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KNOWLES MILL,
BEWDLEY

HISTORIC BUILDING
RECORDING AND
ARCHAEOLOGICAL
EVALUATION

UNIVERSITY OF BIRMINGHAM

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Knowles Mill,

Wyre Forest, Bewdley, Worcestershire

Historic Building Recording, Archaeological Evaluation

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In Association with
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Knowles Mill,
Wyre Forest, Bewdley, Worcestershire

Historic Building Assessment, Record and Evaluation

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SUMMARY

Birmingham Archaeology was commissioned in September 2010 by the National Trust, to undertake archaeological building recording and evaluation of the standing remains of Knowles Mill and the area of the meadows associated with the mill, Dry Mill Lane, the Wyre Forest, Bewdley, Worcestershire (NGR SO 7617 7658).

Historical research has shown that the mill was one of nine possible mills of which seven mills have been located on the Dowles Brook. This included mills that were initially used for corn-milling but later mills were used for a variety of industries including a furnace and clay-grinding. The mill represented well-preserved remains of an 18th century water-driven mill initially designed and used for corn-milling. Investigations may suggest the possibility that an earlier mill existed on the site but currently this seems unlikley. The majority of the remains of the mill structure appear to be 18th-century in date, probably dating to around 1757 when the mill was announced for sale in the local paper.

The original wooden mill mechanism survives only in sections; as the upright shaft of the mechanism and possibly the crown wheel. The mill mechanism appears to have been almost entirely replaced in the mid-19th century with a cast-iron over-shot wheel and mechanism. Some 20th-/ 21st-century repair has been undertaken on the wooden structural support of the mill mechanism. The beams of the first and second floor survive in tact, but except for a small area on the second floor little remains of the original floor surfaces as these were removed in 2006 in order to allow a more open view of the mill mechanism to be achieved. Evidence of subsidiary industrial use suggested there was also a fulling mill for leather capping mentioned in an advert of 1775 but no evidence was forthcoming from the current investigations.

Four evaluation trenches were excavated. Trench 1 revealed evidence that the cast-iron mill wheel survived partially preserved beneath rubble collapse in the wheel pit. Trench 2 revealed the remains of the head race culvert that would have fed the pen trough of the over-shot mill wheel. Trench 3 and 4 were excavated either side of a bridge associated with the dam and weir above the mill pond head race. The evidence from the trenches suggested water flow was restricted to the mill pond by a stone culvert preventing it refilling and eventually the entire mill race and pond silted up. Some water flow is still present today as an aquifer still exists feeding the mill pond in the winter months.

Knowles Mill,
Wyre Forest, Bewdley, Worcestershire

Historic Building Assessment, Record and Evaluation

1. INTRODUCTION

1.1. Background to the project

1.1.1. Birmingham Archaeology was commissioned in October 2010 by Jeremy Milln of the National Trust to undertake an historic building assessment, record and evaluation on the wheel pit and mill race in respect of the extant structures and remains of Knowles Mill, Bewdley.

1.1.2. The work was being undertaken as part of a programme to inform future conservation and interpretation associated with the continued maintenance and upkeep of the mill and with a view to making the remains more publicly accessible.

1.1.3. The work forms part of a HLF (Heritage Lottery Fund) Grow with Wyre Project through the Forestry Commission that has involved a number of partners. In 2006 the National Trust entered Knowles Mill into the Wyre Forest Landscape partnership scheme. The partnership scheme seeks to conserve, restore, enhance, and appropriately manage key features of the forest. It is the National Trust's belief that Knowles Mill fits this criteria and with the help of the other organisations in the partnership scheme will initially conserve and perhaps eventually restore the mill to its working state.

1.2. Circumstances of Survey

1.2.1. At the time of survey, the buildings were unoccupied but still contained elements of the machinery and some work tools. The fabric of the building was structurally sound but internal floor surfaces had been removed. The machinery remained *in situ* but was not complete and was not in working order. The wheel pit and lower mill race had become heavily silted and in-filled during the floods. The mill leat and pool were partially silted up and the head race was almost entirely backfilled/ silted-up.

1.3. Scope of Report

1.3.1. The project was undertaken in accordance with a Written Scheme of Investigation (WSI), prepared by Birmingham Archaeology (2010; see **Appendix B**) in response to a project brief (**Appendix A**) by the National Trust.[1]

1.3.2. This report outlines the results of the assessment, which has been prepared in accordance with the Institute for Archaeologists' *Standard and Guidance for Archaeological Desk-Based Assessment* (IfA, 2008a), and the building record, which was undertaken in accordance with English Heritage guidelines as published in *Understanding Historic Buildings: A Guide to Good Recording Practice* (EH, 2006), within the Institute for Archaeologists' *Standard and Guidance for the Archaeological Recording of Standing Buildings or Structures* (IfA, 2008b). Excavation work was carried out in accordance with the Institute for Archaeologists' *Standard and Guidance for Archaeological Excavation* (IfA, 2008c).

[1] Jeremy Milln 2010.

1.3.3. This report has been prepared based upon information current and available as of October 2010.

2. LOCATION AND GEOLOGY

2.1. Site location

2.1.1. Knowles Mill lies on the Dowles Brook within the Wyre Forest, Bewdley (centred on NGR SO 7617 7658; Fig. 1; Plate 1). The mill stands on the southern bank of the brook in the wooded, steeply sided small valley.

2.1.2. The mill and its appurtances, including mill pool, mill meadow, mill cottage and gardens (Fig. 2) are owned by the National Trust but are surrounded by lands that form part of the Wyre Forest and are subject to multiple land ownerships including the Forestry Commission, Natural England and Worcestershire Wildlife Trust. Repairs to the mill were undertaken in 2010 following flood damage and as part of a programme of general maintenance to ensure the building remained structurally sound. The Mill and adjacent cottages are grade II listed.

2.1.3. The Wyre Forest comprises an extensive tract of semi-natural woodland with Dowles Brook flowing through its centre. It represents one of the largest areas of ancient broad leafed woodland in Britain and is in an Area of Outstanding Natural Beauty. In addition to the woodland the area includes unimproved grasslands which have been designated Special Sites of Scientific Interest and is actively managed by Natural England. While the mill, mill cottage and garden is outside, the majority of the land lies within one of these Sites of Special Scientific Interest.

2.2. Geology and Topography

2.2.1. The site lies within the Wyre Forest on the valley floor of the Dowles Brook. The Dowles Brook falls from a height of *c.* 152.00m AOD in the west at Wyre Common to 91.00m AOD in the east at Skey's Wood. The solid geology of the area comprises Coal Measures and Old Red Devonian Sandstone overlain by superficial deposits of clay with localised superficial alluvial deposits within the valley floor of the Dowles Brook.

3. AIMS AND OBJECTIVES

3.1. Project Specific Aims and Objectives

3.1.1. Within the aims and objectives outlined above the following project forms the archaeological survey of the mill. The general aim of the historic building assessment, record and excavation as stated in the brief, was to collate existing archaeological and historic information relating to the site and to provide a detailed record, analysis and assessment of the mill in order to inform future conservation. Specifically, the project sought to:

- provide a summary drawn, written and photographic record of the mill.
- provide an interpretive assessment of the origin and development of the mill.

4. METHODOLOGY

4.1.1. For the purposes of the assessment, the study area includes the mill, mill pool, mill meadow, mill cottage and gardens. Full details of the methodology are provided in the written scheme of investigation as Appendix 2.

4.2. Documentary research

4.2.1. Extensive Historic Research has been carried out by Robert Samuel Galloway on *Knowles Mill and Mills of the Dowles Brook*[2] as an element of the Ironbridge Historic Environment Conservation Course and this forms the basis of the documentary research of the current report. In addition there are further material including a report on the mill by Derek Ogden, Millwright and Architects Report[3]; detailed description of the mill mechanism by Tim Booth[4]; structural condition survey[5]; structural report[6] and a LIDAR Survey[7]. In addition detailed notes have subsequently been provided by Tim Booth and Dave Poyner. The report drew on all these sources to provide a comprehensive archaeological and historical record of the mill as it currently stands.

4.3. Historic Building Record and Assessment

4.3.1. The building record and assessment comprised an examination of the mill buildings and wheel pit. Existing survey drawings (supplied by the National Trust[8]) included plans of all floor levels, elevations and cross-sections. Physical recording of the fabric was undertaken to elucidate the sequence of construction, deposition and relationships between mill-related structures and surfaces, including:

- Main Wheel Pit, wheel remains and tail race structure.
- Competent Drawings of the machinery such as it is at 1:20.
- Ground Plan including detailed recording of the floor at 1:20.
- Stone-by-stone recording of the small bridge over the head race close to the site of the dam to elucidate any details of constructional or depositional sequences.

4.4. Excavation

4.4.1. The detailed excavation of the site included:

- Removal of silt and debris at base of external wheel pit so that it and its wheel can be properly recorded.
- Excavation in area at the back of the mill excavated down to occupation level sufficient to elucidate and record evidence for penstock or launder or whatever structure/s relates the mill pond with the wheel by means of a trench 1m by 5m (approximate).
- Excavation of area close to the head race footbridge to allow recording sufficient to determine profile of the race and the full elevation and condition of the bridge to allow assessment for its conservation.
- Allowance for a bulk samples for environment if stratigraphic secure sealed waterlogged deposits encountered in the Mill Pool.

[2] Knowles Mill and the Mills of the Dowles Brook, Robert S Galloway 2007.
[3] Report by Derek Ogden, Millwright, and Architects Report Knowles Mill, Bewdley, Worcestershire, 1971.
[4] Tim Booth 2006.
[5] Structural condition Survey of Knowles Mill, Dowles Brook, Steven Holloway 2007.
[6] Structural Report, Frank W Haywood and Associates 2007.
[7] LIDAR Survey undertaken by Adam Mindikowski of Worcestershire Archaeological Service
[8] J. Milln 2009 Measured Survey Drawings, National Trust

5. HISTORICAL CONTEXT *by Chris Hewitson and Tim Booth*

5.1. Introduction

5.1.1. *This section of the assessment describes the known archaeological and historical development of the study area. It is based upon information current and available as of October 2010. It represents a summarisation of the work of Robert Samuel Galloway with regards the mill as well as further research undertaken by Tim Booth and David Poyner. The research was conducted at the Worcestershire County Record Office (WCR), Shropshire County Record Office (SCR), Birmingham City Archives (BCA), Worcester History Centre (WHC), Worcestershire County Council Archaeology Service (WCCAS) and the Bewdley Historical Research Group (BHRG).*

5.2. Historic Background

5.2.1. Knowles Mill lies in Bewdley Parish in the Wyre Forest. Dowles Brook flows west to east before entering the River Severn just north of Bewdley, near to the ruins of the former Dowles Church. It was the major source water power for industrial mills in the parish.

5.2.2. The forests and landscape surrounding the mills along Dowles Brook was abundant in natural resources and these were used in industries including clay for brick-making and wood for charcoal burning. However, it was water as a natural resource in the form of Dowles Brook that has been used for a number of centuries by industries, such as the mills. Throughout the 18th, 19th and early part of the 20th century, seven or possibly eight water mills operated along the Dowles Brook. Within this context the remains of Knowles Mill and others on the Dowles Brook represent an important remnant of the Wyre Forest industry.

5.2.3. Robert Galloway's Survey of Knowles Mill also undertook a wider survey of the mills in the Dowles Brook valley, identified the remains of seven mills along the valley as it flows through the Wyre Forest: Dry Mill or Oat Mill, Dowles Mill, The Clay Grinding Mill, Town Mill, Knowles Mill itself, Cooper's Mill and Forge Mill. The Mills are listed in the table below;

TABLE 1: Mills of the Dowles Valley within the Study Area (see Fig. 3)

HER Ref	Type	Site Name/ Description	NGR	Period/ Date
WSM03284	AS	Dry Mill or Oat Mill – former mill location	SO 7721 7628	Post-medieval to modern
WSM03283	AS	Dowles Mill – former mill location	SO 7752 7634	Post-medieval to modern
WSM38128	AS	Clay Grinding Mill – Former Mill Location, visibl surviving	SO 7720 7650	Post-medieval to modern
WSM03591	HB/ AS	Town Mill – former mill location, accommodatio	SO 7678 7639	Post-medieval
WSM22321	HB/ AS	Coopers Mill – former mill location, accommoda	SO 7571 7667	Post-medieval to modern
WSM37267	HB	Furnace Mill -	SO 7198 7653	Post-medieval to modern
WSM03282	LB	Knowles Mill	SO 7622 7659	1857 -

*** Site Classification:**

SAM: Scheduled Ancient Monument
LB: Listed Building
HB: Historic Building (unlisted)

5.2.4. In addition historic research by Tim Booth has identified the possibility of further mills. The first historic references to the mills in Bewdley Parish were in the will of Thomas Southall of Fox Cote, Kinlet, dated 1574, that refers to *'…to my (3rd) son Richard, my two watermills with all closes…in the lordship of Bewdley in the*

occupation of John Corbett'.[9] By 1670-1715 two mills in Bewdley were mortgaged to Mr. Taylor in Bridgnorth since assigned to Mr. Ash of Atterley near Wenlock.[10] The likelihood is that these refer to some of the archaeologically known mills, probably the Town Mill and Dowles Mill but they do not fit into current understanding of the chronology of the mills.

5.2.5. The Cob or Cop Mill is named in a lease for the Town Mill in 1716 (see below) and John Snape's map of Dowles in 1784 shows a track from the 'Old Mill' but no archaeological evidence for this mill has been uncovered.

5.2.6. A further blast furnace was mentioned between 1575 and 1600 (see Furnace Mill below; SO 712 764) but has not been mentioned within this study (VCH 1924).

5.3. Dry Mill

5.3.1. The Dry Mill (NGR SO 7721076280), so called because it stood on a small tributary of Dowles Brook which was liable to dry up in the summer period. It was located at the bottom end of what, is known as Dry Mill Lane today. The Coventry Mill is mentioned in a survey of the manorial boundary of Shropshire '*so down by Dowle's side to Coventry Mill, so up a lane to Bark Hill*' that suggests it may have been Dry Mill (Auchmuty 1911). Dry Mill or Oat Mill, and its adjacent sling were first mentioned on an undated map suggested to be from 1620-40.[11] In 1662 the mill had been held by Richard Barkeley, deceased, who left it to his nephew Thomas Barkley.[12] The 'Sling' was leased to Daniel Crun in 1729. The mill was still noted on Baugh's Map of Shropshire in 1808. However in October 17th 1862 Dry Mill and the sling was in the hands of the Reverent Joseph Fletcher and his wife Mary Henrietta; they sold the mill and sling to the Tenbury and Bewdley Railway Company for £50, plus a strip of land containing 25 perches with all the trees on the land. By 1864 the building served as a blacksmith's shop for the railway (Elliott 1917). Today there is now no visible trace of the former Dry Mill, however there are some fruit trees of the miller's garden remain (Barrett 1974).

5.4. Dowles Mill

5.4.1. Dowles Mill (NGR: SO 077520 76340) was in 1521 held by the Prior of Great Malvern who leased it to a William Southall of Bewdley (VCH 1924, 264). By 1543 the mill had been conveyed to Thomas Grey by James Leverson, it was still with the manor in 1587 (VCH 1924). By 1784 the mill is marked on J. Snape's map as belonging to the manor of Samela Skey.[13] The mill was subject of a case with Dowles Mills when a law suit between Foley and Skey; Skey was ordered to demolish the mill and remove the weir and mill race, which flowed onto Foley's land (Barrett 1974; WCCAS 2007). The tithe map of Dowles Parish in 1840 still shows the mill recorded on it, but in 1875 after a period of three months of frost the mill wheel was destroyed. It is suggested that the miller lit fires under the wheel in an effort to free it from the ice, but without success.[14]

[9] National Archives no ref
[10] Worcestershire Record Office SA 4134/6/3-04
[11] Undated Map of Bewdley
[12] Bewdley Manorial Court Records (MCR) 1662
[13] John Snape's Map of Dowles
[14] Kidderminster Shuttle, 1956

5.5. Clay Grinding Mill

5.5.1. There are archaeological features still *in situ* of the former Clay Grinding Mill (NGR: SO 772765). This was horse-powered and should be seen as distinct from the water powered forges elsewhere. The land was owned by the Foley family and therefore the mill was possibly worked by them, yet the date when it was built and the date of its demolition has not yet been established. The first record of the mill is recorded on the tithe map of Dowles Parish in1840. The fire kiln and chimney where removed in the 1850s. The land around Oak Cottage and the former Clay Grinding Mill was owned by the Elliott family in 1903 which lived in the manor house (Galloway 2007; Sylvia Sheldon pers. comm) and the boundary of the manor land was near to the clay mill. It now appears to be owned by Mrs Petronella Trustram Eve the daughter of Mr Elliott (ibid.). The cottage was used as the office for the works associated with the kiln and clay grinding mill.

5.5.2. The former mill site is currently heavily overgrown only leaving the grindstone just visible. Excavation by Robert Galloway in 2007 revealed a grindstone with a cast iron band around it, surrounded by a cast iron channel. Excavation revealed roof titles, bricks and the remains of another sandstone wheel. This sandstone wheel lay directly under the other grindstone and would appear to be the bedstone of the pair (Galloway 2007, 15-19).

5.6. Town Mill

5.6.1. Town Mills, mill has long disappeared, all that is left is the accommodation building (NGR: OS 7678576395). Town Mill had three pairs of mill stones which may be in the garden now used as decoration pieces (Galloway 2007, 20-1).

5.6.2. However, in 1595 Dowles Mill and Town Mill where left for the benefit of the poor of Bewdley by Sir John Hibbotts (VCH 1924, 4). In 1716 it was leased for 51 years at £8 per annum from the Baliff and Burgesses of Bewdley Borough to Daniel Crunn of Ribbesford, miller described as '*a messuage, dwelling house and water corn mills called Town's Mills, late in the possession of William Wynn, with one close or leasow adjoining lying between Town's Coppice, the brook called Dowles Brook and Cob Mill or Cop Mill Close'*.[15] A draft lease of 1762 for 31 years to William Tench details the size of the millstones at the end of the tenure.[16] It was marked as '*William Tench Copyhold*' on a map of Bewdley, property of Sir Edward Winnington in 1785.[17] This was followed by the occupation by George Tench under a 99 year lease in 1790. This was followed by various tenancies including John Jennings, George Griffiths, William Toomey, Henry Knowles Junior and Joseph Trow throughout the 19th century. Some of these tenancies may have been sub-let as George Griffiths leased the mill from 'Mrs Tench' in 1848 (Griffiths 1870). By the 1904 Ordnance Survey Map the mill is marked as disused.

5.7. Cooper's Mill

5.7.1. Cooper's Mill was located to the west of Knowles Mill on Dowles Brook (NGR: SO 75707 76665). It was demolished as unsafe in 1967 when most of the building materials and machinery were said to be buried in a pit (Galloway 2007, 22). The mill house has been renovated and the external walls rendered; today this is used

[15] Worcestershire Record Office 889:749/8782/61/9
[16] Worcestershire Record Office 899:749/8782/58/ii/27
[17] Birmingham City Archives 4600/737

as a youth hostel. The main vertical wheel spindle and spur wheel have just been discarded in the garden and left to the elements.[18]

5.7.2. The first reference to the mill may date back as far as 1278 when Roger de Mortuo Mari, Lord of Wigmore and Sir John de Seagrave granted to John and his issue the abutments and fishpond of his mill of Stottesdone above Roger's land in the Chase of Wyre, which mill is situated above the water of Doules which didvides Roger's land from John's.[19] In 1785 it is marked as Coventry Mill on a map of Bewdley.[20] A number of tenants are present at the mill in the 19th century. This included Mr. Bishton in 1841,[21] Thomas Weaver in 1841, Richard Band in 1849, Benjamin Smith in 1866, Thomas Edward Weaver in 1878 who continued to work there until it was disused. The mill is marked as disused in 1885 on the 1st edition Ordnance Survey but was still being used to grind oats in 1895 before it became finally disused in *c.* 1898 (Elliott 1917).

5.8. Furnace Mill

5.8.1. Furnace Mill (NGR: SO 71980 76526) lies just over the border in Shropshire. As Furnace Mill's working life terminated in 1920, the building was renovated with an extension and the addition of a front door. Changes continued from 1920 to 1960 when the property was modernised. However this reconstruction of what was a former mill and the landscape in which it is located offer no insight into its former working life. The building has lost it original state; the only part of the building that resembles the former mill is left hand side of the buildings as seen from the front elevation and today it resembles a country house. It is unclear how much of the fabric has been altered by 20th-century renovations. As part of the redevelopment of the buildings on the mill site, the original water course was changed to flow further away from its natural route in Dowles Brook (Galloway 2007, 23-6; David Lloyd-Jones pers. comm.). Flooding in 2007 occurred of the complete ground floor of the original mill and the new building extensions.

5.8.2. There is no precise evidence for the date when the mill was built; A blast furnace in the forest serves one of the Cleobury Mortimer Forges in c. 1575-1600 as mentioned in a court case between Alice Weston and Edward Blunt: '*to recover rent of two water corn mills called Cleobury Mills and two iron furnaces in Cleobury Park and Forest of Wyre, situate in the Parish of Celobury Mortimer*' (VCH 1924). By 1643 it is named for the first time as the Furnace Mill in the survey of Earnwood.[22] Habingdon in 1647 and Yarranton in *c.* 1677 review the status of timber in the Wyre Forest and make reference to forges.[23] It is again mentioned in 1749, '*in the middle of the common above Dallows new Inclosure, Tenement and Orchard where Dovey dwelt before he took Furnace Mill*' in the Survey of the Manor of Bewdley (Ingram 1749, 88). Chapman (1996) refers to it as being present in 1785. The original building had a rectangular shape with small extensions added at latter dates. The iron smelting ceased at Furnace Mill in 1865 and after this period the mill was renovated. Thereafter the Furnace Mill was a corn mill; from 1863 to 1900 under George Barber and by 1913 the miller was a Henry Tolley (Kelly's Directory 1913). It is possible that he was the last miller because in 1920 the corn mill closed (Lloyd-Jones, 2002).

[18] WCCAS Library accessed 2007
[19] Berkley Castle Muniments GC482 BCM/D/5/74/16
[20] Birmingham City Archives 4600/737
[21] G & R Turton 1841)
[22] Bewdley MCR 1643
[23] WCCAS Library accessed 2007

5.9. Knowles Mill

5.9.1. Knowles Mill (NGR: SO 7621976593) is the only near complete mill on the Dowles Brook. The mill and cottage now belong to The National Trust after it was gifted to them by Paul Cadbury in 1938 (Milln 2006).

5.9.2. The first record of the mill was made in 1757 when it was advertised for sale. The sale particulars refer to the mill as:

> *To be SOLD*
> *A new-erected messuage, with the water corn mills and out-buildings, thereto adjoining, situate on Dowles Brook, together also with six acres of very good meadow ground lying contiguous to the fame, being copyhold of Inhertance of the Manor and within a mile and half of the town of Bewdley of the yearly value of £14, or thereabouts, and now in the occupation of William Crun, Miller.*[24]

5.9.3. It was recorded on Morden's Map of 1785 as Coventry Mill or Brasiers Mill.[25] itself occurs in 1789 when it is mentioned in an indenture with regards the forthcoming marriage of Samuel Skey the Younger to Mary Divett of Twickenham relating to the dowry and refers to the corn mill and messuages tract of land, pools and streams.[26]

5.9.4. The chronology of the ownership of the mills was established by Robert Galloway (2007, 21-8). They were accrued form records accrued relating to the mill. The names of the some of millers and owners are taken from entries in the Manor Court Rolls relating to Knowles Mill before and after its construction, also from other evidence relating to the historical background of the tenants who lived and worked at the mill. The evidence gained from the Manor Court Rolls give details of both owners and millers, but does not go into detail of which is which. As no mention is made of the mill in the earliest records considerable caution should be given to owners of the Mill pre-dating 1757 and the mill was stated in the sale particulars above as newly erected messuage. However, for completeness these records are listed below.

TABLE 2: Possible Mill owners of Knowles Mill Property (pre-1757)* Based on Galloway 2007

Owner/ Tenant	Description of Property	Notes
Arthur Palmer, 26th April 1661.	*Messuage, garden, orchard and two closes containing approximately four acres of land situated near to Dowles Brook.*	It was surrendered by Arthur Palmer and the lands were granted to Humfry Wheeler.[27]
Edward Wheeler, 9th May 1693.	*[As above]*	The lands were surrendered by Humfry Wheeler. Similarly at the same court Edward Wheeler and Margery his wife surrendered the property back and it was granted to Richard Wheeler, Gentleman of Cookley.[28]

[24] Berrows Worcester Journal, July-December 1757.
[25] Morden Map
[26] Abstracts of the Titles Manor of Dowles, 1789
[27] Bewdley MCR 1661
[28] Bewdley MCR 1693

Owner/ Tenant	Description of Property	Notes
Roger Hunt, Butcher, 7th November 1704.	*[As above]*	Richard Wheeler died a bankrupt leaving many creditors, such as, Thomas Tyrer of Wednesday, (Ffrances) Frances Jordon of Kinver and Edward Dyson of Stourbridge. All of his property had to sold to pay off his debts. The property was granted to Thomas Palmer of Halesowen, Gentleman and William Rea of Wollaston, Gentleman. The at the same court Palmer and Rea surrendered it back and its granted to Edward Milward, Gentleman of Bickley, Worcestershire.[29]
Anthony Betts, 3rd July 1717.	*[As above]*	The property was surrendered by Edward Milward. Then the property was granted to John Soley for the rest of his life and then to Elizabeth his wife and then to his male heirs. For the first time the rent is recorded as 2 shillings, but it does not indicate if that is yearly or not.[30]
Edward Faulkner, 5th December 1722.	*[As above]*	It was surrendered by John and Elizabeth Soley of Sandbourne. It was then granted to Daniel Crun of Ribbesford, a miller for the same rent of 2 shillings.[31]
Daniel Crun, 27th May 1735.	*[As above]*	It was surrendered by Daniel Crun or Crunn and granted to his son William Crun for the same rent.[32]

TABLE 3: Owners of Knowles Mill Property (Post-1757)* based on Galloway 2007 with alterations according to Tim Booth.

Owner/ Tenant	Description of Property	Notes
William Crun 10th September 1757	*Messuage with a Water Corn Mill, with outbuildings, gardens, orchard and 2 closes containing 4 acres of and situate near Dowles Brook.*	
William Herbert, 1757	*[As above]*	It was surrendered by William and Catherine Crun and then passed to William Herbert. William Herbert died and in his will the mill passes to his widow Mary Herbert as freebench and then it reverted back to his son John Herbert. John Herbert had to pay a £4 allowance for his daughter Mary Haddock the wife of John Haddock.
Mary Herbert, 2nd April 1772.	*[As above]*	Two days later the property was surrendered by Mary Herbert the widow of William Herbert and her son John Herbert and her daughter Mary Haddock. [33]
William Nicholls, 4th April 1772	*[As above]*	The mill and lands were granted to William Nicholls a miller of Dowles and to his heir for the same rent of 2 shillings. The land appears to be the same size but is sub-divided.[34]
Arthur Nott Brasier, 25th September 1775.	*Messuage and Water Corn Mill with outbuildings garden, orchard and 3 closes containing 4 acres of land.*	It was then surrendered by William and Mary Nicholls and granted to Arthur Nott Brasier of Bewdley, a baker again for the same rent.[35] The mill was sold for copyhold at the Bell Inn in Bewdley. The mill was advertised as presented but mentioned for the only time 'a very good stock for milling leather or caps, two pairs of stones and a dressing mill'.[36]
Arthur Nott Brasier, 1785	*[As above]*	Marked as 'Arthur Brasier Copyhold' on Map of Bewdley[37]
James Knowles, 6th January 1803	*[As above]*	It was surrendered and passed to James Knowles of Bewdley a Husbandman for the rent of 2 shillings. This was the first association of the name Knowles.[38]

[29] Bewdley MCR 1704
[30] Bewdley MCR 1717
[31] Bewdley MCR 1722
[32] Bewdley MCR 1735
[33] Bewdley MCR 1757
[34] Bewdley MCR 1772
[35] Bewdley MCR 1775
[36] Berrows Worcestershire Journal July 1775
[37] Map of Bewdley BCA 4600/737

Owner/ Tenant	Description of Property	Notes
Thomas Knowles, 25th January 1821	*[As above]*	James Knowles died and the property was surrendered. It was in turn granted to his eldest son Thomas Knowles on condition he paid £40 annuity to James Knowles widow Mary and is sister Mary Ann Knowles. The rent was again 2 shillings. Thomas Knowles died with no heirs by will 3 proclamations were made for a tenant on the 19th may, 3rd June and 16th August 1867 without claimants.[39]
Richard Knowles, 18th July 1867	*[As above]*	Richard Knowles was granted tenancy.Short sub-let tenancy to James Knowles before surrender.
Henry Rowe, 30th September 1871	*Tenement, Mill and Closes near Dowles Brook Nos: 776-777-778-779-780 on the Town Map (Tithe?).*	Granted to Henry Rowe, architect of the City of Worcester for 2 shillings.
Edward Pease, 7th April 1874	*[As above]*	It was surrendered by Edward Pease a merchant deceased and granted to Joseph Whitwell Pease and Arthur Pease the brothers of the Edward Pease for the same rent.
Sir Joseph Whitwell Pease, 7th April 1881	*[As above]*	
Isabella Neilson Adam, William Alexander Lamberton, Margaret Neilson Milne and Paul Strangman Cadbury, 20th September 1902.		The last entry states the franchise was granted to the Pease of Hutton Hall, Yorkshire.
Paul Cadbury, 1924-25	*[As above]*	Whether it was sold or past hands to just one person needs to be investigated further.
National Trust, 1938		Paul Cadbury gave Knowles Mill to The National Trust and still belongs to them to this day.

5.9.5. The last miller was William Smith; a bad winter and an icy period of three months frost in 1891 put pay to the working life of the mill (Worcestershire Archaeology Unit, Library 2007).The mill eventually passed to the Cadbury Family in 1874 but continued to be known as Knowles Mill. In 1938 the mill was donated to the National Trust by Mr Paul Cadbury.

6. MAP REGRESSION

6.1. Ordnance Survey maps

6.1.1. *1892 Ordnance Survey Map* (Fig. 4): Knowles Mill is denoted as a corn mill at this date and the mill stream and mill pond are clearly described. A weir is annotated in the vicinity of the mill head race along with a ford and ford bridge in the vicinity of the mill and cottage. The Great Western Railway, Tenbury and Bewdley Branch is shown running east to west on the higher ground to the south of the mill. The surrounding area is predominantly woodland at this date, with a network of footpaths notably within the area to the west of Knowles Mill and extending down to the fording point.

6.1.2. *1904 Ordnance Survey Map* (Fig. 5): Knowles Mill is marked as disused at this date, in common with Town Mill to the east. Again a weir is marked, which appears to coincide with the location of the current stone foot-bridge. It is clearly marked

[38] Bewdley MCR 1803
[39] Bewdley MCR 1821

across the Dowles Brook at this time. In addition a small sluice can be seen just south of the weir connecting the mill race with the Dowles Brook.

6.1.3. *1929 Ordnance Survey Map:* The weir is still marked at this date, and the mill stream and mill pond remain visible alongside the disused mill. The character of the area remains unchanged.

6.1.4. *1954 Ordnance Survey Map:* Very little change is evident at this date, with a weir, mill-stream, disused mill, foot-bridge and ford still being marked within a predominantly wooded landscape.

7. BUILDING DESCRIPTION *by Chris Hewiston and Tim Booth*

7.1. Overview

7.1.1. The following description of the building is based on notes made by Chris Hewitson and Tim Booth, as well as personal notes previously made by Derek Ogden[40] and Tim Booth[41].

7.1.2. The mill is a three-storey gable roofed structure with attached wheel pit on its western side and a low gable-roofed outhouse on its western side (Fig. 6). The mill is constructed in narrow coursed sandstone, with quoins and openings picked out in hand-made red brick (9½" x 4½" x 2¾"). The roof is of slate construction (recently replaced).

7.2. Exterior

East elevation (Fig. 7, Plate 2)

7.2.1. The principal east elevation faces towards the Dowles Brook. The quoins on both side are in hand-made red brick (9½" x 4½" x 2¾") and an area that defines the flue for the chimney has been carried up in hand-made red brick in the Stretcher bond. Two doorways are located centrally on the wall (Plate 3). The ground floor doorway is plain with a wood lintel and a row of header bricks, and a plain door frame with a stable door of planks, ledged and braced. A first floor doorway is set directly on the wood lintel and soldier brick head. The doorway is segmental arched with brick surround. The door frame is in wood with a door of planks, ledged and braced. Set within the gable on the second floor is a single low window with segmental arch and plain casement window frame.

North elevation (Fig. 8, Plate 4)

7.2.2. The north elevation is set within the embankment of the mill pool, with a low outbuilding at ground floor level extending to the north (see below). A single doorway was centrally located at first floor level at the same level as the mill pool. It is segmental arched with brick surround. The door frame is plain in wood with a door of planks, ledged and braced. The base of the northern elevation was of double-width to a height of *c.* 1m, visible in the lean-to outbuilding. This was visible within the trench to the west of the lean-to during remedial works of 2010.

West Elevation (Fig. 9, Plate 5)

7.2.3. The western elevation faces onto the external wheel pit. The wheel pit is surrounded by a boundary wall that runs north-south before turning to the east and

[40] Report by Derek Ogden, Millwright, and Architects Report Knowles Mill, Bewdley, Worcestershire, 1971.
[41] Tim Booth 2006.

joining the mill building on its southwest corner. Although the original elevation is constructed in sandstone the lower portion has been extensively replaced in brick. A single conglomerate block is visible high in the wall on its northern quoin.

7.2.4. The opening for the mill wheel is located centrally with a wooden lintel that has been replaced. The brickwork is good quality hand-made red brick (9½" x 4½" x 2¾") in a very mixed coursing. The location of the brickwork suggests it was replaced in a contemporary episode with the replacement of an earlier waterwheel with the current one in cast iron. Above this is a small segmental arched opening. Inside this set in a wooden frame is a small single hinged door, hinged left to right.

South elevation (Fig. 10, Plate 5)

7.2.5. The southern elevation faces the small cartway between the mill and associated cottages. It is also constructed in roughly coursed sandstone. The ground floor has a window with wood lintel and wood casement frame that was inserted in the 20th century (Tim Booth pers. comm.). On the western side is a twin-opening that gives direct access to the mill mechanism (Plate 6). The brickwork surrounding the openings is in hand-made red brick as before but is possibly reused and the holes may have been inserted any time between the 18th and 20th centuries. There is evidence of belt wear on the side of the holes. The holes may relate to possible machinery that was attached to the main mill mechanism but this cannot be proved conclusively.

7.2.6. On first floor level are two windows, one a small plain wooden casement window with wood lintel, inserted in the 20th century and the other a segmental arched window with brick surround and a wood casement frame (Tim Booth pers. comm.).

Outbuilding (Fig. 8, Plate 7)

7.2.7. The low single-storey outbuilding set on the northern side of the mill is gable roofed with an open bay facing east onto the Dowles Brook. This had been boarded-in until the floods of 2007. The outbuilding is built in sandstone and a single window is set within the northern gable with a wood lintel and brick surround. The frontage has a wood lintel beam with a post on its south-eastern corner. A single wooden lathe and batten door faces south.

7.2.8. Extensive damage to the wall in the 2007 flood led to the replacement of the north-eastern corner of the building. The window appears to have been replaced at the same time.

Roof

7.2.9. The pitched roof is in plain clay tiles. A single chimney stack constructed in red brick is set in the gable on the eastern side. The chimney and stack are integral to the elevation.

Wheel Pit and Culvert (Plate 8, Plate 9)

7.2.10. The wheel pit wall is sandstone built in regular courses and runs west from the south-west corner of the mill, before turning north. It forms a wall *c.* 1.2m high on the path side (southern and eastern) and *c.* 3.5m deep on the pit side (northern and western). Coursing within the southern part of the wall suggests it has been re-built at least once. The mill-race continues through an arched hand-made red brick culvert to the south. The mill race culvert has partly collapsed the pathway adjacent to the southern elevation as visible in a slump. The wall adjacent to the mill wheel on the southern elevation has also been replaced in hand-made red-brick due to erosion from water feeding over the wheel, frost damage or mechanical damage from the wheel itself. The internal elements of the culvert have also been lined for a second time.

Waterwheel (Fig. 9)

7.2.11. The waterwheel is the overshot type and constructed of iron with six arms cast with naves that were made in two sections bolted together. The wheel is 9ft (2.75m) diameter and 6ft (1.83m) wide. The hexagonal cross-section shaft of the wheel rested on a low brick-built wall (see excavation below) that supported the gudgeon pin of the shaft. Six shroud plates form each ring of the wheel, jointed where they meet the arms, and the rings were connected by tie rods. Thirty wrought iron buckets were bolted to flanges on the shrouds, and these were riveted to wrought iron sole plates. The present wheel probably replaced an earlier arrangement possibly in timber as the upright shaft and crown wheel in the interior of the mill appear to belong to an earlier arrangement.

7.2.12. The wall (western elevation) was almost entirely rebuilt to accommodate the current mill wheel with a replacement lintel above. A single blocked pudlock is visible in the wall at the correct level to have accommodated the pen trough. A blocked hole with wooden lintel is located adjacent to the opening above. This appears to have accommodated the axle for the ratchet system that lifted the penstock. The axle and gear system is still located inside the mill (SF 2129-9).

7.3. Interior

7.3.1. The interior of the building consists of three floors, the ground or meal, first or stone, and second or bin floors. The interior surfaces of the wall are predominantly in rough coursed sandstone as with the exterior. The upper level (second floor) has been finished with a lime plaster whilst the lower wall surfaces are lime rendered in places.

Ground (or Meal) Floor (Fig. 11 and 12, Plate 10)

7.3.2. The floor surface is an intermixture of earlier rough sandstone sets and slabs and hand-made red brick on edge that predominates in the door sill and the centre of the room. The floor was concrete skimmed that survives in patches. The area around the mill machinery and the wheel pit is destroyed with only a few slabs/ bricks surviving *in situ*. The earthen floor shows through here.

7.3.3. The main entrance is from the east and a single window opens to the south, with a deep sill. A single fire hearth and grate is set in the north-east corner (Plate 11). A moveable work-bench is set on the south-eastern corner of the room. The artefact assemblage distributed throughout the room is described below (see Appendix 3).

7.3.4. The mill machinery is supported on the hurst (timber framework) in the western side of the room (described below with mill machinery; Plate 12). The fabric of the hurst was replaced in 2010. This includes the replacement of the southern stud replacement of stone work and the realignment of the pit wheel.

First (or Stone) Floor (Fig. 13 and 14, Plate 13)

7.3.5. The main machinery framework was covered by early floor boards which in turn supported the bedstone (see below) on the northern side, and a series of re-used doors on the southern side. The remainder of the first floor was supported on two axial beams running from the cross-beam to the eastern wall. The floorboards, previously consisted of old doors on light joists and were removed for safety in 2010. New floorboards had been put in place on the northern side.

7.3.6. The first floor was originally accessed by a single stairway. The 1971 survey[42] records this as running centrally towards the mill machinery but has subsequently

[42] Derek Ogden 1971

been removed. Originally it would have been located on the northern side of the building. The surviving stairway now lies on the floor on the northern side of the ground floor (see artefacts below).

Second (or Bin) Floor (Fig. 14, Plate 14)

7.3.7. The second floor is supported on the tie-beam of the roof truss. A series of 15 rough cut east-west timber joists support timber floorboards to some parts of the second floor on the eastern side. A single square hatch in the centre of the floor represents the location of the sack hoist as it lies directly below the pulley mechanism (see below). On the northern side of the floor an opening in the floor boards suggests a stairwell was positioned against the northern wall.

7.3.8. The original layout would have included a narrow floor running centrally along the axis of the building (east-west) to enable sack trucks to convey sacks of grain to the required bin. This passageway is now missing. A stairway would have accessed the floor on the northern side of the building.

The Roof (Fig. 14, Plate 15)

7.3.9. The roof has been extensively relined and re-plastered. The roof structure is supported by an original timber truss at mid-span. The roof truss is of unconventional queen post design with a series of four vertical timber posts supporting the principal rafter. A wooden housing for the hoist pulley is attached to the truss apex and represents the remnants of the sack hoist. The pulley for the sack hoist now sits as an unattached artefact on the bench (see below, Plate 16).

7.4. **Mill Mechanism** (Fig. 15, Plate 17)

Machinery (All number references are to Fig. 15)

7.4.1. The pit wheel (1) is one-piece cast-iron bevel gear, with six arms in common with the water wheel (Plate 18). The wallower (2) is also cast iron, a single casting with worn teeth (Plate 19). The great spur wheel (3) is a one-piece cast iron and is morticed for wooden cogs (Plate 20). Remnant of wood survives in the cogs but the wheel does require new cogs.

7.4.2. The crown wheel (8) is timber, with iron straps and bands, with compass arms fixing to the vertical shaft and is very much older than any of the other gearing and machinery (Plate 24, 25). The wheel is in fairly good condition but will require some minor repair and new cogs.

Mill Framework (Hursting)

7.4.3. This consists of a cross-member (N-S) supported by four front posts set on sandstone pads, of these three are original and only the southern post has been replaced. The stone plinths vary considerably with the central two in worked stone whilst the outer stones are much coarser and suggest they have been repaired in an *ad hoc* fashion. The front posts are morticed for brayers, the southern brayer has been renewed. Two posts are set into the western mill wall, with a further cross member above (N-S). Of the posts the southern has been renewed.

7.4.4. Two lower beams across the hurst (E-W) rest in the lower of double mortices in the rear post. A support bridging beam rests between these beams (N-S) and this supports the shaft and the mill machinery. The bearing support and bearing for inner gudgeon of the wheel shaft is missing. Two bridgetrees (upper beams) rest on the brayers and cross the hurst (E-W) to sit in the upper of the double mortices. These in turn support the millstones.

7.4.5. Spouts were visible in the cross-member of the hursting that suggested the location of the meal troughs lay in front of the hursting.

Upright Shaft

7.4.6. The timber upright shaft (7) is undoubtedly the shaft used from earlier milling machinery and the same date as the crown wheel with compass arm fixing (Plate 25). If the iron great spur wheel were removed there would probably be found mortices where a wheel with compass arms was originally fitted. The vertical shaft shows signs of decay but is not serious enough to require replacement.

7.4.7. The bottom footstep bearing is missing but the bridging box and bridge tree remain. The top support bearing is complete but will require overhaul and adjustment. The two main bridging beams for the bridge tree have badly rotted and will have to be replaced and the whole assembly realigned with the wheel shaft and vertical shaft.

Millstones and Drive Gears

7.4.8. The stone nuts and stone spindles were described as being removed (Ogden 1971) and much was lying on the floor. The present mechanism is a replacement of surviving mechanisms.

7.4.9. The lifting mechanism (4) for the runner stone (north side) was a rudimentary bridge tree. This consisted of two beams, one mortised through the two studs (the brayer), a second resting on top of and perpendicular to this beam (the bridgetree). This supported the stone nuts and stone spindles connected to the runner stone. The ground nut (4) was powered by the spur wheel which in turn powered the stone shaft connected to the set of stones (Plate 21). The brayer could be raised by a screw which lifted the bridgetree, allowing the gap between the millstones to be adjusted (tentering) disengagement was by a jackring which is still in place.

7.4.10. Two pairs of right hand stones of which only one French burr bedstone (5) remains in situ, 48 inch in diameter. Mortar adheres to the upper surface of the bed stone (Plate 22 and 23). The runner stone (6) has been removed but a peak stone is present in the cottage garden that may be the original runner stone.

7.4.11. There were a number of pudlocks set on the ground floor on the northern wall beneath the mill stones. It is unclear what there purpose was for.

Alternative Mechanisms

7.4.12. Ogden mentions in his report that Knowles Mill had two sets of mill stones. At some time in the past the downstream pair had been removed. A single front post survived and the other post and the brayer have been replaced in 2010. Double mortices in the rear post support the location for the bridge tree.

7.4.13. On the first floor a timber hanger and inclusions in the brickwork of the southern wall at the same level as the crown wheel is all that remains of an auxiliary drive powered by the crown wheel. It may be this drove a dressing machine.

7.4.14. Inclusions in the brickwork and the removal of the left hand grinding set appears to have coincided with the piercing of the two angular openings in the left hand wall. Wear marks in the wooden opening show that a vertical leather flat belt passed through this opening to drive an external piece of machinery. Alternatively this could have been auxiliary power provided by an engine drive to the downstream pair of stones.

Sackhoist Mechanism

7.4.15. The arrangement of sack hoist drive was described by Ogden (1971). The usual arrangement is a horizontal drum with beam and a catch operating lever working on a slack belt principle.

7.4.16. The sack hoist mechanism (Plate 25; Fig. 8, 15) at Knowles Mill involves a clutch mechanism on the upright shaft. The connection between the upright shaft and sack hoist drum could not be inspected. The hinged attachment at the roof had been altered to stabilise the upright shaft.

7.4.17. A rope or chain would extend from the drum to a pulley in the apex (Plate 16) of the roof truss and through a series of trap doors to the ground floor and the sacks located there. Access was also available from the first floor and it may have been the case that sacks were also taken to the second (bin) floor from this location as well.

7.4.18. Some alteration to the mechanism appears to have occurred as it has now been fixed by a board added to the mechanism.

8. ASSOCIATED STRUCTURES AND LANDSCAPE FEATURES *by Chris Hewitson*

8.1. Overview

8.1.1. The mill is set within an environment of associated buildings and structures. That were originally described in the sale notice of 1757:

…A new-erected messuage, with the water corn mills and out-buildings therto adjoining, situate on Dowles Brook, also with six acres of very good meadow ground…

8.1.2. In addition to the water-meadows the site included the orchard, weir, mill pool, fleam and tail race (Fig. 16).

8.2. Mill Cottages

8.2.1. The mill cottage is consists of a low single-storey block of sandstone construction with a pitched roof at the southern end. The southern part of the cottage is low and squat and has a steep pitched roof, typically designed to carry a heavy thatch as opposed to a lighter tile roof. The thatch could well have been of bracken, or other woodland materials. The main cottage to the north consists of three bays of two-storey construction with a pitched roof. Twin segmental-arch windows are set either side of a central doorway. It uses similar hand-made red-brick quoins and devices as much of the eastern principal elevation of the mill. It is difficult to estimate the construction date of the cottage as it is built in the same sandstone material of which the mill has been constructed. This may point to this building being the '*new-erected messuage*' described in 1757 (see above) but this cannot be conclusively proved.

8.3. Orchard and Water Meadows

8.3.1. The water meadow and orchard extend to the south and north of the mill and cottage on the western bank of the Dowles Brook. They include an apple orchard beside the mill pool.

8.4. Mill Pool, Weir, Bridge, Head Race and Tail Race

8.4.1. The weir across the Dowles Brook is located at the head of the orchard. It has been largely removed by various floods that would have tended to inundate the brook over the years, including ultimately two floods in 2007. The remains consist of a series of large sandstone rubblework (up +/- 0.50m in size) now visible in the bank of the brook on either side. The bank extended beyond the fence parallel to the stream and met up with a bridge over the tail race. Originally the weir may have risen to a height of *c.* 1.5 to 2m above the current stream level. It is unclear if it was ever more than dry-stone constructed. It has been suggested that this may once have extended across the brook to form a weir in order to raise the water level to feed the mill race. This is supported by the presence of a weir annotated on the historic mapping.

8.4.2. The head race was separated from the main stream course by a bridge which was 2.6m wide at the surface of a grassed path, and was faced with sandstone rubblework on either side. The bridge formed a bank on its eastern side which extended up to the weir and helped divert the stream course down the head race. Excavations (see below) suggest the continuation of the weir wall was dry-stone construction and strongly supports this to be the case.

8.4.3. The head race survived as an open course, heavily silted up but with clear traces of both banks on either side. Both banks were revetted with dry-stone construction sandstone walls. The head race continued for *c.* 75m (north-south) before it meets the remains of the mill pool.

8.4.4. The mill pool is constructed using the natural topography of the valley. The western bank is formed by the natural slope of the valley side, whilst the eastern bank has been formed by an earthen bank that extends for *c.* 90m roughly north-south before turning towards the head race culvert and the pentrough. It has been drained but still retains water during the winter months or after heavy rain. The pool maintains ecology of water-based plants (e.g. bull rushes, sedges etc.) suggesting that the water level is still relatively high even during the summer months and an aquifer exists. A single feature in the eastern bank is the remains of an over flow sluice partially excavated (Tim Booth pers. comm.) but its purpose is as yet not fully understood. The sluice was modified after the mill ceased working. Gabions were in place prior to the 2007 floods.

8.4.5. The tail race is partially described above (section 7.2.14) as it exits the wheel pit and passes beneath the path under a brick arch. It continues to the south and east and is contained within a below-ground pipe that exits somewhere to the south-east of the mill into the brook. The remains of the original exit of the tail race have been obscured by flood defences put in place after the 2007 floods that include large stone revetments.

9. ARCHAEOLOGICAL EXCAVATIONS *by Chris Hewitson And Jon Halsted*

9.1. Introduction

9.1.1. Four trenches were excavated in total. The first two (Trench 1 and 2; Fig. 16) were excavated to understand and investigate the mill race and wheel mechanism close to the mill. This was important to understand the mechanism by which the mill functioned but also to establish the state of preservation of the mill race and wheel. Two trenches (Trench 3 and Trench 4; Fig. 16) were excavated either side of an earth and stone bridge crossing the former mill stream, close to the point where water was diverted from Dowles Brook.

9.2. **Trench 1: the wheel pit** (Fig. 17)

9.2.1. The wheel pit is formed on its western, northern and southern sides by a stone retaining wall and on its eastern side by the brick and stone built mill building, from where the iron mill wheel projects (Plate 26). The southern retaining wall has an integral culvert designed to divert water from the wheel pit back into Dowles Brook (Plate 27).

9.2.2. A structure, comprising three courses of hand-made red brick (1006), was recorded on the west side of the iron water wheel to support the wheel axle, although any stone or metal socket for the axle had been previously removed by the time of excavation (Plate 28).

9.2.3. An accumulation of silting and successive dumps of domestic debris filled the area of the wheel pit between the brick platform and the mill building. In total 1.1m of silting and domestic waste was removed from the wheel pit in order to further expose the wheel and any associated structural features. The lowest excavated fill was silty clay (1003) stained orange with rust from the water-wheel and was at the level of the present water-table. This layer contained some stone slabs with brick and tile fragments, alongside a wide variety of domestic waste including pottery and glass. This layer was overlain by a deposit of light brown silt, 0.25m thick (1007), tipping from the west side of the wheel pit that was also seen sealing the area of the wheel axel (1004) and a layer of black silty clay, 0.3m thick (1002) containing large quantities of domestic debris, similar in nature to that described above. A layer of stone rubble (1005; Plates 26-27) tipped into the wheel pit from the west covering the brick plinth. It seems likely that this rubble derived from a previous partial collapse of the western wheel pit retaining wall. Further layers of material filled the wheel pit, a light brown silt, 0.3m deep (1001), and a further deposit of silty clay, 0.05m deep, with modern domestic debris. (1000).

9.3. **Trench 2: area between mill pond and mill wheel** (Fig. 18)

9.3.1. Trench 2 was located immediately north of the wheel pit. A linear brick culvert channelled water between the mill pond further north and the water wheel (Plate 29). The culvert was 2.9m long by approximately 1.3m wide of hand-made brick in Stretcher bond. A segmental arch 0.4m high (2004) was supported on vertical brick pillars. Located at the northern side of the culvert a flat-laid brick plinth formed the base of the culvert. At the southern end remnants of a ferrous metal feature lay on the base of the culvert and probably related to the remains of the pen trough. The culvert was filled by dark brown silty clay with brick and stone fragments and occasional pieces of iron at the northern (2001) and southern (2002) ends.

9.3.2. Overlying the brick culvert on its eastern side were up to three courses of brickwork and a layer of rough un-worked sandstone slabs (2003). These formed the level layer of a bridge over the arched culvert below.

9.3.3. Between the culvert and the wheel-pit, a stone wall was recorded which appeared to be effectively blocking the water channel into the wheel pit. This was designed to block the culvert at the end of its use. The whole area was sealed by dark brown silty clay, 0.3m deep, with angular sandstone rubble (2000).

9.4. **Trench 3 and north facing bridge elevation** (Fig. 19; Plate 30)

9.4.1. The base of the head race on the north side of the bridge appeared to be indicated by a layer of clean, sterile grey silt 2.36m below the level of the earth and stone bank where it met the fence line adjacent to the brook.

9.4.2. The north-facing elevation of the bridge (3003) was best preserved on its western side where up to eleven courses of roughly coursed dry-stone wall survived 1.8m high, composed of sandstone rubblework. Up to seven courses of dry-stone wall were recorded on the east side towards the bank of the Dowles brook, above which the bridge was composed of rubblework and an earth bank (3000).

9.4.3. A gap in the rubblework of the bridge indicated the location of the head race as it passed under the bridge. The culvert was 0.6m wide by 0.5m deep; the jambs were formed by three stones on both the eastern and western sides. An area of limestone mortar had formed at the base of the culvert beneath the bridge (3005). A comparable layer of lime mortar was also recorded within Trench 4 (see below). Within the culvert on its northern side were two relatively substantial stone blocks; a lower block with a slab above. These may have been deliberately placed to block or restrict the flow of water through the culvert to form a smaller channel. Alternatively they may have fallen into the channel as it became disused.

9.4.4. The trench became slowly backfilled by a homogenous layer of pale brown silty clay (3001), 0.6m thick, charcoal flecked with rubble blocks within. This layer post-dated the construction of the bridge and reflected a natural silting of the area to the north, interspersed with sandstone blocks that had collapsed from the bridge. Layers of silt formed around the stone blocks placed at its base. Initially mid-brown silty clay (3006) was deposited, followed by darker brown silty clay with charcoal, 0.2m thick (3002) and a contemporary deposit of mid orange-brown silty clay filling the culvert (3004). These deposits appeared to be filling a much shallower channel running into the upper part of the culvert (Fig. 20). The fills above contained later 20th century material, including corroded iron and two glass bottles complete with crew caps and indicates that it was no longer functioning as a mill-stream by this date.

9.5. **Trench 4 and south-facing bridge elevation** (Fig. 20; Plate 31)

9.5.1. The base of the head race on the south side of the bridge appeared to be indicated by a layer of gritty iron-panning 2.49m below the level of the earth and stone bank where it met the fence line adjacent to the brook.

9.5.2. The east and west sides of the head race were revetted with dry-sandstone rubble work walling. The eastern side (4007), survived to a height almost level with the top of the bridge and 1.6m above the base of the excavated section. The west side (4006) had partially collapsed but survived at the edge of the channel to 1.2m above the base of the stream channel, where two courses of walling were recorded. The edge of the head race was marked by a line of stones, with the area between the base and the surface slumping into the head race.

9.5.3. Two rectangular stone blocks were recorded at the base of the channel within a dark-brown silty clay (4005) appeared to be the foundation of the overlying bridge structure. They were sealed by a layer of lime mortar (4004) that tipped down into the head race towards the south and acted as its base. Constructed above this layer of mortar was the southern face of the bridge, a dry-stone wall (4002) 1.8m high. The rubble work wall was made up of unevenly coursed elongated slabs and sub-square blocks of sandstone. The upper nine courses of the wall tipped to the east, echoing the natural slope towards the Dowles Brook. In contrast, the lower five courses of stone were laid in a near-level fashion. In the centre of the bridge was a culvert. Three courses of roughly-laid stone formed jambs at the east and west sides forming an opening 0.9m wide by 0.5m deep. No apparent lintel survived above this culvert and there was a void 0.6m wide by 0.4m deep, were some collapse of the wall had occurred.

9.5.4. The mill stream channel was subsequently filled by mid-yellow-brown silty clay (4001) 0.55m deep with large angular sandstone blocks tipping from the east side of the mill stream, where the east wall had collapsed. Silting and wall collapse post-dated the use of the head race as a functioning channel. Further stone collapse was recorded above this, overlain by dark yellow-brown silty clay containing modern iron debris (4000), 0.3m deep and red-brown silty clay (4003).

10. ARTEFACT ASSEMBLAGE

10.1. Introduction

10.1.1. All finds were collected on site from Trenches 2, 3 and 4, marked, washed and quantified and form part of this assessment.

10.1.2. A large and substantial collection of later modern finds (late-19th to 20th century) were recovered from the Wheel Pit during the excavation of Trench 1. These included pottery, glass, fe metal residues and animal bone. Due to the size of the assemblage, their relative significance and date a selective disposal policy was operated on site and in post-excavation. This was based on the principal that individual examples of fabric, form or type were collected first and foremost. The most complete examples of each type would then be kept, with duplicates, either discarded or removed from the archive and kept at the mill for display and education purposes. The pottery, ceramic material and glass have been washed and marked, whilst the remainder of the material has been quantified.

10.2. Moveable Artefacts

10.2.1. A number of moveable artefacts were located around the interior of the mill. These have been catalogued and photographed as part of the work. The catalogue is available in Appendix 3 and the photographic record is available as part of the archive.

10.3. Pottery *by Emma Collins*

10.3.1. The site revealed a total of 222 sherds of Post-Medieval/Modern pottery weighing 9589.9g from eight contexts. The pottery was examined macroscopically and was sorted into wares. The majority dated from mid 19th century to early 20th century and was all from domestic waste.

10.3.2. The majority of wares were utilitarian white glazed earthernwares in the forms of cups, plates and bowls. There were also a few fragments of slightly higher status wares in form if porcelain and bone china cups. There was one 17th century vessel in the remains of a large steep-sided yellowware bowl or 'Pancheon' with a 38cm rim diameter, 36 % being present, from 1003. The unusual forms present were two egg cups and least two teapots.

10.3.3. There were jars of fruit preserves including Harley's Jam and James Keiller and Sons Marmalade. There were some fragments of large stoneware bottles.

10.3.4. Flower pot fragments were present, one sherd from context 1003 with impressed writing '…KEY & SON BULWELL NOT…'. This is a fragment of Sankey flowerpot, a company founded in 1855. Context 1000 contained a foot off a garden gnome.

10.3.5. Other wares present were various coloured transfer prints, lusterware, chromium yellowware and creamware.

10.3.6. No further work is recommended on this assemblage.

10.4. Glass *by Erica Macey-Bracken*

10.4.1. A total of 149 bottles or fragments of bottles were recovered from the site. Most of the bottles dated from the late-19th to the early 20th century, and many were complete. The earliest fragments were two body sherds from a green glass wine bottle of possible 18th century date, although as no diagnostic features were present on these fragments this is only a tentative dating. One complete Codd bottle, dating to the later 19th century was also noted.

10.4.2. Embossed names and trade-marks on many of the bottles showed that they originally contained a wide range of domestic products such as milk, beer, meat/fish paste, coffee and brown sauce. Brands that are still familiar in the 21st century such as Lea & Perrins, Gartons HP Sauce, Daddies sauce and Bovril were noted. Beer bottles from midlands breweries such as Mitchells & Butlers, the Kidderminster Brewery and Cheshire's Brewery of Smethwick were also recovered along with a spirit bottle from the White Horse Distillers. Milk bottles from dairies such as Wattville Dairies of Handsworth and Midland Counties Dairy Ltd were also represented.

10.4.3. Medicine bottles included a bottle of Venos lightning cough cure, a medicine bottle with dosage marks and a bottle from the Homeopathic Hospital, Birmingham, which occupied various premises in Birmingham from 1845 onwards. One small blue poison bottle was also noted, embossed with the words NOT TO BE TAKEN.

10.4.4. Several ink bottles were also noted, as well as several other pieces of glass including a near-complete circular glass lens, possibly from a lamp, two legs from an ornate moulded glass ornament and two joining fragments from a thick moulded glass object with ribbed sides.

TABLE 3: Catalogue of Glass Bottle Labels

CONTEXT	BOTTLE LABEL
1000	Midland Counties Dairy Ltd. Birmingham and Wolverhampton STERILISED MILK
1001	Mitchells & Butlers Ltd
1001	ABC FVF
1001	BOOTHS DISTILLERIES LONDON LTD
1001	CHESHIRE'S BREWERY LTD SMETHWICK
1001	WATTVILLE DAIRIES HANDSWORTH (on the base - JL & Co LD C 40L157)
1003	40oz BOVRIL LIMITED 300
1003	DADDIES SAUCE
1003	FIELD & HUMPHRIES BRIERLEY HILL AND WEDNESBURY (on reverse STERILIZED MILK)
1003	GARTONS
1003	GARTONS HP SAUCE
1003	Guy's (B'ha m) Ltd
1003	HOMEOPATHIC HOSPITAL BIRMINGHAM
1003	IODEX LONDON
1003	J.HITCHON KIDDERMINSTER TRADE MARK (on reverse - A.1 RYLANDS & BARNSLEY)
1003	KIDDERMINSTER BREWERY Co LTD KIDDERMINSTER
1003	LEA & PERRINS WORCESTERSHIRE SAUCE
1003	Medicine bottle – NOT TO BE TAKEN

CONTEXT	BOTTLE LABEL
1003	Medicine bottles – TABLE SPOONS
1003	PATERSON'S ESS "CAMP COFFEE" & CHICORY GLASGOW
1003	T.HARDIMAN & Co LTD KIDDERMINSTER
1003	T.SHAW & SONS (BHAM) LTD BURBURY ST BIRMINGHAM (on reverse DRINK MORE MILK AND KEEP FIT)
1003	VEN YUSA
1003	VENOS LIGHTNING COUGH CURE
3002	Kit-E-Kat The Perfect Food for Cats (tin)

10.5. Fe and Cu Alloy Artefacts *by Erica Macey-Bracken*

10.5.1. A large quantity of ferrous metal material was recovered predominantly from Trench 1. It was badly decomposed and only a small amount of the material was diagnostic. The material was quantified by weight and forms part of the archive.

10.5.2. A single cu alloy artefact of note was a cu alloy pocket watch of early 20th century date recovered from Trench 1. This item, 54mm in diameter, has a white face with the hours marked in Roman numerals. The centre of the dial has the words "Celebrated Chronograph" printed in an arch shape, below which are the words "Specially Examined Swiss Made". The back of the watch also has some kind of logo stamped into the case, but this is very worn, and it is impossible to read any of the detail.

11. DISCUSSION AND CONCLUSIONS

11.1. Chronology

11.1.1. It is clear from detailed examination of the building fabric that the construction of the cottages, mill races, mill pool, mill building and machinery has a somewhat complex history and is possibly a multi-period construction. Although considerable debate is possible about the chronology several possibilities can be postulated for the development of the mill and its appurtances.

Phase 1 – Pre-mill buildings, an earlier mill?

11.1.2. A disputed pre-1757 phase for the mill has been opened up by historic research and examination of the mill fabric. Robert Galloway's historic research (2007) suggests that a pre-existing mill was present on the Dowles Brook prior to 1757. Details of the sale of the mill suggest that the sale consisted of a:

> *…A new-erected messuage, with the water corn mills and out-buildings, together also with six acres of very good meadow ground…*

11.1.3. The cottage may be of multi-phase construction as the southern side of the cottage is of a separate build and the rear wall of the cottage has a separate building technique. It is possible that elements of this refer to the messuage described in 1661 as belonging to Arthur Palmer, (26th April 1661) and following through to Daniel Crun (27th May 1735), the father of William Crun. The building could have a chronology of this date – but obviously this does not pre-suppose a mill on the site.

11.1.4. The mill may have had an earlier origin. Examining the building the low bulge in the wall present on the northern side may suggest an earlier chronology for the construction of the rear of the mill. Excavations undertaken after the floods of 2007 also revealed the wall to be much wider below the bank. This may just be a constructional detail designed to add extra support to keep the bank back, however it may point to an earlier phase of the mill incorporated into a later build.

11.1.5. At this stage until further evidence can be accumulated through historic research or archaeological excavation no conclusive evidence suggests a pre-existing mill or cottage on the site.

Phase 2 – The 18th-century mill

11.1.6. The main build of the mill must be seen to be of a single phase of construction. In particular elements such as the hand-made brick-built chimney are integral to the eastern elevation. The interior trusses and cross-beams all to be of similar age in appearance and suggest that the timber element of the building was of a single phase of construction. This perhaps should not come as a great surprise as the material was readily available within the forest.

11.1.7. The construction of the building in sandstone makes it difficult to place firmly in any time period. The building material of Carboniferous Sandstone appears to have been derived from local quarry sources one of which exists to the north-west of the site (see Appendix 5). The hand-made red brick quoins were 9½" x 4½" x 2¾" inches in size and suggest that they developed before the adoption of the brick tax in 1784 by George III that saw brick sizes increase in volume to 150 cubic inches (10" x 5" x 3"). They are something of an enigma as they only appear on the eastern principal façade. This may suggest they are a decorative motif as opposed to practical. They also appear on the northern half of the cottage and would appear to suggest that both structures are contemporary. The use of brick to date construction is difficult, reuse is common and caution should be adopted for any proposed dates. Brick sizes within the mill structure varied little and it would appear clear that the brick was locally sourced and varied little in size.

11.1.8. How much of the mill machinery is original is debatable. The mill would almost certainly have been wood built at this stage and without dendrochronological dating of the wooden elements it will be difficult to place them specifically in this stage. However, the wooden upright shaft would appear to be of sufficient antiquity to relate to the 1757 date suggested for the mill. How much of other elements of the mill relate to this phase is questionable but it must be assumed that in principal at least elements of the head race, mill pool and tail race date to this period. Indeed the use of hand-made red-brick to line the culvert may suggest that this is an 18th century element.

Phase 3 – 19th-century alterations

11.1.9. Alterations to the mill almost certainly started to occur during the 19th century. Large scale replacement of the original mill equipment must have occurred at some point in the 19th century. The style of the ironwork suggests a 19th-century date and it would not be unreasonable to suggest that the majority of the mill mechanism (main shaft excluding) dates to the 19th century. The brickwork in the western wall suggests that large parts of the wall was taken down and re-built in order to accommodate the new mill mechanism.

11.1.10. Whether the mill interior was re-aligned at this time is unclear. There does appear to be a certain amount of minor alterations to the mechanism. The pair of millstones downstream were removed. It is unclear if this was during the lifespan of the mill or subsequent to its abandonment. A number of brick features on the outside of the mill may suggest that the penstock was raised, possibly during the insertion of the current cast iron wheel.

Phase 4 – 20th century abandonment

11.1.11. The abandonment of the mill is visible throughout the archaeological excavations. Excavation in Trench 1, the wheel pit, revealed a series of deposits of 20th century domestic debris derived, presumably, from the occupants of the associated cottage

confirming that the mill fell out of working use in the early 20th century. Much of the area west of the wheel and silts within the wheel pit were covered with substantial deposits of stone rubble. This stone rubble may have derived from a previous collapse of the wheel pit retaining wall on its western side.[43]

11.1.12. The culvert opening on the north side of the bridge (Trench 4) appears to have been deliberately restricted by the placing of two large stones at its base. Nevertheless, it appears that water-flow could still have continued above these restricting stones, as indicated by the upper silt fills present in the upper part of the culvert here and as seen filling a slight channel to the north of the culvert. These later silts do, however, appear to relate to the disuse of the mill stream with modern debris being incorporated in the later 20th century, particularly on the southern side of the footbridge. This may suggest that water flow was restricted prior to the entire disuse of the mill race in order to possibly continue to fill the mill pool which may have continued a function including fish pool or duck pond.

11.2. Function

Weir, footbridge and the head race

11.2.1. The excavations either side of the head race footbridge (Trench 3 and 4) have revealed a roughly constructed dry-stone structure with an integral culvert. The small culvert may have acted as a means of controlling water flow into the head race, simply by restricting its flow. The lime mortar recorded at the base of the culvert appears to have been primarily concerned with preventing erosion by the water flow at the base of the culvert.

11.2.2. Much of the footbridge on its southern side, particularly in the area closest to the boundary with the brook, was made up of earth and stone rubble, at least in its upper levels. It is possible that the bridge was incorporated into a general bank which could be observed on the other side of the boundary fence for a short distance of around 1-2m (Plate 32). It has been suggested that a weir existed in this area, in order to raise water levels to feed a holding pond and the mill race (which exists at a significantly higher level than the adjacent brook). It may be possible therefore that the small footbridge marked the western extent of the weir as recorded on historic mapping from at least 1892.

11.2.3. The base of the mill stream was recorded at a comparable level to the base of the stone foot bridge, suggesting that the two are contemporary. This is further suggested by the dry-stone edging/ revetment of the mill stream bank to the south of the footbridge. No such dry-stone walling was recorded edging the bank on the west or east sides of the sunken area to the north of the footbridge. This is not to say that such walling does not exist beyond the limits of excavation, but may suggest that this area was more loosely defined than the mill race to the south. Therefore this area appears to have been concerned with generally channelling water from the river, the flow of which was controlled by the presence of a bank/ footbridge and small culvert. From here the head race fed the mill pool via the remainder of the head race.

Mill pond, head race culvert and pen trough

11.2.4. At the head of the mill pond (Trench 3) water was channelled from the mill pond through a brick culvert and ultimately onto the over-shot iron mill wheel. The brick

[43] NB - unconfirmed evidence suggests that the wheel fell out of use when it was broken by a cart horse falling in the wheel pit. Although this cannot be confirmed damage to the southern element of the wheel and the quantity of debris in the wheel pit may point to the wall having collapsed in the early 20th century and hence the wheel became redundant.

culvert had a relatively restricted opening, as indicated by a brick floor on its north-side.

11.2.5. Remnants of a horizontal or slightly convex iron feature forming the base of the culvert on its southern side may have been an integral part of the pen trough. An infilled pudlock on the western elevation of the mill would have housed a timber which supported the pen trough. The design of the wheel (overshot buckets) meant that water would have to be provided at the apex of the wheel or slightly beyond in order to maximise the rotation of the wheel. A further hole in the western elevation of the mill accommodated a metal shaft with two pinions (currently loose inside the mill, SF2129-9, see Appendix 3) that would have controlled the penstock, a gate for water control. A stone wall to the south of the culvert and at a right angle to the axis of the wheel later blocked the mill pond from the wheel pit.

11.2.6. The presence of the brick culvert to the north of the wheel pit indicates that space at the surface was required for access or working operations, otherwise an open channel may have sufficed. This is supported by the presence of roughly hewn stone slabs overlying the culvert to form a bridge and access to the door to the first floor of the mill. Although the sackhoist clearly allowed delivery of material to the ground floor it may have been corn was delivered to the first floor (see below).

The wheel and wheel pit

11.2.7. Excavation within the wheel pit revealed the lower portion of the iron wheel at its junction with the existing water table. Remains of a corroded wheel bucket were present at this level. To the west of the wheel a brick platform was partially revealed, onto which the wheel previously rested, although any bearing or supporting mechanism for the wheel was no longer present (Plate 28). The wheel had 30 buckets and calculations by Rod Sproat have been used to calculate the wheel rotation at optimum operation to be about ¼ of a revolution every second (see Appendix 6).

The mill

11.2.8. The use of brayers places the original mill mechanism before *c.* 1820 in date, with the later cast iron wheel and mechanism a mid-19th century adaptation. The main mill mechanism appears to have been fairly standard in function and operated two sets of stones originally set either side of the main axle of the mill. Both may have originally operated for the grinding of corn. The second floor would have contained the corn hoppers above the stones on the western side. All trace has now been removed. The eastern side still contains the floor and would have contained storage for corn. In addition the sack hoist mechanism would have passed through a series of trap doors from the ground floor. The first floor (stone floor) contained both stones for grinding the corn, whilst the ground floor may well have been largely open away from the machinery. An example from Abberstone Mill, Hampshire is illustrated in isometric style (Plate 33). In its final form however, the presence of peak stones in the garden of the cottage suggests it had been adapted to mill for animal feed, with the other French stones adopted for flour.

11.2.9. As with many corn mills constructed in the 18th century their power was maximised in the later period for industrial use. The mill was known to have been used for leather milling, including cappers as it was advertised in 1775 as having a good stock suitable for milling caps or leather.[44] Bewdley was known for its leather industry from the 17th century (Purcell 2003) and the use of tanning mills was probably common.

[44] Berrows Worcestershire Journal July 1775

11.2.10. Within the first (stone) floor where a series of pudlocks that may have contained machinery. It is possible that an axle came from the crown wheel to the southern wall and hence to the south-east corner to power machinery in this location. The evidence for this can be seen in an infilled pudlock on the southern wall opposite the crown wheel and a stud with tenon that could have supported an axle mechanism.

11.2.11. Two further holes on the ground floor lead at an angle from the main spur wheel externally and may have supported a machine located externally to the mill. Wear on these holes suggests that belts ran through the holes.

Socio-economic history

11.2.12. The artefact assemblage from Trench 1 is useful in providing information about the lifestyle of the occupants of the cottage and the economic contacts of such an isolated dwelling in the last century after the cessation of milling. It could be reasonably assumed that much of the debris will relate to a period post-dating the use of the mill and may therefore be of limited value in terms of reconstructing the life of the successive millers.

11.3. Conclusion

11.3.1. Detailed recording of the mill has suggested that the majority of the fabric of the mill cannot be dated earlier than the mid-18th century with a date of 1757 suggested by historic records. Some historical information and elements of the fabric of the northern wall open the possibility that this represents a second mill built on the site but as yet no conclusive evidence can be presented that make this likely.

11.3.2. The mill mechanism contains elements that may date to the original wooden mechanism, the upright shaft and the crown wheel, but also possibly elements of the mill hursting (support structure). The majority of the cast-iron mechanism can be attributed to a second mechanism dated to the mid-19th century that has seen subsequent alteration. This includes the mill wheel, the mill gear system and probably the one surviving bedstone. The mill appears to have originally operated with two sets of stones, either for the grinding of corn or a combination of corn and animal feed. Only one set operated at the end of the mill's life.

11.3.3. The majority of the mill race, mill pond and wheel pit were silted or infilled with rubble collapse. The excavation of the wheel pit revealed the lower half of a substantially corroded iron pit wheel. The axle of the pit wheel was originally supported by a low brick wall on its western side. Rubble and silts had consequently subsided over much of the remains of the wheel (Trench 1). The head race present between the mill pond and the mill wheel was culverted with a bridge over the top to allow access to the mill on its northern side (Trench 2). Where water entered the head race prior to the mill pool excavations revealed a previously unrecorded stone culvert within the foot bridge. The bridge was of roughly coursed dry-stone build which appeared better preserved on its southern side. The upper part of the footbridge on its northern side and in the area of the boundary with Dowles Brook is made up of earth and stone rubble (Trenches 3 and 4). The head race had possibly been blocked that caused it to slowly silt before it became rapidly silted at the end of the lifespan of the mill.

11.3.4. The mill represents the best preserved of any of the mills along Dowles Brook and of any of the archaeological features from the industrial period in the Wyre Forest. Recording and evaluation of the mill has enabled a more complete understanding which can form the basis for any future conservation management plan.

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The report was written and collated by Chris Hewitson and Jon Halsted of Birmingham Archaeology. It was based on historic research of Robert Galloway who conducted the survey of Knowles Mill and the mills of the Dowles Brook as part of an MA at the Ironbridge Gorge Institute and independent research work by Tim Booth and David Poyner; a structural condition survey by Steven Holloway and Frank W Haywood and Associates. Particular thanks must be given to Tim Booth who took the time to come to site and for his invaluable advice on the mill and its history. Illustrations were the work of Nigel Dodds and Jon Halsted from original surveys done by Jeremy Milln and On-centre Surveys and the report was edited by Chris Hewitson who also managed the project for Birmingham Archaeology.

13. LIST OF SOURCES

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APPENDIX 3: Moveable Artefacts from the Mill

Artefact No.	Description	Location	Photo Ref
SF2129-1	Runner stone with seating for gimbal rynd. 48" diameter in multiple pieces. At current time a total of 10 pieces have been located. Probable bed stone from series of mill stones.	Ground Floor, south side.	2129-5 (1,2)
SF2129-2	Wheel, unknown function cast-iron fe,	Ground Floor, table	2129-5 (4)
SF2129-3	Cast-iron fe fragment, Fragment of the wheel rim, recovered, contains bracket for bucket	Ground Floor, table	2129-5 (5)
SF2129-4	Pulley wheel, cast-iron fe, removed from position at the apex of the truss as part of the sack hoist system	Ground Floor, table	2129-5 (6)
SF2129-5	Sheet-iron fe hoop, probable hoop from main shaft of mill mechanism, diameter	Ground Floor, table	2129-5 (8)
SF2129-6	Fe (Steel) handle from a bench vice	Ground Floor, table	2129-5 (9)
SF2129-7	Fe cast-iron footspep bearing box for stone spindle of downstream mill stones, one of pair other is in place.	Ground Floor, table	2129-5 (10)
SF2129-8	Fe bench vice, pincer type	Ground Floor, table	2129-5 (11)
SF2129-9	Fe axel, penstock control, shaft with 2 pinions to work on racks to control the gate, square cross-section	Ground Floor, against wall	2129-5 (12)
SF2129-10	Set of six, leather and fe metal chains, snow chains	Ground Floor, on E wall	2129-5 (13)
SF2129-11	Fe metal hoop, sheet metal, probable from main shaft or upper shaft of mill mechanism	Ground Floor, on E wall	2129-5 (14)
SF2129-12	Fe metal and wood scythe, spare scythe blade	Ground Floor, on N wall	2129-5 (15)
SF2129-13	Fe metal and wood scythe,	Ground Floor, on N wall	2129-5 (16)
SF2129-14	Wood scythe handle, from blade SF2129-12	Ground Floor, on N wall	2129-5 (16)
SF2129-15	Fe metal chains, 2 sets, unknown use	Ground Floor, on N wall	2129-5 (17)
SF2129-16	Fe metal fire grate, 3 rung *in situ*	Ground Floor, fire place, NW corner	2129-5 (18)
SF2129-17	Fe metal pins and braces (3), function unknown	Ground Floor, against N wall	2129-5 (19, 20)
SF2129-18	Set of wooden stairs, 8 steps (all replaced), former stairs to 1st floor, originally rested in front of mill mechanism, possibly not original	Ground Floor, against N wall	2129-5 (25)
SF2129-19	Plate fe, fragment, function unknown	Ground Floor, window sill	2129-5 (26)
SF2129-19	Strap-hinge fe, fragment, no earlier than 18th century	Ground Floor, window sill	2129-5 (26)
SF2129-19	Crow-bar, tool, fe metal, function unknown	Ground Floor, window sill	2129-5 (26)

APPENDIX 4: Quantification of Artefacts

	Building Material			Ceramic			Metal Work					Glass				Environmental		
Context	**Tile**	**Stone**	**Mortar**	**Pottery**	**Clay Pipe**	**Other**	**Fe: Nails**	**Fe: Other**	**Copper /Alloy**	**Other Metal**	**Slag**	**Bottle**	**Other Vessel**	**Window**	**Other**	**Animal Bone**	**Charcoal**	**Misc.**
1000	1 (38.5g)	0	0	26 (321.5g)	0	0	4 (15.3g)	3 (377.7g)	0	5 (327.1g)	0	48 (16,850g)	1 (92.2g)	0	0	1 (8.5g)	0	9 (94g)
1001	0	0	0	36 (2411.2g)	0	4 (258.3g)	0	36 (6614.8g)	1 (55.1g)	1 (118.5g)	1 (431.2g)	18 (6370.2g)	1 (243.2g)	0	15 (312g)	4 (22.1g)	10 (2.6g)	1 (6.5g)
1002	1 (274.5g)	0	0	18 (986.8g)	0	1 (622.6g)	0	13 (4976.3g)	0	3 (133g)	0	7 (2309.6g)	2 (379g)	0	0	2 (82.5g)	0	1 (14.6g)
1003	3 (359.1g)	0	0	85 (5278.9g)	0	2 (103.4g)	0	0	0	2 (33.5g)	2 (40.5g)	34 (9903.7g)	7 (1333.3g)	0	31 (616g)	0	0	1 (702g)
1004	0	0	0	10 (214.7g)	0	0	0	0	0	1 (4.7g)	0	0	0	0	0	14 (213.5g)	0	0
2000	3 (199.4g)	1 (27g)	2 (47.2g)	35 (317.6g)	0	2 (39.1g)	5 (114.6g)	0	0	0	0	3 (53.6g)	0	0	27 (694.5g)	1 (2.2g)	0	0
2001	0	0	0	1 (7.6g)	0	0	0	0	0	0	0	3 (46.7g)	0	0	0	0	0	0
2002	0	0	3 (379.7g)	11 (51.6g)	1 (2.7g)	0	18 (1189.6g)	26 (1505.1g)	0	0	0	1 (7.6g)	0	2 (11.5g)	1 (50.7g)	4 (150.6g)	0	0
2007	0	0	0	0	0	0	0	12 (44.2g)	0	0	0	0	0	0	0	0	0	0
3000	0	0	4 (31.6g)	0	0	0	1 (12.5g)	0	0	1 (35.5g)	1 (24.1g)	8 (277.7g)	0	0	0	0	0	0
3001	0	0	0	0	0	0	0	7 (156.7g)	0	0	0	1 (290.7g)	1 (89.3g)	0	0	0	0	0
3002	0	0	5 (40.5g)	0	0	1 (13g)	0	25 (1680.2g)	0	1 (60g)	0	17 (984g)	0	0	0	0	0	3 (57.7g)
3004	0	0	0	0	0	0	0	0	0	0	0	2 (444.2g)	0	0	0	0	0	0
4000	0	0	0	0	0	0	0	27 (1796.1g)	0	0	0	0	0	0	0	0	0	0
4001	0	0	0	0	0	0	0	45 (4806.9g)	0	0	0	1 (122.5g)	0	0	0	0	0	0
U/S	0	0	0	0	0	0	0	0	0	1 (550g)	0	6 (225.3g)	0	0	0	0	0	0
Total	**8 (871.5g)**	**1 (27g)**	**14 (499g)**	**222 (9589.9g)**	**1 (2.7g)**	**10 (1036.4g)**	**28 (1332g)**	**194 (21,958g)**	**1 (55.1g)**	**15 (1262.3g)**	**4 (495.8g)**	**149 (37,885.8g)**	**12 (2137g)**	**2 (11.5g)**	**74 (1673.2g)**	**26 (479.4g)**	**10 (2.6g)**	**15 (874.8g)**

APPENDIX 5: Geology Locality Record *by Herefordshire and Worcestershire Earth Heritage Trust*

Locality Information

Site Name/Alternative name Knowles Mill		Field Surveyor R.Gillespie
Grid Reference SO 76217667+/-50		Date 19.10.2010
County and Local Authority Worcestershire/WYRE FOREST	Parish Bewdley	Access TRACKWAY IN WOODLAND. PUBLIC OPEN ACCESS
Landowner NATIONAL TRUST		Directions Follow Dry Mill Lane, Bewdley to Knowles Mill and walk up old mill pond for about 100 m. Can drive to mill.
Locality type ED See *below		Facilities None
Threats & Safety NONE		Other
Condition Good		Site Dimensions. (Use this format. H x W x L) in metres. 5.5x 25 m

*LOCALITY TYPE – Earth Science Conservation Classification. Disused quarries, pits and cuttings (ED), Active quarries and pits (EA), Coastal and river cliffs (EC), River and stream exposures (EW), Inland outcrops (EO), Mines and tunnels (EU), Extensive Buried Interest, (EB), Road, Rail and Canal cuttings (ER), Static (fossil) Geomorphological sites (IS), Active process Geomorphological sites (IA), Caves (IC), Karsts (IK), Finite mineral, fossil or other geological sites (FM), Mine dumps (FD), Finite underground mine and tunnel (FU), Finite buried interest (FB).

FIELD DIAGRAM/NOTES. Source e.g. field notes/memoir/paper etc,
Small quarry with alternating bands of sandstone and varied sized conglomerates. Appears overall to be cycles of varied energy and with repeating fining up sequences, 7 or 8 cycles seem. Small coal seams are visible in lenses and draping conglomerate. The overall picture is of a meandering active stream flowing East/West or West/ East. Sandstone grades vary to medium coarse with erosive surfaces that are superceded with the dumping of conglomerates often mixed with sharp angular clasts up to 6 cms width. Clast composition is varied with red and cream, brown and yellow hard mudstones and with vein quartz and quartzite pebbles. To the left side beds have cobbles up to 12 cms in size, rounded and subrounded to angular. A thick bed is coated with lignitic fragmentary coal as if this is deposited on and intermixed with the gravels of a point bar deposit. Such point bar deposits appear to be the feature of most of the beds. Some thin beds are laminated and speckled with tiny coalified fragments. Sandy lenses may contain coalified tree fragments and one such bed has the profile of a calamites tree trunk which could have had a diameter of 25 cms. Some sand beds are laminated and trough cross bedded. These vary in colour from brown to red buff. Mica content appears to be present in a small proportion. To the right cliff face is a nodular structure, which is ringed internally, about 25 cms across which may be a dewatering or pressure formation.

RECOMMENDED AS A LGS. SC/ ED/ deposition features, lithology and palaeo environment.

Summary

Stratigraphy	CARBONIFEROUS.WARWICKSHIRE GROUP/ Etruria Formation (OLD HILL MEMBER)
Lithology	SANDSTONE, CONGLOMERATE WITH BRECCIATED CLASTS, coal seams
Fossils	Calamites and fragments
Minerals	lignite, coal, quartzite, muscovite mica
Structure	Dip 020/250W
Paleoenvironment	FLUVIAL, TROPICAL, DELTAIC, BRAIDED CHANNELS

Supporting Information (to be added once information available)

Samples	Description One sample clast, and various sand beds containing coal fragments	Sample code
Photographs	Description	
	Photograph 1 LEFT Photograph 2 CENTRE : SCALE IS HALF METRE BAR IN 10 CM Photograph 3 RIGHT GRADUATIONS	Image 1492 Image 1493 Image 1494 Plano
Bibliography	Harvard Reference (Author, date, title , page no's, publisher)Mitchell.GH, Pocock.RW, Taylor. JH. 1962. The Geology of the country around Droitwich, Abberley, and Kidderminster. HMSO.	
RIGS Designation	Accepted/Date	Rejected
	Office document stored as	

APPENDIX 6: Mill Speed calculations *by Rod Sproat, North Worcestershire Archaeological Group*

The rotation speed of the mill wheels is crucial. Too fast and the grain will heat up and even catch fire, too slow and the wheat germ will form a paste and clog the machinery. Therefore the flow of the water over the mill waterwheel must be kept at a constant rate at all times during the operations of grinding. Below is a table of the optimum rotational speeds for grain grinding wheel sets using empirical figures gained by miller's practical experience over the centuries.

Table XX: Optimum Peripheral Speed at the circumference of the stones

Diameter of stones diameter	**Rotational speed** [i]	**Peripheral speed at**
2ft 6in	250 rpm	1963.50 ft/min
3ft	200 rpm	1884.96 ft/min
3ft 6in	180 rpm	1979.20 ft/min
4ft	150 rpm	1884.96 ft/min

Using the formula:

Peripheral speed at diameter (rim) = π x diameter x Revs/min

It can be seen that the optimum linear speed at the periphery, (at the rim of the wheels), and circumference of a grinding wheel set, is on average about 1930 feet per minute when grinding grain.

To determine the waterwheel speed the gearing ratios must be considered.

At Knowles Mill the stone nut has 25 teeth whilst the Great Spur Wheel has 110 teeth;

*This gives a reduction in the ratio of 25 ÷ 110 = **1:4.4** ratio*

Below on the Main Shaft is the Wallower with 44 teeth driven by the Pit Wheel with 108 teeth. The Pit Wheel is connected to the Axel Tree on which the Waterwheel, (9ft diameter by 6ft wide), is mounted;

*This gives a reduction in the ratio of 44 ÷ 108 = **1:2.45** ratio*

With the Knowles Mill Grindstones at 4 feet diameter[ii] the optimum rotational speed from the above table is 150 rpm. Therefore:

Speed of millstones x Stone nut to Great Spur Wheel x Wallower to Pit Wheel = Waterwheel Speed			
150 rpm	**1:4.4** ratio	**1:2.45** ratio	**13.88 rpm**

This gives a guide that at optimum operation the waterwheel rotates at about ¼ of a revolution every second. Much depends upon the type of corn, and the condition and hardness of the corn being ground. It is expected that an efficient miller, using 4ft diameter grindstones could grind 5 bushels an hour, and thus produce nearly 3cwt of flour or nearly 2cwt of fine dressed flour for bread making. Double these quantities might be achieved if the corn was ground to make coarse meal for cattle food.

[i] Syson. L. *The Watermills of Britain.* David & Charles (Publishers) Ltd. 1980.
[ii] Ibid.

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Figure 01: Site Location

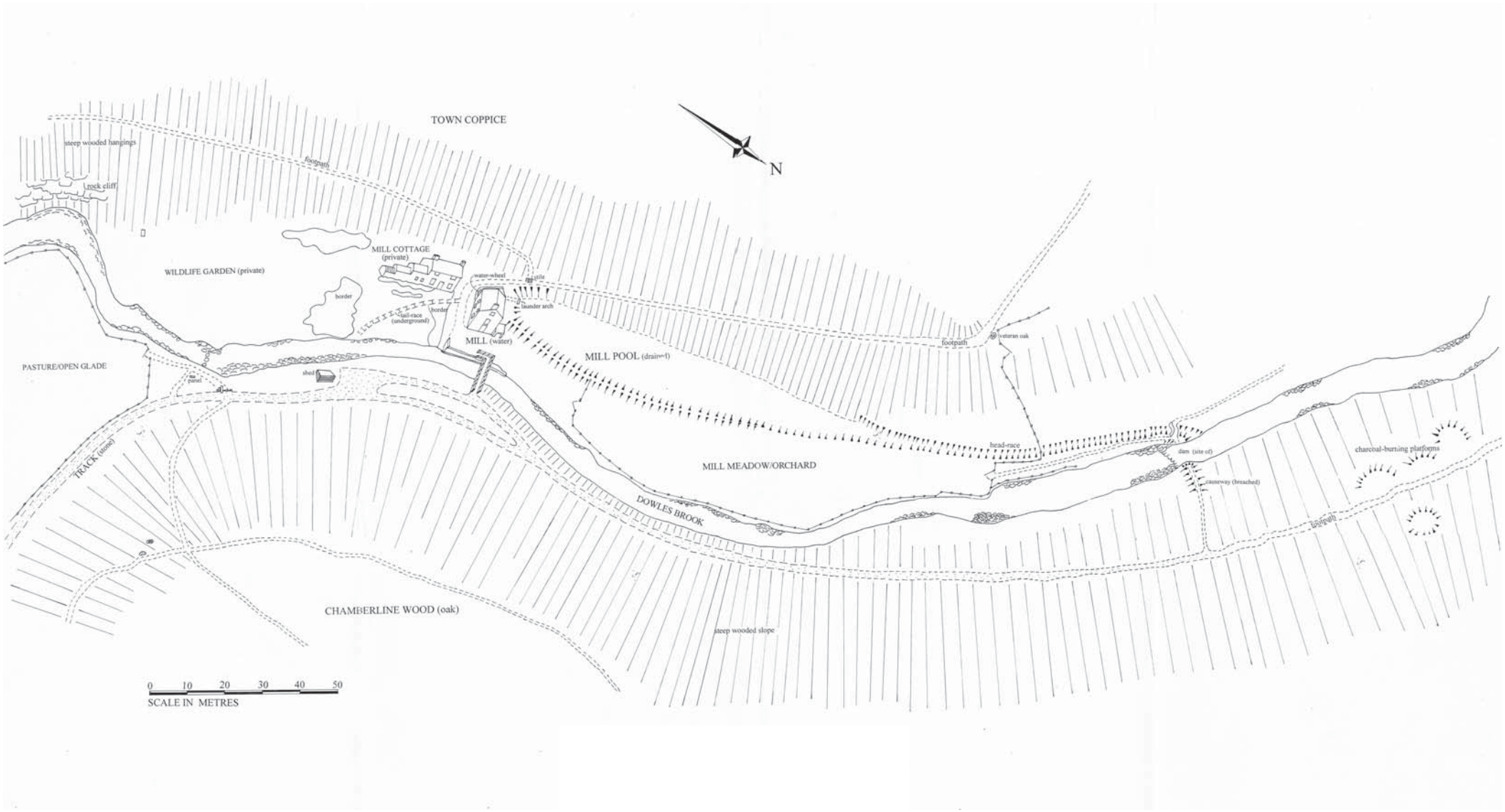

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Figure 2: Site

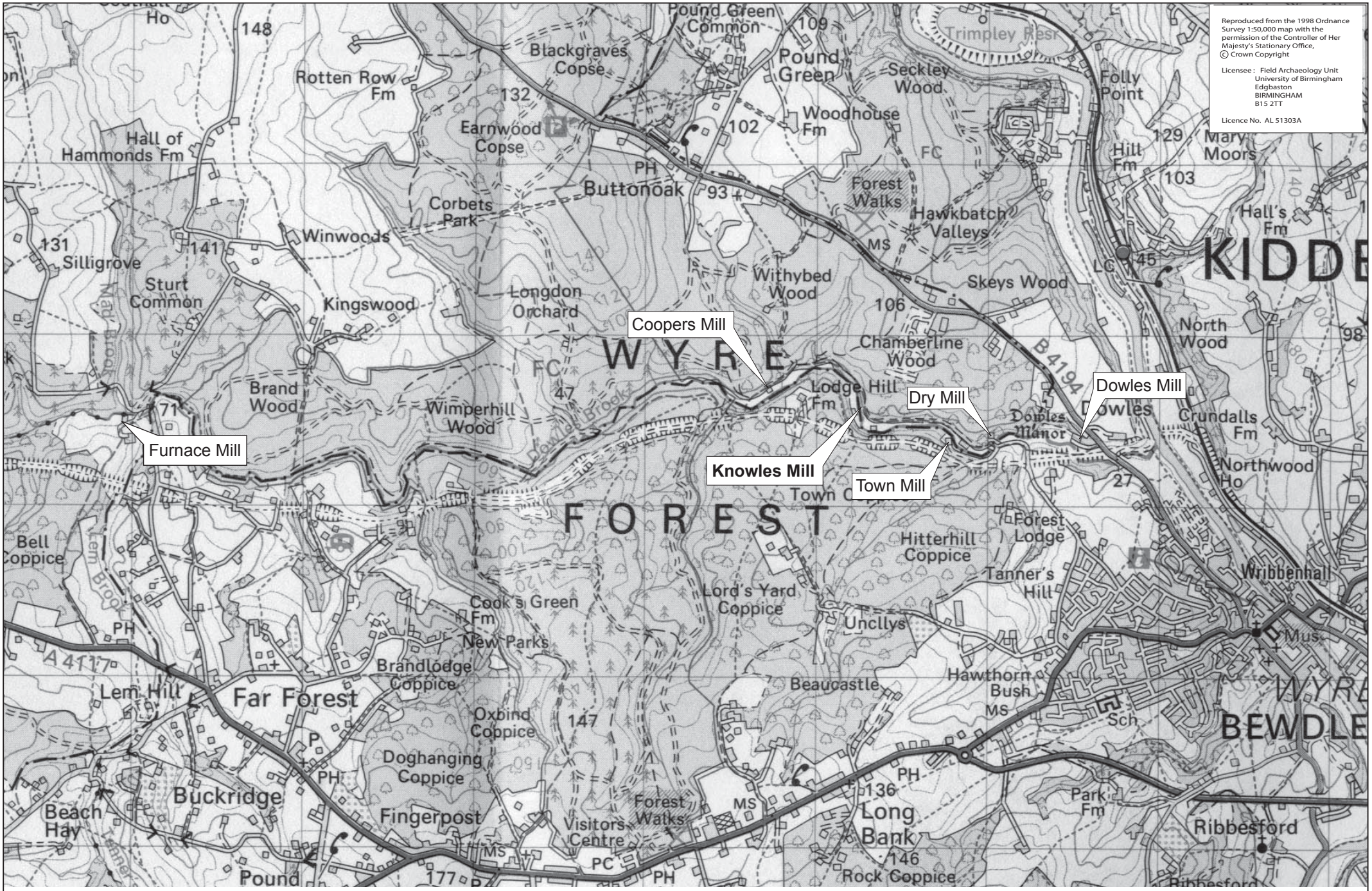

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Figure 3. Mills on the Dowles Brook, Wyre Forest

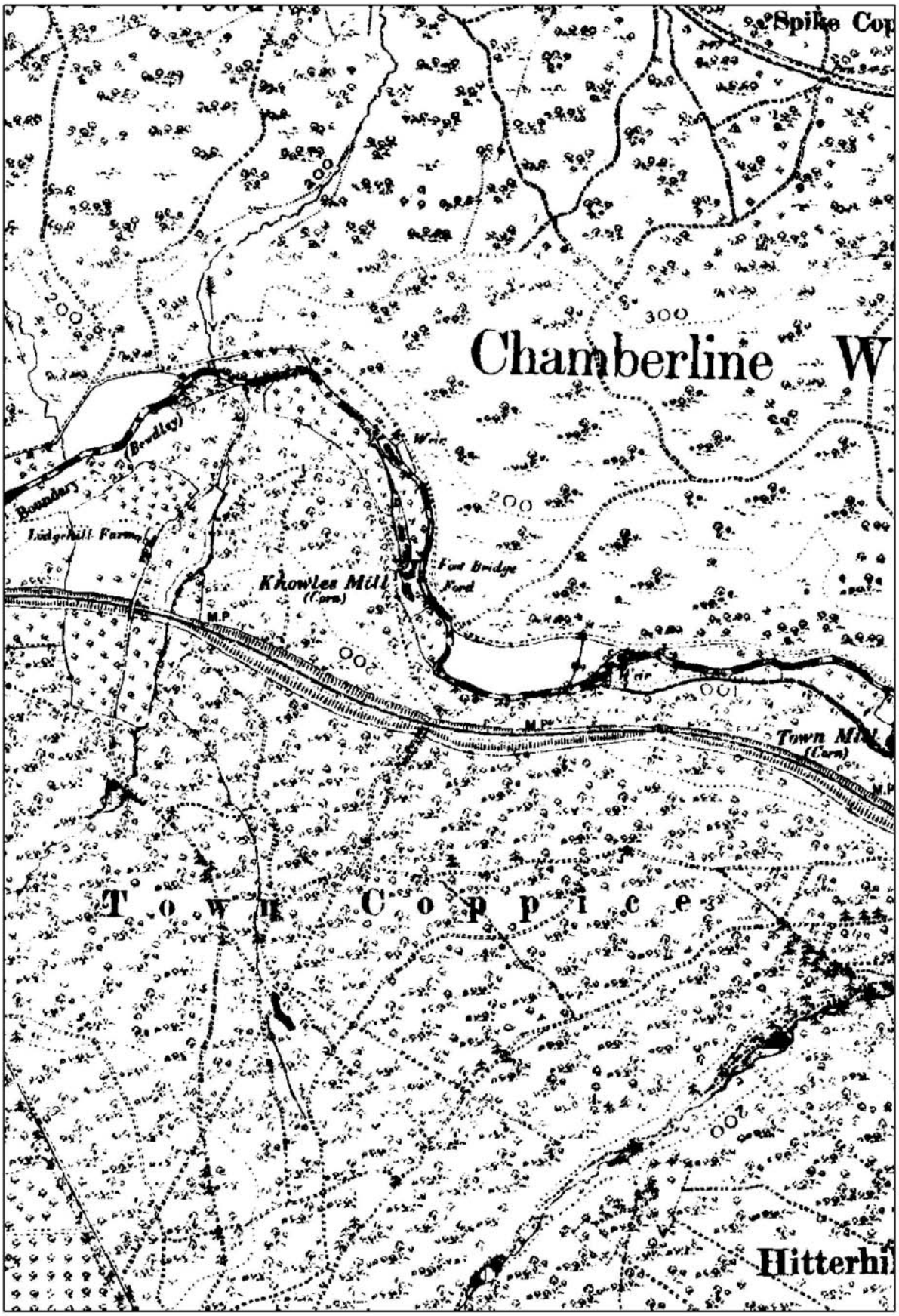

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Figure 4: 1st Edition o.s. map 1892

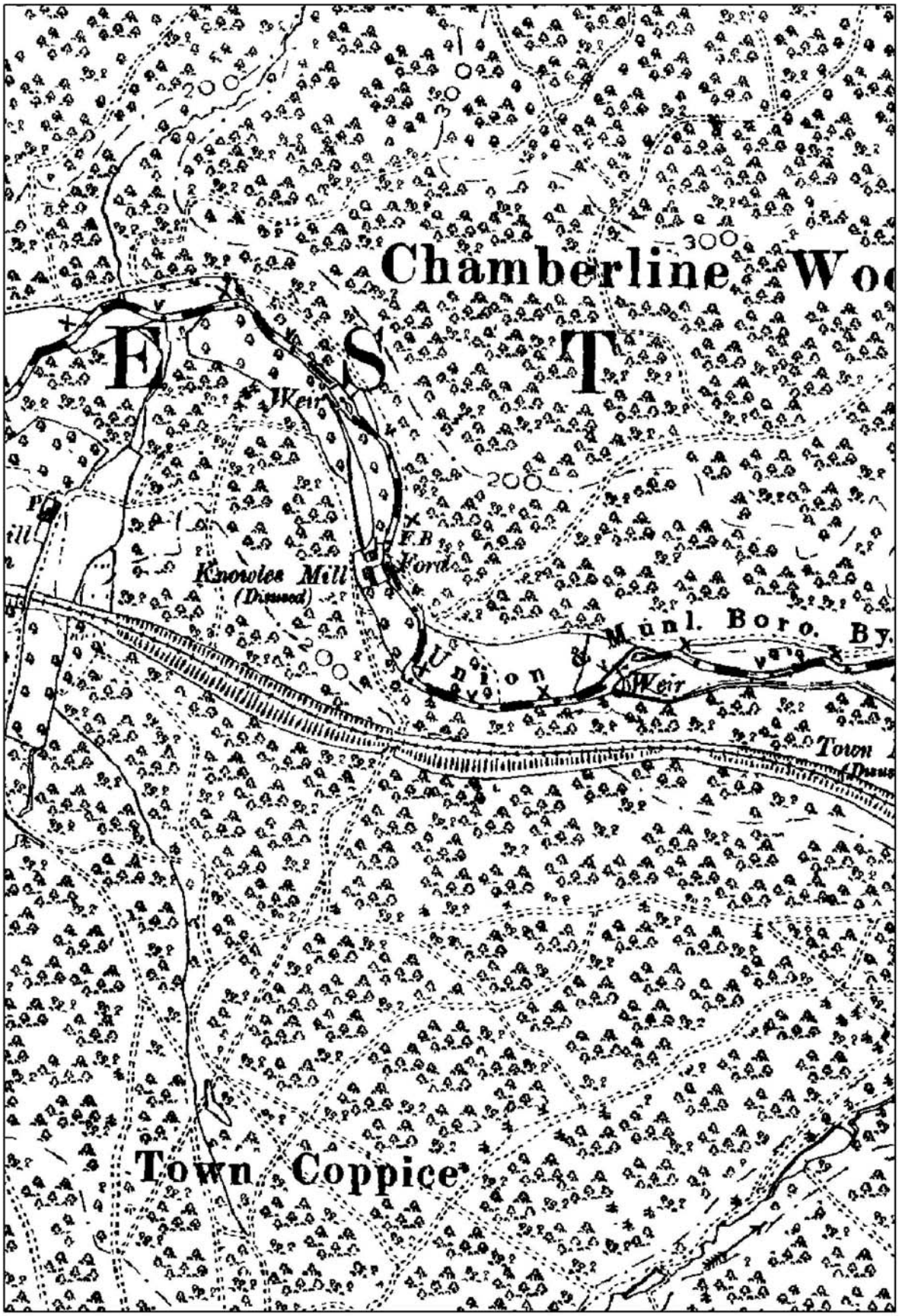

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Figure 5: 2nd Edition o.s. map 1904

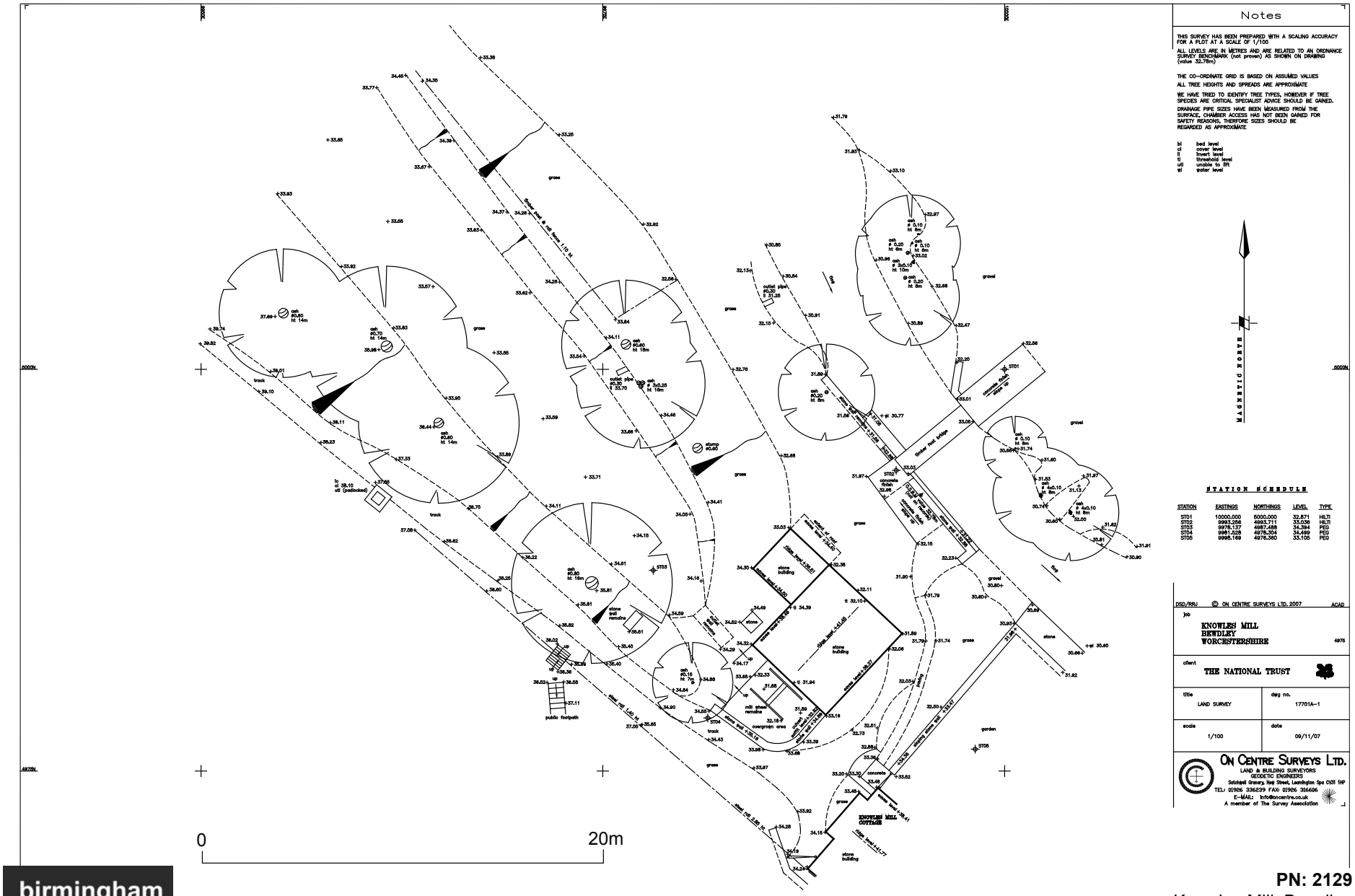

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Figure 6: Land Survey

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Figure 7: East Elevation

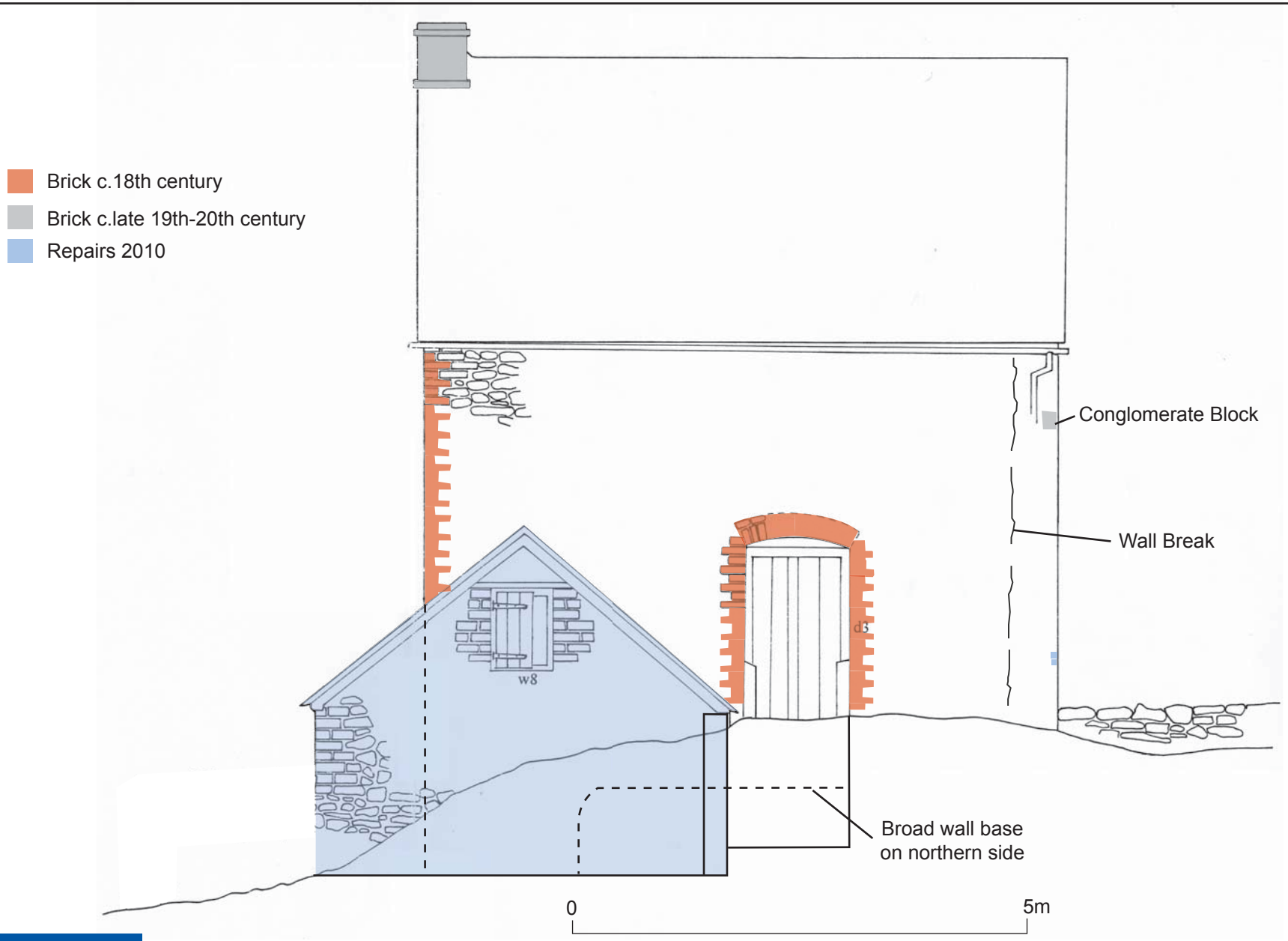

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Figure 8: North Elevation

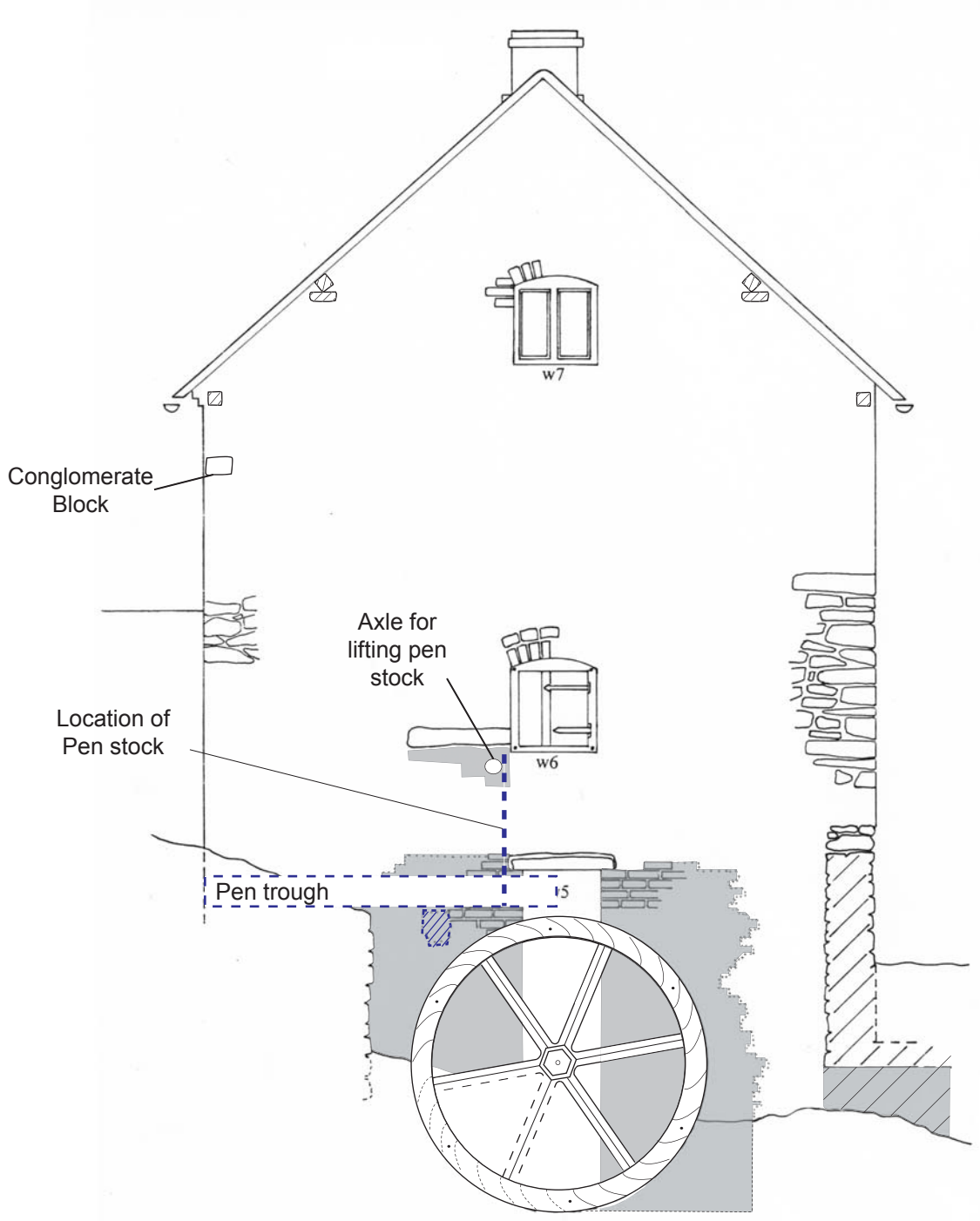

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Figure 9 : West Elevation

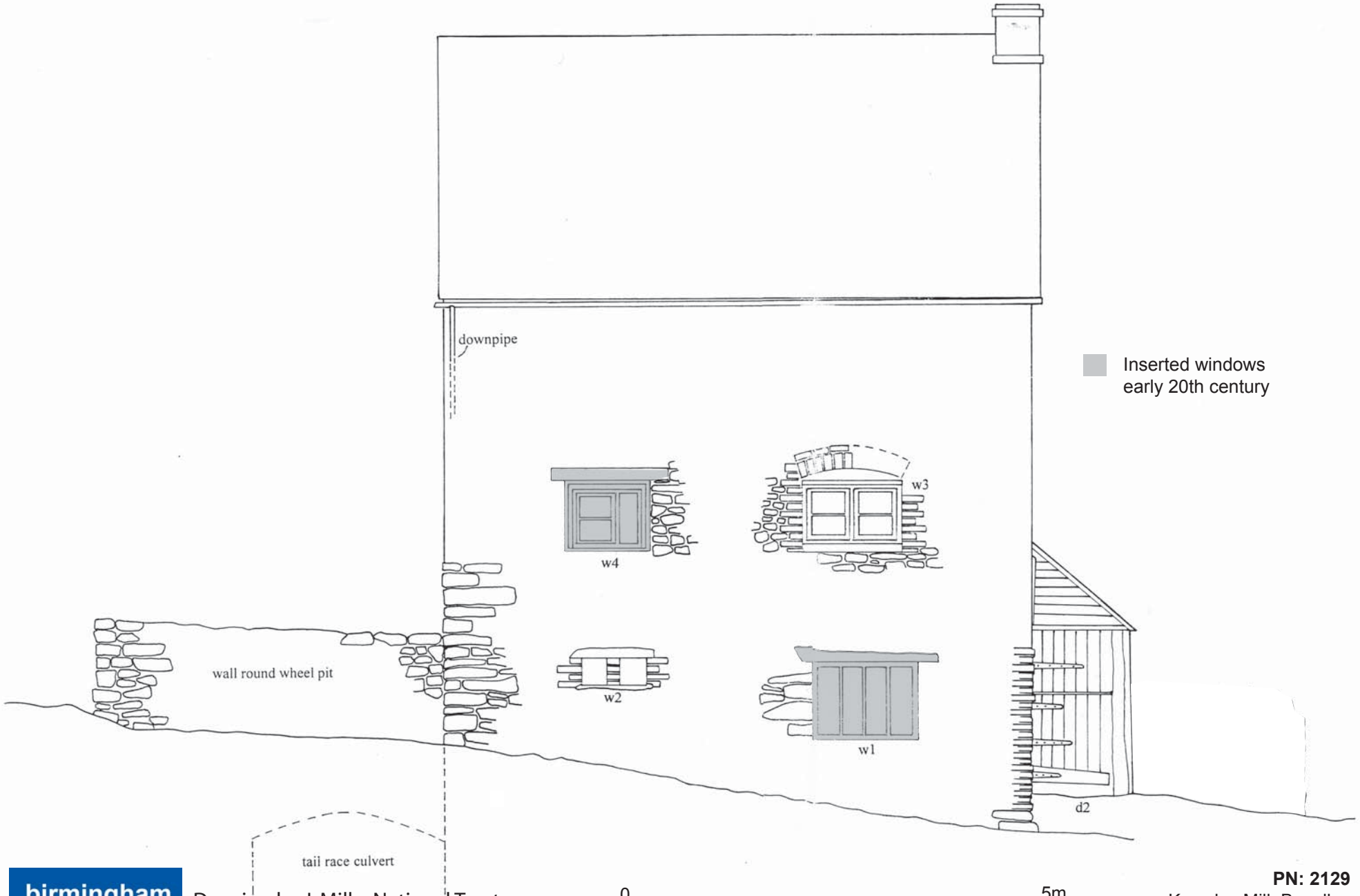

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Figure 10: South Elevation

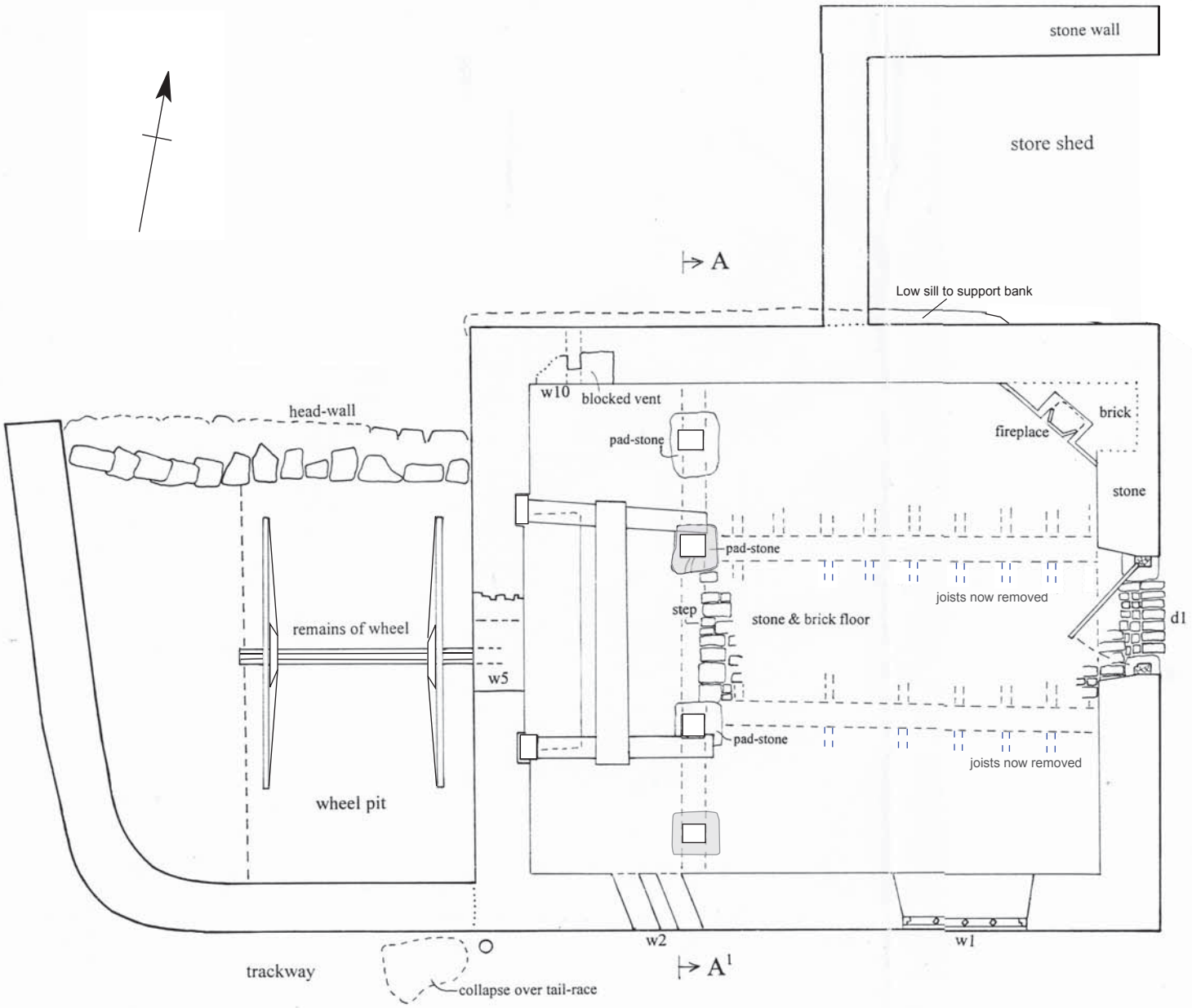

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Figure 11: Ground/ Meal Floor (general)

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Figure 12: Ground/Meal Floor (surface)

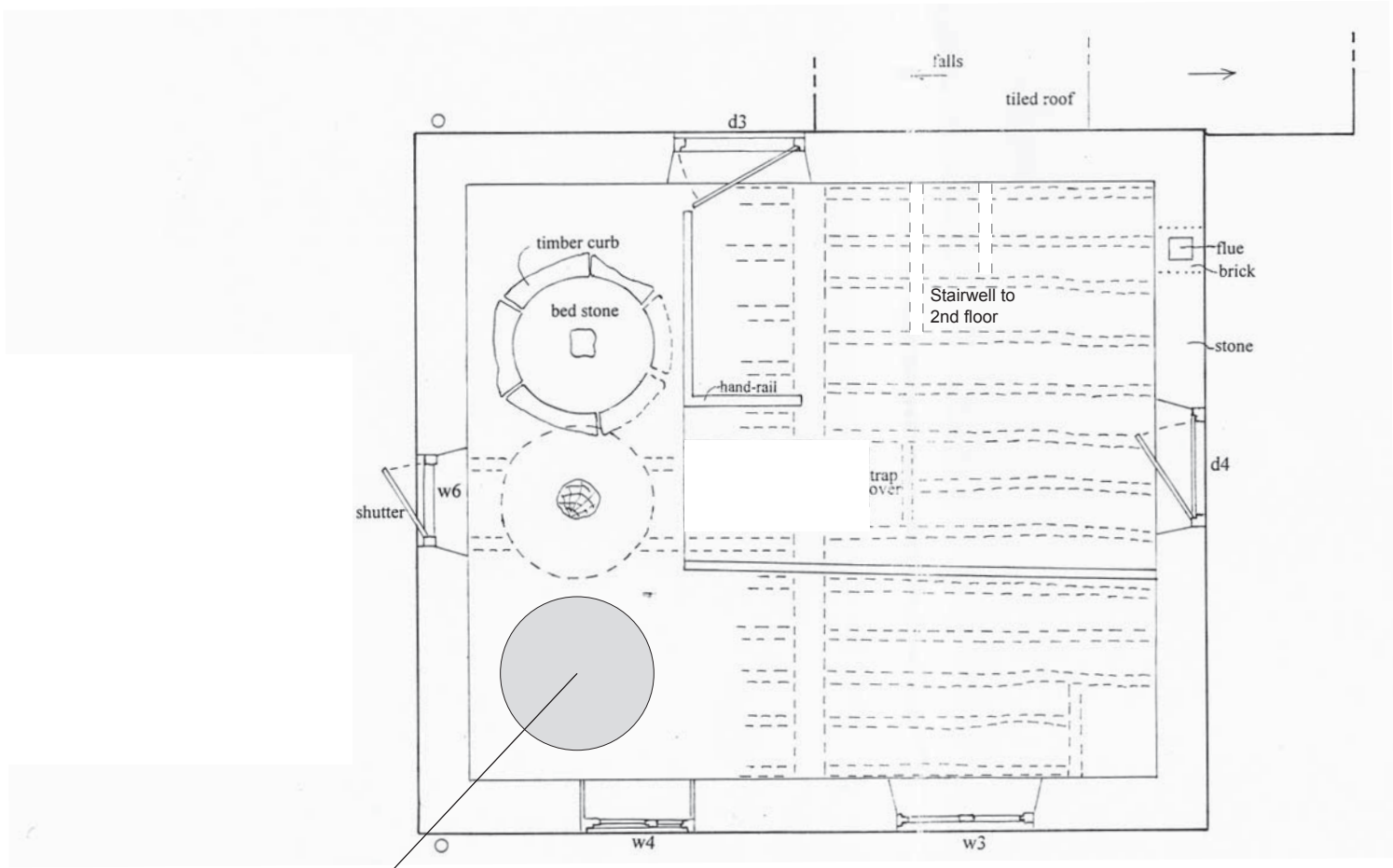

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Figure 13: First/Stone Floor

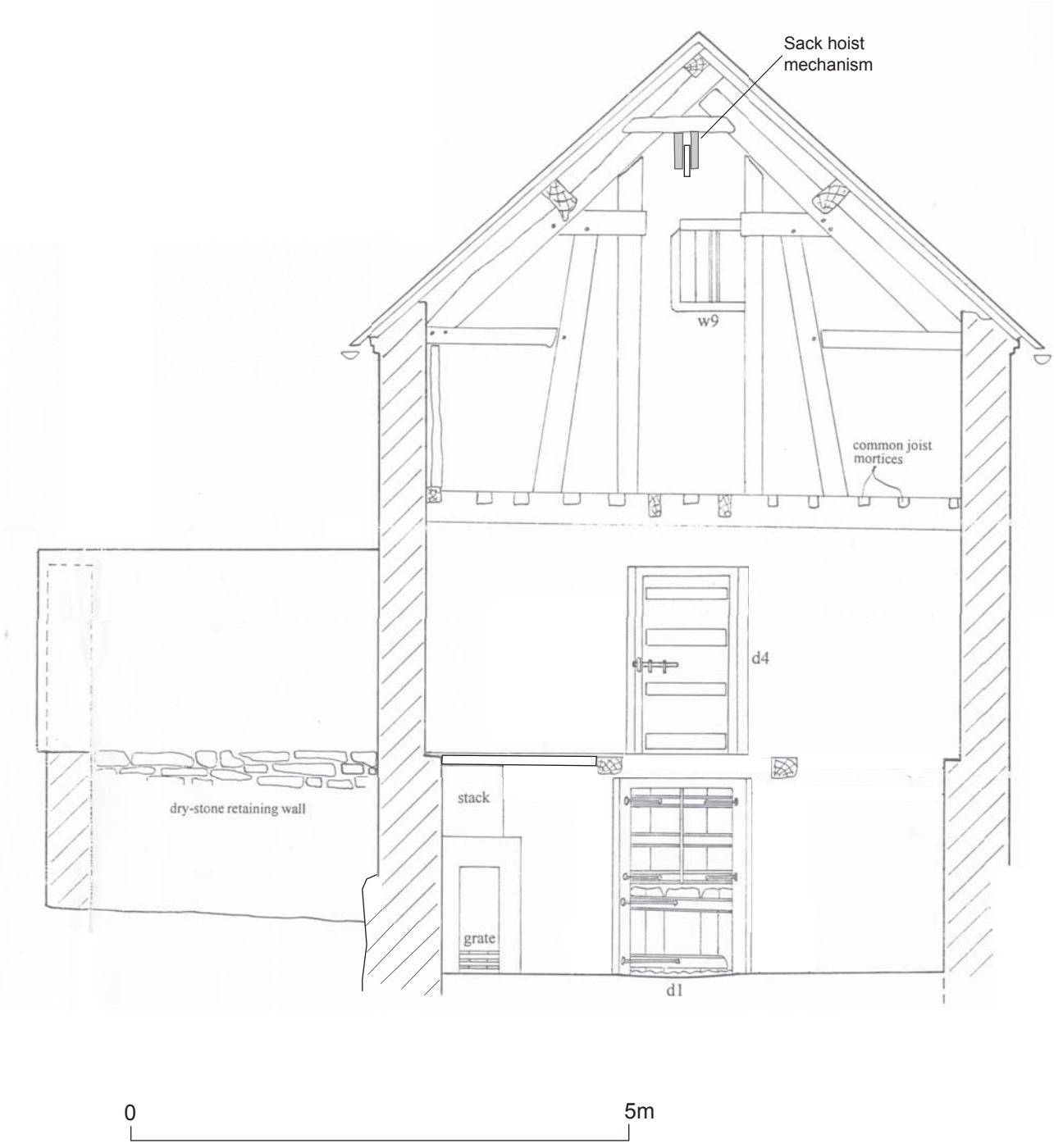

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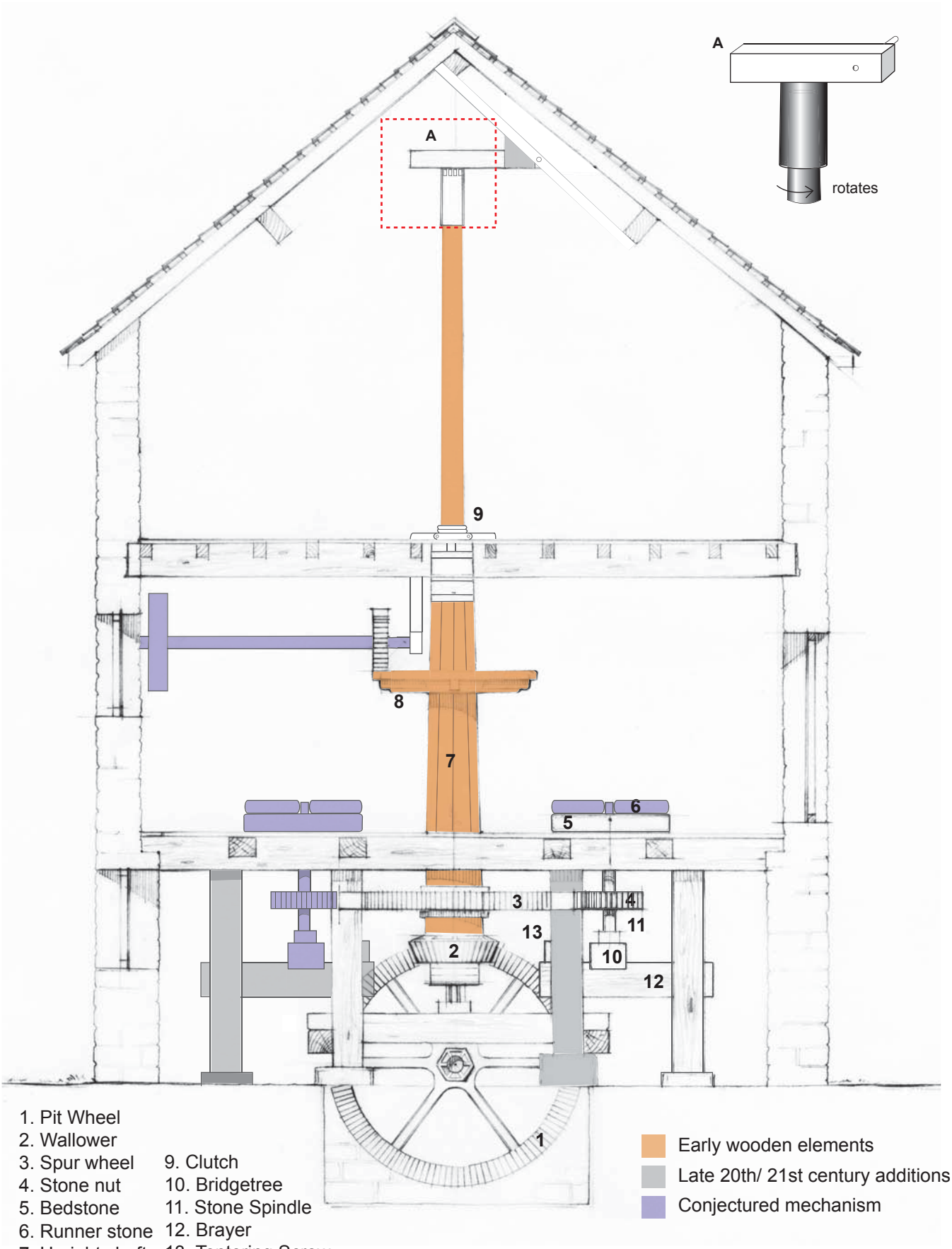
Figure 14: Cross section and east-facing internal elevation



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Drawing by National Trust, Derek Ogden, Tim Booth,
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Figure 15: Waterwheel Hydraulic System

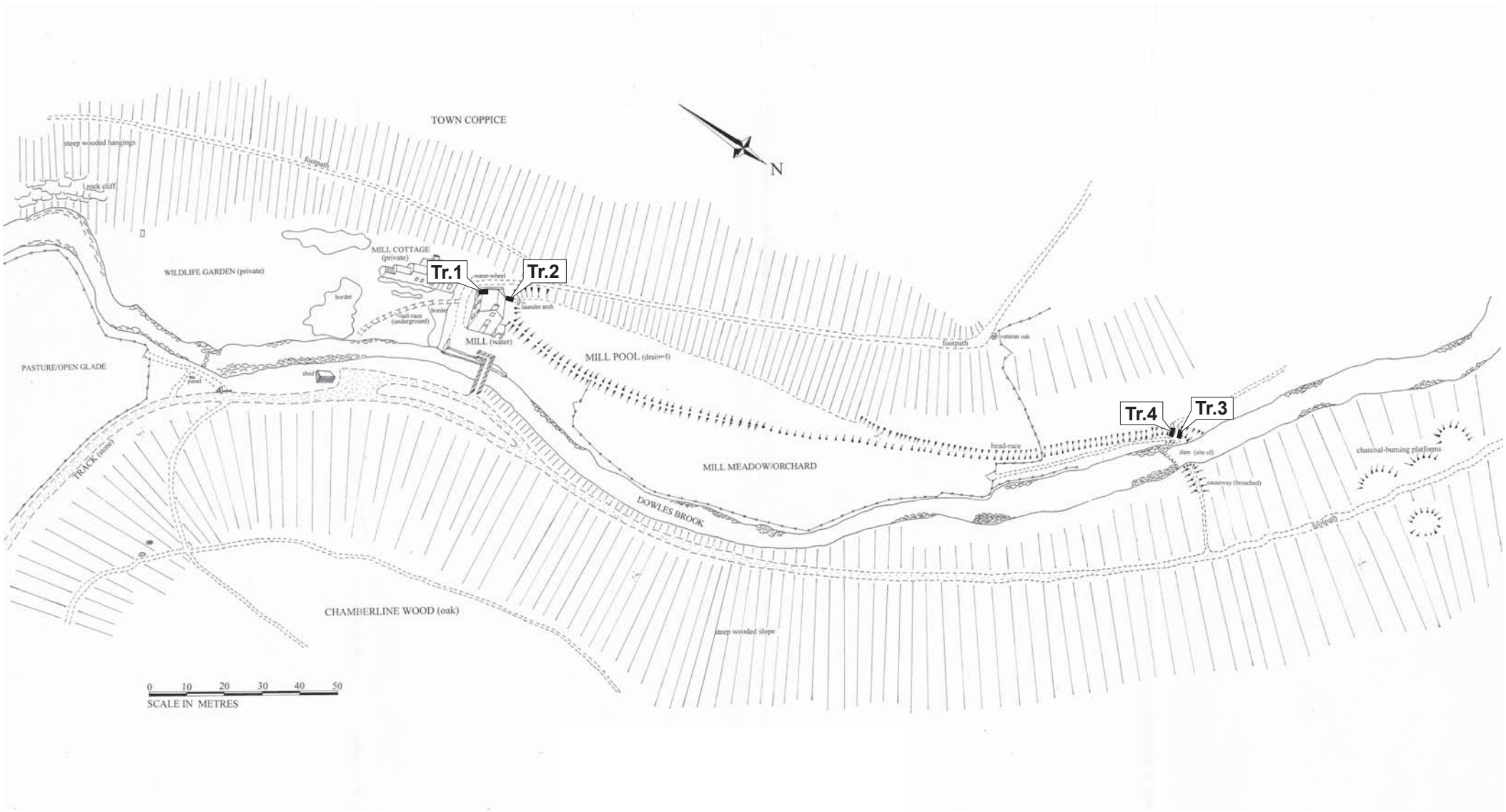

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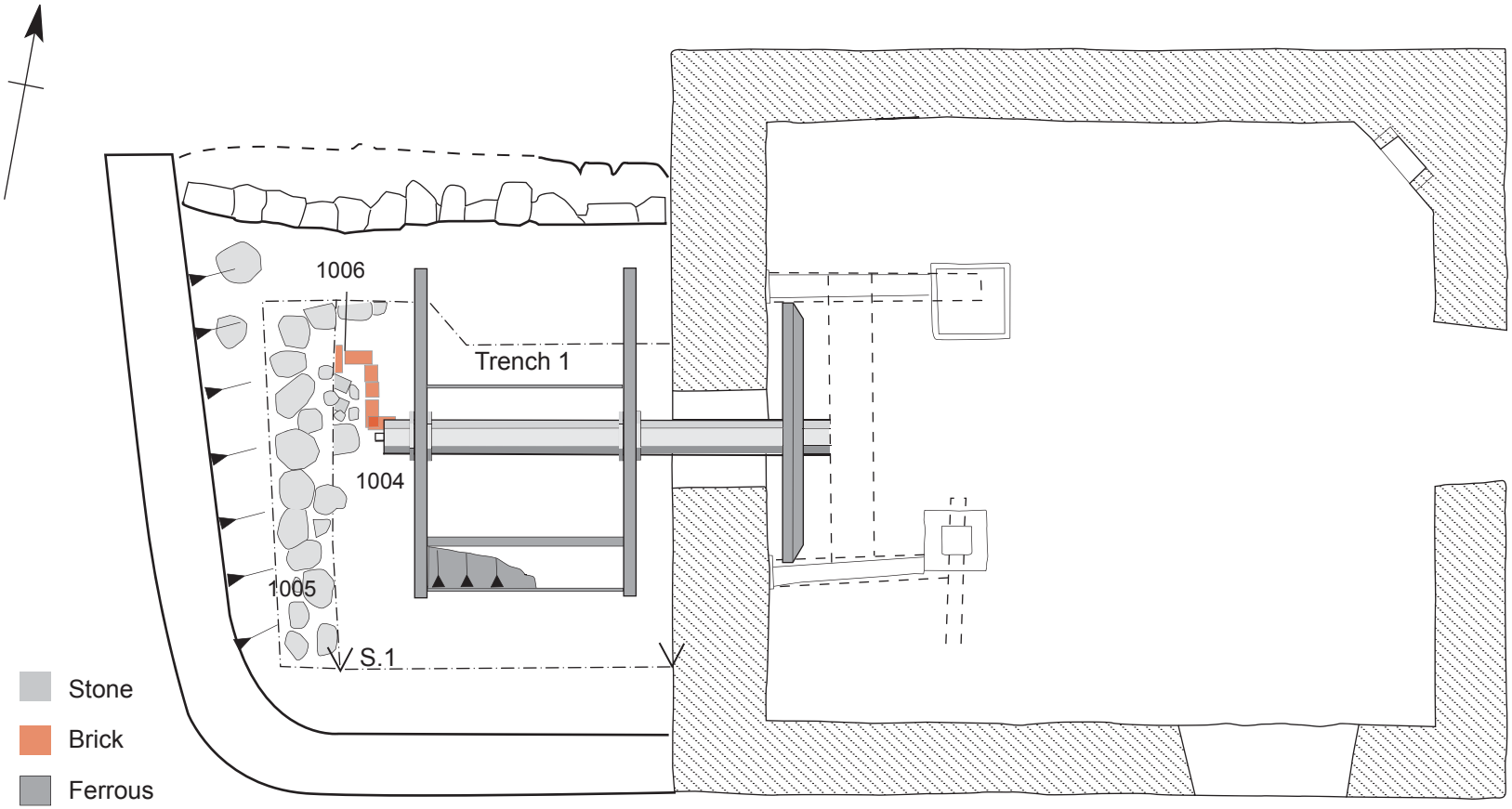
Figure 16: Trench locations



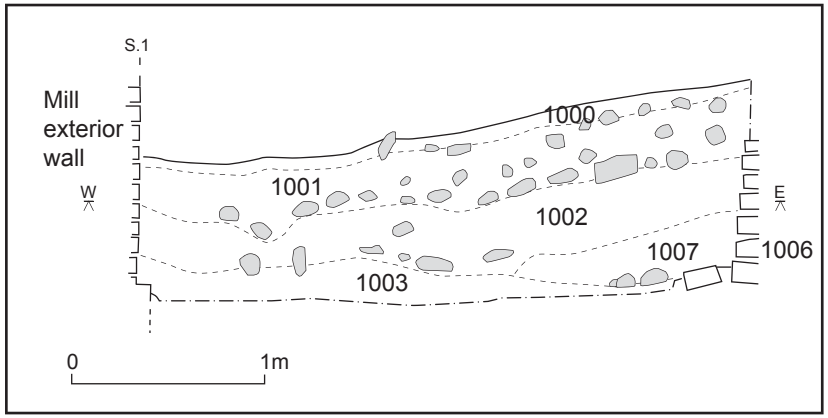


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Figure 17: Wheel pit, Trench 1

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Figure 18: Trench 2 Mill Race

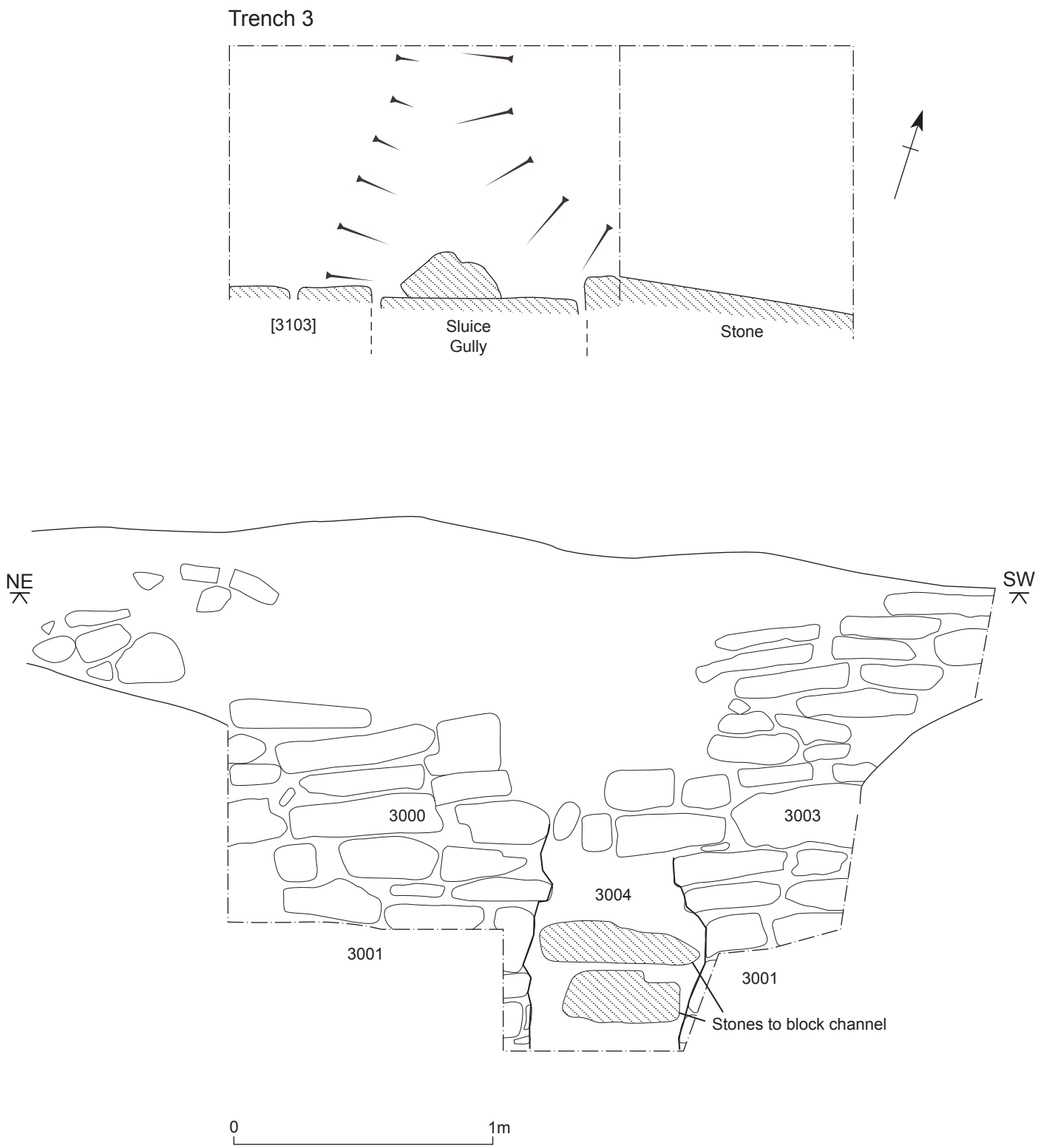

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Figure 19: Trench 3 North-facing Bridge Elevation

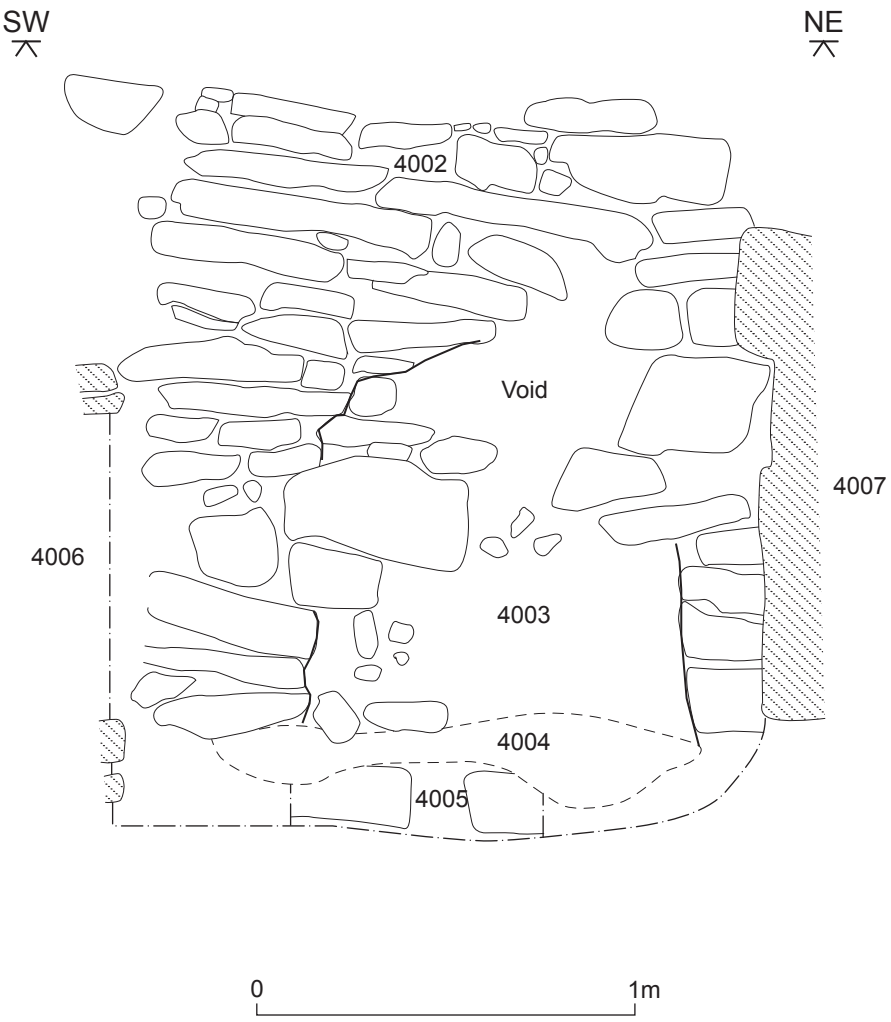

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Figure 20: Trench 4 South-facing Bridge Elevation

Plate 1: General View of Knowles Mill and Cottages

Plate 2: Knowles Mill – Eastern Elevation

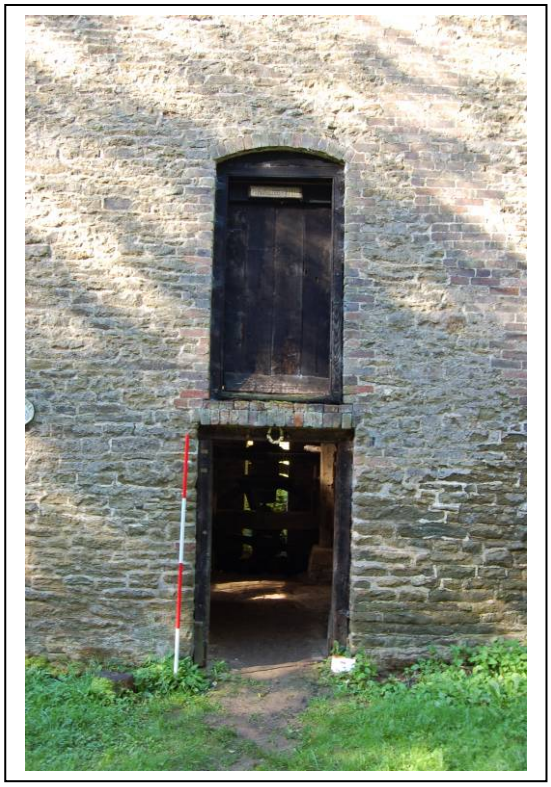

Plate 3: Doorways, Eastern Elevation

Plate 4: Northern Elevation

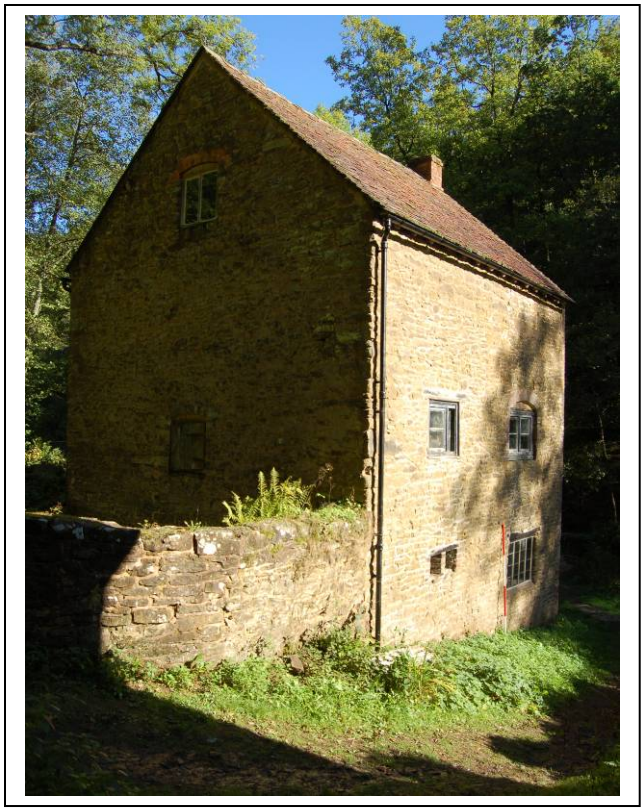

Plate 5: Western and Southern Elevation

Plate 6: Detail of two holes to mill machinery, southern elevation

Plate 7: Outbuilding, south facing

Plate 8: Wheel pit and remains of the wheel, pre-excavation

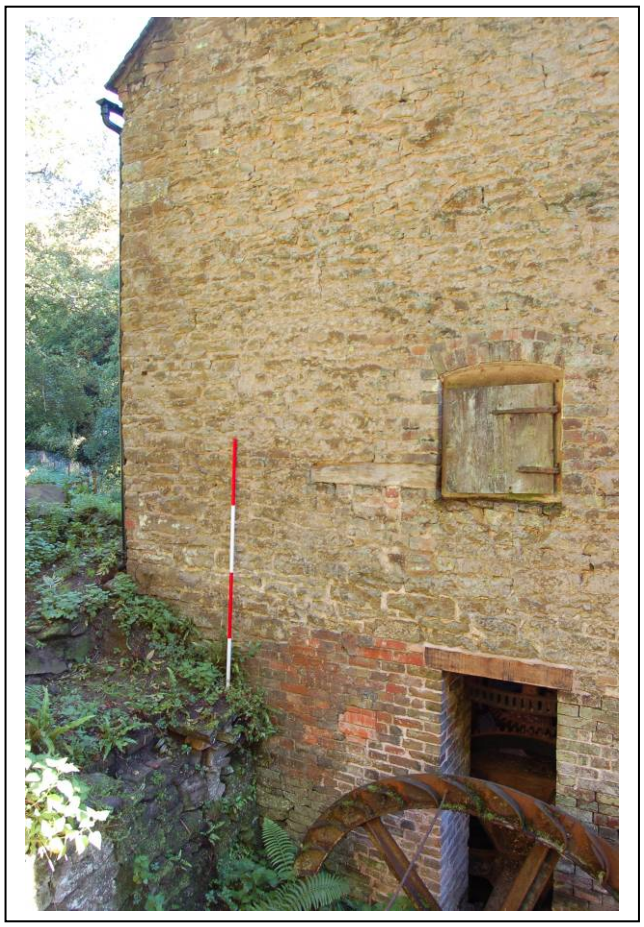

Plate 9: West elevation including wheel pit

Plate 10: Ground floor, east facing

Plate 11: Hearth, north-east corner ground floor

Plate 12: Mill machinery, ground floor, west facing

Plate 13: First floor, axial beam, south-east facing

Plate 14: Second Floor, surviving floor joists

Plate 15: Roof truss, south-east facing

Plate 16: Sack-hoist pulley mount, in apex of roof truss

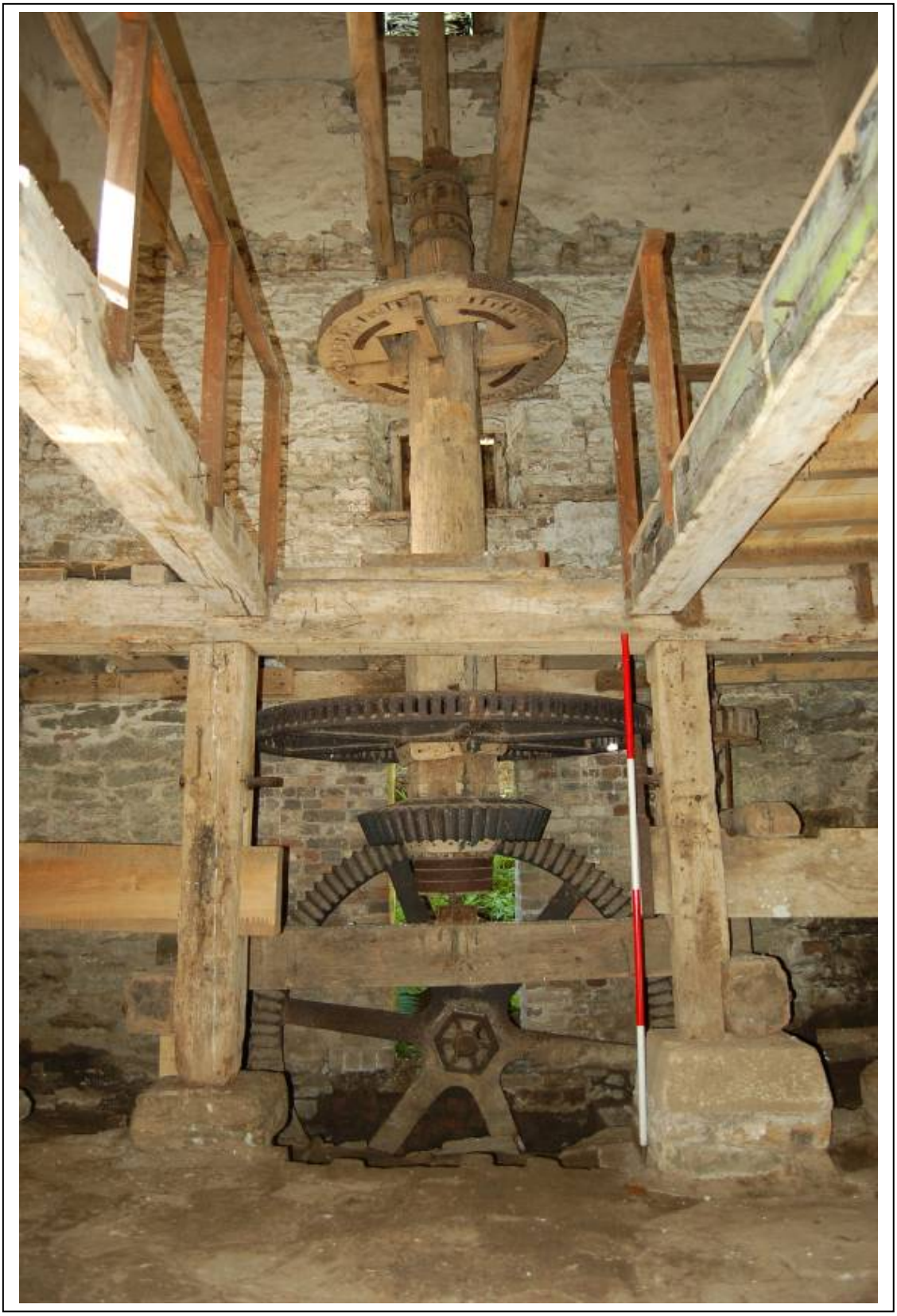

Plate 17: Mill mechanism overall, west facing

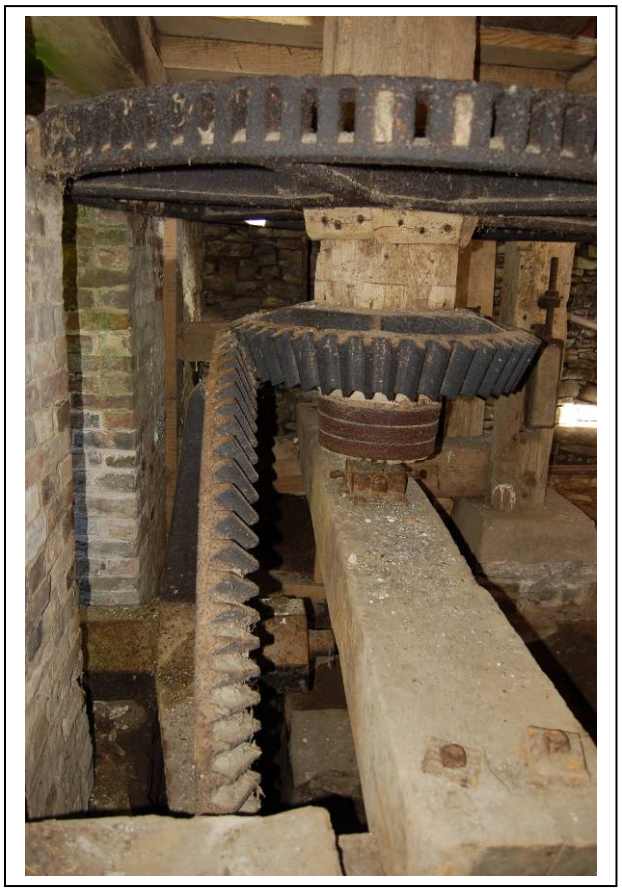

Plate 18: Pit wheel, wallower and spur wheel north facing

Plate 19: Wallower, detail

Plate 20: Spur wheel, west facing

Plate 21: Stone nut, connecting to spur wheel, south-west facing

Plate 22: Bedstone, with mortar adhering

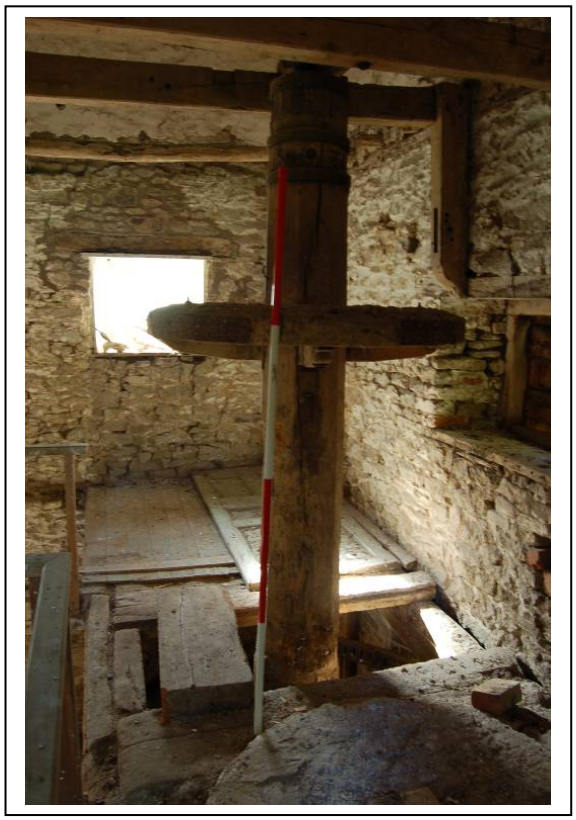

Plate 23: Bedstone, and main shaft, south-west facing

Plate 24: Crown wheel, detail

Plate 25: Crown wheel, main axle and sack hoist mechanism

Plate 26: Trench 1, excavation of wheel pit, west facing

Plate 27: Trench 1, excavation of wheel pit, south-east facing

Plate 28: Trench 1, Bench detail

Plate 29: Trench 2, Launder Arch

Plate 30: Trench 3, weir/ bridge, south facing elevation

Plate 31: Trench 4, weir/ bridge, north facing elevation

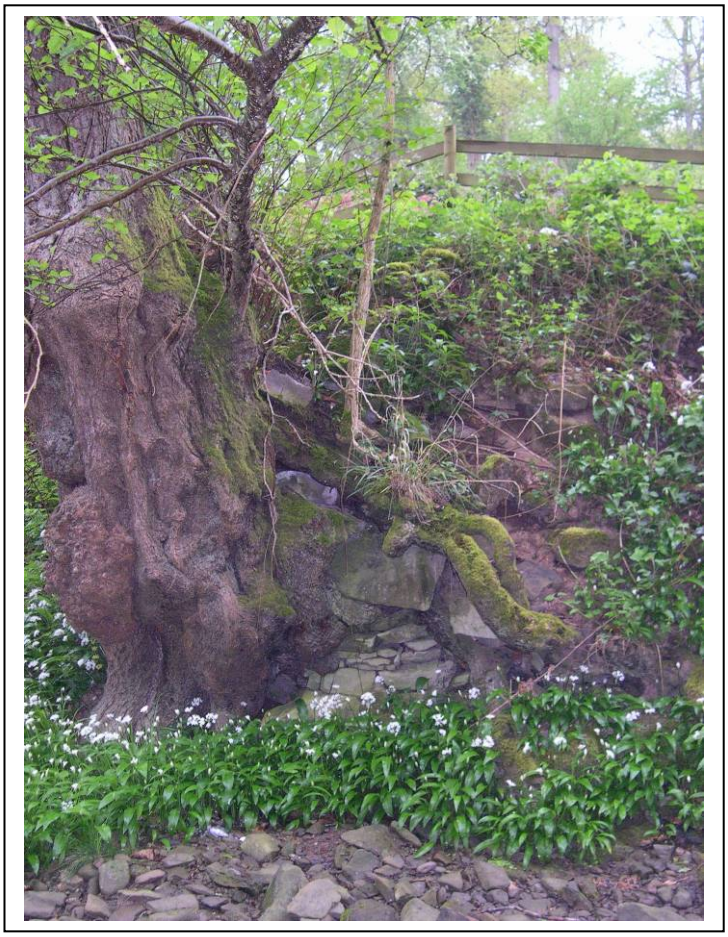

Plate 32: Weir, as seen from Dowles Brook, post-2007 flood, west facing

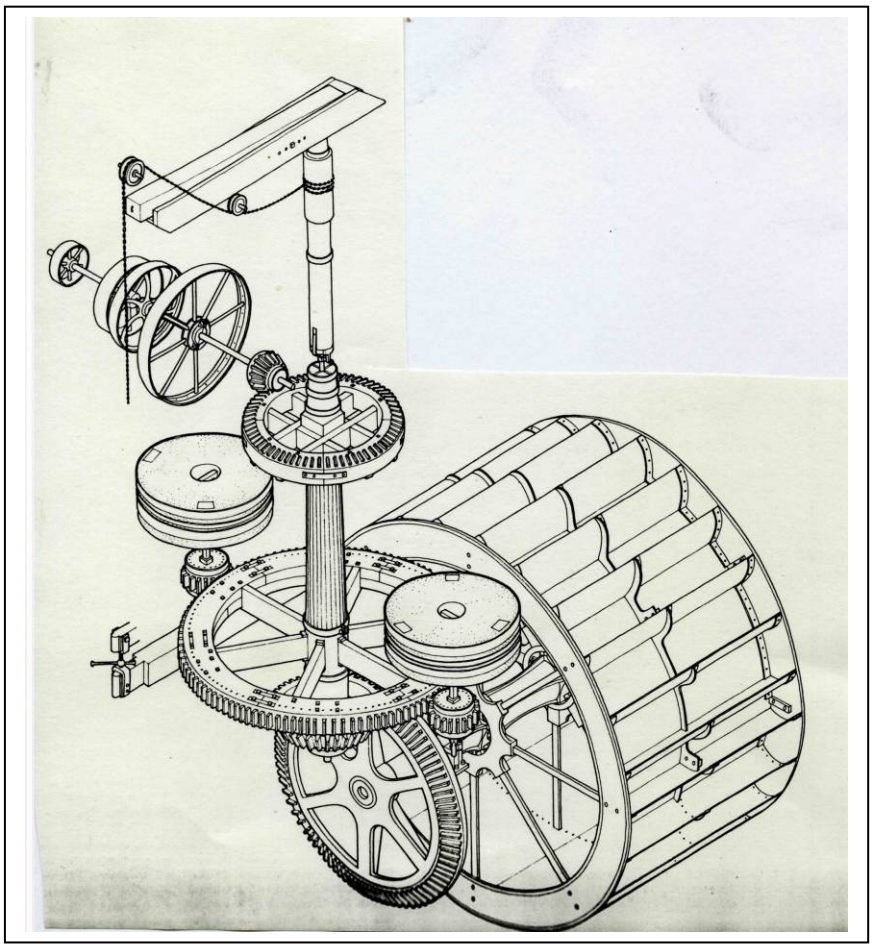

Plate 33: Mechanism of the Abbotstone Mill, Hampshire