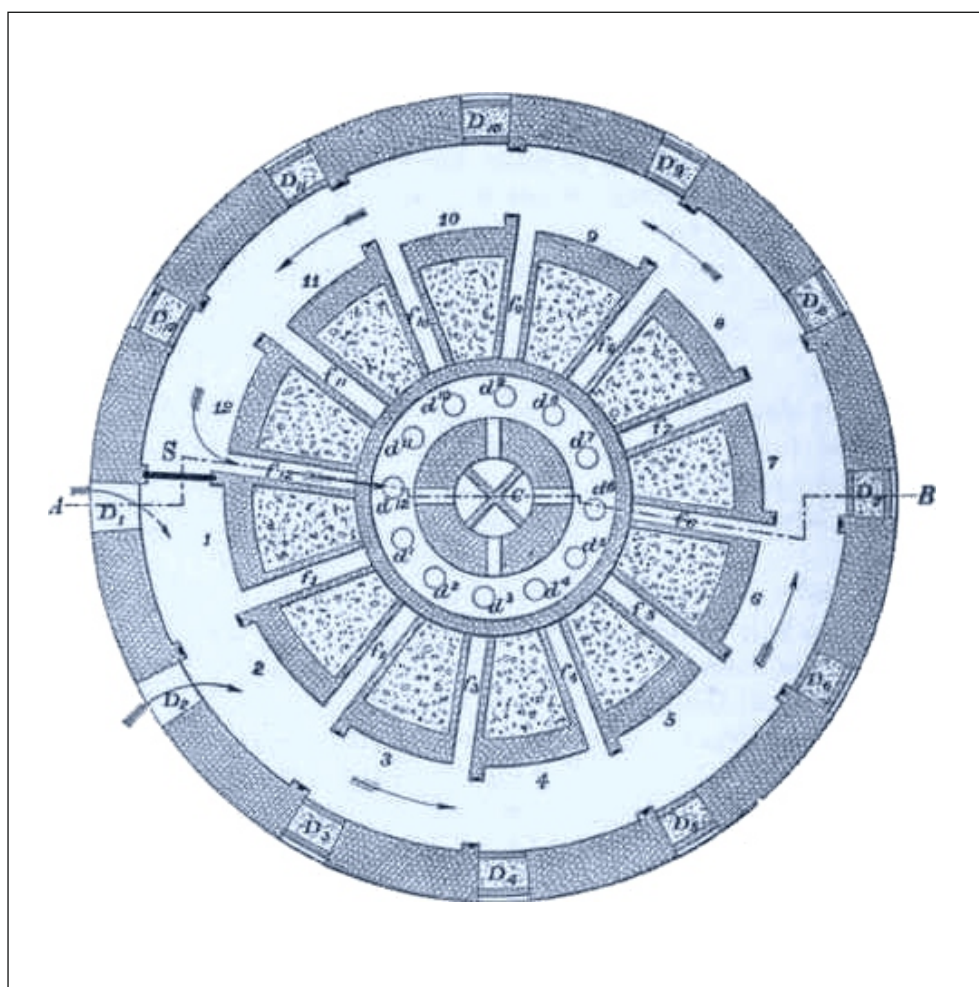




making sense of heritage

Gregory's Bank Industrial Estate Gregory's Bank, Worcester

Archaeological Watching Brief



Ref: 88601.01
July 2013



**Gregory's Bank Industrial Estate
Gregory's Bank
Worcester**

Archaeological Watching Brief

Planning Application Ref: PRA12M01

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Gregory's Bank Industrial Estate Gregory's Bank Worcester

Archaeological Watching Brief

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Gregory's Bank Industrial Estate Gregory's Bank Worcester

Archaeological Watching Brief

Summary

Wessex Archaeology was commissioned by St Modwen Properties Ltd to carry out an archaeological watching brief during proposed development groundwork's at Gregory's Bank Industrial Estate, Gregory's Bank, Worcester. After an Archaeology and Cultural Heritage Assessment was carried on the site and as part of planning condition 11, Historic Building Recording was undertaken on the remains of the 19th century brick and tile works known as Worcester Patent Brickworks. This study identified the existence of the possible remains of a circular Hoffman Kiln which, may be disturbed by the proposed groundwork's.

A subsequent watching brief was carried out between 21st March and 5th April 2013 on a specified area agreed between the Client and Worcester City Council and their archaeological advisor, James Dinn.

The site overburden was removed by machine until deposits and features related to the Hoffman Kiln were recorded. The site was badly damaged by later development including concrete ground beams and drains but several features were identified, including sections of outer kiln wall, a paved fire chamber surface, a brick built vaulted smoke flue and part of the brick foundation of the central chimney. The remains of the smoke flue were sufficient to compare with the radial arrangement of such features in a typical Hoffman Kiln. In this case, it is possible that the flues in the kiln at Gregory's bank were not radial but angled off-centre.

No other features relating to the Hoffman Kiln and associated structures, such as the inclined ramp to deliver fuel to the fire-holes on top of the kiln were found.

An internet search revealed documented detailed information of the construction of the central chimney stack which, provided dimensions and quantities of bricks used in its construction. Other valuable information was gleaned from the internet as to the plan form and cross section of a typical annular Hoffman Kiln. This information provided an understanding of the flow process of an annular kiln and was used to compare the surviving remains at Gregory's Bank.



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Archaeological Watching Brief

Acknowledgements

Wessex Archaeology was commissioned by St Modwen Properties Ltd and Wessex Archaeology is grateful to Robin Smith and Nick Seddon in this regard. Thanks are also extended to Andrew Hancock of Wakemans and Martin Kettle and his groundteam of CMR (Demolitions) Ltd. The help, advice and site visits by James Dinn the archaeological officer for Worcester City Council are also gratefully acknowledged.

The watching brief was carried out by Charles Hay of Wessex Archaeology, Northern Region. This report was compiled by Bob Davis and Karen Nicholls prepared the illustrations. The project was managed for Wessex Archaeology by Damian De Rosa.



Gregory's Bank Industrial Estate Gregory's Bank Worcester

Archaeological Watching Brief

1 INTRODUCTION

1.1 Project background

- 1.1.1 Wessex Archaeology was commissioned by St. Modwen Properties Plc (the Client) to carry out an archaeological watching brief during proposed development groundwork's at Gregory's Bank Industrial Estate, Gregory's Bank, Worcester. Prior to the granting of planning permission (Planning Ref: P12M0021), an Archaeology and Cultural Heritage Assessment was carried out by Waterman Energy, Environment & Design in order to inform the planning process in regard of the archaeological potential of the Site.
- 1.1.2 As a result of this assessment, and as part of planning condition 11, Historic Building Recording was undertaken (Wessex Archaeology 2013) on the remains of the 19th century brick and tile works known as Worcester Patent Brickworks which, occupied part of the Site. This study identified the existence of the possible remains of a circular Hoffman Kiln which, may be disturbed by the proposed groundwork's.
- 1.1.3 Following a meeting between the Client and Worcester City Council and their archaeological advisor, James Dinn, it was agreed that an additional archaeological strategy (watching brief) beyond the requirements of condition 11 should be implemented to record the possible surviving below ground remains of the Hoffman Kiln, and a possible second kiln and chimney, which could survive within the watching brief area of the proposed development of the Site.
- 1.1.4 The subsequent archaeological watching brief was undertaken in accordance with a Written Scheme of Investigation (WSI) (Wessex Archaeology 2013) which, was submitted to, and was agreed in advance of the work by, WCC and their archaeological advisor.
- 1.1.5 The archaeological watching brief was carried out between 21st March and 5th May 2013.

1.2 Site location and description

- 1.2.1 The Site is located approximately 1km north of the city centre of Worcester. It covers an area of approximately 6.6ha and lies c. 27m above Ordnance Datum (aOD). The Site is bounded to the west and north-west by the Worcester and Birmingham Canal (a designated conservation area), to the east by a steep, partially vegetated clay bank, known as Gregory's Bank, and to the south by St. George's Lane North and Merriman's Hill. The Site is divided approximately into two parts (east and west) via the north-south running Gregory's Bank road (**Figure 1**).
- 1.2.2 The area covered during the watching brief measured c.60m x 30m in size (**Figure 1**).

2 HISTORICAL BACKGROUND

2.1 Introduction

- 2.1.1 The Site was first developed by D. W. Barker in 1869, as the Worcester Patent Brickworks. This occupied the Site until the mid-20th century when, it was redeveloped as a large industrial estate, consisting of several large steel-framed warehouses and workshops with attached offices. The only remains of the original brickworks were two small buildings located at the western edge of the Site. The historical background and development of the Site has been outlined in detail in the Historic Building Recording report (WA 2012) and it is deemed unnecessary to repeat it here. A brief summary of the history of the Site and in particular the Hoffman Kiln, which is the subject of the archaeological watching brief, is presented below.

2.2 Development and process flow

- 2.2.1 The erection of the brickworks started in January 1869, and was completed by July of the same year. The kiln was supplied by Messrs' Hoffman and Licht of Berlin and Danzig, from whom Mr Barker purchased the license for exclusive use of the patent in Worcester and the surrounding area. The kiln was a large circular brick structure (**Figure 2**) and was a Hoffman and Licht patent "Annular Oven" which had gained a prize at the Paris Exhibition of 1867. It consisted of a railway tunnel shaped passage, forming a large 'annular' chamber or ring. This ring was divided into 12 compartments which could be opened or separated from one another by the raising or lowering of a partition or damper. Each compartment contained an entrance doorway which could be closed with temporary brickwork. Flues led from the bed of each compartment to the central smoke chamber, which joined with the main flue of the chimney.
- 2.2.2 Details of the kiln chimney were published in a book entitled *A Practical Treatise on the Construction of the Chimney Shafts* in 1885 by Messrs Robert. M. and Francis. J. Bancroft. In this publication, the chimneys architect is named as F. Chamberlain and built in 1869 (www.archive.org). The text provides key dimensions such as height, diameter and materials. The chimney was founded on rock marl 4 feet (1.21m) below ground level. The height from ground surface was 160 feet (47.76m) and the diameter of the circular brick footings was 24 feet (7.31m). The document tells us that the shaft was built by day labour, under the supervision of Mr Barker and it took 92,000 purposely made red bricks to build the shaft, the lime and sand mortar were ground together in a mill, and used almost hot. The bricks were laid in English Bond and, when complete, the chimney weighed 390 tons. To reach such a height, the scaffold was erected inside the shaft.
- 2.2.3 The book also describes the chimney cap: formed by a course of round end bricks then two courses of white bricks cornered out, then two courses of ordinary red bricks, then a course of round ends, then gathered in and, finished with half round coping. This work was set in cement. The book informs us of Mr Barker's opinion of the finished shaft, he says '*this cap gives a pleasing finish to the shaft, and is excellent in its simplicity, and he cannot understand why heavy cast iron caps are adopted when better affect can be obtained in brick-work*'. A lightning conductor was fitted in copper and cost £11 fixed. Sadly, this document does not give any details of the kiln chambers and flues.
- 2.2.4 The process and production of bricks in a Hoffman Kiln is a circular or annular flow (www.chestofbooks.com) (See **Figure 2**). The 'flow' of production is as follows: Chamber 1 is being filled with raw or green bricks, Chamber 2 is being emptied of cold fired bricks, Chambers 3,4,5,6 contain bricks which have been fired and are cooling. Chambers 7 and 8 contain bricks which are in the process of being fired. The fuel for this purpose is supplied through the fire-holes along the top of the chambers. The fuel (probably coal)

was transported by horse and cart up to the level of the fire-holes via an inclined ramp, this feature can be seen on the 1886 Ordnance Survey plan together with the 1880's sketch of the works and the 1920 engraving (**Figures 3-4**). Chambers 9,10,11 and 12 are drying and becoming very hot from the heat created from chambers 7 and 8. The cold air is fed through the open doors of chambers 1 and 2 and proceeds in the direction shown on the figure by the arrows. The air becomes partly heated by passing over the cooling bricks 3,4,5 and 6, it then enters chambers 7 and 8 where it gets super heated and then passes into chambers 9,10,11 and 12 to dry and heat the green bricks. It then meets the blocking screen between chambers 12 and 1, travels down the sloping flue of Chamber 12 and is allowed to pass into the base of the main chimney by a raised damper.

- 2.2.5 Following this sequence of firing the process is moved around one chamber the next day so that the kiln burns continuously, never being allowed to go out except for repairs.
- 2.2.6 This basic pattern was followed but, where large outputs were required, 'shank kilns' were built. These kilns were developed with the tunnel built in a zig-zag manner and enabled the effective length of the tunnel to be doubled (www.lowtechmagazine.com). A continuous circular kiln was sometimes enlarged by adopting the 'shank' principal (**Figure 5**) but, in enlarging a kiln in this way, it was mostly necessary to supplement the chimney-draught by the aid of a fan.
- 2.2.7 Study of Ordnance Survey mapping of 1940 (not shown in this report) suggests that the Hoffman Kiln at this Site had been demolished by this time, although, the brickworks continued in production until its closure in the mid 20th century.

3 METHODOLOGY

3.1 Aims

- 3.1.1 The principal aim of the watching brief was to document and record any surviving structural remains of the Hoffman Kiln. In addition, it was also the aim to determine the potential remains of a further kiln and chimney not apparent on the OS mapping, but which would appear to be depicted on a sketch dating to 1880 and to prepare a report on the results.

3.2 Methods

- 3.2.1 A single discrete area targeted over the position of the Hoffman Kiln was monitored during machine stripping. The stripping of surface deposits was carried out using a 360 degree mechanical excavator fitted with a toothed bucket and under archaeological supervision.
- 3.2.2 Recording of archaeological features was carried out using Wessex Archaeology pro-forma record sheets supported by digital photography. A digital plan survey of identified archaeological deposits was also carried out using GPS. This data has been overlain onto both digital mapping and historic Ordnance Survey maps in an effort to identify the various sections, areas and features of the kiln. This can be seen in **Figure 1**.

4 RESULTS

4.1 Introduction

- 4.1.1 Although the general area of the Hoffman Kiln, and in particular the east half of the watching brief trench, had been badly truncated by modern concrete building foundations, four identifiable features, relating to the Hoffman Kiln, were recorded during the watching brief. For clarity, the separate areas have been superimposed onto existing mapping and,

where possible, overlain onto an historic plan of an Annular Hoffman Kiln for comparison (**Figure 1**). Each of the features was numbered separately.

4.2 Outer wall of kiln

- 4.2.1 A small segment of outer kiln wall was identified (**context 1004, Figure 1**) It was constructed from a mixture of yellow and red bricks. Although badly damaged, and only an internal 'skin' of bricks survived, it could be seen that the bricks were laid in header bond (**Plate 1**) to provide strength. The full thickness of wall was not determined due to the outer layer of bricks being removed.

4.3 Chamber flooring

- 4.3.1 An area consistent with a chamber floor was exposed (**context 1003, Plate 2**). Measuring approximately 2m square it consisted of a gently undulating surface of brick sets or pavers. These were laid in a hap-hazard manner with no identifiable pattern. What was apparent, from the exposed upper surface, was the amount of scorching consistent with the area being a firing chamber floor.

4.4 Kiln flue

- 4.4.1 Arguably, the most readily identifiable feature recorded on-site was the remains of a smoke flue (**context 1006, Plate 3**). This feature once formed part of a series of flues radiating from the centre of the kiln and provided an exhaust flue to the smoke generated by the firing process. The flue had an arched profile measuring 1.07m wide and 0.87m high (**Plate 4**). The total length recorded was 2.73m. The arch was constructed from a double layer of 'compass' bricks founded on parallel walls also constructed in brick and laid in English Bond. All of the bricks are recorded as being bonded by cementitious mortar. The flue was constructed at an angle pointing down toward the centre chimney area at an approximate slope of 10%. It was recorded passing through a narrow brick wall (**context 1007, Plate 5**). This narrow wall was a single brick wide (9") laid in English Bond for additional strength. This narrow wall was thought to be the outer wall of the damper area. No evidence was found of a damper opening in the top of the flue.
- 4.4.2 Curiously, the plan alignment of the flue was at angle to the projected centre of the kiln and not aligned radially (**Figure 1**). It is known from documentary evidence (www.lowtechmagazine.com), that there were some variations to the basic plan form of the radial flues in a Hoffman Kiln. **Figure 5** shows an adapted annular Hoffman kiln into a 'shank' kiln. What is interesting, is, that the plan shows the original annular kiln with angled flues and not radial. The angled plan alignment of the flue recorded at Gregory's Bank would fit this plan but, sadly, no other flues survived so; a comparison could not be made with any of the other flues on-site which would have confirmed this.

4.5 Central footings

- 4.5.1 A section of curving inner walling, probably relating to the central chimney foundation, was also recorded (**context 1005, Figure 1**). This section of walling measured approximately 2m long and was constructed from the same bricks as the other recorded features on-Site. (**Plate 6**). Laid in a typical English Bond, the extrapolated diameter of 7.31m would be consistent with the measurements provided by Robert. M and Francis in their published article on the chimney dimensions. What was not seen was the interior core of the chimney base or foundation it had apparently been destroyed by later groundwork.
- 4.5.2 There were no signs of the 'second kiln and chimney' noted on the earlier image and these are thought to have been destroyed by the construction of buildings in the 1950s associated with the industrial estate.



5 CONCLUSIONS

- 5.1.1 The watching brief has demonstrated that features relating to the Hoffman Kiln survived. It would appear, even though little survives, that the plan form mostly conformed to the established pattern. It is also possible that the alignment of the flues was based on a variant form of plan but, this was not confirmed as only a single flue was identified. The outer wall, together with remnants of a firing chamber floor, angled smoke flue, damper area and chimney foundations were identified but in poor condition.

6 REFERENCES

6.1 Bibliography

Wessex Archaeology 2013 *Gregory's Bank Industrial Estate, Gregory's Bank, Worcester Written Scheme of Investigation for Historic Building Recording*. Ref: T16848.01

Wessex Archaeology 2013 *Gregory's Bank Industrial Estate, Gregory's Bank, Worcester Historic Building Record*. Ref 88600.01

6.2 Online resources

<http://www.lowtechmagazine.com/2009/10/hoffmann-kilns-brick-and-tile-production.html>

<http://chestofbooks.com/architecture/Building-Construction-2/Comparative-Advantages-Of-Kiln-And-Clamp-Burning.html#.UefGd9KOTa9>



APPENDIX 1: OASIS FORM

OASIS DATA COLLECTION FORM:

England

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OASIS ID: wessexar1-155588

Project details

Project name	Gregory's Bank Industrial Estate Gregory's Bank Worcester
Short description of the project	<p>Wessex Archaeology was commissioned by St Modwen Properties Ltd to carry out an archaeological watching brief during proposed development groundwork's at Gregory's Bank Industrial Estate, Worcester. Studies undertaken for the Site identified the existence of the possible remains of a circular Hoffman Kiln which, may be disturbed by the proposed groundwork's. As a result of the studies and the proposed development a watching brief was carried out between 21st March and 5th April 2013 on a specified area agreed between the Client and Worcester City Council and their archaeological advisor, James Dinn. The site overburden was removed by machine until deposits and features related to the Hoffman Kiln were recorded. The site was badly damaged by later development including concrete ground beams and drains but several features were identified, including sections of outer kiln wall, a paved fire chamber surface, a brick built vaulted smoke flue and part of the brick foundation of the central chimney. The remains of the smoke flue were sufficient to compare with the radial arrangement of such features in a typical Hoffman Kiln. In this case, it is possible that the flues in the kiln at Gregory's bank were not radial but angled off-centre. No other features relating to the Hoffman Kiln and associated structures, such as the inclined ramp to deliver fuel to the fire-holes on top of the kiln were found. An internet search revealed documented detailed information of the construction of the central chimney stack which, provided dimensions and quantities of bricks used in its construction. Other valuable information was gleaned from the internet as to the plan form and cross section of a typical annular Hoffman Kiln. This information provided an understanding of the flow process of an annular kiln and was used to compare the surviving remains at Gregory's Bank.</p>
Project dates	Start: 21-03-2013 End: 05-04-2013
Previous/future work	Yes / No
Any associated project reference codes	88601 - Contracting Unit No.
Any associated project reference codes	PRA12M01 - Planning Application No.
Type of project	Recording project

Current Land use	Industry and Commerce 1 - Industrial
Monument type	BRICK KILN Post Medieval
Monument type	BRICK KILN Modern
Significant Finds	BRICK Modern
Investigation type	"Watching Brief"

Project location

Country	England
Site location	WORCESTERSHIRE WORCESTER WORCESTER Gregory's Bank Industrial Estate Gregory's Bank Worcester
Postcode	WR3 8AL
Study area	1500.00 Square metres
Site coordinates	38515 25650 38515 00 00 N 25650 00 00 E Point

Project creators

Name of Organisation	Wessex Archaeology
Project brief originator	Local Planning Authority (with/without advice from County/District Archaeologist)
Project design originator	Wessex Archaeology
Project director/manager	Damian De Rosa
Project supervisor	Charles Hay
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Name of sponsor/funding body	St Modwen Properties Ltd

Project archives

Physical Archive Exists?	No
Digital Archive recipient	Worcester Museums Service
Digital Media available	"Images raster / digital photography", "Survey", "Text"
Paper Archive recipient	Worcester Museums Service
Paper Media available	"Context sheet", "Plan", "Report"

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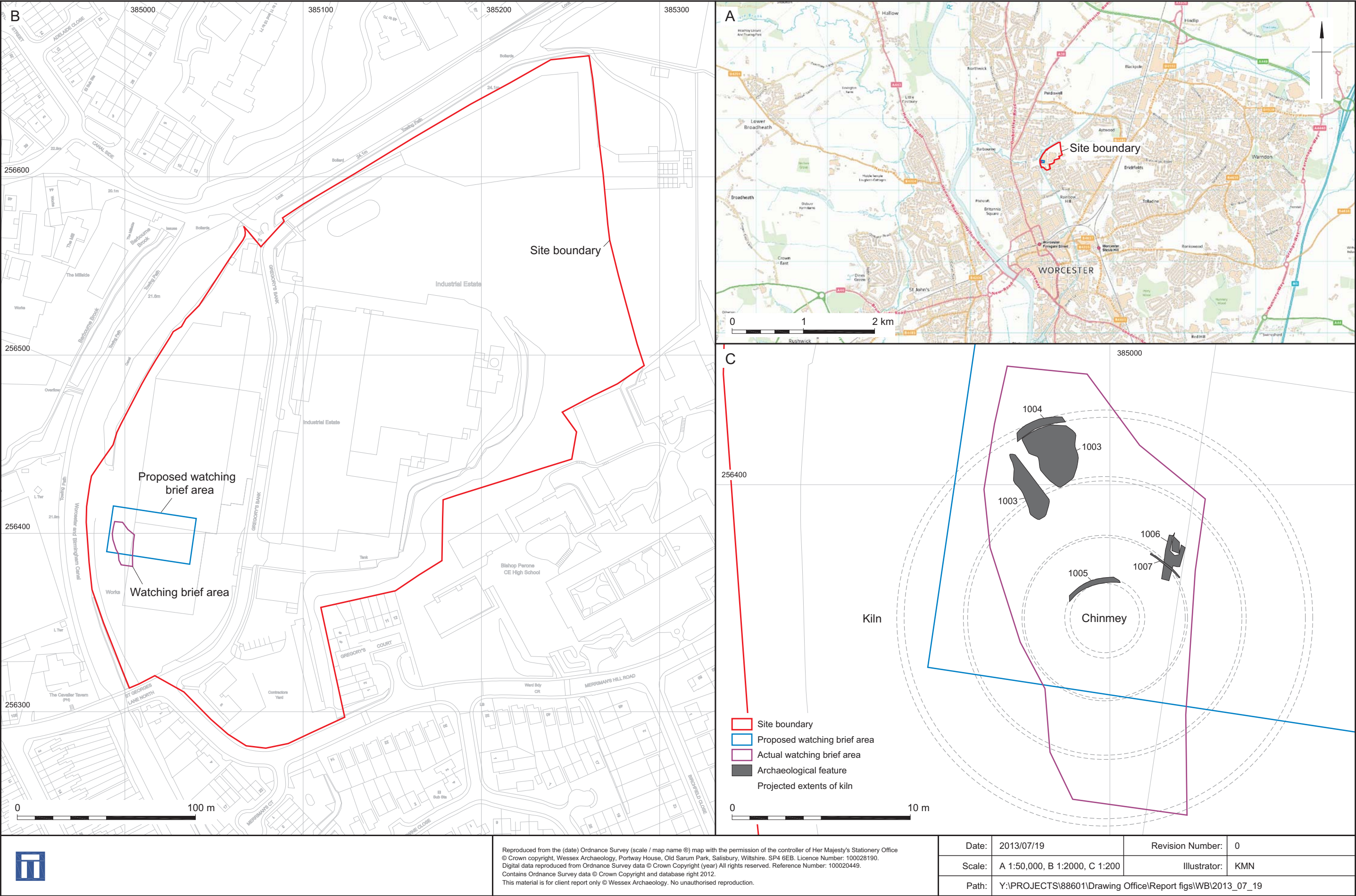
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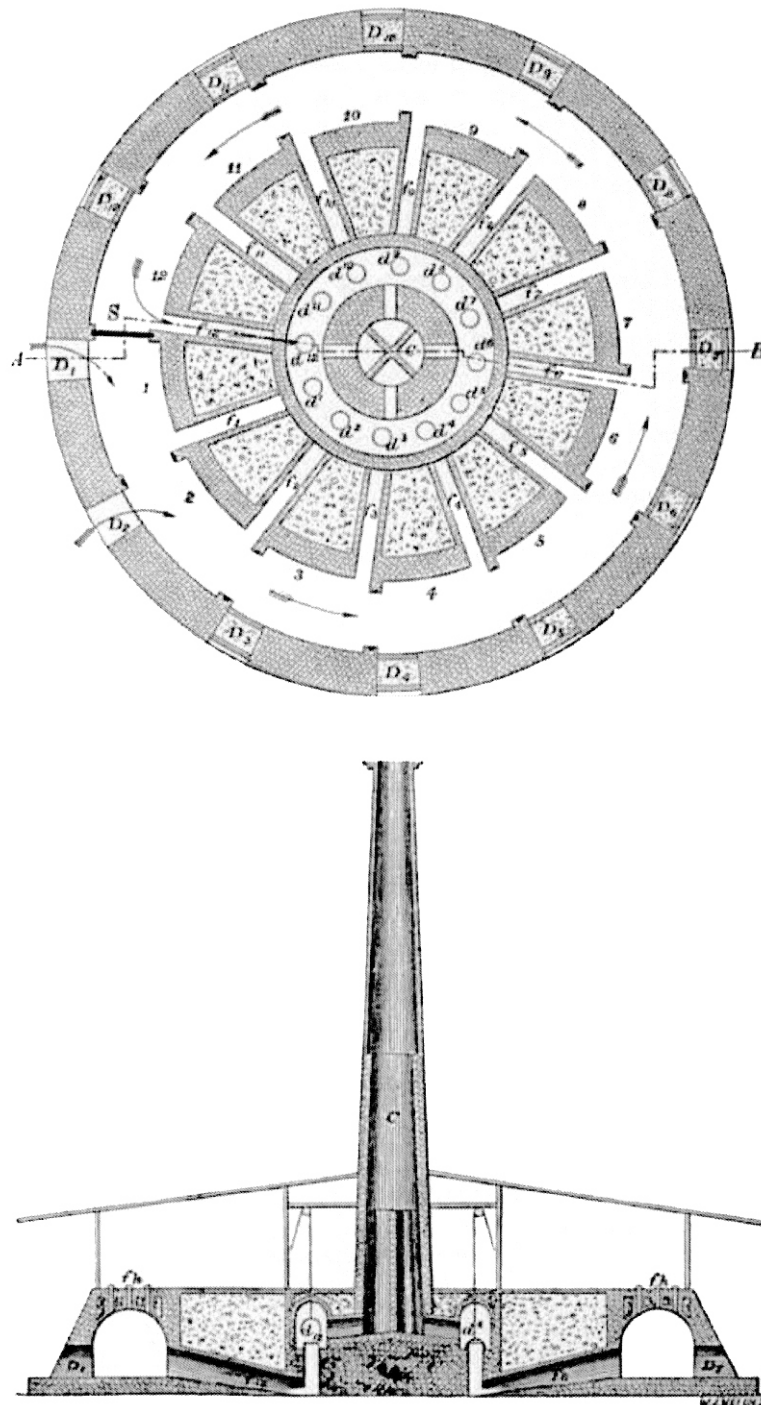
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Site location showing area of watching brief trench

Figure 1



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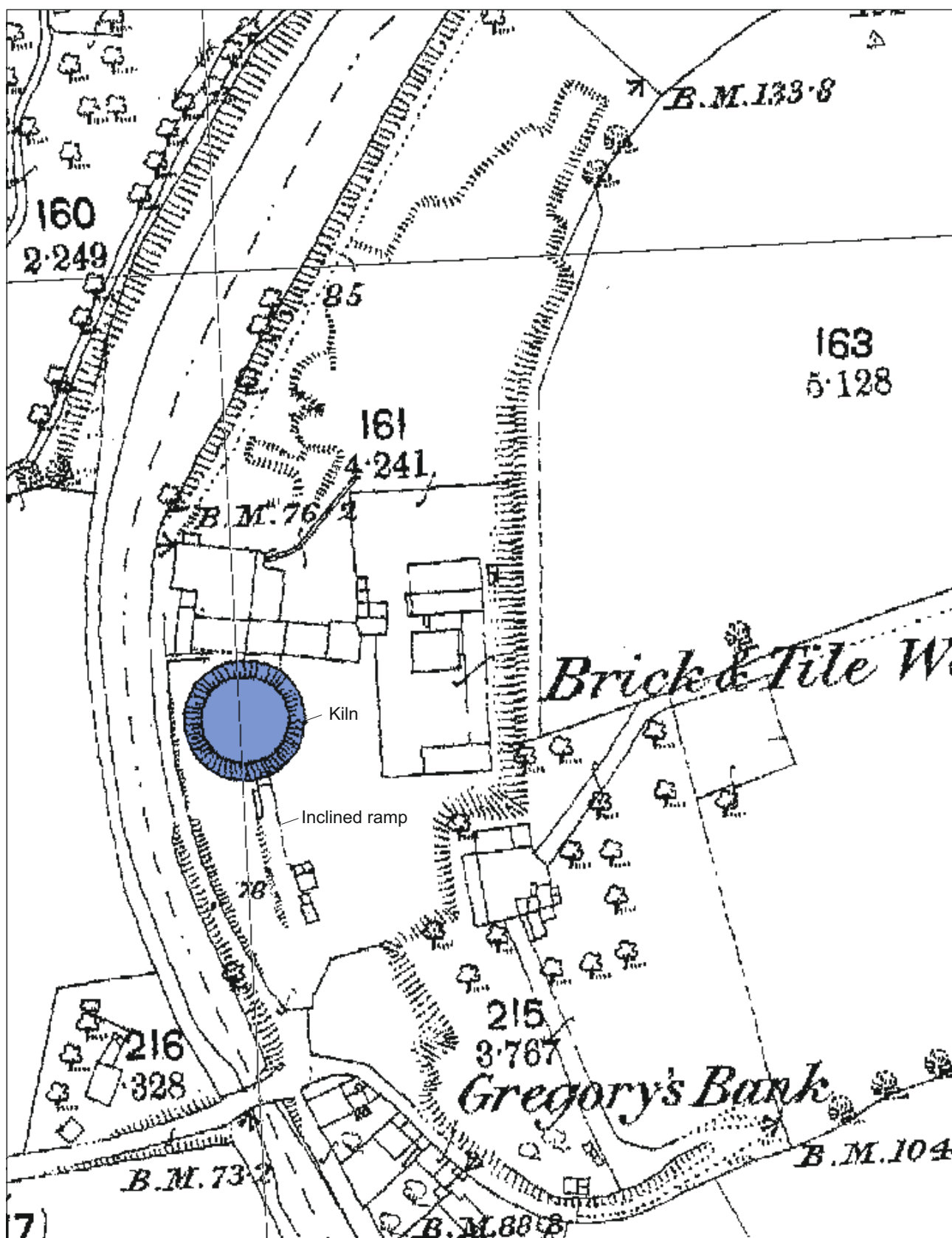
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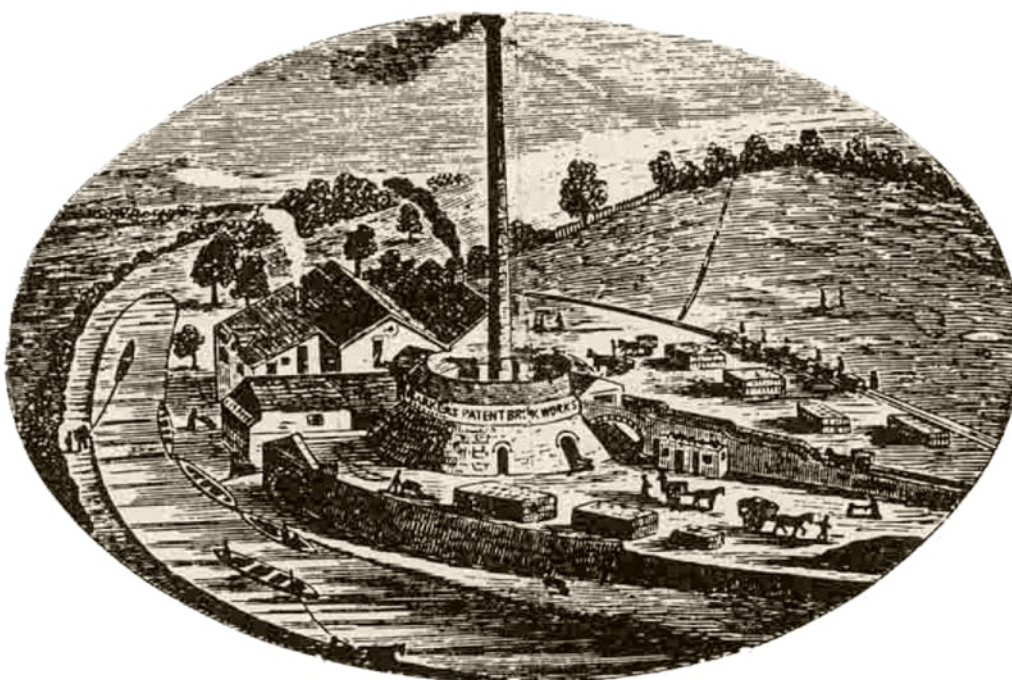
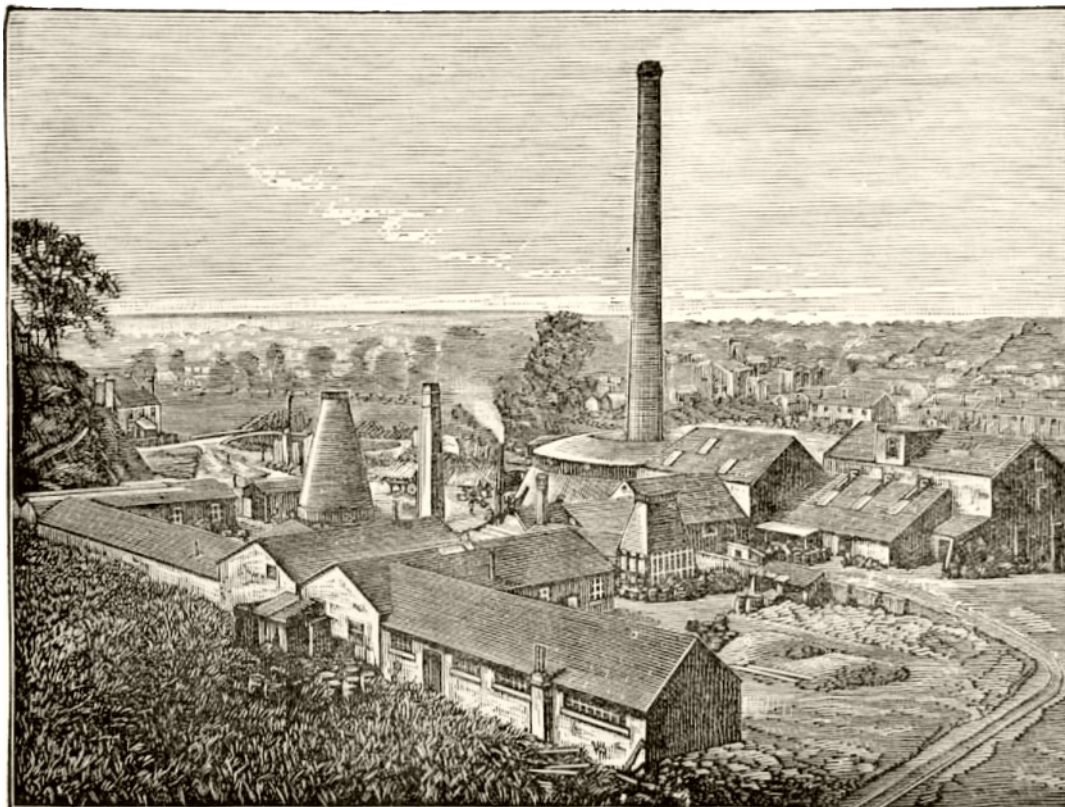
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Historic plan and cross section of typical Hoffman Kiln showing process flow

Figure 2



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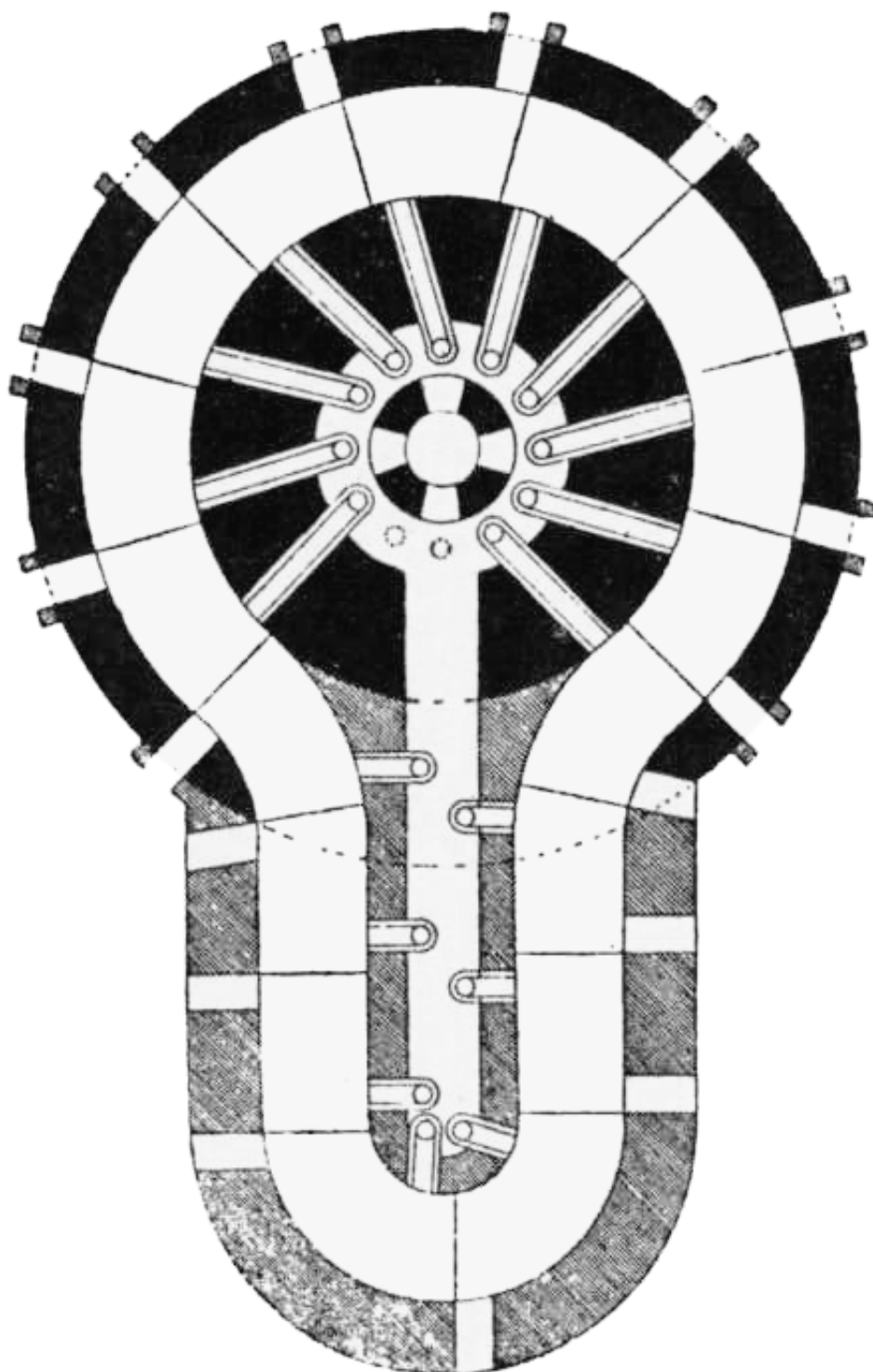
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1880's sketch and 1920 engraving showing brick works with Hoffman Kiln and inclined ramp for fuel

Figure 4



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Plan of Hoffman Kiln adapted into a 'shank' kiln

Figure 5



Plate 1: Surviving section of outer wall of kiln



Plate 2: Exposed area of firing chamber brick flooring


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Plate 3: Smoke flue showing arched brick profile



Plate 4: Interior view of flue showing profile



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Plate 5: Angled smoke flue passing through outer wall of damper area



Plate 6: Section of central chimney foundation

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