	Quartz, Limonite, Carbonaceous (?woody) material (dirty appearance)
<b>Any non-geological markings</b>	Dressed, weathered surface
<b>Possible Source</b>	This is a typical Carboniferous fine-grained 'Dirty' sandstone, sourced locally
<b>Comments</b>	Moderately to well cemented porous and fine-grained sandstone. Angular quartz grains + limonite = water lain deposit. Carbonaceous material (dirty in appearance) = near terrestrial to terrestrial environment of deposition
<b>Type Lithology</b>	Typical of a delta top fluvatile (river) sandstone. Possibly sourced locally from the Carboniferous sediments (top of the Namurian to Coal Measures)

<b>Sample Number</b>	182
<b>Context Number</b>	[22]
<b>Feature Type</b>	Grinding stone
<b>Description</b>	Sandstone sample from SF 4
<b>Colour</b>	Fresh face – cream to light orange brown
<b>External Geological Structure</b>	Nothing noted
<b>Internal Geological Structure</b>	Nothing noted
<b>Fossil Content</b>	Nothing noted
<b>Reaction to dilute HCl (10%)</b>	No reaction noted on a fresh rock surface, however, on a weathered surface, a very positive reaction was noted. This could have been caused by calcitic rich ground waters (geologically) or the application of cement as a bonding agent (human activity). White veneer (human activity) possibly cement gave a very positive reaction
<b>Composition</b>	Quartz, Limonite, minor amounts of Black Specs (?biotite mica or ?carbonaceous remains)
<b>Any non-geological markings</b>	Thin veneer of ?cement
<b>Possible Source</b>	This is a typical Carboniferous fine-grained sandstone, sourced locally
<b>Comments</b>	Moderately to well cemented porous and fine-grained sandstone. Angular quartz grains + limonite = water lain deposit. Carbonaceous material (dirty in appearance) = near terrestrial to terrestrial environment of deposition
<b>Type Lithology</b>	Typical of a delta top fluvatile (river) sandstone. Possibly sourced locally from the Carboniferous sediments (top of the Namurian to Coal Measures)

<b>Sample Number</b>	183
<b>Context Number</b>	[22]
<b>Feature Type</b>	Grinding stone
<b>Description</b>	Sandstone sample from SF 1
<b>Colour</b>	Fresh face – dirty cream
<b>External Geological Structure</b>	Appears to be three dressed surfaces at right angles to one another
<b>Internal Geological Structure</b>	Nothing noted
<b>Fossil Content</b>	Nothing noted
<b>Reaction to dilute HCl (10%)</b>	No reaction noted on a fresh rock surface, however, on a weathered surface, a very positive reaction was noted. This could have been caused by calcitic rich ground waters (geologically) or the application of cement as a bonding agent (human activity). White veneer (human activity) possibly cement gave a very positive reaction.
<b>Composition</b>	Quartz, Limonite, Muscovite Mica, Black Specs (?biotite mica or ?carbonaceous remains)
<b>Any non-geological markings</b>	Three dressed faces, corner of a sandstone block
<b>Possible Source</b>	This is a typical Carboniferous fine-grained 'Dirty' sandstone, sourced locally
<b>Comments</b>	Moderately to well cemented porous and fine-grained sandstone. Angular quartz grains + limonite = water lain deposit. Carbonaceous material (dirty in appearance) = near terrestrial to terrestrial environment of deposition
<b>Type Lithology</b>	Typical of a delta top fluvatile (river) sandstone. Possibly sourced locally from the Carboniferous sediments (top of the Namurian to Coal Measures)

<b>Sample Number</b>	184
<b>Context Number</b>	[22]
<b>Feature Type</b>	Grinding stone
<b>Description</b>	Sandstone sample from SF 9
<b>Colour</b>	Fresh face – dirty orange brown
<b>External Geological Structure</b>	Nothing noted
<b>Internal Geological Structure</b>	Nothing noted
<b>Fossil Content</b>	Nothing noted
<b>Reaction to dilute HCl (10%)</b>	Nothing noted
<b>Composition</b>	Quartz, Limonite, minor amounts of Carbonaceous (?woody) material (dirty appearance), Muscovite Mica
<b>Any non-geological markings</b>	Two dressed surfaces, with one face having groove type features
<b>Possible Source</b>	This is a typical Carboniferous fine-grained 'Dirty' sandstone, sourced locally
<b>Comments</b>	Moderately to well cemented porous and fine-grained sandstone. Angular quartz grains + limonite = water lain deposit. Carbonaceous material (dirty in appearance) = near terrestrial to terrestrial environment of deposition
<b>Type Lithology</b>	Typical of a delta top fluvitile (river) sandstone. Possibly sourced locally from the Carboniferous sediments (top of the Namurian to Coal Measures)

<b>Sample Number</b>	185
<b>Context Number</b>	Unstratified
<b>Feature Type</b>	Grinding stone.
<b>Description</b>	Sandstone sample from SF 29.
<b>Colour</b>	Fresh face – dirty cream.
<b>External Geological Structure</b>	Appears to be 2 dressed surfaces.
<b>Internal Geological Structure</b>	Nothing noted.
<b>Fossil Content</b>	Nothing noted.
<b>Reaction to dilute HCl (10%)</b>	No reaction noted on a fresh rock surface, however, on a weathered surface, a very positive reaction was noted. This could have been caused by calcitic rich ground waters (geologically) or the application of cement as a bonding agent (human activity).
<b>Composition</b>	Quartz, Limonite, minor amounts of Carbonaceous (?woody) material (dirty appearance), Muscovite Mica.
<b>Any non-geological markings</b>	Two dressed surfaces, plus a veneer of white material, ?cement.
<b>Possible Source</b>	This is a typical Carboniferous fine-grained 'Dirty' sandstone, sourced locally
<b>Comments</b>	Moderately to well cemented porous and fine-grained sandstone. Angular quartz grains + limonite = water lain deposit. Carbonaceous material (dirty in appearance) = near terrestrial to terrestrial environment of deposition
<b>Type Lithology</b>	Typical of a delta top fluvitile (river) sandstone. Possibly sourced locally from the Carboniferous sediments (top of the Namurian to Coal Measures)

<b>Sample Number</b>	186
<b>Context Number</b>	[12]
<b>Feature Type</b>	Masonry.
<b>Description</b>	Wharf Building, sandstone steps.
<b>Colour</b>	Fresh face –light grey.
<b>External Geological Structure</b>	One dressed face was noted.
<b>Internal Geological Structure</b>	Nothing noted.
<b>Fossil Content</b>	Nothing noted.
<b>Reaction to dilute HCl (10%)</b>	No reaction noted on a fresh rock surface, however, on a weathered surface, a very positive reaction was noted. This could have been caused by calcitic rich ground waters (geologically) or the application of cement as a bonding agent (human activity).
<b>Composition</b>	Quartz, Muscovite Mica.
<b>Any non-geological markings</b>	One dressed face + whitish veneer = ?cement.
<b>Possible Source</b>	This is a typical Carboniferous fine-grained sandstone, sourced locally.
<b>Comments</b>	Moderately to well cemented porous and fine-grained sandstone. Angular quartz grains + limonite = water lain deposit. Carbonaceous material = near terrestrial to terrestrial environment of deposition
<b>Type Lithology</b>	Typical of a delta top fluvitile (river) sandstone. Possibly sourced locally from the Carboniferous sediments (top of the Namurian to Coal Measures).

<b>Sample Number</b>	187
<b>Context Number</b>	[16]
<b>Feature Type</b>	Masonry
<b>Description</b>	Wharf Building, wall
<b>Colour</b>	Fresh face – red.
<b>External Geological Structure</b>	One dressed face was noted
<b>Internal Geological Structure</b>	Nothing noted
<b>Fossil Content</b>	Nothing noted
<b>Reaction to dilute HCl (10%)</b>	No reaction noted on a fresh rock surface, however, on a weathered surface, a very positive reaction was noted. This could have been caused by calcitic rich ground waters (geologically) or the application of cement as a bonding agent (human activity)
<b>Composition</b>	Quartz, Hematite, ?Feldspars, Carbonaceous (?woody) material (dirty appearance), Muscovite Mica
<b>Any non-geological markings</b>	One dressed face
<b>Possible Source</b>	A typical Carboniferous fine to medium-grained sandstone, which has been subjected to terrestrial weathering during the early Permian (<295Ma)
<b>Comments</b>	Quartz is fairly angular = water lain. The iron which originally oxidised to limonite (water lain deposition) has been changed to hematite through terrestrial weathering, sourced locally, near to the Permian unconformity to the east of the archaeological site
<b>Type Lithology</b>	Typical of a delta top fluvitile (river) sandstone. Possibly sourced locally from the Carboniferous sediments (top of the Namurian to Coal Measures)

<b>Sample Number</b>	188
<b>Context Number</b>	[10]
<b>Feature Type</b>	Masonry
<b>Description</b>	Wall
<b>Colour</b>	Fresh face – cream
<b>External Geological Structure</b>	Nothing noted
<b>Internal Geological Structure</b>	Nothing noted
<b>Fossil Content</b>	Nothing noted
<b>Reaction to dilute HCl (10%)</b>	No reaction noted on a fresh rock surface, however, on a weathered surface, a very positive reaction was noted. This could have been caused by calcitic rich ground waters (geologically) or the application of cement as a bonding agent (human activity). White veneer (human activity) ?cement gave a very positive reaction
<b>Composition</b>	Quartz, Limonite, Carbonaceous (?woody) material (dirty appearance), Muscovite Mica
<b>Any non-geological markings</b>	Whitish veneer, ?cement
<b>Possible Source</b>	This is a typical Carboniferous fine-grained 'Dirty' sandstone, sourced locally
<b>Comments</b>	Moderately to well cemented porous and fine-grained sandstone. Angular quartz grains + limonite = water lain deposit. Carbonaceous material (dirty in appearance) and Muscovite Mica = near terrestrial to terrestrial environment of deposition
<b>Type Lithology</b>	Typical of a delta top fluvatile (river) sandstone. Possibly sourced locally from the Carboniferous sediments (top of the Namurian to Coal Measures)

<b>Sample Number</b>	188
<b>Context Number</b>	[17]
<b>Feature Type</b>	Masonry
<b>Description</b>	Half Forge Building, wall
<b>Colour</b>	Fresh face – dirty cream to light orange brown
<b>External Geological Structure</b>	Nothing noted
<b>Internal Geological Structure</b>	Laminar bedding
<b>Fossil Content</b>	Nothing noted
<b>Reaction to dilute HCl (10%)</b>	No reaction noted on a fresh rock surface. White veneer (human activity) ?cement gave a very positive reaction
<b>Composition</b>	Quartz, Limonite, Carbonaceous (?woody) material (dirty appearance), Muscovite Mica
<b>Any non-geological markings</b>	Whitish veneer, ?cement
<b>Possible Source</b>	This is a typical Carboniferous fine-grained 'Dirty' sandstone, sourced locally
<b>Comments</b>	Moderately to well cemented porous and fine-grained sandstone. Angular quartz grains + limonite = water lain deposit. Carbonaceous material (dirty in appearance) and Muscovite Mica = near terrestrial to terrestrial environment of deposition
<b>Type Lithology</b>	Typical of a delta top fluvatile (river) sandstone. Possibly sourced locally from the Carboniferous sediments (top of the Namurian to Coal Measures)

## **9.5 Sources**

- 9.5.1 It is the opinion of the author that all finds examined (sandstones) were sourced from local exposures of the Carboniferous Coal Measures.
- 9.5.2 The sourcing of the stone would have been by direct human action (either worked then transported or transported then worked) or indirectly by glacial action (transported), followed by human action on site.

## **9.6 Recommendations**

- 9.6.1 The findings of the assessment comprise an adequate record of the lithic material recovered and no further research needs to be carried out for archaeological purposes.

## 10. ARCHAEOMETALLURGICAL ASSESSMENT

By: *Rod Mackenzie*

### 10.1 Introduction

10.1.1 Due to the quantities of technological residues recovered during the excavation, a visit was made to Pre-Construct Archaeology Limited to select material from specific archaeological contexts for assessment. The aim of the assessment has been to determine whether further analysis could provide additional information about specific aspects of the site and processes carried out there. A summary of the material assessed is listed below in Table 10a.

<i>Context</i>	<i>Bulk Sample No. or SF No.</i>	<i>Material type</i>	<i>Description</i>
23	22	Refractory/slag	Refractory brick with slagged surface on one side
23	23	Refractory/slag	Small fragment of refractory brick with possible metalliferous slag attached
23	24	Refractory/slag	Assortment of fragments of fuel ash slag, slagged refractory brick and possible metalliferous slag
23	26	Refractory/slag	Assortment of fragments of fuel ash slag, slagged refractory brick and possible metalliferous slag
23	6	Refractory/slag	Large fragment of slagged refractory brick
29	1	Bulk soil sample	Possible compacted floor material – consists of earth, coal slack, hammerscale, soot and clinker. Fragments of metal also present within sample
57	32	Bulk soil sample	Possible compacted floor material, fragments of metal present within sample
75	79	Spot sample	Possible compacted floor material, with agglomerations of iron oxide
76	84	Spot sample	Possible compacted floor material – consists of earth, small fragments of coal, slack, hammerscale, clinker and small agglomerations of iron oxide
79	83	Spot sample	Possible compacted floor material – consists of earth, coal slack, hammerscale, soot and clinker
89	SF 15	Ferrous metal	Partially manufactured 'straw knife', c. 800mm in length
89	SF 27	Ferrous metal	Partially forged bar of iron or steel, c. 590mm in length
91	134	Bulk soil sample	Fragments of metalliferous slag from furnace structure [21]. Slag is graphite grey in colour and is comparatively dense

*Table 10a: Assessed technological material*



<b>SF</b>	<b>Context</b>	<b>Weight (kg)</b>	<b>Description</b>
14	89	<1	Iron bar with fittings
16	89	<1	Wrought iron ?bar/strap
17	89	2.6	Wrought iron, cross piece is corroded strapping from chimney, long piece has no obvious function, the two are corroded together and not necessarily associated
18	89	<1	Iron ?cone/ring
19	89	<1	Part of an iron ratchet mechanism
20	89	8	Flattened iron ring, machinery from a grinding wheel, has a chamfered hole
22	89	4	Iron ring
23	89	<1	Iron three square file
24	89	2.2	Iron chisel/jumper for drilling hole for coal blasting
25	89	<1	Iron plate
26	89	2.2	Shovel
28	89	<1	Iron ring

Table 10b: Metal small finds (SF) list

## 10.2 Results and Discussion

### 10.2.1 Metal artefacts

10.2.1.1 One of the metal artefacts from context [89] is possibly part of an agricultural tool known as a straw knife. The artefact is made from ferrous metal, probably wrought iron; it is incomplete and does not have a cutting blade. It seems likely that the artefact was manufactured using metals produced at the site. Metallographic analysis could identify what metal the artefact is made from and confirm whether it was likely to have been manufactured using metal produced at the site.

10.2.1.2 Documentary research may provide more information about the artefact and an estimate of its date of manufacture.

10.2.1.3 The second artefact from context [89] is a bar of ferrous metal that appears to have been partially forged at one end. It is possible that this bar is made from wrought iron, blister steel or shear steel. Further analysis could confirm the type of metal the bar is made from, and whether it is likely to have been produced at the site.

### 10.2.2 Refractory materials and slag

10.2.2.1 Sample 134 contains fragments of a dense dark grey metalliferous slag; this was recovered from context [91], part of the Furnace Chimney located within the Forge Building. Preliminary analysis on two fragments of slag from Sample 134 has been performed using optical microscopy. The results suggest that the slag may have been produced by the 'puddling' process. Further analysis to characterise the slag would allow comparison with analyses from other sites, which could confirm the type of furnace.

10.2.2.2 The material recovered from context [23] is made up of fragments of slagged refractory brick. The slag attached to the brick fragments is predominantly fuel ash slag (clinker), although some pieces also have what appears to be metalliferous slag mixed within the clinker.

### **10.2.3 Soil samples**

- 10.2.3.1 All of the bulk soil samples assessed have very similar characteristics. The samples are composed of a compacted mixture of earth, fine cinders, coal dust, hammerscale and small fragments of clinker. Some of the samples contain agglomerations of iron oxide.
- 10.2.3.2 The deposits are typical of compacted floor deposits found on industrial sites where ferrous metals were being manufactured. The presence of hammerscale in the samples suggests the presence of iron/steel forging, whilst the high proportion of cinders, coal dust and clinker suggests the presence of fossil fuelled furnaces and/or hearths on the site. Due to their corroded state, the agglomerations of iron oxide cannot be attributed to a specific process.
- 10.2.3.3 Samples 1 and 32, from contexts [29] and [57], contain small ferrous metal pieces. The size and shape of the pieces suggests that they may be scrap from the production of iron or steel castings. The samples were both recovered from possible late 18th to early 19th century contexts within the former iron warehouse.
- 10.2.3.4 It is possible that the pieces of metal are scraps of cast iron or steel that were being kept for remelting. If the scraps are cast iron, it is possible that they were feedstock for the furnace located within the Forge Building. Metallographic analysis could reveal what type of metal the scraps are made from, and suggest how their presence fitted with the processes carried out at the site.

### **10.3 Recommendations**

- 10.3.1 Given what is known about the site from historical records and the nature of the archaeological contexts and deposits, it is recommended that further analysis should focus on answering the following questions:
- Was the furnace a 'puddling furnace'?
  - Were the metal artefacts made using metal produced at the site?
- 10.3.2 A more detailed analysis of slag from Sample 134 (context [91]) could be performed to characterise and identify the slag. This will also allow comparison with any slag inclusions present within the metal artefacts recovered from the site. It is recommended that any further analysis of the slag should include chemical characterisation using Scanning Electron Microscopy with Energy Dispersive Spectrometry (SEM-EDS) or Electron Probe microanalysis (EPMA).
- 10.3.3 Metallographic analysis could be undertaken on some of the metal artefacts, including the knife and bar from context [89] and at least two of the 'scrap objects' from within the bulk samples from contexts [29] and [57]. If slag inclusions are found within the metals, SEM-EDS will be required for comparison with the slag from Sample 134.
- 10.3.4 A representative selection of slag from each of the bulk soil samples and from at least 10% of each of the spot samples could be examined and identified by a specialist to assess the potential for further research. Samples should be retained as part of the site archive.
- 10.3.5 Once metal objects have been removed from bulk soil samples, the soil can be disposed of, with metal objects being retained as part of the site archive.

## 11. SIGNIFICANCE OF THE PROJECT DATA AND PUBLICATION OUTLINE

### 11.1 Summary of the Significance of the Project Data

- 11.1.1 The North East Regional Research Framework for the Historic Environment (NERRF) is an English Heritage-funded initiative that aims to provide a viable, realistic and effective academic basis for the undertaking of archaeological investigations.<sup>25</sup> The draft Research Agenda is available online and, following a period of consultation, will be ultimately published. The Research Agenda is divided into Period Groups and the pertinent group for this excavation is the '*Post-Medieval Period*'.
- 11.1.2 NERRF Research Topic 7.2.6: '*Iron and Steel Industry*' notes that compared with the coal and lead industries, there has been relatively little work carried out on the important regional iron and steel industry. A particular need is identified for further work on early (18th century or earlier) industrial technology. This topic also emphasises the need for specialist metallurgical advice during fieldwork and analysis of residues where appropriate. NERRF also refers to several other regional research agendas. These include a report produced by the Architectural and Archaeological Society of Durham and Northumberland which details the requirement for further research into known 18th century blast furnaces, as well as the larger-scale integrated iron and steel works of the 19th century.<sup>26</sup> In addition, the Historical Metallurgical Society has put forward a range of research topics related to smelting and refining, including blast furnace technology, forge technology and early steel production.<sup>27</sup> The need for research into secondary processing, including the development of iron foundries, rolling and slitting mills, wire drawing and finishing trades has also been highlighted.<sup>28</sup>
- 11.1.3 The NERRF overview of the resource assessment for the '*Post-Medieval Period*' notes that puddling forges have received little archaeological attention nationally, and no work is known within the region. The resource assessment also lists the major fabrication ironworks at Winlaton Mill and Teams and Crowley's Ironworks at Swalwell and notes that archaeological fieldwork, up to then, had been undertaken only at Winlaton Mill. Later development of the engineering works, often incorporating both forging and foundry elements, has received little archaeological study either regionally or nationally.
- 11.1.4 The Swalwell project is therefore of considerable local, regional and national significance and it is considered that dissemination of the findings through publication is merited. The undoubted importance of the site data underlines the need for further analysis ultimately leading to production of a publication in a refereed academic journal such as the *Industrial Archaeology Review*. The justification for this recommendation is demonstrated by the aforementioned existing academic research frameworks, which highlight the significance of the Swalwell data.

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<sup>25</sup> North East Regional Research Framework, [www.durham.gov.uk](http://www.durham.gov.uk).

<sup>26</sup> Linsey 2002, 210.

<sup>27</sup> Blick *et al.* 1991, 3.

<sup>28</sup> *ibid.*, 4.

## **11.2 Summary of Potential for Further Analysis**

- 11.2.1 The results of all phases of archaeological investigation, *i.e.* desk-based assessment, evaluation, building recording and excavation, should be fully integrated as part of the next phase of work, leading to the production of a publication paper. The further analysis of the stratigraphic and artefactual evidence should also be fully integrated into this publication paper.
- 11.2.2 Further research should be undertaken to identify any further documentary or cartographic resources detailing Crowley's Ironworks, particularly any further information regarding the works in its later years following the various changes in ownership. Where possible, original documents and maps should be consulted.
- 11.2.3 Further documentary and cartographic research, including examination of primary sources, should aim to clarify the precise form of the original Wharf Building with the objective of providing firmer dating for unmarked common bricks. These handmade bricks have the potential, if the structures from which they derive can be closely dated, to add to knowledge of local post-medieval brick forms and their development.
- 11.2.4 Further archaeometallurgical analysis should focus on determining whether the structure recorded within the Forge Building was a puddling furnace, such work could include chemical characterisation of slag samples using SEM-EDS or EPMA. If it can be proven that the structure was a puddling furnace, then further research about this type of industrial structure would need to be undertaken.
- 11.2.5 Metallographic analysis should be carried out on a selection of the metal artefacts.
- 11.2.6 A further selection of slag samples from floor deposits should also be examined for their potential for further research, which could then be undertaken, as appropriate.

## **11.3 Publication Proposal**

- 11.3.1 It is considered that the archaeological data-set from the excavation at Swalwell merits publication in the form of a detailed synthesised report published in a suitable archaeological journal, such as the *Industrial Archaeology Review*.
- 11.3.2 A full assessment of the data-set has been undertaken and a summary of the potential of each element of the data-set for further research/analysis is set out in the preceding section. A detailed publication outline can only be compiled once all further analysis is completed. However, any publication of the site should, as a minimum, contain the following:
- A description of the site in its modern setting, detailing the background to the excavation and outlining the methodology of the excavation.
  - A description of the geology and topography of the site and discussion of how these elements may have been influenced the origin and development of the site.
  - A discussion of the historical background to the site detailing the changes in use and ownership throughout the post-medieval period and including a detailed discussion of Crowley's Ironworks.

- A detailed description of the archaeological remains, including descriptions of each structure examined during the investigations.
- Detailed descriptions of all metallurgical analysis.

11.3.3 Any publication of the site would include, at a minimum, the following illustrations:

- Site location plans, showing the site in relation to its immediate and regional modern environment.
- Location plan of the excavation area.
- Detailed plans of structural remains.
- Various elevation and section drawings, as appropriate.
- A selection of photographs.

***PART C:***  
***REFERENCES AND ACKNOWLEDGEMENTS***

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## 13. ACKNOWLEDGEMENTS AND CREDITS

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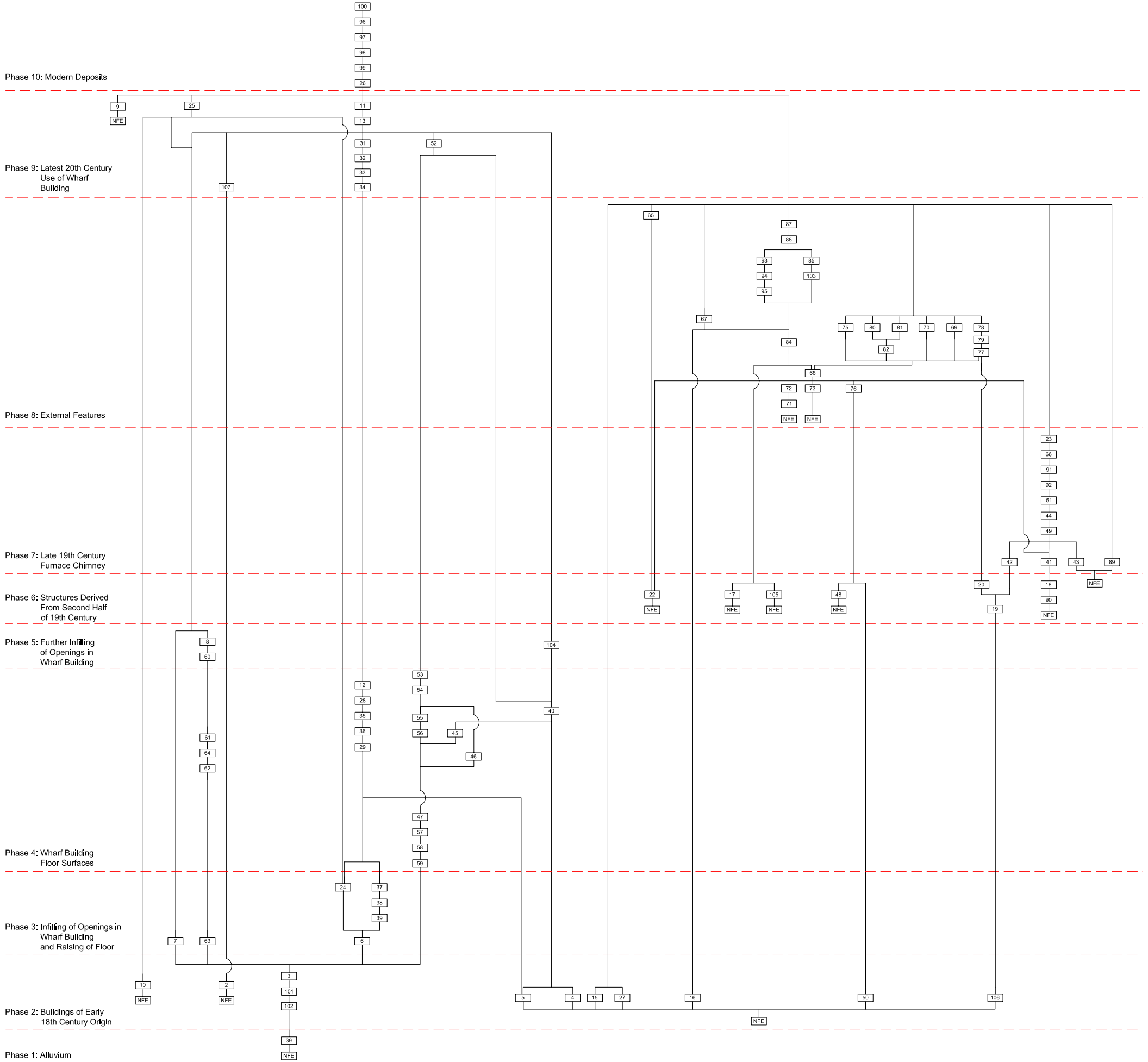
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**APPENDIX 1**  
**STRATIGRAPHIC MATRIX**

SRS 05: MATRIX



**APPENDIX 2**  
**CONTEXT INDEX**

Context	Phase	Type	Type	Description	Interpretation
1	n/a	Structure	Building	Wharf Building, walls [2], [3], [4], [5], and several later infills [6], [7], [8] and [24].	Wharf Building
2	2	Masonry	Wall	Red bricks 230mm x 110mm x 60mm; bonded with a light grey gritty lime mortar; mainly English bonding pattern with occasional courses of a Flemish bonding pattern irregularly spaced; 8.15m NE-SW x 0.61m NW-SE x at least 1.37m high	South wall of Wharf Building
3	2	Masonry	Wall	Red bricks 240mm x 110mm x 60mm; bonded with a light grey lime mortar; English bonding pattern; 25.60m NW-SE x 0.72m NE-SW x 0.72m high	West wall of Wharf Building
4	2	Masonry	Wall	Red bricks 230mm x 120mm x 60mm; bonded with a light grey gritty lime mortar; bonding pattern varies from English to English garden wall; 5.83m NE-SW x 0.48m NW-SE x 1.60m high; entrance centrally located in wall [4] measuring 1.10m wide and 1.50m high and arched using ordinary bricks.	North wall of Wharf Building
5	2	Masonry	Wall	Red bricks 230mm x 120mm x 60mm; bonded with a light grey gritty lime mortar; bonding pattern varies between an English bonding pattern and a English cross bonding pattern; 24.80m NE-SW x 0.60m NW-SE x 1.76m high	East wall of Wharf Building
6	3	Masonry	Wall	Red bricks 240mm x 120mm x 60mm; English bonding pattern; bonded with a light grey gritty mortar; infill of wall [3] narrowing the SE most entrance; NW extent 0.86m NW-SE x 0.60m NE-SW x 0.30m high; SE extent 0.86m NW-SE x 0.60m x 0.19m high	Infill of wall [3]
7	3	Masonry	Wall	Frogged red bricks 230mm x 110mm x 70mm; bonded with a light grey gritty mortar; stretcher bonding pattern; infill of wall [3]; 2.70m NW-SE x 0.50m NE-SW x at least 0.22m high	Infill of wall [3]
8	5	Masonry	Wall	Red bricks 230mm x 110mm x 60mm; bonded with a light grey lime mortar; stretcher bonding pattern; 2m NW-SE x 0.44m NE-SW x 0.86m high	Infill of wall [3]
9	9	Masonry	Concrete	Concrete; 5m NE-SW x 0.76m NW-SE x at least 0.59m high	Concrete dam
10	2	Masonry	Wall	Sandstone blocks maximum 400mm x 350mm x 280mm and minimum 220mm x 150mm x 70mm; bonded with a light grey lime mortar; squared and built to courses; at least 1.04m NW-SE x 0.72m NE-SW x at least 0.62m high	Wall extending from south-west corner of Wharf Building
11	9	Masonry	Stairs	Concrete; 2.67m NW-SE x 1.16m NE-SW x 0.72m high	Concrete stairs in Wharf Building
12	4	Masonry	Stairs	Sandstone; 1.44m NW-SE x 2.06m NE-SW x 1.50m high	Sandstone stairs in Wharf Building
13	9	Deposit	Layer	Concrete; 24.35m NW-SE x 4.80m NE-SW x 0.08m thick	Concrete surface in Wharf Building
14	n/a	Structure	Building	Structure [14] comprising Half Forge and Forge Buildings, walls [15], [16], [17], [18], [19], [20], [50], [90] and Furnace Chimney [21]	Half Forge and Forge Buildings
15	2	Masonry	Wall	Red bricks 240mm x 120mm x 70mm; bonded with a light grey gritty mortar; English and English Cross bonding pattern; 7.85m NE-SW x 0.64m NW-SE x at least 1.43m high	South wall of Half Forge Building
16	2	Masonry	Wall	Red bricks 230mm x 110mm x 70mm; bonded with a light grey lime mortar; English bonding pattern with an excess of stretchers at the base; sandstone block quoin at NW extent ; 4.92m NW-SE x 0.52m NE-SE x at least 1m high	South-west wall of Half Forge Building
17	6	Masonry	Wall	Sandstone blocks maximum 400mm x 115mm x 38mm; bonded with a light grey gritty mortar; regular courses; 0.72m NW-SE x 0.38m NE-SW x at least 1.30m high	West wall of Forge Building
18	6	Masonry	Wall	Red bricks 230mm x 110mm x 63mm; bonded with a light grey lime mortar; English garden wall bonding pattern; 4.68m NW-SE x 0.60m NE-SW x at least 0.95m high	West wall of Forge Building
19	6	Masonry	Wall	Red bricks 230mm x 110mm x 65mm; bonded with a light grey lime mortar; irregular bonding pattern; over sandstone foundations, blocks 350mm x 150mm; possible re-use of grinding stone within wall foundations; keyed into wall [20] and abuts Furnace Chimney wall [42]; 2.57m NW-SE x 0.37m NE-SW x at least 0.94m high	North-west wall of Forge Building
20	6	Masonry	Wall	Red bricks 240mm x 110mm x 70mm; bonded with light grey lime mortar; irregular bonding pattern; keyed into wall [19] for top 6 courses; appears to have been truncated; wall [20] may have been added as a later rebuild or repair; 1.16m NW-SE x 0.24m NE-SW x 0.85m high	North wall of Forge Building
21	6	Structure	Furnace	Furnace Chimney, structure [21] comprising walls [41], [42], [43], inner skins [44], [49], [51]; three-sided brick structure truncated by modern service trench; inner skins appear to have been replaced, heat damage to the bricks is asymmetrical with greatest damage to the eastern side	Furnace Chimney

Context	Phase	Type	Type	Description	Interpretation
22	6	Masonry	Wall	Sandstone blocks of various sizes (predominantly reused grinding stones) 650mm x 310mm x 170mm (max) to 110mm x 90mm x 50mm (min); bonded with pale grey, gritty mortar; grinding stones used in both visible courses; also contains other dressed stones and roughly hewn blocks; contains evidence of a wooden beam; 3.35m E-W x 0.86m N-S x 0.32m high; abuts walls [5] and [48]	Retaining Wall for Derwent Gut
23	7	Deposit	Layer	Firmly cemented; mid brownish red; iron slag; contains occasional brick fragments (max 230mm x 110mm x 60mm); 1.40m N-S x 0.90m E-W	Slag deposit in Furnace Chimney
24	3	Masonry	Wall	Red bricks 240mm x 120mm x 60mm; bonded with light greyish white mortar; English bonding; possibly made of reused material; 1.05m NW-SE x 0.24m NE-SW x 0.60m high	Infill of wall [3]
25	9	Deposit	Layer	Indurated; light greyish white; concrete render; frequent small stone flecks; 25.60m N-S x 0.85m high x 0.02m thick	Render on face of wall [3]
26	10	Deposit	Layer	Loose; varicoloured; demolition rubble; fragments of concrete, brick, with asbestos roof tiles, steel reinforcing, cinder, glass; covers extent of excavation	Modern levelling deposit
27	2	Masonry	Wall	Red bricks 230mm x 120mm x 70mm; bonded with pale whitish grey, gritty mortar; only corner of wall seen so coursing not visible; corner truncated and wall runs into L.O.E so extent and alignment of wall not known; 0.65m NE-SW x 1.20m high; keyed into wall [15]	Wall adjoining wall [15] Half Forge Building
28	4	Deposit	Layer	Firm; dark brown; cobbles (round to sub-rounded, 0.20m) within a dark brown, coarse, silty sand matrix; very occasional flecks of charcoal and small sub-rounded stones (<0.02m); >4.90m NW-SE x >3.51m NE-SW x 0.16m thick; underlies concrete surface in Wharf Building; ?contemporary with stairs [12]	Cobbled surface in Wharf Building
29	4	Deposit	Layer	Firmly cemented; black; iron slag; frequent iron objects, occasional small sub-rounded to sub-angular stones (<0.02m); <4.90m NW-SE x >3.51m NE-SW x 0.06m (min) to 0.12m (max) thick; underlies cobbled surface [28]	Slag surface
30	3	Deposit	Layer	Soft; light brown; clayey sandy silt; very occasional small sub-rounded stones (<0.03m), fragments of brick, flecks of white lime mortar, flecks of light yellow sticky clay, medium sub-angular fragments of sandstone and small flecks of sandstone; >3.51m NE-SW x >3.90m NW-SE x 0.19m thick; underlies slag deposits within Wharf Building, may be associated with construction phase	Deposit in Wharf Building
31	9	Deposit	Layer	Loose; grey black; fragments of slag with fragments of brick; 3.50m NNW-SSE x 4.80m ENE-WSW x 0.10m thick	Slag deposit in Wharf Building
32	9	Deposit	Layer	Friable; dark brownish grey; slightly clayey sandy silt; frequent small fragments of brick and sandstone; >3.50m NNW-SSE x 4.80m ENE-WSW x 0.21m thick	Rubble/demolition deposit in Wharf Building
33	9	Deposit	Layer	Loose; light whitish yellow; sand, lime mortar and brick fragments; >3.50m NNW-SSE x 4.80m ENE-WSW, 0.43m thick	Demolition deposit in Wharf Building
34	9	Deposit	Layer	Compact; dark grey; clayey sandy silt; >3.50m NNW-SSE x 4.80m ENE-WSW x 0.05m thick	Silt layer over cobbled surface [28]
35	4	Deposit	Layer	Loose; dark brownish grey; silty sand; moderate small fragments of brick and sandstone, occasional medium fragments of slag; >3.50m NNW-SSE x 4.80m ENE-WSW x 0.17m thick	Bedding layer for cobbled surface [28]
36	4	Deposit	Layer	Loose; light yellowish brown; sand; >3.50m NNW-SSE x 3.50m ENE-WSW 0.20m (max) to 0.05m (min) thick	Bedding layer for cobbled surface [28]
37	3	Masonry	Sandstone	Sandstone block; 1.24m NNW-SSE x 0.21m thick (width unknown); squared and dressed.	Sandstone block below slag deposit [29] in Wharf Building
38	3	Deposit	Layer	Loose; yellowish grey; small rounded and rub-rounded stones and gravel; 1.30m ENE-WSW x 0.05m thick	Gravel layer in Wharf Building
39	1	Deposit	Natural	Soft; mid yellowish brown; clay silt; very occasional small sub-rounded stones (<0.03m); dimensions >4.90m NW-SE x >3.51m NE-SW x >0.20m thick; only visible in SE extent of Structure [1]	Natural alluvial deposit
40	4	Deposit	Layer	Stone cobbles; rounded and sub-rounded; dimensions of cobbles 50mm x 50mm x 50mm (min) to 110mm x 150mm x 170mm (max); dimension of surface 4.76m NE-SW x 2.36m NW-SE x 0.11m thick	Cobbled surface in Wharf Building

Context	Phase	Type	Type	Description	Interpretation
41	7	Masonry	Wall	Yellow bricks 240mm x 110mm x 60mm; bonded with light yellowish grey mortar; English garden wall bonding on SW face, irregular bonding on NE face; 1.78m NW-SE x 0.34m NE-SW x at least 1.67m high; abuts wall [18]; SE face has iron fitting to stabilise structure during heat expansion; bricks on NE face show smoke blackening	West wall of Furnace Chimney
42	7	Masonry	Wall	Yellow bricks 240mm x 110mm x 60mm; bonded with light yellowish grey mortar; mainly English garden wall with patches of English bonding; 1.76m NW-SE x 0.24m NE-SW x at least 1.65m high; contains opening at mid point of wall, evidence of an arch, possibly a vent for the furnace, opening measures 1.09m high x 0.42m wide x 0.24m deep; stamped bricks present on wall ('Ramsay' and 'Hannington'); abuts wall [19]; large iron plate on lower extent of wall; additional row of bricks added to internal face of wall but not keyed in	North wall of Furnace Chimney
43	7	Masonry	Wall	Yellow bricks 240mm x 110mm x 60mm; bonded with light yellowish grey mortar with flecks of charcoal and stone; no recognisable bond, possible variation on English garden wall; wall dimensions 1.77m NE-SW x 0.34m NW-SE x 1.40m high; least well preserved of furnace walls; iron brackets visible; keyed into inner skin [49]; sandstone black uncovered during further excavation, possible foundations of	East wall of Furnace Chimney
44	7	Masonry	Wall	Yellow bricks 230mm x 110mm x 60mm; bonded with light pinkish orange, loose sandy mortar; no set bonding pattern, formed from columns of stretchers, with header ends pointing inwards which are not keyed into main structure; dimensions on NE face 1.45m NW-SE x 0.24m NE-SW x 1.38m high; on SE face 1.19m NE-SW x 0.24m NW-SE x 1.30m high; on SW face 1.50m NW-SE x 0.24m NE-SW x 0.85m high; forms secondary brick skin on inside of Furnace Chimney [21]; internal faces covered in slag; stamped brick visible ('Hannington' and 'H'); appears to have blocked vent in wall [42]	Secondary brick skin in Furnace Chimney
45	4	Deposit	Layer	Soft; mid grey; silty sand; frequent small fragments of red brick, fragments of lime mortar, small pieces of iron slag, flecks of charcoal; >4.28m E-W x >1.25m N-S x 0.16m thick; deposit possibly same as [56]	Bedding deposit for cobbled surface [40]
46	4	Deposit	Layer	Firmly cemented; mid to dark greenish grey; iron slag; very occasional small sub-rounded stones (<40mm); 1.70m E-W x 1.80m N-S, thickness unknown; contains two grinding stone fragments	Slag deposit in Wharf Building
47	4	Deposit	Layer	Firmly cemented; mid orange brown; iron slag; occasional small sub-angular and sub-rounded stones (<20mm); very occasional coal fragments (<20mm); >3.06m E-W x >1.50m N-S x 0.15m thick	Slag deposit in Wharf Building
48	6	Masonry	Wall	Sandstone blocks 120mm x 30mm (min) to 490mm x 170mm (max); dressed; varying from square to rectangular; red bricks and yellow bricks 220mm x 110mm x 70mm; concrete slabs 410mm x 70mm; bonded with pale grey gritty mortar; northern face mainly sandstone, squared and built to courses; southern face irregular coursing and contains sandstone, brick and concrete, suggesting N face may have been external face; 13.50m E-W x 0.43m N-S x 0.54m high; lowest exposed courses yellow bricks, overlain by 2 courses of sandstone, then courses of sandstone and brick, and 3 uppermost courses red brick; extends into limit of excavation	Retaining Wall for Derwent Gut
49	7	Masonry	Wall	Yellow bricks 230mm x 110mm x 60mm; bonded with light pinkish orange sandy mortar, with frequent stone flecks; irregular bonding pattern, stretchers either side of opening and header infill; not keyed into walls [41] or [42]; 1.08m E-W x 0.11m N-S x 0.92m high; some keying in to wall [43]; mortar composition similar to that used for [44] and [51]	Primary skin of bricks in Furnace Chimney
50	2	Masonry	Wall	Red and yellow bricks 220mm x 110mm and 240mm x 120mm; bonded with pale grey sandy mortar; less than 1 course high so coursing cannot be seen; >2.66m E-W x 0.40m N-S x 0.50-0.10m high	North-East Wall Half Forge Building
51	7	Masonry	Wall	Yellow bricks 230mm x 110mm x 60mm; bonded with light pinkish orange sandy mortar; irregular coursing; covers 3 sides of the chimney interior; not keyed in; western section 2.32m N-S x 0.25m E-W x 0.58m high; northern section 0.60m E-W x 0.25m N-S x 0.58m high; eastern section 1.02m N-S x 0.25m E-W x 0.58m high	Tertiary skin of brick in Furnace Chimney, covered in slag and may have formed expendable part of chimney interior
52	9	Deposit	Layer	Loose; light grey; sandy silt; occasional large fragments of brick (<0.20m); very occasional large fragments of ceramic roof tile (<0.30m), frequent patches of light grey lime mortar, very occasional flecks of charcoal; >4.74m E-W x >3.78m N-S x 0.29m thick	Levelling deposit below concrete surface [13]

Context	Phase	Type	Type	Description	Interpretation
53	4	Deposit	Layer	Soft; black; clayey sandy silt; occasional small fragments of iron slag (<0.05m), very occasional small sub-rounded and sub-angular stones (<0.05m), very occasional small coal fragments; >1.72m NE-SW x >2.14m NW-SE x 0.09m thick	Slag deposit
54	4	Deposit	Layer	Firm; mid orange brown; iron slag; very occasional small sub-rounded and sub-angular stones (<0.04m); >4.74m E-W x >3.78m N-S x 0.15m thick; abuts brick floor surface [55] and cobbled surface [40]	Slag deposit in Wharf Building
55	4	Masonry	Floor	Red bricks 100mm x 100mm x 230mm; no bonding material or visible bonding pattern; 1.62m NE-SW x >0.10m NW-SE x 0.10m thick; only visible in section as extends beyond the l.o.e;	Brick floor surface in Wharf Building, may be same as surface [61]
56	4	Deposit	Layer	Soft; mid grey; silty sand; occasional small fragments of red brick (<0.04m), small fragments and flecks of light grey lime mortar; very occasional small pieces of iron slag (<0.05m), occasional fragments of coal (<0.02m); 1.45m NE-SW x >0.50m NW-SE x 0.10m thick; only visible in section	Bedding deposit for brick floor [55]
57	4	Deposit	Layer	Soft; mid grey; clay silt; very occasional small fragments of coal (<0.01m); >1.92m NE-SW x >1.64m NW-SE x 0.11m thick; only visible in section	Surface in Wharf Building
58	4	Deposit	Layer	Firm; light yellow brown; iron slag; very occasional small sub-rounded and sub-angular stones (<0.02m), small fragments of coal; occasional small flecks of charcoal; dimensions >1.75m NE-SW x >1.64m NW-SE x 0.07m deep; only visible in section	Slag deposit in Wharf Building
59	4	Deposit	Layer	Firm; mid grey; iron slag; very occasional small fragments of coal (<0.01m), small sub-rounded and sub-angular stones (<0.02m); >1.58m NE-SW x >1.64m NW-SE x 0.11m thick; only visible in section	Slag deposit in Wharf Building
60	5	Deposit	Layer	Loose; light grey; sandy silt; frequent large fragments of brick and flecks of light grey mortar; 1.85m NW-SE x 0.35m NE-SW x 0.26m thick	Rubble deposit, may be foundation deposit for wall [8]
61	4	Masonry	Floor	Red bricks measuring 110mm x 70mm; no bonding material or bonding pattern visible; 2.00m NW-SE x 0.11m NE-SW x 0.07m thick; only visible in section	Brick floor surface in Wharf Building, may be a repair to cobbled surface [40]
62	4	Deposit	Layer	Compact; mid greyish brown; iron slag and slightly clayey sandy silt; occasional small and medium fragments of brick, occasional small flecks of grey lime mortar; 2.00m NW-SE x 0.13m thick; only seen in section	Bedding layer for surface [60]
63	3	Masonry	Wall	Red brick 230mm x 110mm x 60mm; bonded with light greyish white lime mortar; stretcher bonding; 2.0m NW-SE x 0.11m NE-SW x 0.34mm thick	Lower infill of wall [3]
64	4	Deposit	Layer	Loose; light yellowish brown; sand; 2.00m NW-SE x 0.11m NE-SW x 0.04m thick	Bedding layer for floor [61]
65	10	Deposit	Layer	Loose; dark brown; silty soil, cinder, ash and soot; frequent fragments of CBM; forms layer around stones in walls [22] and [48]	Rubble deposit
66	7	Deposit	Layer	Firm; light greyish yellow and dark brownish red; brick and iron slag; made predominantly of brick rubble cemented with iron slag; 0.66m N-S x 0.46m E-W x 0.40m thick; contained within tertiary skin [51]	Brick and slag deposit within Furnace Chimney, may represent partial collapse of a skin layer
67	8	Deposit	Layer	Firm; dark brownish black; clay silt with patches of sand; frequent fragments of angular stone and CBM; 5.00m N-S x 3.54m E-W; not excavated so thickness unknown	Rubble deposit, external, material between walls [5] and [16]
68	8	Deposit	Layer	Soft; dark brown to black; silt; frequent fragments of concrete, brick, iron slag and iron waste, occasional medium fragments of brick and concrete; 17.88m N-S x 9.86m E-W; unexcavated so thickness unknown	Debris deposit, external
69	8	Deposit	Layer	Compact; dark brown to black; iron slag and silt; 0.82m NE-SW x 0.38m NW-SE; unexcavated so thickness unknown	Slag deposit, external
70	8	Deposit	Layer	Compact; dark orange brown; slag; 3.16m N-S x 0.52m (max) to 0.10m (min) E-W x 0.14m thick approximately; situated against wall [5] and steps [11]	Slag deposit, external
71	8	Deposit	Layer	Soft; dark brown to black; silt; very frequent brick, concrete and iron slag fragments (up to 0.15m); 1.64m N-S x 1.94m (max) to 0.40m (min) E-W; unexcavated so thickness unknown	Slag deposit, external
72	8	Deposit	Layer	Compact; dark brown to black; slag; frequent fragments of cinder; 1.08m E-W x 0.32m N-S; unexcavated so thickness unknown	Slag and cinder deposit, external

Context	Phase	Type	Type	Description	Interpretation
73	8	Deposit	Layer	Compact; dark brown to black; slag; 0.68m N-S x 0.46m E-W; unexcavated so thickness unknown	Slag deposit, external
74	VOID				
75	8	Deposit	Layer	Firm to compact; dark greyish brown to black; slag and cinder; 1.24m N-S x 1.00m (max) to 0.70m (min) E-W; unexcavated so thickness unknown	Slag and cinder deposit, external
76	8	Deposit	Layer	Firm; dark brown to black; silt; frequent mortar, concrete, slag and brick fragments; 4.32m E-W x 1.62m (max) to 0.34m (min) N-S; unexcavated so thickness unknown; southernmost boundary corresponds to line of walls [20] and [50]	Slag and rubble deposit, external
77	8	Deposit	Layer	Firm to compact; dark orange brown; slag; 1.62m NE-SW x 0.10m NW-SE; unexcavated so thickness unknown; lies against wall [20]	Slag deposit, external
78	8	Deposit	Layer	Soft; dark brown to black; silt; occasional flecks of brick and mortar; dimensions 1.72m E-W x 0.42m (max) to 0.10m (min) N-S; unexcavated so thickness unknown; may be same as deposit [79]	Black silt deposit, external
79	8	Deposit	Layer	Soft; dark grey brown to black; silt; occasional fragments of cinder, slag, concrete, mortar and brick; 1.04m (max) to 0.30m (min) E-W x 0.72m (max) to 0.04m (min) N-S; unexcavated so thickness unknown; may be same as deposit [78]	Silt and iron waste deposit, external
80	8	Deposit	Layer	Compact; mid orange brown; iron waste and slag; 0.31m E-W x 0.24m N-S; unexcavated so thickness unknown	Slag deposit, external
81	8	Deposit	Layer	Firm to hard; dark bluish grey; glassy slag; 1.08m NW-SE x 0.66m NE-SW; unexcavated so thickness unknown	Glassy slag deposit, external
82	8	Deposit	Layer	Compact; dark brown to black; cinder and iron slag; 2.00m N-S x 1.32m E-W; unexcavated so thickness unknown; lies against wall [21]; deposit contained large worked fragment of sandstone SF 13	Slag and cinder deposit, external
83	VOID				
84	8	Deposit	Layer	Soft; dark brown to black; silt; frequent fragments of concrete, brick and mortar; occasional patches of pale grey brown clay; 6.58m N-S x 3.50m (max) to 0.64m (min) E-W; unexcavated so thickness unknown	Black silt deposit, external
85	8	Masonry	Brick	Red and yellow bricks 240mm x 120 mm and 260mm x 120mm; bonded with pale grey gritty mortar; unexcavated so bonding pattern not seen; 1.84m N-S x 0.82m (min) to 0.90m (max) E-W; abuts walls [18] and [90]	Brick structure external to Forge Building
86	10	Deposit	Layer	Soft; dark brown to black; silt; frequent fragments and flecks of concrete, brick and mortar; 5.64m N-S x 1.46m (max) to 0.34m (min) E-W; unexcavated so thickness unknown	Backfill well construction cut [95]
87	10	Deposit	Layer	Compact to hard; varicoloured; brick, stone, concrete and mortar rubble with small amount of black silt; 2.00m N-S x 1.88m E-W; unexcavated so thickness unknown	Backfill well construction cut [95]
88	VOID				
89	7	Deposit	Layer	Soft; dark grey; humic clayey silt; occasional medium fragments of yellow brick (<0.15m), very occasional small sub-rounded and sub-angular stones, flecks of charcoal and flecks of CBM; 0.94m E-W x 0.84m N-S x >0.14m thick; not fully excavated; iron objects found throughout deposit	Demolition material, Furnace Chimney
90	6	Masonry	Wall	Red bricks 110mm x 160mm x 60mm; bonded with pale whitish grey mortar; irregular coursing, 3 courses of shortened stretchers and a top course of headers; keyed into wall [18]; >0.78m NW-SE x 0.26m NE-SW x 0.80m high; on same alignment as wall [17]	West wall Forge Building
91	7	Deposit	Layer	Firm; mid greyish blue and mid reddish orange; iron slag; 1.74m N-S x 0.52m E-W x >0.10m thick; unexcavated so full thickness not known; layer contained within tertiary brick skin [51] in Furnace Chimney	Iron slag deposit from Furnace Chimney, may be evidence for puddling within furnace as contains no inclusions
92	7	Masonry	Wall	Yellow bricks 230mm x 110mm x 60mm; bonded with light orange pink, very sandy mortar with frequent small stone flecks; no visible coursing pattern; brick infill at NW end of brick skin [51] which may represent stepping or angling of base; continues under slag layer [91]	Brick infill/stepping in Chimney Furnace



Context	Phase	Type	Type	Description	Interpretation
93	8	Masonry	Surface	Sandstone slabs; dressed; Slab A 0.61m N-S x 0.31m E-W; Slab B 0.59m N-S x 0.44m E-W; Slab C 0.59m N-S x 0.40m E-W; Slab D 0.60m N-S x 0.39m E-W x 0.17m thick; Slab E 0.59m N-S x 0.41m E-W x 0.20m thick; Slab F 0.53m N-S x 0.58m E-W x 0.20m thick; have no mortar or bonding material, appear to be wedged in position	Well capping
94	8	Masonry	Wall	Sandstone blocks and red bricks; visible bricks damaged or broken; sandstone blocks vary greatly in size from small fragments (<0.10m) to reused grinding stones (SF 30) measuring 0.47m E-W x 0.40m N-S; unexcavated so coursing not clearly seen, appears to be random courses of sandstone and brick, with brick forming upper course on southern side of structure; some evidence of mortar or lime wash on some blocks and bricks; a neat brick surface is also visible under the capping stones along the southern edge of the structure; 3 worked stone fragments noted within structure, SF 30, SF 31 and SF 32	Well
95	8	Cut	Well	Sub-square; unexcavated so sides and base not seen; 2.18m N-S x 1.78m E-W	Construction cut for well
96	10	Deposit	Fill	Firm; black; clay silt; occasional small and large fragments of brick, yellow sandstone, CBM, very occasional small flecks of charcoal, one large fragment of sandstone; >14.90m total length NW-SE and NE-SW x 0.76m wide x >2.20m thick; surrounds ceramic drain pipe approximately 0.50m diameter	Fill of trench [97]
97	10	Cut	Services	Linear; sharp top break of slope with steep sloping sides approximately 65 degrees); not excavated so depth unknown; >14.90m NW-SE x 0.76m wide x >2.20m thick; orientated NW-SE then turns 90 degrees to run NE-SW	Service trench
98	10	Deposit	Fill	Firm; black; clay silt; frequent large and small fragments of brick, very occasional small fragments of sandstone and flecks of charcoal, occasional small flecks of CBM; >12.40m total length NW-SE and NE-SW x 1.00m wide x >2.20m thick	Fill of trench [91]
99	10	Cut	Services	Linear; sharp top break of slope with steep sloping sides (approximately 65 degrees); not excavated so depth unknown; >12.40m total length NW-SE and NE-SW x 1.00m wide x >2.20m thick; orientated NW-SE then turns 90 degrees to run NE-SW	Service trench
100	10	Deposit	Layer	Mid to light grey; concrete; extends across whole of site; varies in thickness from 0.15m to 0.40m; comprises of several layers in some places	Concrete ground surface
101	2	Masonry	Wall	Sandstone blocks 500mm x 250mm (max) to 330mm x 170mm (min); roughly hewn; regular coursing; >1.76m NW-SE x >0.45m thick; only seen in section	Foundation for wall [3], west wall of Wharf Building
102	2	Cut	Wall	Linear; not excavated so sides and base not seen; >1.76m NW-SE x >0.45m deep; only seen in section	Cut for foundation [101], west wall [3] of Wharf Building
103	8	Cut	Structure	Sub-rectangular; unexcavated so sides and base not seen; 1.84m N-S x 0.94m E-W; abuts walls [18] and [90]	Construction cut for brick feature [85]
104	5	Masonry	Wall	Red bricks 230mm x 120mm x 70mm; bonded with light grey, gritty mortar, with occasional flecks of charcoal; 1.07m E-W x 0.38m N-S; unexcavated so depth unknown	Infill in wall [4]
105	6	Masonry	Wall	Red bricks 240mm x 120mm x 60mm and 220mm x 110mm x 65mm; bonded with pale grey gritty mortar; English garden wall bond with evidence of an archway; 0.74m NW-SE x 0.50m NE-SW x 1.37m high; on same alignment as wall [16]; archway visible on NE and SW faces	Remnants of archway in west wall of Forge Building, may be associated with Furnace Chimney
106	2	Masonry	Wall	Red bricks 230mm x 110mm x 60mm; bonded with light grey gritty lime mortar with small flecks of charcoal; coursing pattern unclear as not excavated; 1.52m N-S x 0.58m E-W x >0.27m thick; may continue in a NE-SW direction, but area not excavated; wall [19] built directly on top of [106]	West wall of Half Forge Building, may be part of original 18th century build
107	9	Masonry	Brick	Variety of bricks used, mainly yellow firebricks 230mm x 115mm x 75mm; brick infill blocking entrance, extends for full height of surviving wall	Infilling of entrance in south wall of Wharf Building

**APPENDIX 3**  
**PLATES**



Plate 1. Wharf Building, during excavation, looking north-west.



Plate 2. Half Forge and Forge Buildings, during excavation, looking north-west.





Plate 3. Furnace Chimney, during excavation, looking south-west (*1m scale*).



Plate 4. Furnace Chimney, after excavation, looking north-west (*1m scale*).



Plate 5. Furnace Chimney, during excavation, looking south-east (1m scale).



Plate 6. Furnace Chimney, after removal of deposit [23], looking south-west (1m scale).





Plate 7. Wharf Building, looking south.



Plate 8. Half Forge and Forge Buildings, looking south-west (2 x 2m scale).



Plate 9. Retaining Wall, looking west (*2m scale*).



Plate 10. Retaining Wall (western end). Wall [22], with reused grinding stones SFs 8-10, looking south (*1m scale*).





Plate 11. Test Pit 1, north-west facing section (2m scale).



Plate 12. Wharf Building. Cobbled surface [40], looking north-east (1m scale).





Plate 13. Half Forge and Forge Buildings. Walls [17] and [105], looking south-west (1m scale).



Plate 14. Reused grinding stone SF 30 in Well [94] (0.5m scale).

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