



Historic England

Water Meadows

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 water meadows (areas of grassland alongside a river or stream irrigated to produce plentiful hay crops and rich pasture). A brief chronology is included along with descriptions of the asset type and its associations. Sections on dating water meadows, and water meadows today follow. A list of in-depth sources on the topic is suggested for further reading.

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Front cover

Water meadows at Alderbury on the River Avon, south of Salisbury (Wiltshire). They were part of an extensive (250 a) and well-documented system constructed along a four-mile stretch of the river between 1665 and 1690. The scheme was financed by Sir Joseph Ashe (a wealthy cloth merchant) and constructed by his steward, John Snow.

Introduction

Water meadows were areas of grassland alongside a river or stream irrigated to produce plentiful hay crops and rich pasture. Precisely engineered channels were dug so that a thin sheet of water flowed steadily across the meadows for set periods of time at prescribed seasons of the year. Water meadow operation, a practice known as ‘floating’ or ‘drowning’, involved skilled management which was often carried out by professionals known as ‘drowners’, ‘meadmen’ or ‘watermen’.

Floating deposited nutrient-laden silt and oxidised the soil. In winter, it provided the additional benefit of reducing the effects of frost and raising the soil temperature to produce an

‘early bite’ of grass for sheep flocks weeks before other pastures were ready. Floating in summer raised moisture levels in the meadows, which increased the hay crop.



Figure 1
Water meadow earthworks on the River Lugg,
Herefordshire, picked out by floodwater.

1 Chronology

Most pre-17th century irrigation in England appears to have been by a simple process known as '*floating upwards*', which involved blocking a watercourse, causing it to overflow and flood the surrounding farmland. This method was used from at least the medieval period and, despite being condemned as 'ancient', continued to be used in some areas of England until the 18th century.

In the 18th century Dutch engineers introduced a further variety of floating upwards, known as '*warping*'. This practice, used particularly in the Fenlands, involved impounding seasonal tidal water and running it over farmland. Floating upwards deposited beneficial silt and provided some frost protection, but if water failed to drain off quickly it could create anaerobic and toxic conditions which would damage the grass.

To offset problems with water-logging, more sophisticated '*floating downwards*' systems were developed, which produced a constant movement of water through the grass sward, and enabled strict control of the flow of water on and off the meadows. Two main forms of floating downwards were used: '*catchworks*' and '*bedworks*', each suited to different topography.

Catchworks have been found all over Europe and field names such as 'Waterleets', and 'Le Flodgatededewe' recorded during the 13th to 16th centuries suggest they were used in England during the medieval period. There is a possible 12th century example at Rievaulx Abbey, Yorkshire. By the early 17th century catchworks were well established in upland parts of south-west England, becoming a particular feature of areas such as Exmoor, and they became more widespread during the later 17th and 18th centuries.

Bedworks, the most sophisticated type of water meadow, appear for the first time in the 17th century as fully fledged systems. They were once believed to have been invented by Rowland Vaughan, a Herefordshire landowner who, in 1610, described irrigation systems which he had created on his farm at Turnastone Court. However, any potential surviving remains of his irrigation system are quite unlike typical bedworks.

Better evidence for early bedworks comes from Affpuddle, in Dorset, where the Manorial Court Book makes reference to ditches and channels, believed to have been bedworks, constructed in the meadows along the River Piddle in 1605. From the 17th century onwards bedworks were created in large numbers, beginning in the chalkland areas of Hampshire, Dorset and Wiltshire, and spreading during the 17th and 18th centuries to adjacent parts of Gloucestershire, Berkshire, Surrey and West Sussex. By the 1790s there were an estimated 15,000 to 20,000 acres of water meadow in Wiltshire alone.

The Agricultural Revolution saw English wetlands turned into productive fields and pastures. As food prices rose dramatically during the Napoleonic Wars of 1803-1815, more landowners and farmers invested in catchworks and bedworks. As the 19th century progressed they became a fashionable form of agricultural '*improvement*', with some landowners offering prizes for their creation and providing raw materials to encourage their tenants to construct them.

Throughout the late 18th and 19th centuries they were promoted by agricultural improvers such as George Boswell (*A Treatise on Watering Meadows* 1779), Thomas Wright (*An Account of the Advantages of Watering Meadows by Art*, 1789), William Smith (*Observations on the Utility*,

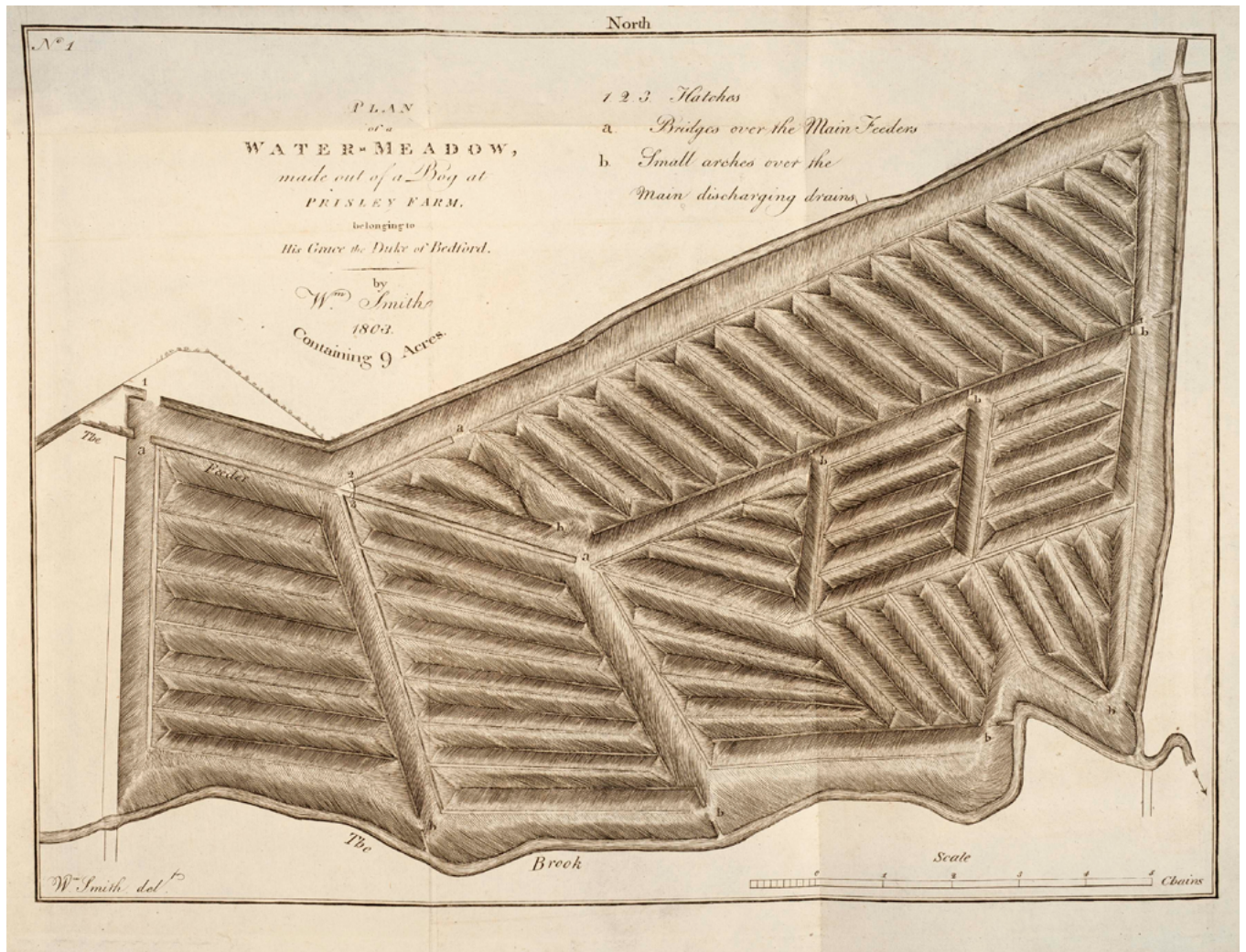


Figure 2
At Prisley Farm, Bedfordshire, William Smith worked for the Duke of Bedford, transforming boggy ground into water meadows.

Form and Management of Water Meadows and the Drowning of Peat Bogs with an account of Prisley Bog, 1806), James Loch (*An Account of the Improvements on the Estates of the Marquis of Stafford*, 1820), via papers in the *Royal Agricultural Society of England's Journal* and through various county surveys or 'General Views' produced for the newly-created Board of Agriculture during the 1790s and early 1800s (Figure 2). By 1850 water meadows had expanded beyond their heartland areas and in southern England extended to approximately 100,000 acres.

The Decline of Water Meadows

Water meadows fell out of use from the late 19th century onwards, following the onset of agricultural recession. During this period imports of cheap foreign grain began, fodder root crops and oil cake were introduced and new grass strains and artificial fertilisers were developed. Catchwork meadows became redundant, as hill pastures could be improved by reseeding and nitrogen application. Bedworks also declined as the sheep and corn farming system, of which they were an integral part, broke down in Wessex.

In addition to imported grain, improved transport links heralded an influx of refrigerated lamb from New Zealand which under-cut British meat prices. By the 1930s dairy cattle had replaced sheep on surviving bedwork meadows and the sale of milk, sent to towns by rail, kept many farmers in business. However, by the mid-20th century falling milk prices and a shortage of labour made the few surviving water meadows uneconomical to maintain and mechanisation was not a viable

option on soft, wet ground surfaces which could not bear the weight of modern machinery.

Between 1918 and 1960 almost all water meadows were abandoned and large numbers were subsequently leveled as their sites were put to new uses. In the 1950s and 1960s the Ministry of Agriculture, Fisheries and Food offered grants for leveling old water meadows as part of a wider drive for more efficient food production.

2 Description

The remains of 'floating upwards' systems are likely to consist of a dam or similar structure used to block a watercourse. Evidence for such systems is highly elusive.

The distinctive character of downward-floated water meadows lies in their patterns of drains and carriers. The layout of these varies depending on their period of construction, the land ownership or tenancy patterns and, most importantly, the topography.

Water meadows can also vary considerably in extent, from a few hectares to entire lengths of river floodplains, frequently occurring in groups where the topographical and geological conditions were most suitable. They contain little complex stratigraphy, so their archaeological integrity is maintained largely by the retention of visible features.

The simplest form of downward floated water meadow was the catchwork (also known as a 'catch meadow' or 'field gutter' system). Catchworks used spring water or hill-side streams to irrigate valley or hill slopes. If neither of these water sources was available rainwater and farmyard run-off was collected in a specially-constructed feeder pond. Water was diverted from the source into a contour-following ditch or 'gutter' which skirted the top of the meadow. When the gutter was blocked by 'stops' of turf, peat or logs, or by using more permanent sluices, water overflowed down the hillside and irrigated the area of meadow below. Further downslope, additional gutters parallel to the first caught the run-off and redistributed it in a similar manner to lower pastures. The process encouraged an even flow of water down the slope. At the base of the meadow surplus water was collected and carried away via a drain (Figures 3 and 4).

Bedworks were more complex systems used to irrigate relatively level ground on river floodplains. A weir or dam containing sluices was placed across a river allowing water to be diverted into a carrier channel known as a 'head main', which was frequently sited on the outside of a bend. A hatch was opened allowing water to flow into the head main and be carried through a network of progressively narrower and shallower channels, each carefully aligned according to the gradient of the meadow. Subsidiary hatches and turf 'stops' were used to keep fine control of the water which was distributed to selected areas as needed. It eventually entered tapering channels known as 'floats', running along the apexes of parallel ridges known as 'beds' and was made to overflow onto each part of the meadow in succession, running down the sides ('panes') of the ridges as a continuous moving film no more than 25 mm deep. Run-off was removed from the meadow via a network of drains between the ridges. The drains mirror the arrangement of the mains and floats, beginning as small gullies and becoming progressively larger as they lead to a single 'tail drain'.

Bedworks thus appear as prominent ridges with interlocking channels. The widths and heights of the ridges range considerably, from 3-15 m (commonly 5 m) wide and about 0.5-0.6 m high. They can resemble the plough ridges of former cultivation and recent research has indicated that some early ridge-and-furrow might have been re-employed for water meadows. However, the layout and form of the ridges, their location, and the presence of water control structures and additional channels all help to distinguish bedworks from ridge-and-furrow (Figure 5).

Very little research has been carried out to establish a national typology of water meadows, but field surveys have shed light on their regional



Figure 3

Catchwork meadows are evident today as parallel contour-following channels ('field gutters') on hill slopes, as seen here at Cloggs Farm, Somerset.

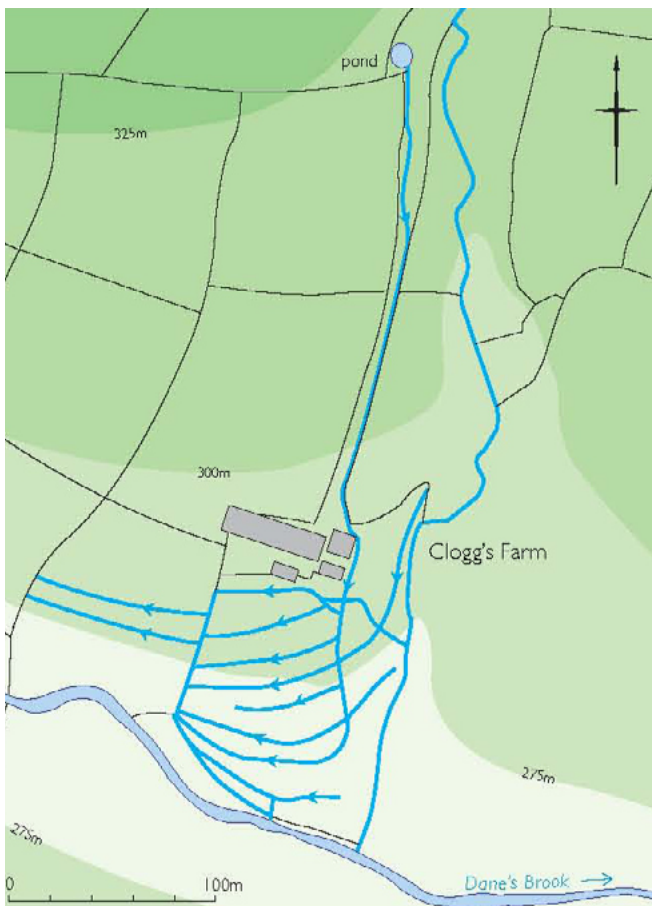


Figure 4

At Cloggs Farm water from a pond flowed into a leat which passed through the farm complex, driving a water wheel. This powered a threshing machine, a grinder, a chaff cutter, a shearing machine and a wood saw. The leat then passed through the farmyard, collecting slurry which it transported to the meadows via the 'field gutters' on the valley side to the south. Water was collected at the foot of the hill and drained back to a brook. The exact date of construction of this system is not known, but it may be contemporary with the farmstead which dates from at least 1688.



Figure 5
Reconstruction drawing showing a typical bedwork water meadow.

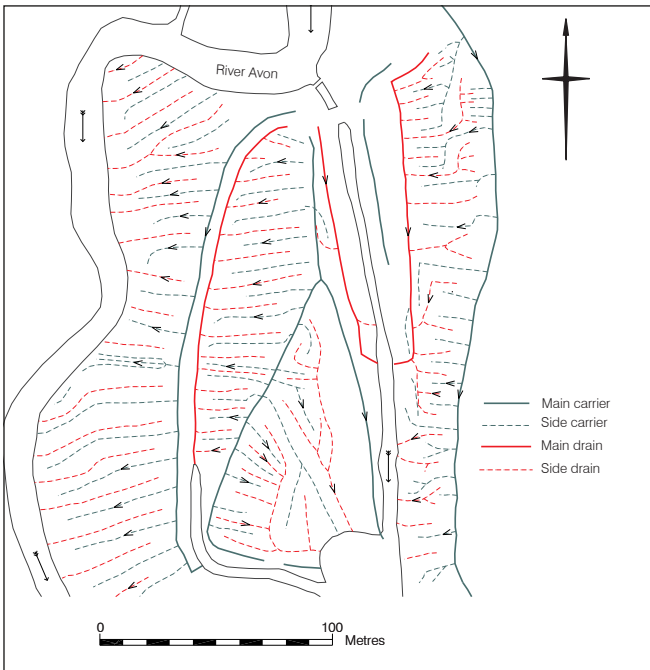


Figure 6
RCHME survey showing a bedwork layout of curved ridges perpendicular to a main carrier at Hindurrington, Wiltshire.

development. Work in Wiltshire by the Royal Commission on the Historical Monuments of England (RCHME) identified two main bedwork layouts: right-angled (Figure 6) or herringbone (Figure 7). Some systems were highly geometric with straight ridges and channels, while others were irregular with curved ridges.

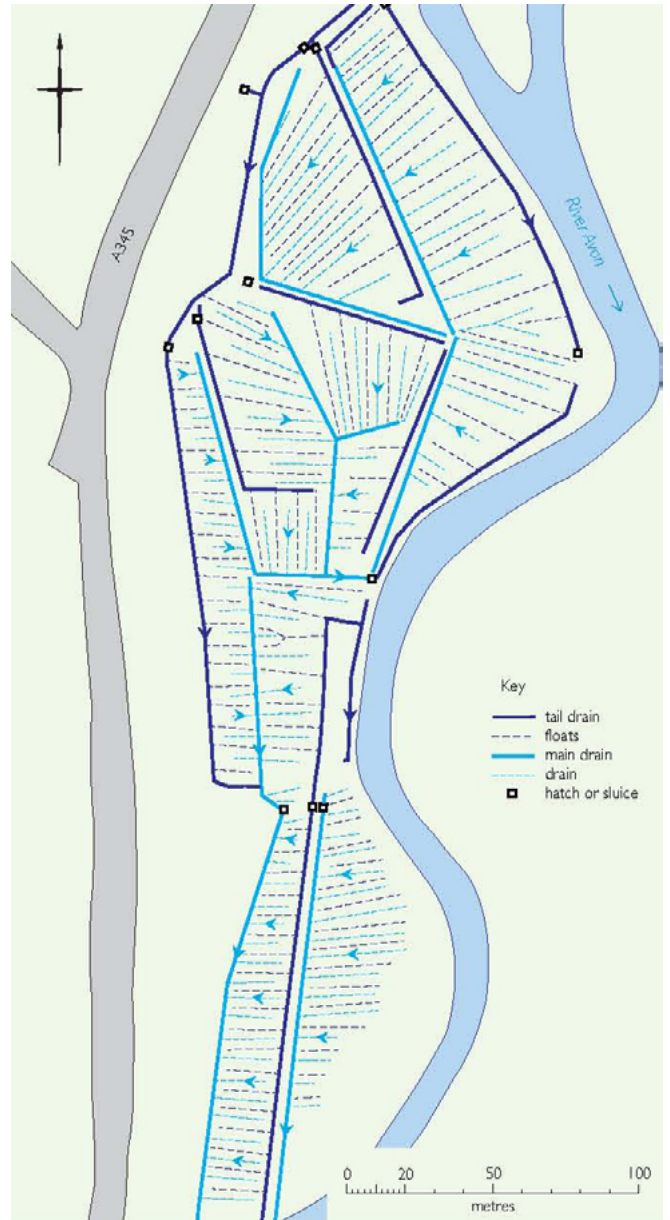


Figure 7
A herringbone bedwork layout, using straight ridges, surveyed by the RCHME at Compton, Wiltshire.

The profiles of bedwork ridges also varied, from high, rounded forms recorded in Wessex to broad, flat-topped forms with sharply-defined edges recorded in Norfolk. This difference may be attributed to variations in local topography and the amount of water available. Early 19th century farmers in Dorset, for example, complained that very wide ridges were too flat to provide an adequate flow of water across the meadows.

Built structures were common features of water meadows. Bridges provided access, while culverts took channels beneath roadways and aqueducts transported water to further areas of meadow.

Bedwork systems had a main weir or dam to divert water from the river or other source and subsidiary weirs and sluices (one-hatch weirs) on smaller carriers to ensure an even distribution of water. These structures came in a variety of materials depending on what was readily available at the time of their construction (Figure 8). Early hatches were simple boards which slotted vertically into wooden frames or stone settings and were raised by peg and hole arrangements (Figure 9). Later, materials such as brick and cement were used for hatch settings and their boards were fitted with iron ratchet and crowbar raising mechanisms. At the beginning of the 19th century cast iron weirs and hatches came into use. The majority of these structures are ruinous today, but collections of loose material near the banks of rivers or streams may indicate their former sites or the presence of buried examples.



Figure 8
A restored water meadow hatch in use today at Harnham, Wiltshire.



Figure 9
A drowner at work on a seven-hatch weir at Lower Farm, Britford, near Salisbury, in 1954.

3 Distribution

Water meadows were created anywhere where conditions were suitable and their remains were distributed widely across England. They were more prolific in some areas than others, depending on the local topography, agricultural system or the former presence of large estates owned by 18th and 19th century agricultural improvers.

As catchworks used sloping ground and were relatively cheap to construct and operate without employing professional drowners, they were popular with hill farmers in Devon, Somerset and the Welsh Marches by the mid-18th century. The improvements catchworks made to hill pastures were dramatic. They transported lime and animal dung to pastures by 'flush' irrigation episodes, treating the grass sward with suspended nutrients – a process known as 'washing in', whereby dung and lime was mixed into the water. The flow of water also improved the soil through oxygenation and broadleaved grasses flourished at the expense of coarser species. A late form of catchwork widespread in Britain from the mid-18th century was sewage irrigation, in which urban sewage was passed along drains to catchwork systems or carted to farms and mixed with head main water.

Catchwork remains are a particular feature of Exmoor, where agricultural improvements promoted by large estates meant that most farms possessed a system during the 19th century. Farmsteads built by the Knight family for tenant farmers from 1815 onwards were all provided with gutters which passed through farmyards or byres, transporting dung and urine mixed with water onto the meadows.

Bedwork remains are found alongside main rivers, tributaries, minor streams and brooks, sometimes clustering at confluences where most water was available and floodplains were widest. Large numbers are associated with chalkland rivers of southern England which provided a reliable flow of water at a constant temperature and good subsoil drainage.

Bedworks were an essential component of the 'sheep and corn' economy of Wiltshire, Dorset and Hampshire for over 400 years. Sheep grazed on the meadows during the day and were moved to unsown arable fields to enrich the soil with their dung each evening (Figure 10). Before the introduction of water meadows, the size of sheep flocks was limited by the amount of food available to sustain stock through the winter, particularly during the 'hungry gap' in March and April when hay supplies were low and grass had not yet grown. Water meadows promoted grass growth several weeks before natural grazing became available and increased the summer hay crop. This meant that larger sheep flocks could be kept, more manure was produced and arable cultivation could be extended to grow more corn.

Although expensive to construct and maintain, bedworks became so profitable that, by the 18th century, they occupied almost every significant floodplain in the region. They commonly doubled the value of meadow land and could increase its value by as much as sixty times its unimproved price.



Figure 10

In 'sheep and corn' areas sheep were moved from water meadows to unsown arable fields each evening. This photograph shows the evening procession of sheep from water meadows by the River Kennet, near Marlborough.

Both catchworks and bedworks were used in other areas of England with varying degrees of success. In addition to the core areas of Wessex and the south-western hills, they have been recorded in many Midland counties, the Welsh Marches and East Anglia. They were adapted to difficult topography, such as the narrow upper valley of the River Wey in Hampshire, where contour-following carrier channels were used to raise water above the river level, aqueducts by-passed bottlenecks in the valley and both the valley sides and the narrow valley floor were irrigated using combinations of catchworks and bedworks.

Nineteenth century commentators unanimously state that water meadows were virtually unknown in northern and eastern England. While it is true that the cold and dry climate, poor-draining soils and gentle gradients of the rivers in eastern England made it less favourable for water meadows, they were adopted sparingly during the 17th and 18th centuries, and in the early 19th century systems managed along Wessex lines were introduced to improve the hay crop.

Hay and haymaking

Hay is dried grass, and until artificial feedstuffs and root crops became widely available in the 19th century, it was the principal winter feed for farm animals – without it draught animals and breeding stock could not be kept alive and in good condition through until spring. For livestock farmers, in particular, securing an adequate reserve of good quality hay was the principal summer task.

While hay was made in many fields, generally speaking the best grass for hay was that grown in waterside meadows, especially carefully-managed water meadows. The grass was tall, lush and rich in nutrients. Experienced farmers were able to judge when it was ready to be cut, and when a spell of good, sunny, haymaking weather seemed likely: make hay while the sun shines, as the old proverb has it. Typically this was in later June or July.

It was essential to get the grass cut and dried – turned into hay – as quickly as possible, to reduce its moisture content from about 75 per cent to 15 per cent. The longer it took to dry (for instance if unexpected rain came) the poorer was its quality and nutritional value. Thus – especially until haymaking started to be mechanised in the mid-19th century – as large a labour force as possible would be assembled, often a mixture of the farmer's family, tenants and hired hands. Typically these worked from dawn until dusk, kept going with copious amounts of beer or cider.

Working in a line, haymakers moved methodically across the meadow, cutting the lush grass with long-bladed scythes, which would be kept razor-shape with whetstones. This process left the cut grass in lines, and women and children would use pitchforks and rakes to turn and fluff the grass in these 'windrows' to speed even drying. Typically this would take a couple of days, and overnight the hay would be raked into heaps – haycocks – to minimise any damage by rain or heavy dew. In the morning the cocks would be opened up, and the turning resumed (Figure 11).



Figure 11

Haymaking at Byfield (Northamptonshire) around the time of the First World War. The dried hay, lying in windrows, is being loaded onto wagons; one has an almost full load; the next waits to the right. On the left is a horse-drawn hay rake, used to scrape up the scattered remnants of the valuable crop.

As soon as the hay was dry it was pitched onto haywains – capacious wagons with high sides – and carted to where it was to be stored. Some would immediately be pitched into the lofts of stables or into well-ventilated barns. The rest would be made into hayricks, normally to one side of the farmyard. Like a house, these ricks had pitched tops which, once the hay had settled over

a few weeks, were thatched with straw to keep out the weather. Come winter, a large-bladed knife was used to cut blocks of the compressed hay. This was fed to stock, either in the barn or shed or in the field. Sometimes a second cut of hay was taken from water meadows a few weeks after the first, although this grass was probably less nutritious.

4 Dating Water Meadows

A detailed complementary approach using documentary records, structural dating and field survey is likely to provide the most useful information about the origins of a water meadow system. Nineteenth century Ordnance Survey 25" maps, or earlier estate maps, may show the layout of major channels and the positions of sluices. Historic aerial photographs frequently capture water meadows as they existed in the 20th century, while documents such as estate accounts, water abstraction agreements or records of disputes may provide clues to dates of construction and periods of use.

Landscape study may also reveal relationships between water meadows and other features in the landscape, providing relative dates for a water meadow's period of use. For example, meadows at Britford, Wiltshire, and Dilham, Norfolk, run off the Avon Navigation (constructed 1675-1730) and the Ant Navigation (constructed 1825) respectively and so cannot pre-date these features. Similarly, truncation of water meadows by later developments such as railway lines, roads and urban expansion provides cut-off dates for their abandonment.

Built structures provide further clues, although many will have replaced earlier structures and so indicate the later stages of a water meadow's period of use. It is possible to estimate the date of bricks by their size, shape or maker's marks, to recognise 19th century concrete and to identify the sources of stone used. The presence of hatch settings and bridges of rough-hewn stone blocks may indicate an early water meadow, constructed before the mid-18th century when brick became freely available (Figures 12 and 13). Later hatches sometimes had iron mechanisms – levers and rack and pinions derived from water mill technology - to assist in raising and lowering hatches. In 1811 Hossey and Galpin of Dorchester produced the first cast-iron weirs and hatches, which were far more durable than earlier wooden ones. Many more were produced in local foundries between 1880 and 1910. Sometimes there may be an inscribed date on a built structure, though this is unlikely to date the whole system.



Figure 12
Slotted stones are often all that remains of water meadow sluices. They are difficult to date without evidence from other sources, though later sluices were frequently brick-built.



Figure 13
Aqueducts carried water through narrow sections of the Wey Valley, allowing its water meadow systems to function in difficult topography. This example at Bramshott Court is one of several built to connect water meadows on either side of the river.

5 Associations

Water meadows can be spatially or functionally related to a range of contemporary monuments. These include farmsteads, religious houses, stately homes, canals, manor houses, stock enclosures, barns, field systems, landscaped parks, roads, trackways, settlements, watermills, bridges, fords and ponds.

Water meadows were typically laid out within pre-existing field patterns and drainage systems which are reflected in their layout. Many catchworks were 'integrated systems' closely associated with isolated farmsteads where the main supply of water passed through a farmyard or byre. Watermills and water meadows were also used in combination, with the raised water tables employed to drive mills being re-used to float meadows and the mill leats supplying water to the meadows.

Although rivers and upland springs were the usual sources of water, other sources were exploited as necessary, so a few water meadows tapped into canal systems or were fed from artificial ponds.

Co-operation between landowners over rights to water was essential for securing a reliable supply for irrigation, so water meadow systems were often initiatives of landowners with large estates.

Fashionable during the late 18th and early 19th centuries, they were often incorporated into the layout of landscaped parks, as at Woburn, Bedfordshire, where the Duke of Bedford's meadows were fed from the 'Temple reservoir'. Capability Brown also created a number of irrigated meadows within the parks he designed, as did other landscape designers.

6 Water Meadows Today

In common with many historic features of the English rural landscape, water meadows are poorly protected and research has shown a high rate of attrition. In the water meadow heartland of Hampshire, a pilot study by the County Council showed that only four per cent of surviving water meadow remains could be classified as 'well preserved' while forty per cent of water meadows identified from mid-20th century aerial photographs had been destroyed by 1998.

Water meadow remains are frequently unidentified and under-represented in Historic Environment Records (HERs). While identifying the presence of surviving remains may be a first step towards their protection it does not guarantee survival, as shown by recent work in Herefordshire where recorded systems have been destroyed in recent years. Statutory protection is rare and although some individual water meadow structures are listed, very few complete systems are scheduled.

Water meadows have attracted academic interest and publications provide a wealth of information about their later history, ecological benefits and day-to-day maintenance (see [Further Reading](#) below). Despite this, some aspects are still poorly understood.

Floating upwards systems are barely represented in the archaeological record, since their remains are extremely difficult to identify. The origins of floating downwards remains obscure and bedworks appear to be absent before the 16th to 17th centuries when they emerge fully developed without any known precedents. A national overview of water meadows to identify their full distribution and their regional characteristics is also lacking.

7 Further Reading

Informative accounts are contained in the following collections of papers: *Water Meadows: History, Ecology and Conservation* (2007), and *Water Management in the English Landscape: Field, Marsh and Meadow* (1999) both edited by Hadrian Cook and Tom Williamson, and *Water Meadows: Living Treasures in the English Landscape* (2005) edited by Mark Everard.

Wiltshire is the subject of several publications including Eric Kerridge's 'The floating of Wiltshire water meadows' *Wiltshire Archaeological Magazine* 55 (1953), 105-18, George Atwood's 'A study of the Wiltshire water meadows' *Wiltshire Archaeological Magazine* 58 (1963), 403-13, John Bettey's 'The development of water meadows in the Salisbury Avon 1665-1690' *Agricultural History Review* 51 (2003), 163-72, and more recently Michael Cowan's *Wiltshire Water Meadows* (2005).

For Dorset, there is B Jane Whitehead's 'Management and land-use of water meadows in the Frome Valley' *Proceedings of the Dorset Natural History & Archaeological Society* 89 (1967), 251-81 and John Bettey's 'The development of water meadows in Dorset during the seventeenth century' *Agricultural History Review* 25 (1977), 37-43.

Further counties and regions are covered by additional papers in the *Agricultural History Review*, including: 'Floated water meadows in Norfolk; a misplaced innovation' by Susanna Wade Martins and Tom Williamson (volume 42 (1994), 20-37) and 'The origins of water meadows in England' by Hadrian Cook, Kathy Stearne and Tom Williamson (volume 51 (2003), 155-62).

A series of detailed, local, topographical surveys of water meadows was carried out by the RCHME, most of which are available from Historic England as grey literature reports.

Examples and summary accounts are included in McOmish, Field and Brown's *The Field Archaeology of the Salisbury Plain Training Area* (2002), 132-6, and Riley and Wilson-North's *The Field Archaeology of Exmoor* (2001), 128-9.

Rowland Vaughan's irrigation system is examined in Taylor, Smith and Brown's paper 'Rowland Vaughan and the origins of downward floated water-meadows: a contribution to the debate', *Landscape History* 28 (2006), 35-51.

8 Where to Get Advice

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9 Acknowledgments

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