ARCHAEOLOGICAL RECORDING AT POWICK WEIR, NEAR WORCESTER

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Sites and Monuments Record

Monument No WSM 8604

Activitiy No WSM 29642

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Project 1309
Report 505
HWCM 8604

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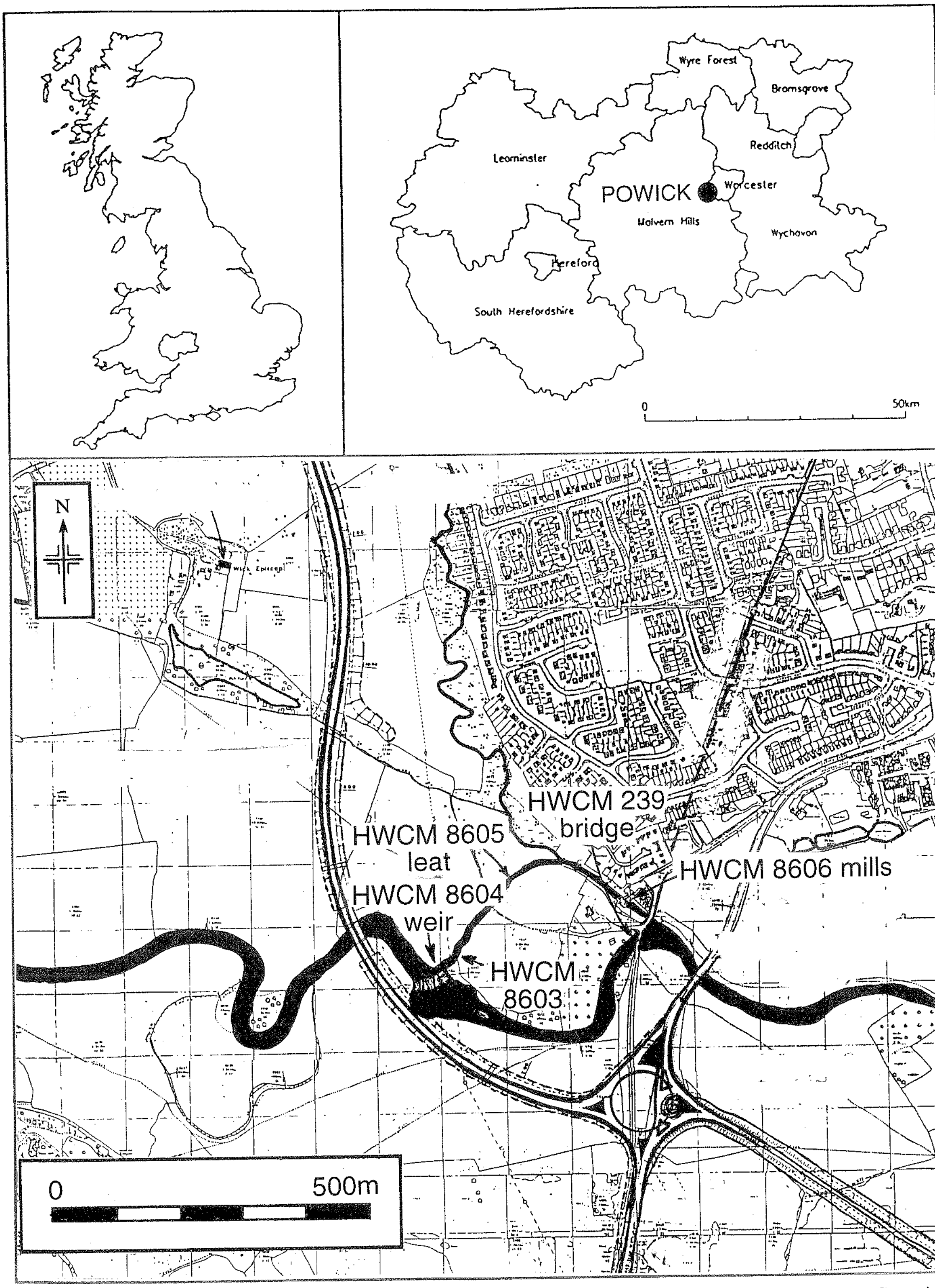


Figure 1: Location of the site

Archaeological recording at Powick Weir, near Worcester

Martin Cook

Part 1 Project summary

1 Reasons for the project

Archaeological recording was carried out at Powick Weir (HWCM 8604), near Worcester in advance of further works on behalf of the Environmental Agency. The weir is of several phases from the late 18th century to the present day. It is associated with other monuments including Powick Bridge (HWCM 239), a principally medieval structure of 15th century date, Powick Mills (HWCM 8606) which has a long history as an industrial site from 1086 to the late 19th century, Powick Mill leat (HWCM 8605) which is known from 1475, and a dump of iron slag (HWCM 8603) on the southern bank of the mill leat, just to the east of the weir on the Teme.

2 Outline of results

The project identified three visible phases of the weir dating from *c* 1795 to recent times. The earliest elements comprise the remains of two adjacent spillways of ashlar separated by the remains of an upstream cutwater and a downstream glacis surfaced with pitched stone and iron-working hearth bases. The fragmentary remains of a spillweir are also present. The remains extend beneath 20th century repairs. The remaining phases comprise repairs carried out in both the 19th and 20th centuries.

3 Conclusions

The project has determined the nature of the surviving elements of Powick weir and has been able to link the earliest of these to iron-working activities in the near vicinity.

Part 2 Detailed report

4 Aims

The aims of the archaeological recording were to record as much of the structure of the weir as was commensurate with safety, with a view to identifying its sequence of development and relationship with surrounding associated monuments. The purpose of this was to produce a baseline record of the structure before further erosion, refurbishment, repair or demolition took place and make it possible to recommend an appropriate treatment which might then be integrated with any proposed further course of action.

5 Archaeological background

Powick Weir (HWCM 8604) is located approximately 900m to the north of Powick village, near Worcester (SO 832 534; Fig 1). The weir lies at the junction of the River Teme and the leat to Powick Mills. The weir is of several phases, three being still visible. The earliest of these consists of a stone construction incorporating reused building materials and possible hearth bases. A date stone of 1826 is visible on the west side of the sluice. The latest phases are of concrete and steel construction suggesting that the weir was in its present position at the end of the 18th century and it is probable that a wooden structure diverted the flow of the Teme into the leat known from 1475 (Napthan and Cooper 1993).

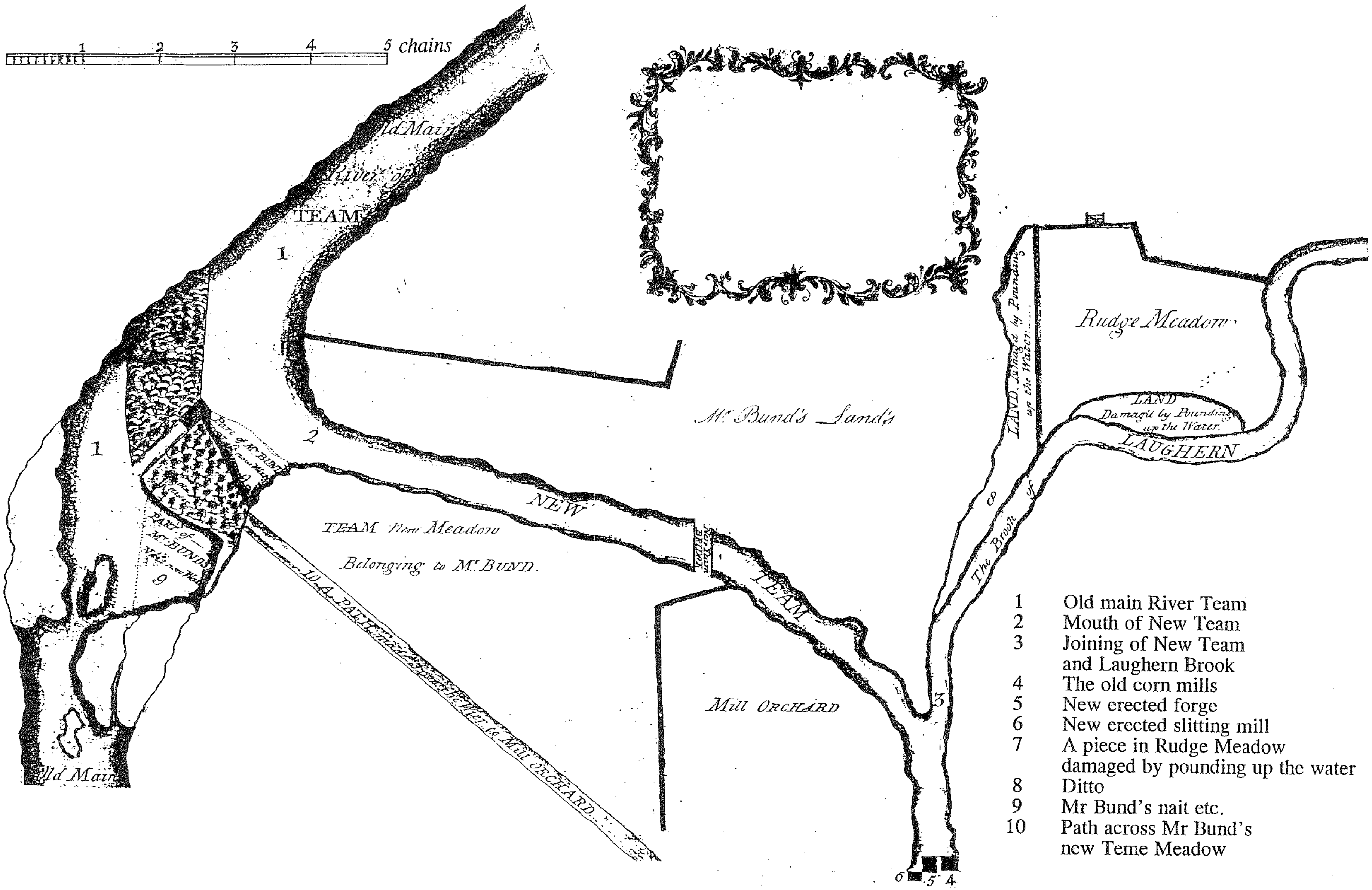
The historic parts of the weir are in poor condition as a result both of water erosion and unsympathetic modern engineering works. Due to repeated rebuilding little of the earlier structures are visible as upstanding remains, but related structures may be anticipated within the alluvial deposits on either bank, particularly within the deserted channel beneath the mill island.

Powick Bridge (HWCM 239) is a principally medieval structure of 15th century date. On the site of an earlier bridge 'the bridge of Wyke by Worcester' was in a dangerous state in 1336 when the Prior of Great Malvern, who was liable to repair it, was refusing to do so. It was again in need of repair in 1447 when indulgences were offered by John Carpenter, Bishop of Worcester, for all those who contributed to its repair (VCH IV, 184-5).

Powick Mills (HWCM 8606) has a long history as an industrial site. Two mills in Wick were attached to the Bishop's manor in 1086 (VCH I, 288). Wick Mill lay on the Teme and Cut Mill on the Laugherne Brook. In October 1299 a covenant was made to pay tithes of one mark *per annum* from the mills of the Bishop of Worcester at 'Wyk' and of 'Cuttemill' which the Prior and Chapter of Great Malvern leased (ADCWC B838).

In 1626 a survey of the manor of Powick was made (Exchequer Special Commission 2 Charles I no 5717), which refers to a windmill and a water corn mill, the latter in decay (VCH IV, 188). Cut Mill was demolished in the 1760s and the millpond filled up (VCH III, 508).

In the 1780s a substantial iron working complex grew up alongside Powick Mills. A plan of *c* 1795 (HWCRO BA 438/III xvii) shows the 'New Team', a weir on the 'old main Team' and three buildings straddling the millstream a



1 Old main River Team
2 Mouth of New Team
3 Joining of New Team and Laughern Brook
4 The old corn mills
5 New erected forge
6 New erected slitting mill
7 A piece in Rudge Meadow damaged by pounding up the water
8 Ditto
9 Mr Bund's nait etc.
10 Path across Mr Bund's new Teme Meadow

MAP OF POWICK MILLS c 1795 (HWRO BA 438/III (xvii)

Figure 2: Map of c 1795

short distance above the bridge. These are described as 'The old corn mill, new erected forge and new erected slitting mill' (Fig 2). Further industrial buildings, including a charcoal barn, warehouse, carpenter's shop and blacksmith's shop were present by *c* 1825 when they were shown on a survey by G Young (Fig 3). Powick Mills were sold in 1892 to become the Worcester City Electricity Works, a short-lived pioneering hydro-electrical and steam power station (VCH III, 508). At this time there existed three mills: a corn mill on the east with two wheels and a mill in the centre with two wheels, which for the last century and a half had been used to grind the material for the Worcester porcelain industry. On the west was another mill with three wheels, known as 'the forge mill' (*Electrical Engineer* 1894).

Powick Mill leat (HWCM 8605; Fig 1) links the Teme and Laugherne Brook to serve Powick Mills. The earliest mention of a leat is of complaints by the tenants of Wick Episcopi that the leat dug for the Prior of Great Malvern in 1475 had damaged their lands (VCH I, 288). The leat has subsequently been widened and deepened to serve the 18th and 19th century ironworks and hydro-electric power station.

A dump of iron slag (HWCM 8603; Fig 1) on the southern bank of the mill leat, just to the east of the weir on the Teme is recorded on the County Sites and Monuments Record. It is described as being 30m in length and 1m deep, covered by 0.7m of alluvium. The slag is described as of pre- blast furnace type (pers comm James Dinn). No direct dating evidence is available, but a forge was present near Powick Mill (Fig 2) by 1775 (Napthan and Cooper 1993).

6 Methods

6.1 Fieldwork

6.1.1 Survey strategy

Fieldwork was undertaken on 27th and 28th August 1996. A plan of the crest, downstream glacis and elevations of the two partially surviving spillways were drawn. Due to the overgrown nature of the surface of the glacis, a typical sample of approximately 4.5m square was drawn in detail. A similar approach was adopted for the timbers recorded immediately to the south-west of the surviving stone-work.

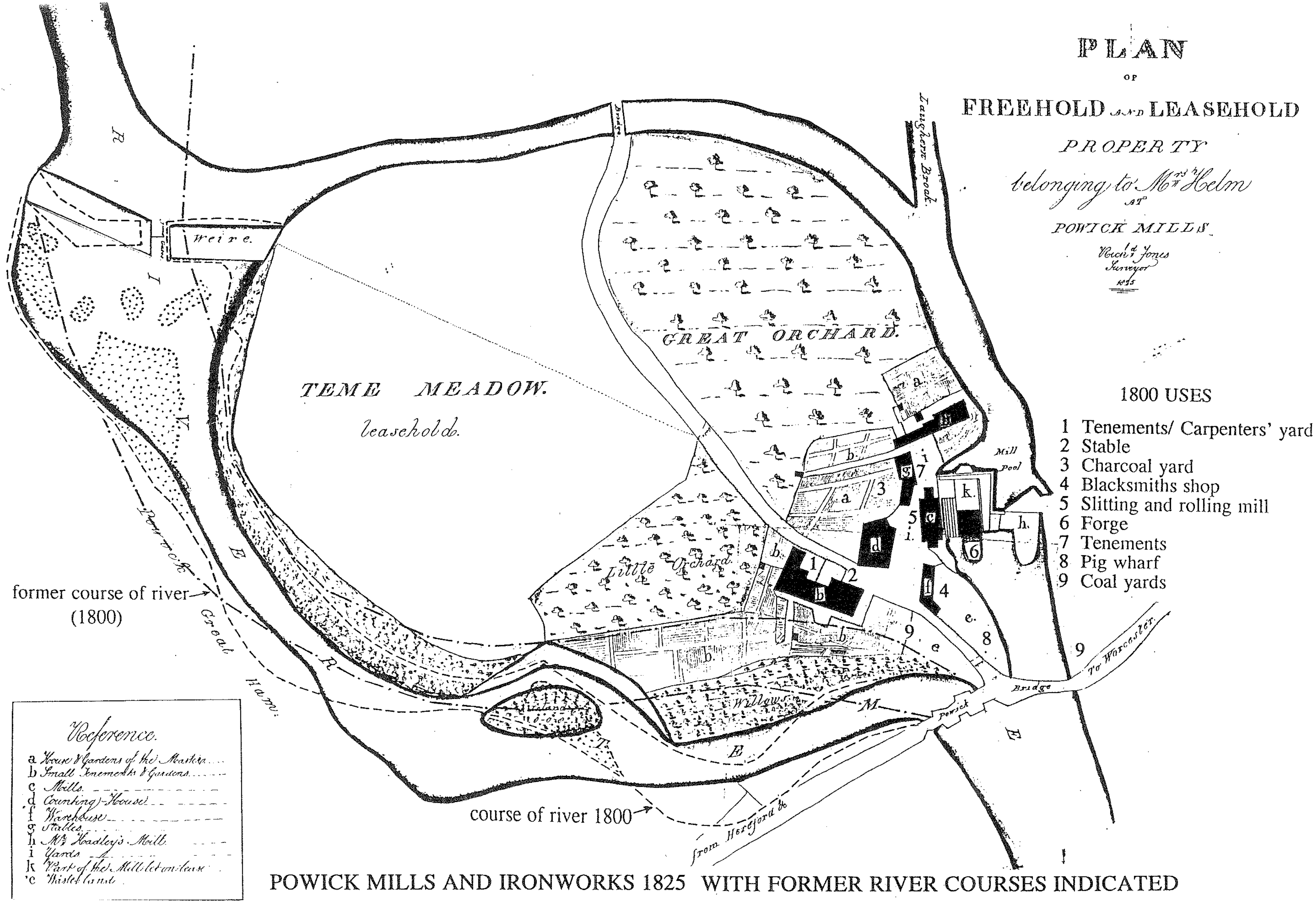
Recording followed standard practice (County Archaeological Service, 1995 *Manual of Service practice: fieldwork recording manual*, HWCC County Archaeological Service internal report, **399**).

No finds were recovered and no environmental samples were taken.

7 Analysis

The visible parts of the weir appear to be of one principal period of construction with at least two episodes of repair and refurbishment.

Phase 1: the stone weir
The visible part of this phase comprises the structure lying north-west to south-east, parallel to the flow of the river, between two spillways (Fig 4). The



POWICK MILLS AND IRONWORKS 1825 WITH FORMER RIVER COURSES INDICATED

Figure 3: Map of c 1825

walls of the spillways are constructed of large ashlar sandstone blocks, from which most of the mortar has been eroded (Figs 5 and 6). On the upstream end of the north-east side is a vertical slot, presumably for a timber or timbers forming part of the spillweir mechanism or possibly for stop-planks for maintenance. At the north-west end are the remains of a cutwater.

To the south west, concealed beneath the Phase 3 repairs, but partially revealed by erosion, are the remains of a similarly constructed weir face running south-west to north-east, perpendicular to the flow of the river.

The downstream glacis is surfaced with pitched stone and many hearth bases (Fig 4). Where the glacis has eroded wooden stakes and timber lacing are visible (Figs 4 and 9).

Phase 2: 1826 and 1854 repairs
Two date stones on the coping of the glacis give the presumed dates of repairs (Figs 5, 7 and 8). These extent of these repairs is unknown but may have included the brickwork visible on the north-east spillway wall.

Phase 3: concrete and steel repairs
In recent years the whole of the weir to the south-west of the stone structure was capped in concrete. Concrete reinforcement was added to the crest and north-east face of the Phase 1 structure (Fig 5) and a new spillway and fish ladder was constructed to the north-east.

8 Discussion

8.1 The development of dams and weirs

The construction of dams ranks with the earliest and most fundamental of civil engineering activities. All great civilisations have been identified with the construction of works for the management of water appropriate to their needs. Operating within constraints imposed by local circumstance, notably climate and terrain, the economic power of successive civilisations was related to their proficiency in water engineering. Prosperity, health and material progress became increasingly linked to the ability to store and direct water (Novak *et al* 1990).

Dams are known from the Middle East from the third millennium BC. The period from 1000 AD onwards saw a spread of dam-building activity with quite rapid growth in the height of dams and in the boldness of their concept. Succeeding years saw the commencement of serious dam building activity in many parts of Europe such as the 6m high embankment at Alresford in Britain.

In the period from 1700 to 1800 the science of dam building advanced relatively slowly. The dawn of the first Industrial Revolution and the canal age gave considerable impetus to embankment dam construction in Britain and in western Europe in the period from about 1780. Design continued to be based on a combination of empirical rules and proven experience. Despite the lack of rational design methods, dams steadily increased in size. Entwistle embankment dam was completed in England in 1838 as the first of its type to exceed 30m in height. In the 19th century British engineers advanced and developed embankment design and construction very successfully. Notable projects included the Longdendale Valley series of seven dams, completed

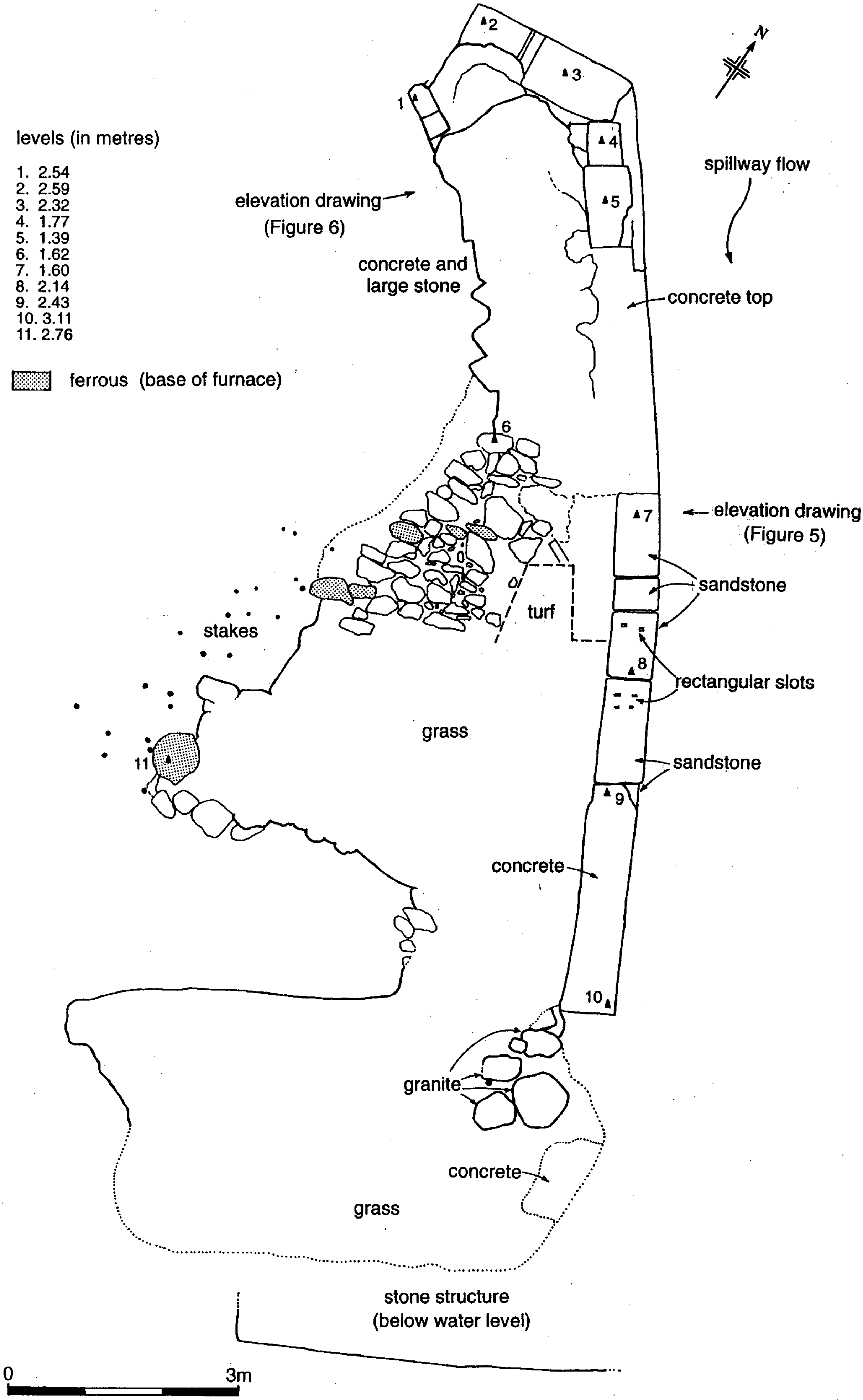


Figure 4: Plan of the stone structure

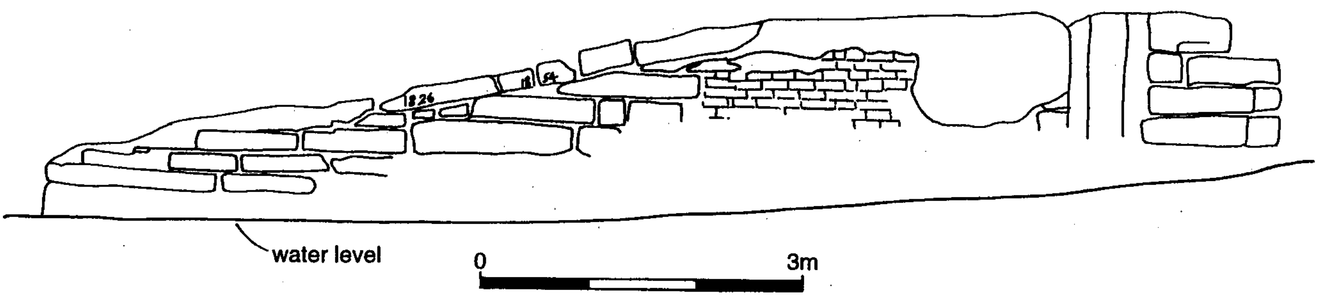


Figure 5: North-east spillway elevation

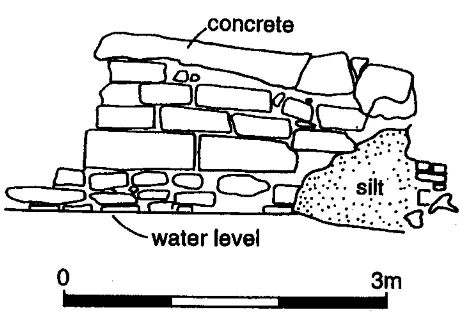


Figure 6: South-east spillway elevation

between 1854 and 1877. Although rational analyses were developed and refined from about 1865, the design of embankment dams continued to be very empirical until the development of modern soil mechanics theory from the 1930s (Novak *et al* 1990).

8.2 Technical aspects of dams and weirs

There is no fundamental difference between the construction of a dam and that of a weir. Generally speaking, weirs are relatively low-level dams constructed across a river to raise the river level sufficiently to divert the flow in full, or in part, into a supply canal or conduit for the purposes of irrigation, power generation, domestic, industrial uses, etc. These diversion structures usually provide a small storage capacity. Although much of the literature concerning water management of this type refers to dams, any statements or conclusions of a general nature are equally applicable to weirs (Novak *et al* 1990).

Dams and weirs are individually unique structures. Irrespective of size and type they demonstrate great complexity in their load response and in their interactive relationship with site hydrology and geology. In recognition of this, and reflecting the relatively indeterminate nature of many major design inputs, dam engineering is not a stylised and formal science. Every structure represents a design solution specific to its site circumstances. The design therefore also represents an optimum balance of local technical and economic considerations at the time of construction.

Early dams and weirs were usually of the embankment type. These were constructed of earth or rockfill. Upstream and downstream face slopes were usually similar and of moderate angle, giving a wide section and a high construction volume relative to height.

In its simplest and oldest form the embankment dam was constructed with low-permeability soils to a nominally homogeneous profile. The section featured neither internal drainage nor a cut-off. Such a dam has been investigated at Rockley Smithies in Yorkshire where a clay and gravel bank was revetted with stone (Raistrick 1972). Dams of this type proved vulnerable to problems associated with uncontrolled seepage, but there was little progress in design prior to the 19th century. It was then increasingly recognised that, in principle, larger embankment dams required two component elements. The first was an impervious water-retaining element or core of very low permeability soil (eg soft clay or 'puddle' clay). The second were supporting shoulders of coarser earthfill (or of rockfill), to provide structural stability.

As a further design principle, the shoulders were frequently 'zoned', with finer soils adjacent to the core element and progressively coarser fill material towards either face.

Dams and weirs require certain ancillary structures and facilities to enable them to discharge their operational function safely and effectively. In particular, adequate provision must be made for the safe passage of extreme floods and for the controlled draw-off and discharge of water in fulfilment of the purpose of the reservoir.

Spillways

The purpose of the spillway is to pass flood water safely down stream when the reservoir is full. It has two principal components: the controlling spillweir

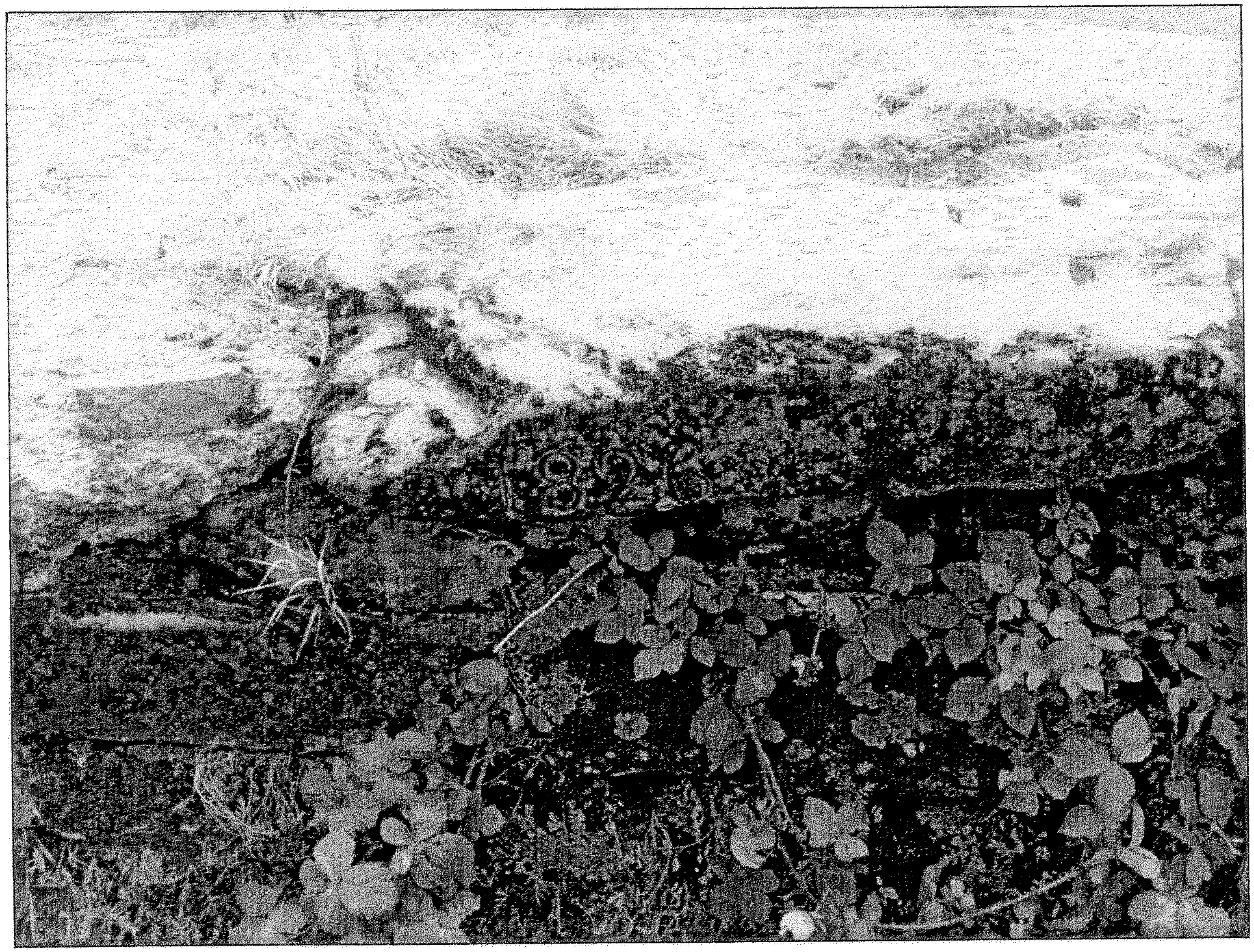


Figure 7: Date stone of 1826

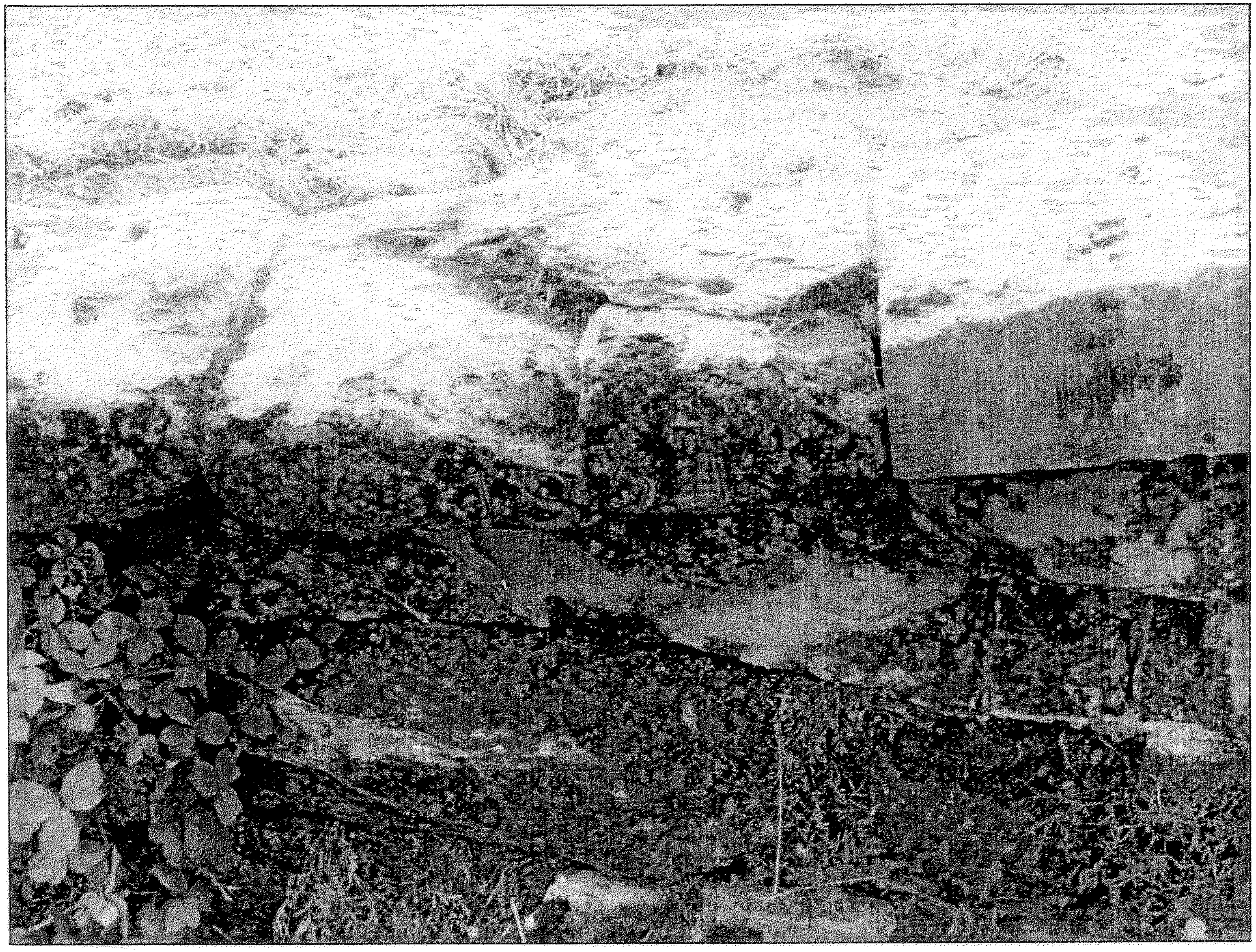


Figure 8: Date stone of 1854

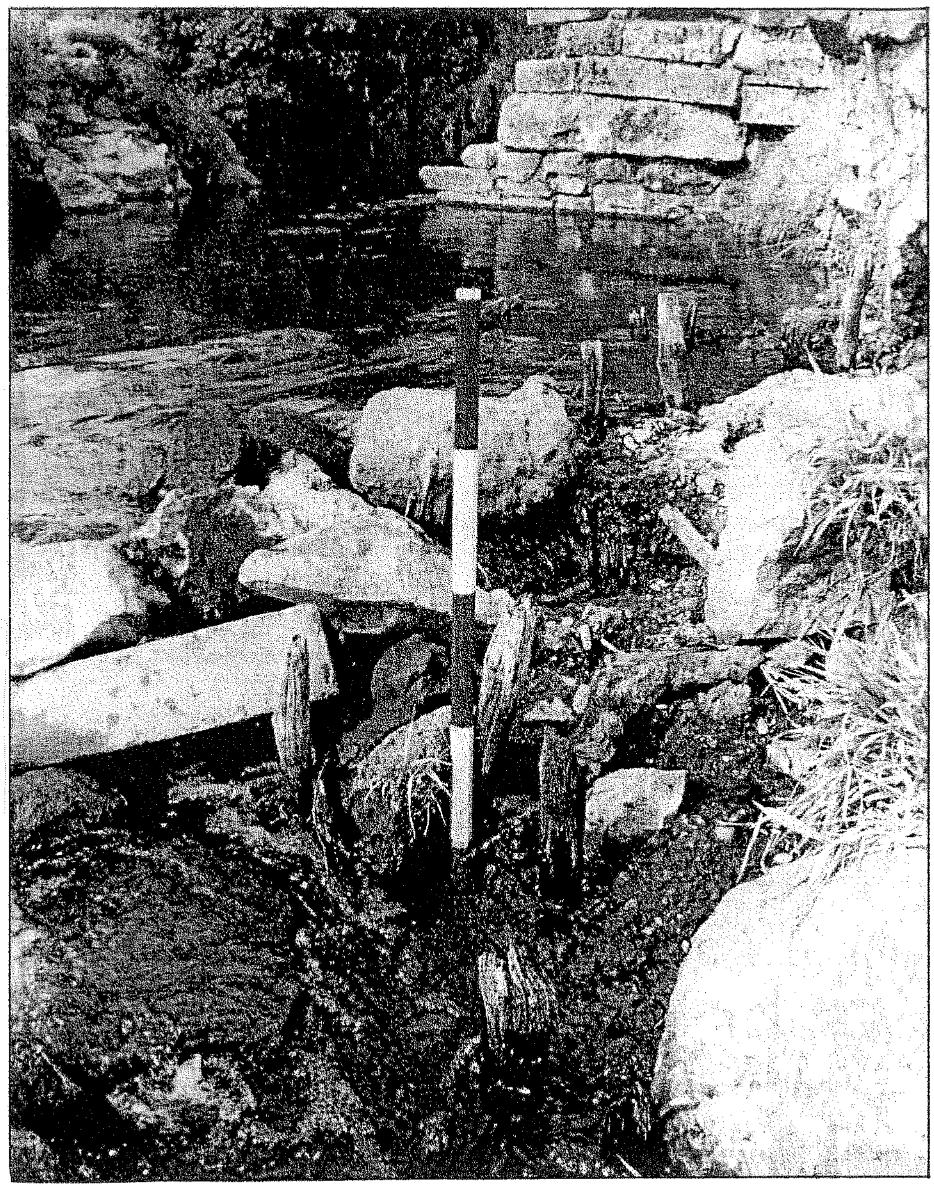


Figure 9: Wooden stakes at toe of downstream glacis

and the spillway channel, the purpose of the latter being to conduct flood flows safely downstream of the dam. The latter may incorporate a stilling basin or other energy dissipating devices.

Spillweirs

Spillweirs are normally uncontrolled: they function automatically as the water level rises above normal water level. Concrete or masonry dams normally incorporate an overfall or crest spillway, but embankments generally require a separate side-channel or shaft spillway structure located adjacent to the dam.

Cut-offs

Seepage under and round the flank of a dam must be controlled. This is achieved by construction of a cut-off below the structure, continued as necessary on either flank. Embankment cut-offs are generally formed from wide trenches backfilled with rolled clay.

The disadvantages of the embankment dam are few. The more important include an inherently greater susceptibility to damage or destruction by overtopping, with a consequent need to ensure adequate flood relief. They also require a separate spillway and are vulnerable to concealed leakage and internal erosion in the dam or foundation.

In contrast masonry dams are more demanding in relation to foundation conditions. Historically, they have also proved to be dependent upon relatively advanced and expensive construction skills (Novak *et al* 1990).

8.3 Powick Weir and its surrounding landscape

No evidence for a weir pre-dating *c* 1795 was found, although mills are documented in the locality from at least 1086 and a mill leat is documented from 1475.

The weir at Powick appears to be a hybrid in character, comprising spillways and an upstream face of ashlar stone, backed by an embankment constructed with wooden stakes and timber lacing. It is clear that on several occasions in the past it has been necessary to carry out major repairs, the most recent of which consisted of encasing most of the structure in concrete.

The map of *c* 1795 (Fig 2) suggests that the stone upstream face and spillway with the extensive downstream glacis was in place by this time. This would have served the newly-erected forge and slitting mill shown on the same map. The waste material from these processes is likely to be that now known to lie in an extensive deposit on the southern bank of the mill leat, just to the east of Powick Weir on the Teme (HWCM 8603). The addition of hearth bases to the downstream glacis may have been a later repair.

9 Academic summary

Archaeological recording was carried out at Powick Weir, near Worcester on behalf of the Environmental Agency. It identified three visible phases dating from c *1795 to recent times. The earliest remains comprise the remains of two adjacent spillways of ashlar separated by the remains of an upstream cutwater and a downstream glacis surfaced with pitched stone and iron working hearth bases. The fragmentary remains of a spillweir are also present. The remains continue beneath 20th century repairs. The remaining phases comprise repairs carried out in both the 19th and 20th centuries.*

The Service has a professional obligation to publish the results of archaeological projects within a reasonable period of time. To this end, the Service intend to use this summary as the basis for publication through local or regional journals. The Client is requested to consider the content of this section as being acceptable for such publication.

10 The archive

The archive consists of:

1 Fieldwork progress record AS2
2 Photographic records AS3

1 Colour transparency films
1 Black and white photographic films
3 Scale drawings
1 Computer disk

The project archive has been placed at:

Hereford and Worcester County Museum
Hartlebury Castle
Hartlebury
Near Kidderminster
Worcestershire DY11 7XZ

Tel Hartlebury (01299) 250416

11 Acknowledgements

The Service would like to thank Ms G Evans of The Environmental Agency and Mr Pete Giles and Mr Tony Willetts of the Fisheries Division for their kind assistance in the successful conclusion of this project.

12 Personnel

The project was coordinated by Simon Woodiwiss BA AIFA, Principal Field Archaeologist. The project was led and the report written by Martin Cook, Assistant Archaeological Field Officer. The report was edited by Hal Dalwood BA MIFA, Project Officer. Assistance on site was provided by David Wichbold, Archaeological Assistant and the illustrations were produced by Carolyn Hunt PIFA MAAIS, Illustrator.

13 Bibliography

Electrical Engineer 1894 edition of 12 October 12 1894, 427

Napthan, M, and Cooper, M, 1993 *Evaluation of the proposed Worcester Western Bypass*, HWCC County Archaeological Service, internal report, **176**

Novak, P, Moffat, A I B, Nalluri, C, and Narayanan, R, 1990 *Hydraulic structures*

Raistrick, A, 1972 *Industrial archaeology: an historical survey*

VCH I, Willis-Bund, J W (ed), 1901 *Victoria History of the County of Worcestershire, I*

VCH II, Willis-Bund, J W, and Page, W (eds), 1906 *Victoria History of the County of Worcestershire, II*

VCH III, Willis-Bund, J W (ed), 1913 *Victoria History of the County of Worcestershire, III*

VCH IV, Willis-Bund, J W (ed), 1924 *Victoria History of the County of Worcestershire, IV*

14 Abbreviations and glossary

Abbreviations

ADCWC - Archives of the Dean and Chapter of Worcester Cathedral

HWCM - Numbers prefixed with "HWCM" are the primary reference numbers used by the Hereford and Worcester County Sites and Monuments Record.

HWCC - Hereford and Worcester County Council.

HWCRO - Hereford and Worcester County Records Office.

Glossary of dams and weirs

Pond	the water retained in front of the structure
Upstream apron	the protected flat surface in front of the structure
Upstream glacis	the sloping face in front of the structure, commonly 2:1
Crest	the top of the structure
Downstream glacis	the sloping face behind the structure, commonly 3:1
Downstream apron	the protected flat surface behind the structure
Spillway	a channel provided in the downstream part of the structure to pass flood water safely downstream when the reservoir is full
Spillweir	the 'gate' usually fixed at a certain height, over which water passes to the spillway when the reservoir is full
Stop-planks	baulks of timber positioned in channels provided in the structure for the purposes of periodic maintenance