Historic England

Mills

Introductions to Heritage Assets

Summary

Historic England's Introductions to Heritage Assets (IHAs) are accessible, authoritative, illustrated summaries of what we know about specific types of archaeological site, building, landscape or marine asset. Typically they deal with subjects which have previously lacked such a published summary, either because the literature is dauntingly voluminous, or alternatively where little has been written. Most often it is the latter, and many IHAs bring understanding of site or building types which are neglected or little understood.

This IHA provides an introduction to mills, the two main types are defined by their power sources; water and wind. Watermills were simpler to construct than windmills and were developed at an earlier date. This guide deals only with the archaeological evidence for mills. Mills that remain as standing buildings, normally designated as listed buildings, are treated in the Industrial Buildings selection guide. Descriptions of watermills and windmills and their development and a brief chronology are included. There does not appear to be a common factor among the associations of the few known Romano-British watermills. Anglo-Saxon watermills were frequently associated with high status sites. Medieval watermills were associated with a wide range of contemporary sites. Windmills, like watermills, needed good road access. A list of in-depth sources on the topic is suggested for further reading.

Front cover
Helsington Snuff Mill, Cumbria. Waterwheels could power a wide range of machinery. A vertical shaft can be seen in the centre of the room running up, from gearing below, to horizontal overhead shafts, from which belts powered various machines.

Introduction

The two main types of mills are defined by their power sources; water and wind. Watermills were simpler to construct than windmills and were developed at an earlier date.

Watermills

A watermill is a building housing machinery dedicated to a particular purpose, such as grinding grain, that was powered by a wheel turned by moving water, usually with associated water management features. They represent one of the earliest forms of non-animal power and remained commonplace well into the 19th century. Watermills have been classified both by their morphology - for example horizontal mills (also known as Greek or Norse mills), vertical mills (also known as Roman mills), and tide/sea mills- and by function (corn-, fulling- and hammer-mills amongst many others).

Examples of watermills are known from the Romano-British period onwards. Five sites with Romano-British watermills have been identified (see below) and many others have been inferred from evidence such as artificial channels, building locations or indicative finds such as iron spindles. The majority (about 60) have been suggested by the discovery of millstone fragments. These sites are all on rivers with the exception of a possible tide-mill excavated at Rustington in West Sussex.

At least nine Anglo-Saxon sites, dated from the late 7th century onwards, are known from archaeological excavation, and about another 50 are known from charter references. Again these are predominantly riverine, although a major and perhaps royal tidal mill of the late 7th century was discovered at Northfleet (Kent) in 2002 during works on the Channel Rail Link.

By the time of the Domesday Book (1086), which records over 5,000 watermills (some clearly long-established), almost all communities had easy access to one. Most lay in river valleys. High numbers occurred in Norfolk, Suffolk, the Cotswolds and Dorset and low numbers in the Fens, Somerset Levels, Weald, western Devon/ Cornwall and on large rivers, such as the lower Thames, Severn and Trent. This pattern was probably due to variations in terrain, population, local traditions and vagaries of recording.

Although most watermills occurred singly or in pairs, there were clusters of up to 15. The number of mills increased rapidly in the medieval period, probably doubling between 1086 and 1300 (though by this period some would have been windmills). After this the number of grain mills declined slowly as mills took on industrial functions, mainly fulling which was concentrated in the west and north of England and absent from much of the east.

Later, in the post-medieval period, some areas saw intensified production and a focus on particular industries such as cloth manufacture in the north-west, paper in the south-east, and ore-dressing in mining areas. Excluded from this description are watermills that remain as standing buildings; normally designated as listed buildings; these are treated in the Industrial Buildings selection guide.

Windmills

Windmills were introduced to England in the mid- to late 12th century. They facilitated grain processing in areas where the water supply was inadequate or unreliable. Medieval windmills were post-mills, where the millstones and gearing were accommodated in a hut-like shelter which was set on, and rotated about, a substantial post, allowing the whole mill (in these early examples the sails may only have been 2 m long) to be turned into the wind. Smock mills were introduced in the later 16th century, and more substantial tower mills of stone and brick appeared later. This guide deals only with the archaeological evidence for medieval and early post-medieval post-mills. Windmills that remain as standing buildings, normally designated as listed buildings, are treated in the Industrial Buildings selection guide.

1 Description

Watermills

Many mills were situated on a millstream or leat, an artificial channel that allowed the flow of water that drove the mill to be managed (Figure 1A). In other cases the mill stood on a natural watercourse, modified with a dam and a bypass channel (Figure 1B). Sometimes a weir was constructed to direct water into the mill race/bypass channel. The millstream had three parts: the millrace above the mill, the wheel-race flowing past it, and the tailrace below.
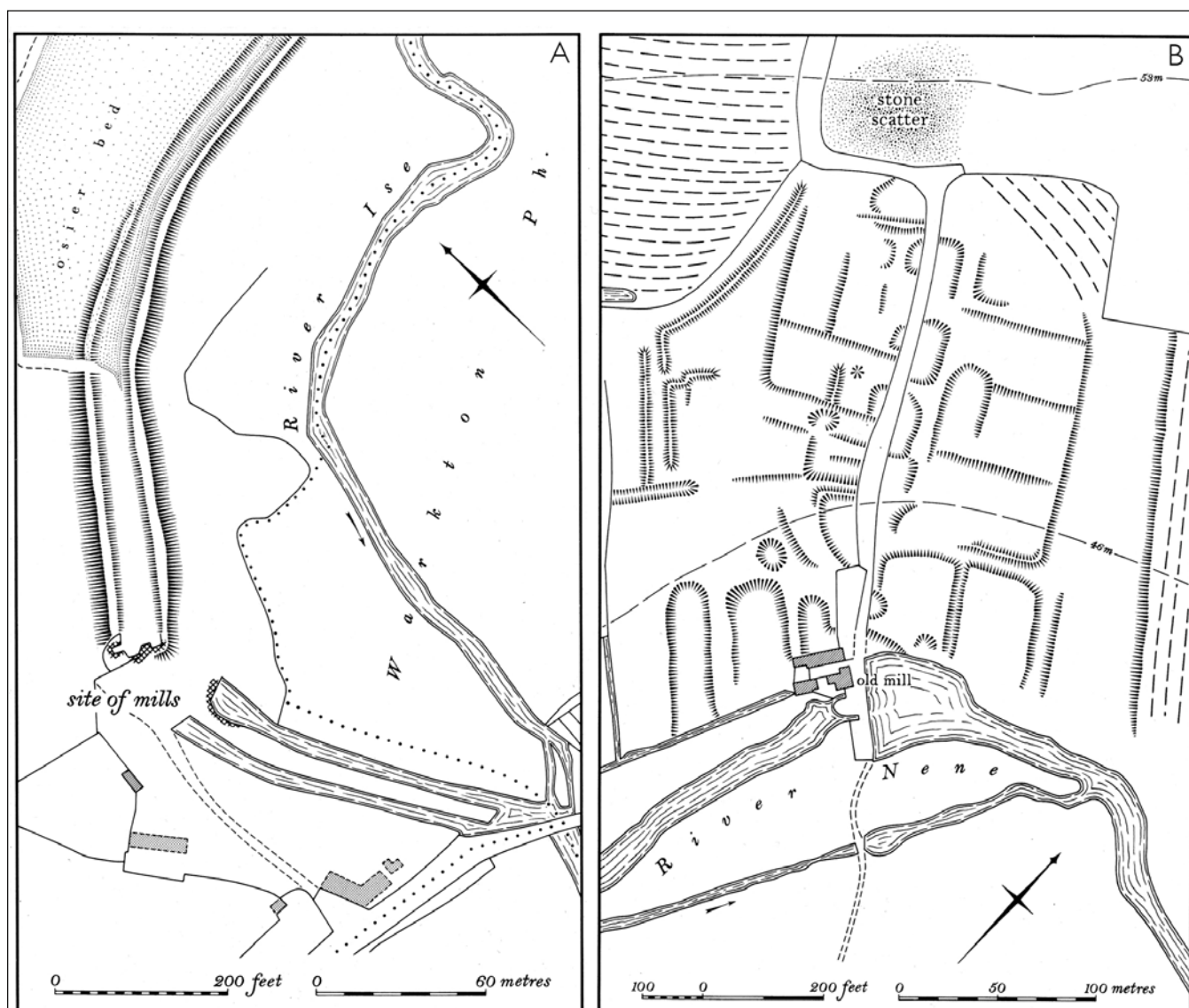

Figure 1
Watermill earthworks: A) Weekley: artificial millstream – the millrace enters from the top of the plan, the tailrace rejoins the river at bottom right; B) Earls Barton: dammed natural watercourse; the bypass channel leaves the river to the left of the plan, rejoins it to the right.

Figure 2
The tide mill at Thorrington, Essex at low tide. The mill is the white building top centre and the wheel race can be seen below its gable end (the wheel can just be made out). Its dam extends towards the bottom left retaining the mill pond to the left and the tidal creek can be seen to the right running to the bottom of the picture.
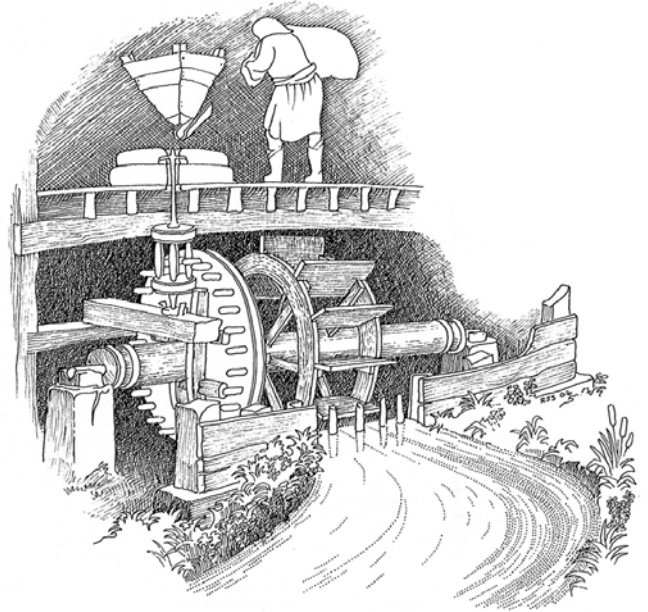

Figure 4
Fullerton Romano-British mill, reconstruction by Bob Spain. This was a simple form of undershot vertical wheeled mill where the water ran under the waterwheel.

Figure 3
Horizontal mill: reconstruction based on a post-medieval example from Lewis, Hebrides.

Figure 5
An unidentified mill with an overshot waterwheel. Water ran onto the top of the wheel which rotated clockwise.

Figure 6
Interior of the former grind mill in the Hook Norton Brewery, Oxfordshire. The millstones, protected by a wooden 'tun', were turned by a shaft from below (see) and fed via the hopper from the floor above.

Figure 7
Early modern mill gearing, Narborough Mill, Norfolk. The waterwheel can be seen through the large vertical gear which it turned directly. The rotation was then transferred through 90° by the small gear and a shaft ran up to the room above to turn a millstone.

Millraces varied from less than a metre wide and a few metres long to over 10 m wide, several metres deep and a kilometre or more in length. The millrace often fed a millpond, and one of the commonest surviving features is the dam built to retain such, the size of the pond and dam varying with the topography and the size of the mill to be powered.

The water then passed into the wheel-race, which was frequently lined with timber or stone, and later brick, where it was directed onto the waterwheel(s). Sometimes there was a bypass channel to carry water when the mill was not in use.

Once the water had passed the wheel it was directed back to the watercourse via the tailrace, which was generally shorter than the millrace. Sometimes there was a millpond below the mill

Figure 8
Helsington Snuff Mill, Cumbria. Waterwheels could power a wide range of machinery. A vertical shaft can be seen in the centre of the room running up, from gearing below, to horizontal overhead shafts, from which belts powered various machines.

Figure 9
Interior view of waterwheel and stamps, Tolgus Tin Streaming Works, Cornwall. Here the waterwheel powered trip hammers. The trips can be seen on the horizontal drum to the right and the vertical hammers behind were used to crush ore.

that would retain water and so even out the flow downstream when the mill was operating.

Tide-mills were a distinct type of watermill, set on the coast, where the head of water was created by allowing seawater through sluice-gates in a dam on the flow-tide and retaining it on the ebb (Figure 2). Other than replacing the millstream with a dam the rest of the technology used would be similar. Tide

mills are known and suspected from documentary evidence and at least one possible Romano-British example has been excavated.

As noted above, watermills may be classified on the basis of the type of waterwheel used: horizontal (Figure 3); or vertical, which might be undershot (Figure 4), overshot (Figure 5) or breast-shot where the water was delivered half-way up the wheel. Horizontal wheels were relatively small; the Anglo-Saxon example from Tamworth (Staffordshire) was 1.2 m in diameter. Vertical wheels were generally larger; a typical small waterwheel might measure 2.5 m in diameter, larger examples perhaps 4 – 6 m.

Vertical wheels were usually accommodated in a wheel-pit; this was typically the lowest point of the mill, and therefore the part most likely to survive even if the rest of the building was demolished or collapsed.

The majority of early watermills were used to grind corn using millstones (Figure 6). In horizontal mills – the simplest technology – the mill wheel was connected directly to and drove the millstone above it, whereas in vertical mills the rotation was transferred though 90 degrees by gears (Figure 7).

In some large industrial complexes the power generated by the wheel was transferred by belts and shafts to drive a range of machines (Figure 8). Some industrial processes, such as fulling, stamping and forging, required vertical forces. In these, cams (lugs) projecting from the axle of the water wheel raised and released drop or tilt-hammers (Figure 9). The milling machinery was located within a mill-house, which generally reflected the local vernacular style and varied widely in size (compare Figures 5 and 10).

Romano-British watermills were probably confined to milling corn, although the suggestion has been made that some may have

powered ore crushers. Medieval watermills also primarily ground corn, but from around the 12th century they were also used for industrial purposes, mainly fulling cloth, iron-working and bark-crushing. The range of industrial activities expanded in the post-medieval and industrial periods.

Windmills

Like modern wind turbines, windmills had to be set on high ground to maximise their ability to catch the wind – while at the same time remaining accessible to carts and packhorses bringing grain for milling or collecting flour.

Some stood on bare hills (Windmill Hill is a frequent place-name), others on high ground within a village's fields; Laxton, in Nottinghamshire, is a good example of such a location (although the mill is no longer standing, having blown down in 1919). Often a suitable site was occupied over the centuries by successive mills, and there may be archaeological evidence for this.

Post-mills were inherently unstable, with an above ground structure with sails, designed to catch the wind, supported on a single post. Accordingly it was essential that the post was as securely founded as possible. The usual solution was to set it in a massive pair of cross-beams (the cross-tree), themselves sunk in deep foundation trenches, sometimes stone-lined. Additional rigidity was sometimes provided by covering the foundations with a low mound. These mill mounds generally remain after the mill itself has gone; while they can be confused with other mounded monument types like barrows, their true character is often revealed by shallow cross-trenches on the top of the mound, the result either of the cross-tree being removed for re-use or being left to rot in-situ.

2 Chronology

Watermills

The earliest watermills date to the Romano-British period. There then appears to have been a hiatus; the earliest known Anglo-Saxon mills have been dated to about AD 700. The Domesday Book (1086) documents some 5,624 watermills, some known to have had their origins in the centuries before the Norman Conquest, others already derelict.

Watermills were used throughout the medieval period and into the early 20th century; many underwent several phases of reconstruction and were in use for centuries - a few survive in use today - though others had shorter lives. They frequently changed functions and some had four or more distinct roles; while each of these required an internal refit, the water management works probably needed little if any modification. In the industrial period many waterwheels were replaced by steam-engines, or later by internal-combustion engines and electric motors, often utilising the same buildings.

A chronological development from horizontal to vertical wheels has been suggested but this is unlikely to be the case. The known Romano-British wheels were all vertical, and although most early Anglo-Saxon examples were horizontal, one of the earliest known examples, at Old Windsor (Berkshire), was vertical. It is not known how many of the mills mentioned in the Domesday Book were horizontal but by the 13th century they had apparently disappeared from England (although 'Norse' mills continued in use in the Shetlands into the 20th century).

Windmills

The precise date of windmills' introduction to England is uncertain, and in the past claims for an early date have been advanced on the basis of extremely weak documentary evidence. The first certain mention is believed to be of a post-mill at Weedly, near South Cave in East Yorkshire, in 1185. This was on an estate owned by the Knights Templar, and some favour the idea that windmills were introduced to England by Crusaders who had seen them in the Middle East – even if there is scant evidence for early windmills there!

TIMELINE
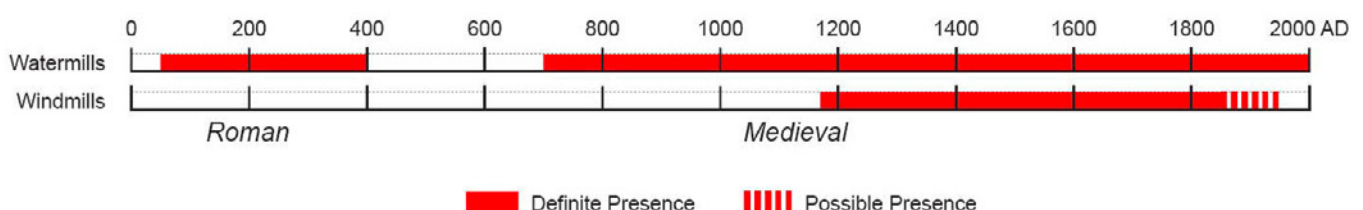
3 Development of the Asset Type

Watermills

Archaeologically, watermills of all periods share certain characteristics including earthworks of the water supply and control system, the mill-house structure, and sub-surface remains. The majority of known medieval and earlier watermills survive only as earthworks and buried features; the survival of standing buildings becomes increasingly common from the late medieval period onwards. Watermill sites have been identified by all the main approaches to archaeological and historical investigation including aerial photography, geophysics, topographic survey, excavation, place- and field-name studies, and documentary and cartographic research.

The fills of the millstream are potentially key contexts, which because they are prone to waterlogging can preserve environmental evidence and timbers which can reveal the nature and date of the building, the latter via radiocarbon dating or dendro-chronology, and evidence of woodland management and carpentry techniques. The make-up of dams, embankments and building platforms are also important, revealing the site's constructional history (at Wharram Percy, Yorkshire, the former mill dam was massively raised when the millpond was converted to a fishpond) and sometimes preserving buried land surfaces.

On the surface, Romano-British watermills are virtually indistinguishable from later examples, and dating sites evidenced by earthworks is often problematic without excavation. The quality of earthworks is generally poor and typically only the millrace remains, although buildings have been excavated at a few sites. Evidence for chronological development was seen at Ickham (Kent) and Fullerton (Hampshire); both had two distinct mill buildings separated chronologically and spatially. They all had small undershot vertical wheels housed in light structures that showed some development over time. The limited number of known examples precludes generalisations however.

Early Anglo-Saxon mills were quite small, constructed almost entirely of wood, and lacked large-scale associated earthworks. Consequently, they have only been discovered by chance and investigated by excavation. Again, not enough examples are known to make generalisations about their development.

Medieval and later watermills have primarily been studied historically. The Domesday Book details the approximate location and value of over 5,600 mills. Later, especially from the 13th century when written record keeping became the norm, documents provide information on matters such as ownership, tenure, function, and repairs. Especially numerous are the disputes over the use of water.

Medieval manuscripts include some early pictorial representations of mills, and from the late Middle Ages estate maps show numerous examples. Sometimes sufficient detail is shown to allow some understanding of how the mill

was functioning, and its type. Relatively few excavations have been carried out of medieval watermills. Of those that have, waterlogging has sometimes preserved parts of timber structures and waterwheels, but few investigations have discovered much about the actual mill machinery.

Windmills

Several mill mounds have been excavated to modern standards, such as the 13th century example from Great Linford (Buckinghamshire). Martin Watts's *The Archaeology of Mills and Milling* (2002) provides a useful illustrated summary.

4 Associations

Watermills

There does not appear to be a common factor among the associations of the few known Romano-British watermills. It is likely though, that their spatial associations will be functional with the mill being located close to the grain producer and where possible, the consumer or distributor, with good access to communication routes.

The watermills at Fullerton and Ickham were closely associated with villa complexes, and Ickham with a road. That at Haltwhistle Burn Head (Northumberland) was almost certainly a military installation. None are known from urban contexts.

Anglo-Saxon watermills were frequently associated with high status sites: Tamworth was a major Mercian royal centre, so too perhaps Ebbsfleet, while Wareham (Dorset) and Barking

Figure 10
The 16th/17th century (with some 19th century additions) Mapledurham Mill, Oxfordshire. A large mill with two waterwheels and a typical arrangement of; lower floor containing the machinery, middle floor where the grain was milled and upper floor for storage.

(Essex) were near minsters. The status of Old Windsor is uncertain; it was probably a royal centre by the later Anglo-Saxon period but may have been a minster. The associations of Corbridge (Northumberland) are unknown.

Medieval watermills were associated with a wide range of contemporary sites. Many were fairly isolated as they were sited on the most suitable watercourse on an estate or manor, although they needed good communications for the transportation of grain and flour with roads, bridges and fords. However, if a convenient stream did allow a mill to be located close to barns and granary (as at the Templar preceptory at South Witham, Lincolnshire) that was obviously advantageous.

Many millers developed sidelines leading to an association with bakehouses, or brewhouses, for example. Since mills could be used for other purposes they might also be associated with sites such as ironworks and tile kilns. Millponds were sometimes used as fishponds.

Windmills

As already noted, like watermills, windmills needed good road access. With watermills, it was commonplace for the miller to live at, or close to, the mill, in what was usually termed a mill house. This was less common with windmills, presumably because many stood on isolated, windy, high ground.

5 Further Reading

For a detailed overview see M Watts, *The Archaeology of Mills and Milling* (2002), while the same author offers brisker treatments in *Watermills* (2006) and *Windmills* (2006).

Two good overviews of the medieval period are Richard Holt, *The Mills of Medieval England* (1988) and John Langdon*, Mills in the Medieval Economy: England, 1300-1540* (2004).

The most accessible summary for the post-medieval period is in David Crossley, *Post-Medieval Archaeology in Britain* (1990), pages 137-52.

The best recently excavated examples of Romano-British watermills are Fullerton: B Cunliffe and C Poole, *The Danebury Environs Roman Programme: A Wessex Landscape During the Roman Era. Volume 2 – Part 3. Fullerton, Hants, 2000 and 2001* (2008),

pages 73-100, 124-30, 165-7; and Ickham: Paul Bennett and others, *The Roman Watermills and Settlement at Ickham, Kent* (2010).

The classic example of an Anglo–Saxon water mill is Tamworth: Philip Rahtz and Bob Meeson (eds), *An Anglo- Saxon Watermill at Tamworth: Excavations in the Bolebridge Street area of Tamworth, Staffordshire, in 1971 and 1978* (1992).

The astonishing Anglo-Saxon mill at Northfleet is reported by P Andrews, E Biddulph and A Hardy in *Settling the Ebbsfleet Valley: CTRL Excavations at Springhead and Northfleet, Kent: The Late Iron Age, Roman, Saxon, and Medieval Landscape, Vol 1: The Sites* (2011). https://www.wessexarch.co.uk/our-work/settling-ebbsfleet-valley

A useful web site for all things mill related is https://millsarchive.org

6 Where to Get Advice

If you would like to contact the Listing Team in one of our regional offices, please email: customers@HistoricEngland.org.uk noting the subject of your query, or call or write to the local team at:

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7 Acknowledgments

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