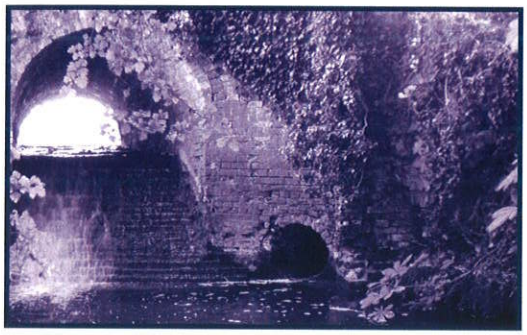
Cuttle Brook Restoration Project Stowe Buckinghamshire



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Cuttle Brook Restoration Project, Stowe, Buckinghamshire

Archaeological Investigations 2002

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SUMMARY

In the summer and autumn of 2002 Oxford Archaeology (OA) carried out a series of archaeological investigations as part of a restoration project at the Cuttle Brook, Stowe, Northamptonshire (SP67683930– SP66703640). The Cuttle Brook is on the western edge of Stowe Estate and forms the north-west boundary of the fallow deer park. Excavation, recording, survey and watching brief works were carried out on behalf of the National Trust, who had initiated a programme of restoration and repairs to the Brook and a number of silted ponds. The principal discoveries were elements of timber and brick water control devices, probably dating to between the mid-18th century and the mid-19th century.

1 INTRODUCTION

(Fig. 1)

1.1 Project background

1.1.1 The Cuttle Brook is a length of managed waterway that forms the western boundary of Stowe Park, Buckinghamshire. It is currently being restored as part of an ongoing programme of restoration and replanting works being undertaken by the National Trust. Oxford Archaeology carried out a series of archaeological investigations over the summer and autumn of 2002, concurrent with the restoration programme.

1.1.2 Stowe is located in north-west Buckinghamshire close to the Northamptonshire border. The site centres around Stowe House (now Stowe School) built in 1683 for Sir Richard Temple and designed by William Cleare, although extensively re-designed in the early 18th century for Viscount Cobham. The house is surrounded by the world renowned landscape gardens designed by a number of the most important architects and landscape gardeners of their day. They include Sir John Vanburgh, Charles Bridgeman, James Gibbs, William Kent and Lancelot "Capability" Brown. The gardens include a series of focal points or 'incidents' that were intended to guide the visiting gentry on a stimulating perambulation around the park. Certain features associated with Cuttle Brook may well have featured on such a tour.

1.1.3 The proposed restoration works, which are being funded by a Heritage Lottery Fund Grant, focus on a 4 km long stretch of water that runs between Roothouse Pond to the north-west of Stowe House down to the Lower Oxford Water to the south. Within this area, key elements associated with a system of water management are being restored. These include restoration and repairs to the Roothouse Pond and monk, the Haymanger Dam and pond and Home Farm mill pond and dam. Part of the exercise will see the re-instatement of the ponds with the silts that clog them being dredged.

1.1.4 In order to mitigate against damage to various archaeological elements identified along the course of the brook, a program of archaeological works was proposed in conjunction with the restoration work, while also serving to expand the understanding and interpretation of the development of water management at Stowe Park.

1.1.5 The National Trust prepared a project brief (National Trust 2002) outlining a series of archaeological works to be undertaken in advance of the restoration works. The initial brief outlined four planned stages of archaeological investigation with each phase informing the subsequent one. Oxford Archaeology (OA) drew up an Archaeological

Project Design in response to the requirements of the brief (OA 2002) and detailed how they would approach the archaeological conditions and requirements specified.

1.1.6 Discussions in advance of the project led to some elements of the original brief being curtailed, with a general agreement to produce a single report on the whole recording exercise. This report presents the results from investigations along the length of the Cuttle Brook and it's associated ponds and structures. The scope of works eventually formed six parts, all generally linked in terms of their methodology and aims, detailed below.

1.2 Scope of work

Walkover Survey

1.2.1 In the first instance a walkover survey was conducted along both sides of the brook, and the stream channel itself was examined for archaeological features. These were plotted onto a base map of the site (see Figs 2a/2b/2c/2d).

Home Farm Mill Pond excavations and recording

1.2.2 The excavation of the silts adjacent to the Mill Pond dam was monitored prior to a recording action being undertaken on the dam and sluice gates. This work was intended to increase knowledge gleaned from previous investigations at this site (see Marshall 1997b and Jessop 2000).

Haymanger Dam excavations and recording

1.2.3 Further excavation and recording of sluice structures at the Haymanger Dam was undertaken, following Jessop's initial survey (Jessop 2000). Further and more intensive excavation and recording here was carried out prior to the re-facing of the Dam structure with a new layer of clay and resealing a breach in the dam made in the 1940s. Following recording, the archaeology was to be sealed beneath a layer of sand and a semi-permanent Wyretex type fabric.

Watching Briefs at Roothouse Pond, Haymanger Pond and Home Farm Mill Pond

1.2.4 A series of watching briefs monitoring the dredging and restoration of the ponds associated with each of the dams was undertaken. This work ultimately comprised the dredging of silts out of the Home Farm Mill Pond, dredging and restoration of the Haymanger (detailed above) and structural repairs to the Roothouse Pond sluice system.

1.3 Geology and topography of the project

1.3.1 Stowe lies on Boulder Clay with discrete outcrops of glacial sands and gravels away from the stream courses. Alluvial silts overlie the clay across the river flood plain. An outcrop of poor quality limestone appears close to the Oxford gates on the southern side of Stowe Gardens.

1.3.2 Acquired by the Trust in 1995, the Cuttle Brook lies at the western edge of the estate forming the north western boundary of the fallow deer park (SP6768 3930 – SP6670 3640). While the Trust owns most of the land that constitutes the current project area, the section south of the Haymanger Pond is privately owned. This area extends past Dadford and encompasses parts of Dadford Close where earthwork remains of house platforms,

once part of the present village, have been identified. The course of the river is artificially straightened here.

1.3.3 Roothouse Dam, at the northern extent of the study area is located within dense woodland set on a gravel terrace. The dam is fed by a tributary of the Great Ouse, which feeds down the length of the brook to eventually rejoin the river at Tingewick Mill. The brook flows through a gently sloping valley bordered on each side by grassland interspersed with patches of wood. At the centre of the site are Home Farm and its adjacent mill. The land around Home Farm has been worked at least since the 1920s and probably before. The National Trust still maintains the farm as a working concern, using the land immediately adjacent to the brook for sheep grazing.

1.4 Archaeological and historical background

Recent Work at Cuttle Brook

1.4.1 Extensive archaeological and documentary evidence exists to show that Cuttle Brook has been intensively managed probably since the late medieval period, although many of the surviving elements date to the re-development and landscaping of the Park in the 18th century. There are a wide range of features related to a number of phases and uses of the waterway for functional, recreational and aesthetic purposes. The site is therefore of historical, archaeological and architectural significance.

1.4.2 Stowe has been the focus of considerable historical and archaeological research in recent years, however, much of this work has concentrated on the house and gardens and it has only been relatively recently that there has been any attempt to understand the development of this aspect of the Park. Most notably, the historic management of the river has been extensively researched and documented in *The Framework Conservation Plan for Stowe* (Felus 1999) which forms the framework for the present project.

1.4.3 In addition to this work, three other survey projects have been undertaken. In 1997 two surveys - on the buildings of Home Farm, and the development of the Home Farm Mill - were produced (Marshall 1997a and 1997b). In 1999 the Trust commissioned English Heritage to undertake an earthwork survey of Haymanger Dam (Riley 1999), and an exposed section through the Haymanger Dam was cleaned and recorded by a small team under the direction of Oliver Jessop (Jessop 2000). Areas to the north and south of Haymanger Dam were also encompassed in this survey. The findings of both of these surveys established a framework to inform the proposed archaeological mitigation needed during the restoration.

The archaeology and history of Stowe's water management

1.4.4 The earliest evidence of occupation at Stowe is from the Roman period. The main NE-SW road through the park appears to echo the line of a Roman road, and various isolated finds have been recorded across the area. Most recently, a Roman tile kiln was identified during replanting works to the south east of Haymanger Dam.

1.4.5 From documentary sources, it can be suggested that some form of water management, in the form of fishponds and managed water meadows along Cuttle Brook may date to the medieval period. During this period the villages of Stowe, Lamport and Dadford

developed as part of manorial estates. Remnants of strip fields and house platforms are known nearby at Dadford Close (Jessop 2000).

1.4.6 Abraham Allen's survey of the "Desmesness of Stowe" in 1633 includes "The bowling green and all the Closes into the Millponds" as well as the "Manor House, Orchard and Coorte". This probably refers to former millponds within the present garden landscape. There is no evidence of an earlier mill on Cuttle Brook before the existing 19th century mill, although the location of the Mill Pond at Home Farm has moved progressively further south, and its earlier outline is shown on Bridgeman's plan of 1739. The Haymanger appears in Allen's 1633 survey and later documentary references include the "Haymanger stews", which suggest that fish were being farmed on the estate.

1.4.7 At the time of Allen's survey, Stowe House was owned by Sir Peter Temple, 2nd Baron of Cobham. By 1673 the land was under the control of Sir Richard Temple and comprised a series of walled gardens to the south of the house including an orchard and vineyard. The fallow deer park was also probably established during this period. In 1677 work started on the new house designed for Sir Richard by William Cleare. Parts of the walled garden were retained and a series of formal parterre gardens where laid out. In 1716 Viscount Cobham employed Sir John Vanbrugh with Charles Bridgeman as garden designer to lay out new gardens and to radically transform the old formal parterres.

1.4.8 During this period water features became an integral design feature in the garden including a forty foot fountain, formal pools and water gardens. In 1728 a dam was built to the south of Home Park to create Eleven Acre Lake. James Gibbs, William Kent and Capability Brown continued to expand the gardens throughout the 18th century. It is unclear whether the ponds on Cuttle Brook formed part of Bridgeman's garden designs. Nonetheless, his plan of 1739 shows that Haymanger was intended to be part of a water feature linked to the Ridings, an area of woodland to the north of the park (Ridley 1999).

1.4.9 The park continued to expand and prosper until the early 19th century when spiralling debts forced the family to sell off large quantities of timber from the Park. Many of the formal avenues and woodlands were thus destroyed and the timber mill at Home Farm may date to this period.

1.4.10 The estate continued to decline until it was eventually sold in 1921 and bought by the Davies family, who ran it as an agricultural concern. The northern area of the park was purchased by the National Trust in 1995.

1.5 Acknowledgements

1.5.1 The principal contractors Barton Plant Hire Ltd. provided plans of the restoration works and showed a commendable interest in the archaeological importance of the project. Gary Marshall, Regional Archaeologist for the National Trust, provided advice, background information and covered some elements of the watching brief.

1.5.2 The site work was supervised by OA's Andy Simmonds and Jim Mumford, with assistance from OA's Survey, Environmental and finds departments as required. The original Project Design was prepared by Penny Middleton formerly of OA.

2 PROJECT AIMS

2.1.1 To provide an updated survey of all archaeological features/structures along the route of Cuttle Brook between the Roothouse Pond and the Lower Oxford Water. To locate each site according to the OS grid and to place it, where possible, within the context of the landscape as a whole.

2.1.2 To minimise and mitigate the impact of the proposed restoration works on any existing archaeology and to preserve by drawn, written and photographic record any archaeological remains that may be revealed.

2.1.3 To identify and record structures related to the workings of the dam heads and sluice gates and to trace the sequence of development of dam technology at Stowe.

2.1.4 To signal in advance any archaeological material that is revealed during excavation which may not have been considered in the initial mitigation program.

2.1.5 To produce a report detailing the results and interpretation of both the initial field survey and the evaluation, mitigation and watching brief work.

3 PROJECT METHODOLOGY

3.1 Strategy and methodology

Walkover Survey

3.1.1 A walkover of the site was conducted by an OA landscape surveyor with a view to identifying all above ground features including standing structures, field boundaries, evidence of land use and historic landscape "furniture" as specified in the National Trust Survey Guidelines (Section 2.1.3). Features were plotted onto a pre-prepared OS map indicating the break and base of slope. A hand held GPS was used to provide a six figure grid reference at appropriate points within the site. All features were allocated a unique identification number, as well as their SMR number where present.

3.1.2 Each site identified on the survey was located (as above) and recorded on a proforma sheet. Digital and SLR photographs were taken using colour or black and white film as appropriate.

Works at Home Farm Mill Pond dam

3.1.3 The work at the Mill Pond dam involved close co-operation with the contractors and difficult working conditions. The southern end of the Mill Pond was secured by a gravel bund running across the width of the pond. The area to the south of the bund (measuring c 110 m x 15 m, 1650 sq. m) that contained the dam and sluice gates was stripped by machine and limited excavation of deposits and recording was undertaken. General site clearance of vegetation and the exposure of structural features were also carried out.

3.1.4 A plan of the dam showing the location of the sluice gates and their associated brick structures was drawn at a scale of 1:50. A section across the working face of the dam was compiled at a scale of 1:50 - a full elevation of the dam was not drawn, as the plan was to restore it as an operating feature. A full photographic record of the elevation was undertaken.

Haymanger Pond

3.1.5 The objectives of the mitigation works were to preserve the existing archaeology through a comprehensive record of the site and to define the extent of the timber and masonry structures and how they related to the main body of the dam. It was hoped to cut back a section across the main clay bank of the dam in order to determine phases of development. This work was anticipated to identify the sequence of technological development associated with the dam adding to the work undertaken (following from the work of Jessop, 2000).

3.1.6 All features, structures and deposits were issued with unique context numbers with context recording in accordance with established OA practices (OA Field Manual, 1992). All contexts, and any small finds and samples from them were allocated unique numbers. Bulk finds were collected by context. Black-and-white negative photographs were taken of all archaeological features, supplemented with colour slides. Site plans were drawn at an appropriate scale (normally 1:50 or 1:20). Section drawings and elevations of features and sample sections were drawn at a scale of 1:20.

Watching briefs at Roothouse Pond, Haymanger Pond, Mill Pond

3.1.7 Watching briefs were undertaken during dredging of the silts of the Home Farm Mill Pond, the restoration of the dam at Haymanger Pond and excavation of material from the pond, and the restoration of Roothouse Pond and dam.

3.1.8 The aims of the watching briefs were to monitor the works of the non-archaeological contractor in order to identify and record any archaeology that may have arisen, and to provide plans and sections of structures that were being restored rather than covered over in the process of the restoration works. All recording was in accordance with established OA practices (OAU Field Manual, 1992).

3.2 Finds

3.2.1 Finds were recovered by hand during the course of the excavation and generally bagged by context. Finds of special interest were given a unique small find number.

3.3 Presentation of results

3.3.1 The results are presented by area, geographically extending from the north to the south, beginning with the results of the walkover survey.

4 RESULTS

4.1 Walkover Survey

(Figs 2a/2b/2c/2d)

4.1.1 The site walkover survey was conducted on Thursday 5th and Friday 6th September 2002 in moderate light and good weather. Both sides of the brook, and the stream channel itself were examined for archaeological features. The only limitations to the survey were dense undergrowth along the Cuttle Brook between the Haymanger pond and Dadford, and impenetrable undergrowth around the feeder channel to the Mill Pond. The area to the west of the Lower Oxford Water and to the south of Oxford Lodge was also thickly overgrown.

4.1.2 The majority of the land surveyed was open grassland for hay and pasture. Areas of woodland surrounded the Roothouse Pond and the Lower Oxford Water and there are also areas of thick woodland to the north and east of the Mill Pond. There are areas of thinner woodland to the west of the Upper Oxford Water, to the north of the Haymanger Pond and to the north of the Boycott Pavilions.

4.1.3 Topographically the ground slopes from both east and west down into the valley of the Cuttle Brook to the Haymanger Dam. The valley becomes less pronounced from the Haymanger Dam to Dadford, where it joins the River Dad and flows through a pronounced valley via a straightened channel towards the Mill Pond. The River Dad then flows on towards the Upper Oxford Water through a broad shallow valley. The known sites within the study area were examined for further information or altered condition and should be read in conjunction with the features plan in this report (Fig. 2a, 2b, 2c). A full gazetteer is presented as Appendix 2 at the end of this report.

Existing and known features and sites

4.1.4 **OA 1** – Vestigial bank and ditch, apparently the 17th century park pale bordering the carriageway or ride identified by the English Heritage Survey report of 2001 as part of Northampton Drive. **OA 2** – A redundant quarry, no noticeable change from the description given in the English Heritage Survey report of 2001. **OA 3** – Probable ridge and furrow adjacent to the Cuttle Brook. No noticeable change from the description given in the English Heritage Survey report of 2001. **OA 5** – There is the site of a probable platform here measuring c. 15 m x c. 3.5 m. **OA 7** – An area of broad ridge and furrow. No noticeable change from the description given in the English Heritage Survey report of 2001. **OA 11** – An area of extensive earthworks in which there is no noticeable change from the description given in the English Heritage Survey report of 2001.

4.1.5 **OA 17** – Old stream channels or a field corner, that the EH survey suggests is an area of tree planting. There are no noticeable changes from the description given in the English Heritage Survey report of 2001. **OA 18** – An area of well preserved ridge and furrow earthworks. No noticeable change from the description given in the English Heritage Survey report of 2001. **OA 21** – This trackway is marked on the maps of 1843, and is visible as an earthwork on both banks of the River Dad. **OA 22** – An area of substantial quarrying, there is no noticeable change from the description given in the English Heritage Survey report of 2001. **OA 23** – A regular mound adjacent to the bridge over the Oxford Water on the northern bank. Possibly the site of an unknown garden feature.

4.1.6 **OA 26** – Brick built sheep wash, there is no noticeable change from the description given in the English Heritage Survey report of 2001. **OA 29** – Former stream channel of the Dad River, there are no noticeable changes from the description given in the English Heritage Survey report of 2001. **OA 30** – A brick arch bridge spanning the Dad River, there is no noticeable change from the description given in the English Heritage Survey report of 2001. **OA 31** - A brick arch bridge spanning the Dad River, there is no noticeable change from the description given in the English Heritage Survey report of 2001. **OA 33** – Large are of ground disturbance, possibly containing a pillow mound. **OA 34** – Probable tree holes extant within the verge of the main drive. The English Heritage Survey of 2001 however suggests they are modern features associate with drainage. **OA 35** - A large area of extant earthworks as shown on the English Heritage Survey of 2001.

New and newly clarified sites

4.1.7 During the survey nineteen new sites were identified or clarified on the ground. These new sites comprise: **OA 4** – A structure platform on the opposite bank of a tributary of the Cuttle Brook from the former kennels. **OA 6** – A small brick bridge over the Cuttle Brook for the Kennels. **OA 8** – Clearly defined lynchet bank above Haymanger pond, possibly defining the original limit of the pond. Probably the same feature as **OA 9**. **OA 9** - Clearly defined lynchet bank above Haymanger pond, possibly defining the original limit of the pond. Probably the same feature as **OA 8**. **OA 10** – Single brick gate pier. **OA 12** – Area of probable larger Mill Pond now slightly waterlogged ground.

4.1.8 **OA 13** - Mill dam, the downstream face of which displays a cascade leading from an overflow culvert, and a separate circular brick culvert opening on the east side. A redundant outflow channel on the opposite bank. **OA 14** – Mill building c. early 19th century. Stone platform to the northern side. **OA 15** - Concrete sheep dip and metal railed sheep enclosure. **OA 16** - Inspection chamber for the mill channel. Brick lined. **OA 19** - Three or four low broad mounds within boggy area, *c*3-3.5 m in width and *c*0.55 m in height, possibly ridges for tree planting. **OA 20** - Lynchet banks running across east facing hill slope. **OA 24** - Sub-square raised possible platform *c* 12 m in width E/W. Stands c. 0.4 m in height.

4.1.9 **OA 25** – Probable site of a former paper mill, after which the adjacent spinney is named, the site is now marked by substantial fragments of brick wall, and concrete floor which have been incorporated into the dam structure. **OA 27** – Possible small platform adjacent to **OA 17**. Measures *c*12 m x 2.5 m of unclear function. **OA 28** – A post-medieval field boundary cutting the well preserved ridge and furrow **OA 18**. Ditch is *c*2.5 m in width x c. 0.75m. **OA 32** – 20th century sheep dip of concrete, apparently now redundant. **OA 36** - A brick arch bridge spanning the Cuttle Brook. Probably 19th century.

5 ARCHAEOLOGICAL INVESTIGATION

5.1 Archaeological Description

The phasing

5.1.1 The phasing applied to the archaeology of the four sites is principally based upon the stratigraphy. The indicated chronology is interpretative, based upon some absolute dating from dendrochronological sampling, documentary references and plausibility, and is discussed in section 7.2.

5.2 Roothouse Pond

(Figs 2a, 3. Pls 1-4)

5.2.1 The investigation was intended to examine the nature of the water management system associated with the dam structure, revealed during the dredging of the silt deposits from the pond. The revealed structures extended north-east into the pond from the brick 'monk' identified by Jessop in 2000.

Phase 1 (Late 18th century)

5.2.2 The material of the dam itself was a dark yellowish brown clay (8). through which was a cut (9), containing a timber box culvert (5). The upper surface of this was exposed for a length of 3.3 m. The top and bottom of the culvert consisted of single planks 0.8 m wide by 0.05 m thick. The sides were formed of slightly thicker planks (0.35 m x 0.15 m).

Phase 2 (Early 19th century)

5.2.3 A second cut (14) was identified through the dam material over the north end of the box culvert, which had evidently exposed the culvert at this point. In the upper surface of the north end of 5 was set a cast iron trap door (6), surrounded by a wooden frame, in the surface of which were six slots, presumably housings for a superstructure. Across the open north end of the culvert (5) was a single timber (20), braced under the northern edge of the trap door frame.

Phase 3 (Mid 19th century)

5.2.4 To the south, a brick culvert (3) was identified within construction cut 11, continuing the run from the end of wooden culvert 5 but at a slight angle. A length of 3.3 m was exposed, although a further 1.1m of the brick floor of the culvert was visible, extending south along the stream. In section the culvert was circular and built of mortared bricks (0.23 m x 0.11 m x 0.07 m).

5.2.5 The 'monk' or brick lined shaft (1), noted in the 2000 work, was identified, and enough of the debris within it was removed to uncover a culvert entering on the line of the revealed culvert (3), and exiting under the dam, towards the outflow on the downstream side of the dam.

5.2.6 Traces of a decorative facade of brick and concrete (18) were noted at the point of the original outflow opening. These were also noted by Jessop in 2000.

5.3 Haymanger Pond

(Figs 2a, 4-6, 10. Pls 5-7)

5.3.1 The investigation was intended to clarify the initial results achieved by Jessop (2000), and if possible determine the technology of the dam and sluice elements. The fieldwork entailed cleaning back the original section and selective excavation to clarify stratigraphic and structural questions.

Note: The actual orientation of the Haymanger sluice complex is NNW-SSE. This is simplified in the following description to N-S, to facilitate understanding.

Phase 1 (Late 18th century)

5.3.2 The natural, a yellowish brown alluvial clay (100) was identified in section, overlaid by remnants of the original stream bed (127) a layer of gravel, pebbles and shell. This was truncated by the cut for the Phase 1 culvert (101), a flat bottomed, steep sided cut oriented NE-SW and at least 15 m long and 0.50 m deep at the north end.

5.3.3 A wooden structure (103) was revealed laid along the base of cut 101. It comprised at least three, and possibly four substantial sawn oak timbers (up to 3.5 m x 0.30 m x 0.20 m) laid end-to-end. This formed the base of the Phase 1 culvert complex. Against the side of the timbers an initial silting (102) was identified.

5.3.4 The timber base 103 supported the Phase 1 stone culvert (104 and 105), represented by a layer of pitched limestone blocks laid over the timbers. The pitched stones were overlaid by flat slabs, and along the northern side the lower courses of a rubble wall were identified. It is likely that the southern side was similarly constructed. The roof of the culvert was likely to be stone built also, but whether it was arched in rubble, or comprised flat slabs, is unknown. At the southern end of the culvert a short length (1.80 m) of a south-facing rubble wall (106) was recorded, almost entirely obscured by the roots of a large tree.

The first silt box (Fig. 4b)

5.3.5 At the front of the dam part of the base of the Phase 1 silt box was identified (107). It comprised a frame of two tranverse timbers (A and B), each approximately 0.30 m x 0.30 m in section, lap-jointed and pegged onto one surviving longitudinal timber (C) on the east side of the frame. A western longitudinal timber (D) was identified in 2000, although this is now missing.

5.3.6 The rectangular frame (1070, measuring 1.76 m long by 2.70 m wide, lay across the base timber 103. Timber B was lapped over 103; timber A would have butted against the northern end of 103, although modern disturbance had dislodged it slightly (see below). Between the line of D and timber 103 a longitudinal timber H was exposed, which, along with transverse timber G, appeared to represent additional support for the structure 107.

5.3.7 Evidence for the nature of the superstructure of the frame was limited. The central base timber (103) had a vertical mortice cut through it measuring 0.23 m x 0.27. Lapped into the surviving longitudinal timber (C) and fixed with an iron nail was a short timber (E) with a small mortice in its end and a hole running through the thickness of the timber. There was no indication (from the 2000 plan) of a similar joint on the western longitudinal timber (D). One surviving plank (F) along the east side of the frame may be a remnant of the superstructure.

The screen

5.3.8 A screen of mostly 1/4 round-wood posts (108), each measuring approximately 0.10 m x 0.10 m was driven in against the leading edge of the front cross-timber (A) of 107. The screen continued along the face of the dam on both sides of structure 107, although only two posts survived on the north-western side, the rest being removed by the modern dam breach. The posts along the earth dam were clearly intended to consolidate and support the front face of the dam, although there was no evidence of any horizontal wattles or planking behind the posts.

The dam

5.3.9 The compact mid-orange brown core of the dam (109) was revealed, abutting the revetment (108), and the surviving side of the Phase 1 culvert and silt box.

Phase 2 (Early 19th century)

5.3.10 The cut (110) for the construction of the second silt box (113) was identified in plan on the south side of the stream. The process involved cutting back the face of the dam to site 113 directly behind the base (107) of the first silt box. There was some evidence of a line of

1/4 trunk posts (111) driven in against the reshaped front face of the dam, and a plank which may have acted to funnel water into the new silt box. A mix of re-deposited dam material and pond silts (112) had been dumped against the completed Phase 2 silt box.

The second silt box (Fig 4b)

5.3.11 The box was formed from a trapezoidal base measuring approximately 1.90 m N-S x 2.00 m W-E (measured across the north face) narrowing to 1.60 m W-E (measured across the south face. The structure consisted of a transverse timber (I) measuring 1.6 m long x 0.18 m x 0.20 m, housing two upright posts of similar section (J and K) forming the open south side The surviving east side of the box base was formed by a similar sized timber (L) 1.9 m long housed into the tranverse timber (I). The north side of the base was formed from a similar sectioned timber (M) tenoned into the east side timber (L). In the angle formed by L and M was a diagonal upright (N) that supported surviving elements of the superstructure. These comprised three rows of planks on the east side, and four on the north side. The lower two planks on the north side were pierced with a regular pattern of drilled holes. The west side of the box was entirely missing, but it is reasonable to suppose a similar construction, the whole forming a flat-topped pyramidical shape.

5.3.12 Within the box, the base was floored with pitched stone blocks (115) which overlay the surviving east side of the base frame. These were sealed by a 0.14 m deep layer of clay (116), which produced two sherds of 18th-19th century white-ware. Overlying 116 was the end of a 3.10 m long timber platform (118), the Phase 2 culvert floor. This was a maximum of 0.37 m wide by 0.03 deep, and consisted of a single decayed split log or a series of split logs side-by-side. In the 2000 work two other planks were found which were interpreted as forming the sides, the structure held together by three iron spikes. The spikes survived, the side planks did not. Overlying layer 116 and the east end of the culvert floor 118 was an accumulated deposit of fine grey silt (117). The south end of 118 was damaged, and it appeared that it originally extended a further 0.70 m to rest on a limestone slab (see Fig. 5, section 1)

Phase 3 (mid- 19th century)

The monk

5.3.13 Just beyond the south end of the culvert floor 118, a cut (119) was identified for the construction of a brick structure (120), which abutted the limestone slab supporting the south end of 118. Structure 120 was a two-chambered construction, measuring approximately 1.90 m long x 1.20 m wide. The surviving south side consisted of mortared brickwork up to 0.75 m wide and up 0.90 m high, sitting on a mortar and rubble hardcore base (128). The cut (119) was backfilled with a mix of silty clay and soil (121). The upper brick courses of structure 120 sloped inwards, suggesting that it originally had an arched or corbelled roof. The floor of the first chamber comprised limestone blocks in a mortar bed, that of the second chamber a single ashlar slab.

5.3.14 In the 2000 investigation, parts of an iron mechanism were recorded in the base of the north chamber, and interpreted as part of a sluice mechanism. These parts were missing in 2002, although the interior of the chamber was heavily rust stained. Both north and south chambers were heavily coated with limescale deposits.

5.3.15 South of Structure 120, a further length of the wooden culvert floor (103) was revealed, leading to the collapsed remains of the brick-built arched roof of the culvert (122). It had evidently been originally set on the stone culvert base (104), but had been disturbed by the breaching of the dam in 1940. The backfill behind the constructed brickwork culvert was identified as redeposited dam material (125). The culvert itself was filled with a mix of silty loam, brick fragments and limestone rubble, indicative of a collapse rather than natural silting.

5.3.16 Where the culvert discharged into the stream the west side of the rear of the dam was retained by a brick wall (123), revealed in 16 courses of English Bond brickwork. The backfill behind the constructed brick wall was identified as redeposited dam material (125). The brick wall (123) appeared to replace the Phase 1 stone wall (106) detected approximately 1.4 m further south. The 1940 breach had evidently destroyed the eastern counterpart to 123.

Phase 4 (1940)

5.3.17 The overall line of the 1940 breach in the dam was traced, measuring at least 2.80 m deep x *c*20 m long x 3 m - 5 m wide, following - from the front to the back of the dam - a shallow S-shaped course to the west of the Phase 1 and 2 silt traps and the brickwork of Structure 120 before obliquely crossing the culvert line to emerge from the back of the dam to the SE of the original outflow.

5.4 Between Haymanger Pond and Home Farm Mill Pond

(Figs 2b, 7. Pls 8, 9)

5.4.1 Following a spell of heavy rain in the winter of 2002-3, at a point approximately 150 m upstream from Home Farm Pond, the remains of a small construction (350) were partly revealed in the bed and banks of the brook.

5.4.2 It comprised four flat limestone slabs of varying sizes, originally strapped together by iron staples (two straps were missing), locked into the stone with lead plugs. The slabs were set across the bed of the stream, immediately downstream of an apron made of bricks set in yellowish brown mortar. Against the downstream side of the stone slabs was the remains of a pitched brick apron appearing to slope down into the stream. The slabs and apron effectively made a small weir, the water falling 0.42 m beyond the edge of the slabs. The nature of the east bank suggested that the slabs originally continued to the east, and that the stream was originally wider.

5.4.3 At the upstream end of the apron, a footing - possibly an abutment - of mortared brickwork was noted in the west bank. On the eastern side of the stream, approximately 1.8 m back from the (current) bank edge and in line with the footing, a line of wrought iron railings extended for approximately 4.5 m away from the stream. It was not possible to see if the railings continued further owing to the heavy undergrowth.

5.4.4 *Other features*

During a later examination of this part of the brook (undertaken on 30th May 2003), a partially silted over brick built feature (351) was identified approximately 40 m upstream from construction 350 (see Fig. 2c, Pl.9). It comprised a brick platform extending across the bed of the stream, exposed for a width (NW-SE) of approximately 0.60 m. Aligned

with this, a possible brick abutment (352), similar to that adjacent to structure 350, was identified in the south-western bank.

A possible remnant of timber edging against the south-western bank some 150 m upstream was observed in 2002 by G Marshall. No trace of this was seen during the examination of 30th May 2003.

5.5 Home Farm Mill Pond

(Figs 2c, 2d, 8, 9, 11, 12. Pls 10-19)

5.5.1 The structure of the dam and the character of the deposits within the silted up pond were revealed during the dredging. This enabled a much closer examination of the structure than was possible in 2000.

Phasing

5.5.2 The archaeological phasing has been determined by stratigraphic interpretation. The chronology is interpretative (see Section 7.2)

Phase 1 (Late 18th-early 19th century)

5.5.3 The first phase is represented by a stone faced dam (317), visible in the exposed (upstream) elevation. This was straight, measured approximately 75 m long, and was constructed of regular mortared limestone courses. A maximum height of 1.4 m was exposed, although its full height of 2.4 m can be inferred by the base of the sluice trap 319 (see below).

5.5.4 The relative size of the Phase 1 dam suggests that the contemporary pond was considerably smaller; while early alluviation/silting (314) was identified at the base of the pond deposits that could be contemporary with the early dam, no clear evidence was found of a smaller pond perimeter.

Phase 2 (Mid 19th century)

5.5.5 The stone wall was retained but extended in both length and height with brickwork, presumably to accommodate a larger (and deeper) pond.

5.5.6 The dam was increased in height by 0.95 m, with coursed brickwork topped by limestone capping stones. At either end of the stone dam, foundations of brick and limestone (316), at least 0.40 m deep, carried the brickwork on to form curving 'wings' (315) to the original dam, giving a total length to the Phase 2 dam of approximately 90 m.

5.5.7 The removal of the pond silts revealed two sluices (318 and 319) and an overflow culvert (320).

5.5.8 A bank of dark grey silty clay (302/304), up to 0.54 m in depth, was identified against the base of the dam along its entire length, excepting the sluice openings. This material was fully excavated by hand and machine, and retained only behind the wattle screens either side of sluice 318.

Sluice 318

5.5.9 The structure comprised an opening 0.90 m wide, cut back behind the dam face to a depth of approximately 1.2 m, and extending the full height of the dam - it was incorporated into the stonework of the Phase 1 dam, and the later brickwork was cut back accordingly to accommodate the sluice mechanism.

5.5.10 On the upstream side the sluice inlet was covered by a vertical cast iron trap door. A ring on the face of the door was attached to a hook on the end of a ratcheted rack-and-pinion lifting mechanism, which was still connected to the winding gear above, behind the parapet. A trash grill of square section iron rods in a wooden frame was set between the sides of the sluice opening, It was designed to prevent debris collecting against the vertical trap door and jamming it shut.

5.5.11 At the base of the dam, two spur brick walls projected 0.80 m on either side of the sluice inlet. Against the base of the dam The angle between both spurs and the dam face was spanned by wattle panels (308, 309), each revetting a bank of silty clay (304, 311) sloping back to the dam face. The wattles on the north-west side of the sluice were held against timber posts (306, 307), each a quarter log roughly chopped. One post (307) displayed a carefully cut, but redundant housing, suggesting that it had been re-used from another structure.

Sluice 319

5.5.12 This was situated 2.7 m to the north-west of sluice 318. It comprised two brick walls spaced 1.10 m apart, each 1.25 m high x 0.35 m thick, and originally projecting 2.5 m from the dam face. The front edge of each wall was originally finished with bull-nosed bricks, although both were damaged to some degree, either by decay over time or the machine excavation of the pond silts. The leading vertical edge of the southern wall incorporated a rebate for a timber upright, the base of which survived. Presumably the northern wall originally incorporated a similar upright. Also noted was a timber sill, extending across the gap between the two walls.

5.5.13 At a point 1.4 m from the dam face, an upright timber, measuring 200 mm x 50 mm was incorporated into each wall, projecting approximately 1.0 m above the wall. The collapsed north wall revealed that these timbers were embedded to the full depth of the walls, and originally would have been at least 2.50 m long.

5.5.14 A timber of similar section was fixed to the inside face of each timber using three bolts. The upper parts of both extension timbers were severely decayed, so their original length is unclear, although given the three bolt fixing, they presumably extended to at least the height of the dam parapet.

5.5.15 The bottom end of each extension timber stopped just short of the upper surface of the wall, leaving room for a longitudinal timber, which overlaid the remains of six planks that originally formed a platform spanning the walls. From the decayed fragments, it appears that at least some of the planking was pierced with holes. On the north wall, the longitudinal timber continued beyond the upright, suggesting that the timber platform originally extended out to the leading edge of the walls, and there presumably attached to the upright wooden frame (see 5.5.12). Fragments of a metal trash grill were found in the silts within the confines of Sluice 319, which presumably was originally attached to the front of the structure.

5.5.16 Between the walls was a horizontal brick floor measuring 1.10 m x 1.80 m into which was set a cast iron trap door, of similar dimensions and design to that within sluice 318, and that recovered from Haymanger dam in 2000 (see below). A leather seal was attached to the underside of the door.

5.5.17 Behind the trap door the flat brick floor butted against a stepped incline to the dam face, also constructed of brick.

Overflow 320

5.5.18 The three small inlets of an overflow culvert were incorporated into a curving recess measuring 6.6 m long x 1.35 m wide at the top of the dam. In front of the inlets a moveable iron trash grill was suspended, and behind the inlets a brick lined culvert 2.10 m wide x 1.20 m high led to a cascade and plunge pool on the downstream side of the dam. Where the road along the dam was carried over the inlets, it was strengthened with iron girders. These rested on concrete blocks (which also supported the trash grill frame) positioned between each culvert inlet.

The pond
(Fig. 2c, 11)

5.5.19 The removal of the pond silts exposed evidence of a possible N-S oriented track across the base of the pond. A 20 m long stretch of compacted flinty gravel (321) was exposed, averaging between 3 m and 5 m wide. The surface was indented with what appeared to be wheel ruts, which in places contained fragments of brick and large flint pieces. Two posts were photographed *in situ* alongside the western edge of the track by G Marshall.

6 FINDS
(Pls 20-23)

6.1 Wood

6.1.1 Sixteen waterlogged oak timbers were selected for sampling from structures within Haymanger Dam during the archaeological work in both 2000 and 2002. Six of the timbers dated giving felling date ranges varying from 1734-66 to 1780-1812 and representing at least two phases of construction. Four other timbers matched each other but failed to date conclusively.

6.1.2 Six other waterlogged boards were recovered during the clearing of the mill pond at Home Farm during 2002 of which five were dated, giving a common felling date range of 1892-1909. It is significant that the boards appeared to have been lost in the pond through the process of water seasoning, and that they had been pit-sawn.

6.1.3 The full report on the dendrochronological sampling is contained in Appendix 4.

6.2 Other finds

6.2.1 Two small sherds of 18th-19th century whiteware were recovered from a deposit within the Phase 2 silt trap it the Haymanger Dam.

6.2.2 During the removal of the accumulated silts from the Mill Pond, and examination by G Marshall of exposed features in the pond and upstream in the vicinity of feature 350, a number of metal and stone objects were recovered. Although their provenance cannot be

certain, as they were not in situ, it is likely that they represent functional and/or decorative elements of the dam, its sluices, and associated features. The objects are listed below, and have been retained by the National Trust.

- Iron rack (from a rack-and-pinion gear assembly), measuring a total of 2.89 m long, broken in two pieces. The toothed part measures 0.99 m in length. The rack is bolted to a circular section bar (0.20 m diameter) which ends in a loop, for attachment to the ring on a sluice trap door *(Pl. 20)*. Recovered by G Marshall from within the outline of sluice opening 319.

- Iron trash grille measuring 0.80 m long x 0.30m wide, comprising two flat end-straps, each 0.035 x 0.01 m in thickness, bearing three bars (*c* 25 mm wide)- each with a curved front face and flat rear face *(Pl. 21)*. Recovered by G Marshall from the vicinity of feature 350.

- Fragmentary iron trash grille, measuring 0.79 m long, x 0.30m wide - similar construction to above, although curved faced bars are slightly narrower (*c* 20 mm) *(Pl. 21)*. Recovered by G Marshall from the vicinity of feature 350.

- Iron grille measuring 0.87 m x 0.12 m comprising three rectangular-section iron bars (20 mm x 15 mm) welded to similar section end pieces. There is notably more rust on this object compared to the other two grilles, which might suggest it was recovered from elsewhere. A similar grille was noted in the vicinity of the brick weir (see section 5.4) *(Pl. 21)*. Recovered by G Marshall from the vicinity of feature 350.

- Cast iron trap door attached to a cast iron frame. (This appears to be the trap door discovered by Jessop in the 2000 work at the Haymanger dam, and noted as absent during the 2002 work). *(Pl. 22)*

- Stone globe surmounting a plain stone. Recovered by G Marshall from silts within Home Farm Mill Pond. This could have been a decorative adornment to the parapet. *(Not illustrated)*

- Length of iron chain. Recovered by G Marshall *(Not illustrated)*

7 DISCUSSION AND INTERPRETATION

7.1 The technology of the dams

Roothouse Dam

7.1.1 The surviving elements of the water management system are significantly different to those of the Haymanger dam to require consideration, although it is important to stress that the core of the dam was not exposed in the same way as the dam downstream. The elements exposed were all within the upstream edge of the dam - indeed, almost extending beyond the dam into the pond itself. The first phase structure seems to have been a wooden box sluice, and the stratigraphy suggests that at a later stage a flat trap door valve was inserted, possibly at the same time as trap doors were inserted into the two downstream dams. The frame around the trap door, and the housings within it indicate that a (wooden) access shaft was attached, to allow access to the trap door. The construction of the brick culvert and monk is a later addition, possibly undertaken at the same time as the enlargement of the Home Farm dam.

7.1.2 Interestingly, there was no evidence of a silt trap in the Roothouse construction, unlike the two phases of probably contemporary Haymanger silt trap. Could this be because silting was less of a problem upstream, and if so might this indicate the land use in the immediate environs of both ponds at the time? If (as today) Roothouse pond was bordered by woodland, one might expect less silt accumulation, as opposed to the stream and pond leading down to Haymanger dam, which - according to the walkover survey (see OA03) may have been bordered by heavily cultivated land. This could have produced large quantities of run-off material into the stream.

Haymanger Dam

The evidence for a pre-18th century dam and pond.

7.1.3 In the report on the 2000 archaeological investigation, a first phase of the Haymanger Pond, dating back at least to the early 17th century, was postulated on the basis of the inferences contained in documentary references, although no archaeological evidence was found in support. The 2002 work also failed to find evidence within the dam of a pre-18th century phase of activity.

7.1.4 A watching brief maintained during the dredging of the pond recorded the stratigraphy across the east side of the pond. It comprised blue clay (6) at a depth of approximately 4.2 m, overlaid by up to 2 m of silty sand (5) and banded gravel (4). These deposits appear to be peri- or post-glacial natural deposits. These were overlaid by a layer of silty peat (3), up to 2.0 m deep, which in turn was overlaid by a thin layer of pale brown clay (2) and a thin topsoil (1).

7.1.5 These later deposits appear to represent the life of the pond, its silting up, and possibly the hillwash from modern agricultural activity. However, there was no evidence in the stratigraphy to date the pond silts so whether some relates to the pre 18th century activity remains unconfirmable, but on the basis of the documentary evidence, likely. The slight dip in the interface of layers 5 and 6 at the north-western end of the section could be construed as the line of the original stream.

The development of the dam (Fig.10)

7.1.6 The purpose of the constructions running through the dam were essentially the same through the various phases - to provide a controllable flow of water downstream by a system which would incorporate a screen to prevent the system being clogged by organic debris, and a trap to separate out the waterborne silt from the flow.

7.1.7 In essence the principle of a simple silt trap is that the inlet feeds into a chamber, the floor of which is significantly lower than the outlet. Thus there is an opportunity for waterborne silt to precipitate out of the water in the chamber. The corollary is that the chamber or trap has to be accessible to facilitate the periodic removal of accumulated silt.

The Phasing

7.1.8 The evidence from the dam suggests four phases of activity. Almost no artefactual dating evidence was recovered from the various deposits, with the exception of bricks from the later structures and timbers in use in both Phases 1 and 2. A selection of the timbers were sampled for dendrochronological dating. The full analysis of the samples is detailed by

Miles in Appendix 4. In summary, the results indicated that the earliest datable elements in the construction were built of timber felled between 1734 and 1766, although most were felled between the years 1766 and 1812.

7.1.9 The last of the four phases of activity (the deliberate breach of the dam in 1940) severely damaged the remains of the first three, but it is possible to offer a plausible explanation of how the system worked, how and why it was rebuilt and speculate with reasonable confidence on the reasons for its ultimate failure.

7.1.10 The components of the original system were simply the frame 107, the timber base 103, and the screen/revetment 108. It is suggested that originally a silt box was mounted on frame 107, possibly of the same design as the phase 2 box (see below). The possibility exists that elements of the superstructure of the phase 1 box were re-used for the superstructure of the phase 2 box. The pierced plank (sample stw 31) on the front face of the phase 2 silt box returned an appreciably earlier felling date range than other elements of the phase 2 box. While this is by no means conclusive (the plank could have been cut many years before it was used), it would support such a hypothesis.

7.1.11 The most significant aspect of the Phase 2 structure is the fact that the inlet is raised by approximately 0.20 m in comparison with the level of the Phase 1 structure. This could represent an attempt to alleviate growing problems of silt accumulation in the pond. The deep deposit of peat and organic build-up in the pond, as seen in the section, is arguably testament to this problem.

7.1.12 The brick monk (120) was seen in the 2000 work to contain elements of an iron valve system, although little trace of this survived in the 2002 work. The similarity of the brickwork to that revealed in the Roothouse monk and the Home Farm Mill dam suggest a contemporary date, and the size of bricks used and their composition supports a mid-19th century date. The evidence points to the conclusion that this structure originally extended to the top of the dam, to allow access to the trap valve mechanism.

Between Haymanger Pond and Home Farm Pond
(Fig. 2b)

7.1.13 It would appear that the stream channel from the point where it passes Vancouver Lodge to the Home Farm Pond itself has been straightened, although it may have been done as much for aesthetic reasons as to improve the flow.

Home Farm Mill Dam and Pond
(Figs 11, 12)

7.1.14 The two phases of dam, and their incorporated water control systems are clearly on a different scale to those of Roothouse and Haymanger ponds; the construction here should be seen as part of the establishment of a fully functioning farm and mill complex.

7.1.15 The interpretation of the technology and operation of the dam draws upon the results of this investigation in the light of the reports by Jessop (2000) and that of Marshall (1997b).

The dam

7.1.16 From the upstream elevation, the appearance of two phases in the fabric of the dam is clear, although this is not apparent in the downstream elevation, which displays only the

brick-built second phase. This suggests either that the first phase dam was narrower in cross section, and the Phase 2 downstream façade completely obscured that of Phase 1, or that the construction of the overflow culvert and cascade (320) entailed the total dismantling of the Phase 1 downstream façade, and its replacement in brick.

The mill sluice (318)

7.1.17 From the evidence of the upstream elevation, the sluice was clearly part of the original stone dam, although the surviving trap door and opening mechanism appear to be later additions, presumably added when the dam was raised. No evidence was found to clarify the character of any earlier sluice mechanism, although it could be suggested that the original sluice might have lacked the two brick spur walls. It is tempting to suggest that the presence of bull-nosed bricks in both the spur walls and the brick plinth for the surviving sluice opening mechanism on the top of the dam may indicate contemporaneity.

7.1.18 The vertical wood and iron grille appears to be set within a slot housing on either side of the niche extending the full height of the dam. This seems to suggest that the grill was moveable - presumably to take account of changes in water level, but if so, no trace of a lifting mechanism survives.

Phase 2

7.1.19 The addition of the spur walls and the wattle revetted banks to either side of them appear to be motivated by the need to prevent waterborne debris fouling the sluice inlet.

7.1.20 The outlet of the mill sluice is partially visible in the eastern bank of the stream as a concrete capped brick built culvert extending to the mill itself. It was not possible to ascertain if it originally was a stone-built channel. Further details and a discussion of the mill leat and tailrace can be found in Marshall 1997b.

The pond drainage sluice and culvert - Phase 2 (319)

7.1.21 The pond drainage culvert has been identified by both Jessop and Marshall where it emerges from the downstream face of the dam to the east of the overflow cascade as a brick-lined tunnel, circular in section (see Pl. 15). On the upstream side, this tunnel emerges at the trap door of structure 319. The line of the culvert was not straight - a distinct change of direction is visible a short distance in from the downstream opening. Comparisons of the respective levels on both sides of the dam indicate that the floor of the culvert sloped downwards through the dam by about 0.60 m.

7.1.22 From the upstream elevation, the existing structure 319 appears to be contemporary with the enlargement of the dam (Phase 2). However, presumably there was a sluice and mechanism to enable the pond to be emptied in its Phase 1 guise; no evidence for this was noted in the watching brief.

7.1.23 The trap door set into the brick floor within structure 319 would have been operated from the wooden platform over the spur walls via a linking mechanism. This did not survive in situ, although the length of iron chain found in the silts between the walls may well have been part of the mechanism.

The overflow culvert (320)

7.1.24 The exposure and clearing of the overflow culvert revealed the structure as described by Jessop (2000) and Marshall (1997b). This would act as means of maintaining a consistent head of water in the pond. It is apparent that the structure relates to the Phase 2 dam, although, as with the pond emptying sluice, presumably there was a Phase 1 version, although no trace of it was evident in the watching brief.

Other features downstream

7.1.25 Noted by both Jessop and Marshall was another brick-lined culvert emerging from the western bank some 12 m below the dam. Removal of the pond silts has shown no corresponding sluice on the upstream side of the dam and that, contrary to the presumption, this culvert was not related to the pond water management regime. The most plausible alternative is that this culvert curves to the north-west and extends under the road leading NW towards Dadford. It was perhaps intended to provide surface water drainage.

7.1.26 The drain's emergence from the western bank so far downstream from the dam may have been an attempt to prevent excessive turbulence immediately below the dam, which would threaten the stability of the banks. The timber posts noted by Jessop and Marshall in the stream bed a little beyond the culvert may be the remains of a later extension to the culvert - possibly indicating that the erosion problem still occurred. This possibility is supported by the generally delapidated character of the banks below the dam. As Jessop and Marshall noted, there was clearly brick and stone revetting of both banks immediately below the dam.

The pond

7.1.27 The trackway across the base of the pond yielded no material with which to attempt accurate dating, other than a few brick fragments noted within the wheel ruts. It was presumably constructed to facilitate access to the area in front of the upstream dam face, and it is reasonable to suggest that it may therefore date to the time of the rebuilding of the dam in brick in Phase 2.

7.2 The chronology of the dams

7.2.1 Attempts to devise a chronology for the construction and development of the water management devices on the three sites is very difficult. Clear and contextually secure artefactual dating was almost non-existent, apart from two pottery sherds from one of the deposits encountered at Haymanger Dam. Brick measurements were recorded from elements of each site - they can provide an approximate guide to the age of a structure, in that bricks tend to get thicker, more standardised and harder over time. The results of the measurements suggest that none of the brickwork examined was constructed of pre-19th century bricks, and all the brickwork examined could quite possibly have been built at approximately the same time.

7.2.2 Only dendrochronology provided any means to achieve absolute dating of any of the elements, and, as far as structures were concerned, only in regard to Haymanger Dam. At best the water-seasoned planks suggest a date after the late 19th century for some of the silting within the pond. Therefore, to construct a plausible and useful chronology for the development of the dams we cannot rely on the archaeology alone, and must call upon the documentary evidence. From a combination of the stratigraphy, the artefact dating, the brick typology and the historical evidence, a plausible chronology can be outlined for the

development of the three dams and their water control devices. This is summarised in Table 1.

Table 1: Summary of suggested Cuttle Brook dam and pond chronology

Period	Event
17th century	Documentary evidence of Haymanger (and Roothouse?) as stew ponds
1760's	1. Construction of Roothouse pond dam and Phase 1 wooden sluice
	2. Construction of Haymanger pond dam and Phase 1 wooden silt trap and sluice
1800's	1. Construction of Home Farm and Phase 1 stone dam
1810's	1. Construction of Phase 2 Haymanger dam silt trap
1840's	1. Construction of Roothouse pond brick culvert and flat valve
	2. Construction of Haymanger dam brick monk and flat valve
	3. Construction of brick weir/bridge between Haymanger pond and Home Farm
	4. Construction of Home Farm Phase 2 dam
c 1900	Redevelopment of Home Farm mill as a sawmill
1940	1. Breach of Haymanger dam to drain the pond

7.2.3 The documentary evidence pertaining to the dams' construction and episodic redevelopment has been reviewed by Jessop (2000), and will not be re-iterated in detail here. Suffice it to say that the first mention of the Haymanger ponds is in the 17th century, when they are referred to as 'stew ponds' - it could be inferred that this includes what is later called Roothouse pond. 'Stew' ponds originated in medieval monastic (or, less commonly, manorial) fishpond complexes, as a means of providing small, controllable ponds where young fish could grow, safe from the predatory fishes that would either be present in the wild, or in the main flights of fishponds.

7.2.4 From the existing topography, it is reasonable to presume that these 17th century ponds along the Cuttle Brook must have been dammed, although, as has been mentioned already, no archaeological traces were found.

7.2.5 The construction of the Phase 1 and 2 sluice complexes through the Haymanger Dam would have entailed large scale earthmoving, and this is possibly alluded to in extracts from the historic archive:

1766 - 'wheeling 849 [cubic?] yards of earth in the river at haymanger'

1766 - 'work at haymanger - wheeling gravel'

7.2.6 As Miles says (see Appendix 4) "it was common practice to build timber-framed structures with green or unseasoned timber" as it was easier to work in that state (especially so in the case of oak). Therefore the correlation of these dates with the end date of the felling range for the earliest (and possibly re-used) elements of the Phase 2 silt box

may be more than circumstantial. If a plausible date for the first Phase silt box at the Haymanger could be set at 1766, then there are reasons for concluding that the Phase 2 box was built within a few decades possibly around the year 1810. Two documentary sources suggest major work was underway at this time, possibly to alleviate severe silting problems:

1810 - 'bill for cleaning the mud out of haymanger pond'

1810 - 'bill...for loading and spreading mud out of haymanger pond'

7.2.7 Where does the construction of the brick monk fit in the sequence of development? The brick sizes (Appendix 3) are consistent with 19th century brickwork, and there is no evidence that any of the brickwork examined on any of the three sites is likely to be earlier. While the monk within the Haymanger dam could have been constructed at the same time as the Phase 2 silt box, the observation by Jessop of two ashlar slabs incorporated into the construction, which he suggested derived from the demolished Kennels, situated nearby, would indicate a construction date of between 1843 and 1880. Given the documentary evidence of the onset of a severe financial crisis in 1848, a date early in this range would seem most likely.

7.2.8 The documentary evidence for the construction of Home Farm indicates a date of around 1791 for the initial ground clearance. It may be postulated, therefore, that the Phase 1 dam was built in stone soon after, around the turn of the century. There is no clear dating evidence for the Phase 2 dam; however, it may well have coincided with the rebuilding of the mill in brick, which Marshall suggests occurred in the first half of the 19th century, before 1843 (1997a), and therefore could broadly be contemporary with the other episodes of brick building along the Brook.

7.3 The dams in their landscape

7.3.1 The construction and development of the three dams (and their ponds) are in some ways a reflection of the prevailing enthusiasm for landscape management and manipulation in the 18th and 19th centuries. However, the three sites display a variety of methods by which the ends were achieved, and this also arguably reflects the different purposes of each dam.

7.3.2 Both the Roothouse and Haymanger dams and water control devices appear to begin as modest devices, built of timber. The Roothouse sluice is only partially rebuilt in brick, and the inference is that its efficient operation as a water control device was not considered a high priority. The Haymanger dam seems to have suffered very severely from silting, requiring a rebuild, possibly after a few decades. Again, the efficiency of the sluice arrangement seems not to have been a priority. Even when the brick monk was constructed, the opportunity was not taken to rebuild the entire structure in brick. Yet if the Home Farm dam is, from its original construction, obviously intended to be a reliable power source - why the disparity in building techniques and evident solidity?

7.3.3 The evidence indicates that the Cuttle Brook was not the principal water source for the Home Farm mill - that role was filled by the River Dad. Therefore the propensity of both upstream ponds to silt up would not have been a critical obstacle to the mill's operation. Their existence as aesthetic landscape features, perhaps originating as ?manorial stew ponds, was apparently more important.

7.3.4 The Roothouse and Haymanger ponds and their dams are perhaps best seen as examples of relatively low-profile (metaphorically speaking) landscaping enterprises, an attempt to add variety to a 'natural' landscape, away from the formality and rigidity of the immediate environs of the house, and not influenced by the practical requirements inherent in the larger downstream pond and dam close by the mill. The small weir and possible bridge abutments between Haymanger Pond and Home Farm Mill Pond fits into this scenario, being a decorative addition to what was intended to be a visually varied and diverting landscape.

7.3.5 The Home Farm Mill Dam was clearly a much larger and more practical construction, with its essential function as a power reservoir for the mill overriding aesthetic considerations. The Phase 1 dam, built in stone probably at the end of the 18th century, must have incorporated all three sluice and drain elements evident in the Phase 2 brick-built version, even if no visual evidence survives. The rebuilding of the dam in brick, and the addition of the curving 'wings' to the dam, suggest a bigger pond, and possibly reflects an increased demand for power to the mill.

7.3.6 The rebuilding raised the level of the top of the dam, and presumably this led to the construction of the causeway to carry the roadway from the farm across the valley bottom.

7.3.7 As practical as the dam was, the Phase 2 construction did, however, contain some concessions to visual effect, with its cascade and plunge pool, and limestone parapet either side of the overlying road. The stone found in the pond silts may be a relic of parapet decoration.

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APPENDICES

APPENDIX 1: Archaeological context inventory

Roothouse Dam

Cxt	*Type*	*Width(m)*	*Depth(m)*	*Comments*	*Phase*
1	Structure	0.86 x 0.64	1.73	brick 'monk'	2
2	Layer		0.08	brick surround of 1	2
3	Structure	1.5 x 0.48	0.56	brick culvert	2
4	Structure			part of 3	2
5	Structure	3.3 x 0.8	0.50	timber culvert	1
6	Structure	0.5 x 0.5		timber/iron flow chamber	1
7	Cut	3.3 x 3.0	1.8	repair of culvert 3	3?
8	Layer			natural	
9	Cut	3.3 x 0.8	0.50	construction of 5	1
10	Structure			earth dam	1
11	Cut			construction of 1,3,4	2
12	Fill			backfill of 11 - over 19	2
13	Layer		0.25	topsoil	3
14	Cut	2.1 x 0.5	0.70	construction of 6	1
15	Fill			backfill around 6	1
16	Fill			backfill over 5	1
17	Fill			backfill over 12	2
18	Structure	>3.3 x 0.86	0.47	brick culvert	2
19	Fill			backfill of 11 - under 12	2
20	Structure			timber - part of 5	1

Haymanger Pond

Cxt	*Type*	*Width x Length(m)*	*Depth(m)*	*Comment*	*Phase*
100	Layer			Natural	
101	Cut		0.50	cut for culvert	1
102	Fill			silting of cut 101	1
103	Structure			3 beams under culvert 104	1
104	Structure	0.96	1.00	stone culvert base	1
105	Structure	0.175 x 0.750	0.43	stone culvert base	1
106	Wall	1.80	1.17	stone revetment at back of dam	1
107	Structure	2.70 x 1.76	0.30	timber base of silt box	1
108	Structure	17.0		timber revetment	2
109	Structure	18.0 x 82.0	2.8	earth dam	2
110	Cut	>5.0 x 5.0	>1.3	construction of phase 2 silt box	2
111	Structure	3.0		timber revetment	2
112	Fill	5.0 x 5.0		backfill over 111 and 113	2
113	Structure	1.85 x 1.80	1.10	phase 2 timber silt box	2
114	Deposit		>0.20	silting against dam revetment	2
115	Structure	1.68 x 2.0	0.26	pitched stone base of 113	2
116	Fill	1.50 x 1.20	0.14	clay lining of 113 - pot x 2	2
117	Fill	1.50 x 1.20	>0.50	accumulated fill of 113	2
118	Structure	3.10 x 0.37	0.035	timber culvert base	2
119	Cut	2.60 x 1.60	0.70	construction cut of 120	3
120	Structure	1.90 x 1.20	1.03	brick 'monk'	3
121	Fill	2.60 x 1.60	1.00	backfill around 120	3
122	Structure	1.84 x 0.44		collapsed brick roof of 104	3
123	Structure	1.40 x 1.10	0.70	brick retaining wall at back of dam	3
124	Fill	3.60	0.45	fill of phase 2 culvert	3
125	Fill		0.22	Fill over 122 and 123	3
126	Cut	>20.0 x<5.0	>2.80	cut to breach dam	4

127	Layer	0.60	0.10	original stream bed	nat
128	Fill	1.12 x 1.00	0.40	foundation for 120	3
129	Cut	>5.00		same as 119 on S side of stream	2

Home Farm Mill Pond Watching Brief

Cxt	*Type*	*Width (m)*	*Depth (m)*	*Comment*	*Phase*
301	Layer		2.0	fill of pond	3
302	Layer		0.2	bank against brickwork	2
303	Layer		0.08	early silting of pond	2
304	Layer		0.54	bank against dam	2
305	Layer		-	natural	
306	Post	0.15x <0.80	0.52	tapered, supports wattle 308	2
307	Post	<0.1x <0.08	0.64	tapered, supports wattle 308	2
308	Wattle	2.66	0.35	channel revetment	2
309	Wattle	1.30	0.35	channel revetment	2
310	Layer		0.14	silting over 311 and 309	2/3
311	Layer		0.20	bank against dam	2
312	Layer		0.44	silting over 308 and 313	2/3
313	Layer		>0.10	same as 304 and 311	2
314	Layer		-	alluvium at base of pond	1?
315	Masonry	1.09	0.95	brick wings added to stone dam	2
316	Masonry		>0.40	footings for 315	2
317	Masonry	75.0	1.40	stone dam	1
318	Structure	0.90	1.25	mill sluice	2
319	Structure	2.50	1.25	drain sluice	2
320	Structure	2.10	1.20	overflow culvert	2
321	Layer	0.30	-	gravel/flint trackway	2?

Between Haymanger Pond and Home Farm Mill Pond

350	Structure			weir/bridge abutment	

APPENDIX 2: Gazetteer Of Walkover Survey

OA No.	Description	Grid Ref.	NMR
1	Field boundary following the curve of the Cuttle Brook. The boundary differs in appearance throughout its length from a ditch to a broad, level embankment which is in appearance similar to a ride or carriage way. This feature connects with the Roothouse Dam which the English Heritage Survey of 2000 reports carrying the Northampton drive.	SP 67426 39041	1350193
2	Redundant quarry, possibly used in the construction of the Roothouse Pond	SP 67630 39044	1350222
3	Possible relic ridge and furrow.	SP 67484 38992	
4	Platform on the opposite bank of a tributary of the Cuttle Brook from the former kennels.	SP 67052 38963	
5	Platform on the same bank of a tributary of the Cuttle Brook as the former kennels.	SP 67067 38961	1318500
6	Small brick bridge crossing the Cuttle Brook towards the site of the kennels.	SP 67106 38924	
7	Extant ridge and furrow	Cen SP 66999 38953	1350166
8	Clearly defined lynchet bank above Haymanger pond, possibly defining the original limit of the pond. Probably the same feature as OA 9.	SP 67021 38924	
9	Clearly defined lynchet bank above Haymanger pond, possibly defining the original limit of the pond. Probably the same feature as OA 8.	SP 66927 38859	
10	Single gate pier. Brick.	SP 66784 38136	
11	Area of significant large earthworks as mapped by English Heritage.	SP 66908 37991	1350627
12	Area of probable larger Mill pond now slightly waterlogged ground.	SP 67080 37930	
13	Mill dam, central sluice section of which appears to have been reconstructed. There is a redundant outflow channel on the opposing side of the bridge / dam.	SP 66962 37800	
14	Mill building c. late 19th century. Stone platform to the northern side.	SP 66961 37744	
15	Concrete sheep dip and metal railed sheep enclosure.	SP 66968 37645	
16	Inspection chamber for the mill channel. Brick lined.	SP 69617 37517	
17	Old stream channels or field boundaries forming a pronounced V shaped field corner. The EH survey suggests that this is probably an area of tree planting.	SP 6680 3762	1350854
18	Area of ridge and furrow cut by the drainage channel OA 28. The ridge and furrow runs east / west and curves at both ends towards the north.	SP 66834 37531	1350848
19	Three or Four low broad mounds within boggy area, c. 3-3.5m in width and c.0.55m in height, possibly ridges for tree planting.	SP 66923 37425	
20	Lynchet banks running across east facing hill slope.	SP 66849 37741	
21	Linear earthwork crossing the Dadford stream, visible on both banks of the stream	SP 66745 37246	1350887
22	A substantial former quarry with apparent associated trackways to the north and south. Surveyed at 1:2500 by English Heritage for the National Trust.	SP 66619 36824	1350904
23	Regular earth mound near the north side of the bridge over the Oxford Water, probably the site of an unknown garden feature.	SP 66732 36799	1350913

24	Sub-square raised possible platform c. 12m in width E/W. Stands c. 0.4m in height.	SP 66743 36784	
25	Probable site of a former paper mill, after which the adjacent spinney is named, the site is now marked by substantial fragments of brick wall, and concrete floor which have been incorporated into the dam structure.	SP 66696 36397	
26	Brick built sheep wash of probable mid nineteenth century date. The fabric of the structure included dressed stonework, probably taken from an unknown redundant garden feature. The structure appeared to consist of a number of brick vaulted cells. English Heritage have surveyed the site at 1:2500 scale.	SP 66932 37646	1350812
27	Possible small platform adjacent to OA 17. Measures c. 12m x 2.5m of unclear function.	SP 66813 37606	
28	A post-medieval field boundary cutting the well preserved ridge and furrow OA 18. Ditch is c. 2.5m in width x c. 0.75m	SP 66826 37521	
29	The former stream channel of the Dad Stream surviving as a substantial earthwork, and apparently forming the boundary of the furlong of ridge and furrow to the north OA 18. The channel appears to be cut by the former field boundary OA 28.	SP 66883 37527	1350860
30	A brick arch bridge spanning the Dad Stream. Probably 19th century.	SP 66900 37550	1350821
31	A brick arch bridge spanning the Dad Stream. Probably 19th century.	SP 66943 37673	1350821
32	20th century sheep dip of concrete, apparently now redundant.	SP 66900 37760	
33	Large area of ground disturbance, probable quarrying. One mound of spoil is a regular sub-rectangular feature c. 11m in length x c. 1.2m in height and c. 2m in width and has the appearance of a pillow mound, it is however probably a feature of quarrying activity.	SP 66665 36665	1350904
34	Tree holes extant within grassland probably mark a tree line adjacent to the road. The English Heritage survey of 2000 however, suggests they more recent and may be connected to drainage works.	SP 66772 36895	1350915
35	An area of extant earthworks as shown in the English Heritage survey of 2000.	Cen SP 67054 38225	1350251 1350602 1350610 1350617
36	A brick arch bridge spanning the Cuttle Brook. Probably 19th century.	SP 66984 38188	

APPENDIX 3: Brick sizes

Brick sizes (mm)

Site	Length	Width	Thickness	feature
Haymanger	220	110	70	monk
Roothouse	230	120	80	monk
Roothouse	230	110	70	culvert
Between Haymanger and Home Farm	220	120	70	apron
Home Farm	230	110	60	dam

APPENDIX 4: The Tree-Ring Dating of Timbers from the Haymanger Dam and the Mill Pond, Home Farm *by Daniel W H Miles*

1 Introduction And Objectives

In 1996 the Heritage Lottery Fund provided a grant to the National Trust to purchase the parkland surrounding Stowe Gardens in Buckinghamshire. An additional grant in 1998 has enabled a programme for the restoration of the former parkland features and buildings which is still in progress.

The Haymanger Pond was one of a series of lakes along the Cuttle Brook, above the sawmill at Home Farm (Grid Ref: SP6705 3895). However, the dam holding back the pond was breached and the water drained during the 1940s. The area of water depicted on 19th century maps is may have incorporated one (or more) stew ponds recorded on an estate survey of 1633. However, it is unclear whether elements of these earlier features are incorporated within the pond and dam undergoing restoration.

In order to provide information for the restoration of this feature an archaeological evaluation trench was cut through the breach during 2000 by Gary Marshall and Oliver Jessop, National Trust archaeologists for the Thames and Chilterns Region, examining a partially exposed timber framework. Structural evidence suggests that there are at least three phases of sluice construction after the initial construction of the dam sluice. Unfortunately, not enough evidence survives for a comprehensive reconstruction of the former operation of the sluices.

During 2002, a much larger excavation of the dam by Oxford Archaeology allowed a further sampling opportunity by Gary Marshall. At the same time during the summer of 2002, the mill pond at Home Farm was being cleared of a thick accumulation of silt (Grid Ref: SP6700 3780). It is not known how long since the pond was last cleared, but it was thought to have been before the last war. This pond served a mill at Home Farm, operating since the late 18th or early 19th century. During a watching brief by Oxford Archaeology on the removal of silts from the pond, a group of six boards were discovered within the silt.

The objective of the dendrochronology was to provide a series of dates to help phase the development of the dam structure excavated at Haymanger Pond. It was also important to date the boards found in the Home Farm Mill Pond as they exhibited evidence of pit-sawing.

2 Methodology

All samples were of oak (*Quercus* spp.) taken from what appeared to be primary first-use timbers. During 2000, an initial small-scale excavation was made by Gary Marshall and Oliver Jessop at the position of the sluice box. These were assessed and seven samples were cut using a chain saw. During 2002, following a more extensive excavation by Oxford Archaeology, an additional nine samples were selected and cut by Gary Marshall on the 26th September 2002. The boards and plank revealed by the clearing of the silt in the mill pond were salvaged by Gary Marshall and kept in storage at Home Farm for assessing. All timbers sampled had between 42 and 180 rings, and with some evidence for sapwood.

The samples were numbered using the prefix ***stw*** followed by the sample numbers. Where more than one radii was measured from a single timber, these were labelled ***a*** and ***b***. Samples obtained during 2000 from the Haymanger dam were numbered ***stw21*** - ***stw27***, and those obtained during 2002 were numbered ***stw31*** - ***stw39***. The boards from the mil pond were numbered ***stw41*** - ***stw46***. All timbers were sampled through sectioning, the reduced slices then being frozen for 48 hours before the surface was prepared using sharp paring chisels, or allowed to dry out naturally if there was no sapwood remaining.

The samples were then allowed to thaw for a couple of hours and were then measured under a x10/x30 microscope using a travelling stage electronically displaying displacement to a precision of 0.001mm, rounded to the nearest 0.01mm. After measurement, the ring-width series for each sample were plotted as a graph of width against year. The graphs of each of the samples in the phase under study were then compared visually at the positions indicated by the computer matching and, when found satisfactory and consistent, were averaged to form a mean curve for the site or phase. This mean curve and any unmatched individual sequences were then compared against dated reference chronologies to obtain an absolute calendar date for each sequence.

Here this was accomplished by using a combination of both visual matching and a process of qualified statistical comparison by computer. The samples were first matched by computer, and then independently visually checked with graphs. When an undated sample or site sequence is compared against a dated sequence, known as a reference chronology, an indication of how good the match is must be determined. Although it is almost impossible to define a visual match, computer comparisons can be accurately quantified. Whilst it may not be the best statistical indicator, Student's t-value has been widely used amongst British dendro-chronologists. The cross-correlation algorithms most commonly used are derived from Baillie and Pilcher's Belfast CROS programme (Baillie and Pilcher 1973), compared on an IBM compatible PC. A version of this and other programmes were written in BASIC by D Haddon-Reece, and latterly re-written in Microsoft Visual Basic by M R Allwright and P A Parker.

In comparing one sample or site master against other samples or chronologies, t-values over 3.5 are considered significant, although in reality it is common to find demonstrably spurious t-values of 4 and 5 because more than one matching position is indicated. For this reason, dendrochronologists prefer to see some t-value ranges of 5, 6, and higher, and for these to be well replicated from different, independent chronologies with local and regional chronologies well represented. Where two individual samples match together with a t-value of 10 or above, this may suggest they originated from the same tree.

Once a tree-ring sequence has been firmly dated in time, a felling date, or date range, is ascribed where possible. With samples which have sapwood complete to the underside of, or including bark, this process is relatively straight forward. Depending on the completeness of the final ring, ie if it has only the spring vessels or earlywood formed, or the latewood or summer growth, a *precise felling date and season* can be given. If the sapwood is partially missing, or if only a heartwood/sapwood transition boundary survives, then an *estimated felling date range* can be given for each sample. The number of sapwood rings can be estimated by using a statistically derived sapwood estimate with a given confidence limit. An accepted sapwood estimate for British and Irish oaks is given as between 10 and 55 rings with a 95% confidence range (Hillam *et al* 1987). A recent review of the geographical distribution of dated sapwood data from historic building timbers has shown that a 95% range of 9-41 rings is more appropriate for the south of England (Miles 1997a), which will be used throughout this report. If no sapwood or heartwood/sapwood boundary survives, then the minimum number of sapwood rings from the appropriate sapwood estimate is added to the last measured ring to give a *terminus post quem* or *felled after* date.

Some caution must be used in interpreting solitary precise felling dates. Many instances have been noted where timbers used in the same structural phase have been felled one, two, or more years apart. Where ever possible, a *group* of precise felling dates should be used as a more reliable indication of the *construction period*. It must be emphasised that dendrochronology can only date when a tree has been felled, not when the timber was used to construct the structure under study. However, it was common practice to build timber-framed structures with green or unseasoned timber and that construction usually took place within twelve months of felling (Miles 1997a). The subsequent distortion in the timbers dated clearly show that the wood was converted whilst green.

3 Results

Haymanger Dam

Details of the timbers sampled are shown in Table 1. Samples ***stw27a*** and ***stw27b*** were cut from opposite ends of an *ex situ* plank to obtain the longest possible sequence. These were combined with a *t*-value of 6.09 and an overlap of 63 rings to form the mean ***stw27***.

The individual samples were then compared with each other within their groups. Two samples taken from wedges, ***stw23*** and ***stw24***, were found to match each other with a *t*-value of 10.28, indicating that they had originated from the same tree, and were therefore combined to form the mean ***stw234*** before any further cross-matching was performed.

All the samples were then compared with each other, and two groups were identified. The first consisted of sequences ***stw234***, ***stw27***, and ***stw33***. These matched as shown in Table 2 and were combined to form the 90-year long site master ***STOWE3x***. A preliminary mean ***STOWE3*** excluding sample ***stw33*** was constructed in 2000 before the second batch of timbers were made available (Miles and Worthington 2001). This was compared with the reference chronologies and was dated, spanning the years 1682-1771. The matches with most reference chronologies were poor, but there was consistently better matches between both individual samples and site masters with the other site chronologies ***STOWE1***, ***STOWE2***, and ***STOWE5*** (Table 3). The Stowe reference chronologies also included ***STOWE125*** which is the mean of the above three site masters (Table 4). This chronology produced the best matches for the ***STOWE3x*** material.

The second group consisted of four samples: ***stw25***, ***stw26***, ***stw36***, and ***stw37***. These were combined to form the site master ***STOWE4*** of 90 rings (Table 5). This was compared to over 1000 reference chronologies as well as all the other material from Stowe, but no consistent matches were found.

All remaining samples were then compared individually with the reference chronologies as well as the two site masters and two more were found to date. Sample ***stw31***, despite having only 49 rings, dated satisfactorily at 1727, and sample ***stw32*** was found to date at 1755. Both samples were from planks. The two samples matched together with a *t*-value of 3.03 which does not suggest a similar source.

None of the samples dated retained complete sapwood, but all did at least retain a heartwood/ sapwood transition. Samples ***stw23*** and ***stw24***, which originated from the same parent tree, produced a felling date range of 1780-1812. Sample ***stw27*** produced a felling date range of 1766-98, ***stw31*** gave a felling date range of 1734-66, ***stw32*** produced a range of 1764-96, and ***stw33*** produced a felling date range of 1775-1807.

Home Farm Mill Pond

All six timbers were compared with each other, and five (***stw41***, ***stw42***, ***stw43***, ***stw45***, and ***stw46***) were found to match exceptionally well, suggesting they had originated from the same tree (Table 6). These were therefore combined to form the site master ***STOWE5*** of 180 years. This was compared with the reference chronologies and was found to date, spanning the years 1712-1891 (Table 7). The remaining sample ***stw44*** of 99 years length failed to date.

Taking into account remaining sapwood on several of the samples, the group produced an average felling date range of 1892-1909.

4 Conclusions

Although none of the dated samples from the Haymanger Dam retained bark edge, the felling date ranges from those dated samples with incomplete sapwood suggested at least two phases of construction. The earliest is represented by sample ***stw31*** from the plank with holes in it which produced a felling date range of 1734-66. Possibly coeval with this are samples ***stw32***, again a plank, with a felling date range of 1764-96, and ***stw27***, a plank found loose outside the excavation, which gave a felling date range of 1766-98. The possibility of one or more of these having been either seasoned or reused must also be considered.

The second phase of construction is represented by the two wedges, samples ***stw23*** and ***stw24***, with the estimated felling date range of 1780-1812, and by another plank, ***stw33***, with a felling date range of 1775-1807.

The four riven stakes which were undated may possibly represent another, later, phase of construction. However, the matching between these four samples shows that they are all coeval with each other.

Regrettably samples ***stw36***, ***stw37***, ***stw38***, and ***stw39***, all failed to date, in that they all had complete sapwood and would have helped considerably in the interpretation of the site.

From the mill pond, five of the samples were found to match each other to the extent that they must have been originated from the same tree. This is confirmed by the visual similarities in the boards themselves. As the sapwood appeared to be virtually intact on sample ***stw41***, the most likely felling date would be in the earlier part of the 1892-1909 felling date range.

What is significant about the discovery of these planks is that they had been pit-sawn, proving that this method of conversion was still in use up to the end of the nineteenth century at Stowe, and that the use of water seasoning, or steeping, was employed. This was the method whereby freshly sawn oak would be submerged in running water for a period of time to flush the sap out of the pores, thus allowing it to dry out during the subsequent seasoning much more satisfactorily.

Although this method is no longer used, there are several historic references to this practice. There earliest is by John Evelyn in 1670 who states: "Some there are yet, who keep their Timber as moist as they can, by submerging it in Water, where they let it imbibe to hinder the cleaving; and this is good in Fir, both for the better stripping and seasoning; yea, and not onely in Fir, but other Timber: lay therefore your Boards a Fortnight in the Water, and then setting them up-right in the Sun and Wind, so as it may freely passe through them, (especially during the heats of Summer, which is the time of finishing Buildings) turn them daily; and thus treated, even newly sawn Boards, will Floor far better than a many years dry Seasoning as they call it." (Evelyn 1670, 178)

Richard Neve in 1726 refers to Evelyn and adds "Others advise to lay Boards, Planks, &c. In some Pool, or Running stream for a few days, to extract the Sap from 'em, and afterwards to dry 'em in the Sun, or Air; for by so doing, (say they) they will neither chap, cast, nor cleave: (Mr. Evelin particularily commends this way of Seasoning of Fir) against shrinking there is no Remedy" (Neve 1726, 260).

This method is still advocated in 1840 by Thomas Tredgold who, again quoting Evelyn, writes: "On account of the time required to season timber in the natural way, various methods have been tried to effect the same purpose in a shorter time. Perhaps the best of these is to immerse the timber in water as soon as it is cut down; and after it has remained about a fortnight in water, but no more, to take it out, and dry it in an airy situation". He also refers to Duhamel, who "made many experiments on this important subject, states, that timber for the joiner's use is best put in water for some time, and afterwards dried; as it renders the timber less liable to warp and crack in drying; but he adds, "where strength is required it ought not to be put in water." And he found, from numerous experiments, the timber which had remained some time in fresh water lost more of its weight in drying than that which was dried under cover; and he observed, that green timber that had been steeped in water for some time was always covered with a gelatinous substance."

Given these historic references to the practice of water seasoning, this would suggest that the Stowe estate were converting large oaks by pit-sawing, and carefully seasoning the planks for use in better-quality work. This is especially interesting given the availability of the saw mill at Home Farm, presumably water-powered from the mill pond. Apart from one of the planks which was nearly 30mm thick, the others were thin boards about 12mm thick, and might have been used for panels. The boards recovered from the mill pond were at least three or four metres long, and presumably become lost in the silt, and therefore abandoned.

5 Acknowledgements

The tree-ring dating was commissioned by Gary Marshall, Archaeologist for the Thames and Chiltern Region of the National Trust. Paul Annetts from Stowe Landscape Gardens assisted during 2000 in chainsawing the timbers, and Oliver Jessop assisted in the site interpretation during the first phase of the works. The author is grateful for the assistance of Mr Michael Worthington for assistance in the laboratory and in producing Figure 1. Acknowledgements are also given to the Ancient Monuments Laboratory of English Heritage, Sheffield Dendrochronology Laboratory, and University of London Dendrochronology Laboratory for both published and unpublished data.

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Figure 1: Dated samples in chronological position

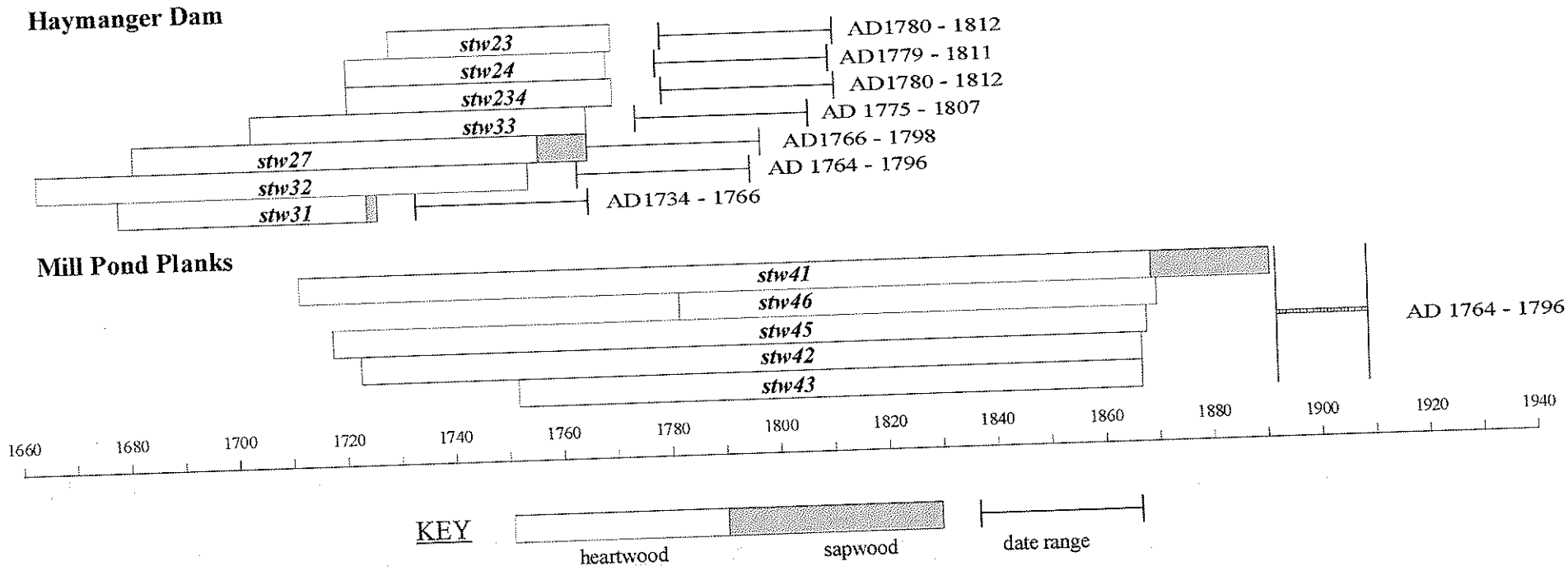

Table 1: Summary of tree-ring dating

HOME FARM, STOWE LANDSCAPE GARDENS

SAMPLE number & type	TIMBER AND POSITION	DATES AD spanning	H/S bdry	SAPWOOD complement	rings	NO OF width mm	MEAN devn mm	STD sens mm	MEAN dates/date ranges (AD)	FELLING SEASONS AND
Haymanger Dam										
stw21	s Part of horizontal frame	-		H/S	Φ44	2.07	0.84	0.265		
stw22	s End of beam with tenon	-		12	⊖41	3.47	0.76	0.208		
stw23	s Wedge	1730-1771	1771	H/S	42	1.29	0.60	0.307	1780-1812	
stw24	s Wedge	1722-1770	1770	H/S	49	1.23	0.51	0.318	1779-1811	
* *stw234*	Mean of *stw23* + *stw24*	*1722-1771*	*1771*	*H/S*	*50*	*1.28*	*0.54*	*0.300*	*1780-1812*	
† *stw25*	s Inclined stake	13-67		H/S	55	2.09	0.67	0.254		
† *stw26*	s Inclined stake	14-62		H/S	49	2.17	0.72	0.237		
stw27a	s Ex situ board	1691-1753	1752	1	63	0.98	0.39	0.272		
stw27b	s ditto	1682-1766	1762	4	85	1.06	0.53	0.278		
* *stw27*	s Mean of *stw27a* + *stw27b*	1682-1766	1757	9	85	1.07	0.48	0.254	1766-1798	
stw31	s Bottom plank with holes	1679-1727	1725	2	49	1.08	0.50	0.276	1734-1766	
stw32	s 2nd uppermost plank	1664-1755	1755	H/S	92	1.23	0.38	0.226	1764-1796	
* *stw33*	s 3rd plank	1704-1766	1766	H/S	63	1.26	0.47	0.294	1775-1807	
stw34	s Lowest square rail	-			47	2.01	0.98	0.203		
stw35	s Stake	-		15C	58	2.22	0.65	0.231		
† *stw36*	s Stake	10-90		26¼C	81	1.86	0.74	0.176		
† *stw37*	s Stake	1-90		28¼C	90	1.44	0.63	0.241		
stw38	s Inclined stake	-		22½C	79	2.33	0.85	0.217		
stw39	s Upright	-			77	1.90	0.64	0.249		
* = ***STOWE3x* Site Master**		**1682-1771**			**90**	**1.13**	**0.48**	**0.257**		
† = ***STOWE4* Site Master**		**1-90**			**90**	**1.70**	**0.66**	**0.195**		
Mill Pond Planks										
§ *stw41*	s Plank	1712-1891	1869	22	180	1.70	0.53	0.197		
§ *stw42*	s Board	1723-1867	1867	H/S	145	1.54	0.51	0.189		
§ *stw43*	s Board	1752-1867	1867	H/S	116	1.35	0.44	0.230		
stw44	s Board	-		H/S+11NM	99	1.36	0.57	0.217		
§ *stw45*	s Board	1718-1868	1868	H/S	151	1.81	0.64	0.218		
§ *stw46*	s Board	1782-1870	1870	H/S+9NM	89	1.06	0.42	0.201		
§ = ***STOWE5* Site Master**		**1712-1891**	**1868**	**23**	**180**	**1.61**	**0.46**	**0.179**	**1892-1909**	

Key: *,†,§ = sample included in site-master; c = core; mc = micro-core; g = graticule; ⊖ = pith included in sample; Φ = within 5 rings of centre; Ω = within 10 rings of centre
¼C,½C,C = bark edge present, partial or complete ring: ¼C = spring (ring not measured), ½C = summer/autumn, or C = winter felling (ring measured);
H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity

Table 2: Matrix of t -values and overlaps for components of STOWE3x

Sample:	***stw27***	***stw33***
Last ring date AD:	1766	1766
stw234	7.93	4.13
	45	45
	stw27	6.08
		63

Table 3: Dating of components and masters of STOWE3x against reference chronologies

Sample:	***stw234***	***stw27***	***STOWE3***	***stw33***	***STOWE3x***
Last ring date AD:	1771	1766	1771	1766	1771
STOWE1	4.35	4.36	5.03	2.04	4.46
	30	70	70	48	70
STOWE2	4.49	5.45	5.33	2.62	4.99
	50	84	89	63	89
STOWE5	3.50	4.91	4.12	2.95	3.86
	50	55	60	55	60
STOWE125	4.85	6.35	6.03	3.16	5.65
	50	85	90	63	90

Table 4: Matrix of t -values and overlaps for components of STOWE125

Sample:	***STOWE2***	***STOWE5***
Last ring date AD:	1776	1891
STOWE1	3.58	3.22
	69	40
	STOWE2	7.56
		65
		STOWE5

Table 5: Matrix of t -values and overlaps for components of STOWE4

Sample:	***stw26***	***stw36***	***stw37***
Last ring date AD:	62	90	90
stw25	5.16	4.68	5.17
	49	55	55
	stw26	6.92	5.70
		49	49
		stw36	8.62
			81

Table 6: Matrix of t -values and overlaps for components of STOWE5

Sample:	***stw42***	***stw43***	***stw45***	***stw46***
Last ring date AD:	1867	1867	1868	1870
stw41	10.27	7.42	8.21	8.96
	145	116	151	89
	stw42	7.20	9.38	6.25
		116	145	86
		stw43	5.59	6.18
			116	86
			stw45	7.58
				87

Table 7: Dating of STOWE5 against reference chronologies at AD 1891

	Reference chronology	**Spanning**	**Overlap**	**t-value**
	STOWE1 *(Miles and Worthington 1998)*	1610-1751	40	3.22
*	**EASTMID** *(Laxton and Litton 1988)*	882-1981	180	6.20
	HANTS97 *(Miles 1997b)*	443-1972	180	6.77
*♣	**ENGLAND** *(Baillie and Pilcher 1982)*	404-1981	180	7.48
*	**MC19** *(Fletcher 1978)*	1399-1800	89	7.48
	STOWE2 *(Miles and Worthington 1998)*	1683-1776	65	7.56
	WALES97 *(Miles 1997c)*	404-1981	180	8.00
	MASTERAL *(Haddon-Reece and Miles 1993)*	404-1987	180	8.57

Chronologies shown in **bold** are composite chronologies

* Component of MASTERAL
♣ Component of WALES97

APPENDIX 5: Summary of Site Details

Site name: Cuttle Brook Restoration Project, Stowe, Buckinghamshire
Site code: STCUB 02
NGR: SP6768 3930 – SP6670 3640.
Date and duration of project: August-October 2002
Area of site: 4 km length of Brook Channel
Summary of results: The principal discoveries were elements of timber and brick water control devices, probably dating to between the mid-18th century and the mid-19th century.

Location of archive: The archive is currently held at OA, Janus House, Osney Mead, Oxford, OX2 0ES, and will be deposited with the National Trust in due course, under the following accession number: STCUB02

Server10(W):/OAUpubs 1/R to Z/S_codes*STCUBPX*Stowe Cuttle Brook*ACT*17.06.03.

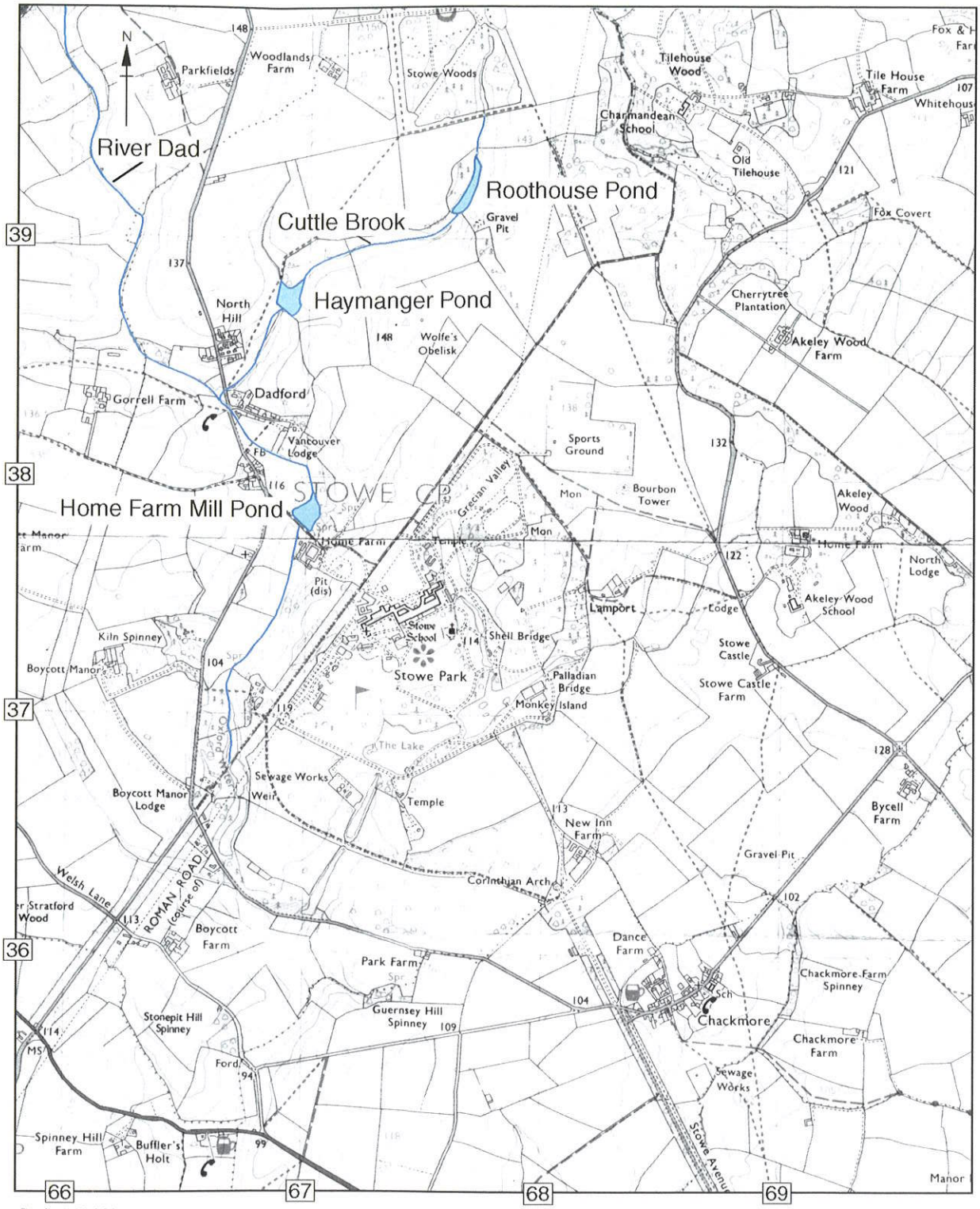

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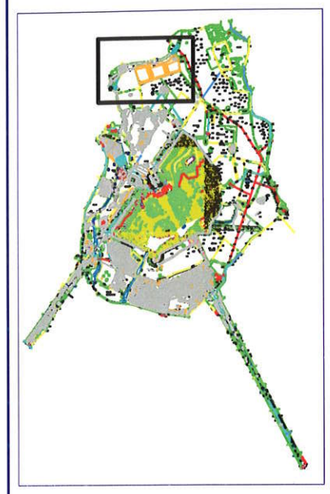
Figure 1

Stowe Gardens

Oxford Archaeology Walkover Survey (over EH Survey Data)



Perimeter of pond

Roothouse Dam

Figure 3

Figure 5 Section 2

Perimeter of pond

Haymanger dam

Figure 4a

North

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1:2500

Key

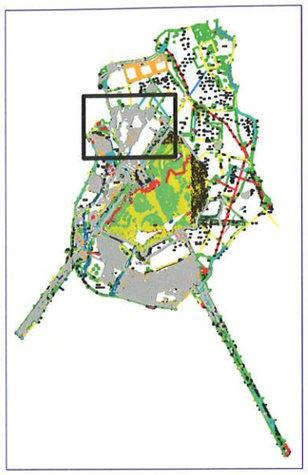
- OA Survey - Earthwork
- OA Survey - Quarry
- OA Survey - Ridge & Furrow
- OA Survey - Structure

Figure 2a

Stowe Gardens

Oxford Archaeology Walkover Survey

(over EH Survey Data)



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- OA Survey - Structure

Fig 2b

Timber edging?

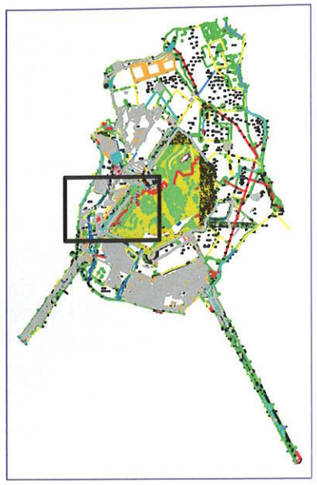
Structure 351
PL.9

Structure 350
Figure X PL.8

Perimeter of pond

Stowe Gardens

Oxford Archaeology Walkover Survey (over EH Survey Data)



Trackway

Perimeter of pond

Culverts / plunge pool

Home Farm Mill dam

Approximate location of outflow from mill

Approximate position of mouth of tailrace culvert (Marshall 1997B)

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Figure 2c

Stowe Gardens

Oxford Archaeology Walkover Survey

(over EH Survey Data)

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Key

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- OA Survey - Quarry
- OA Survey - Ridge & Furrow
- OA Survey - Structure

Figure 2d

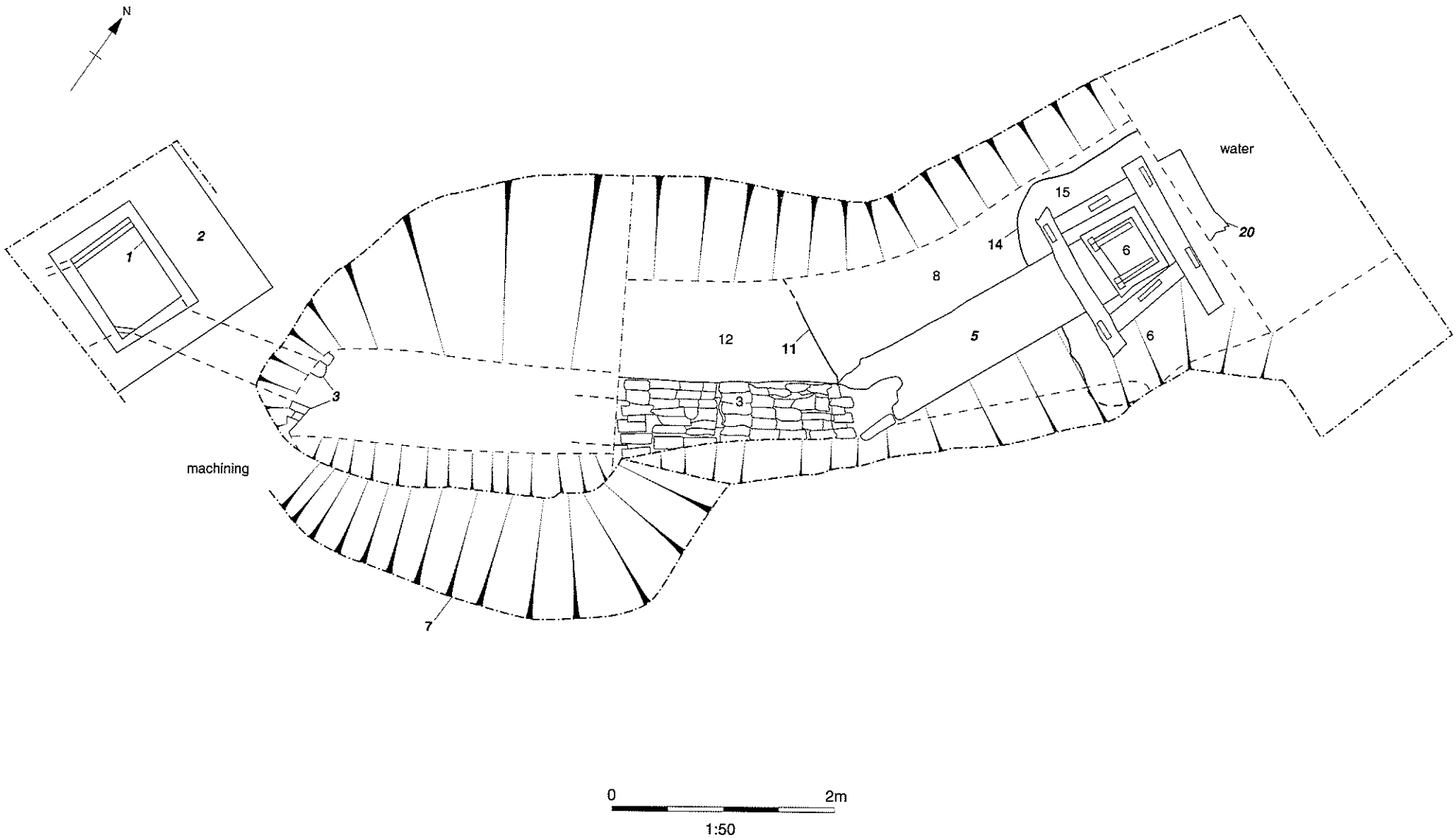


Figure 3

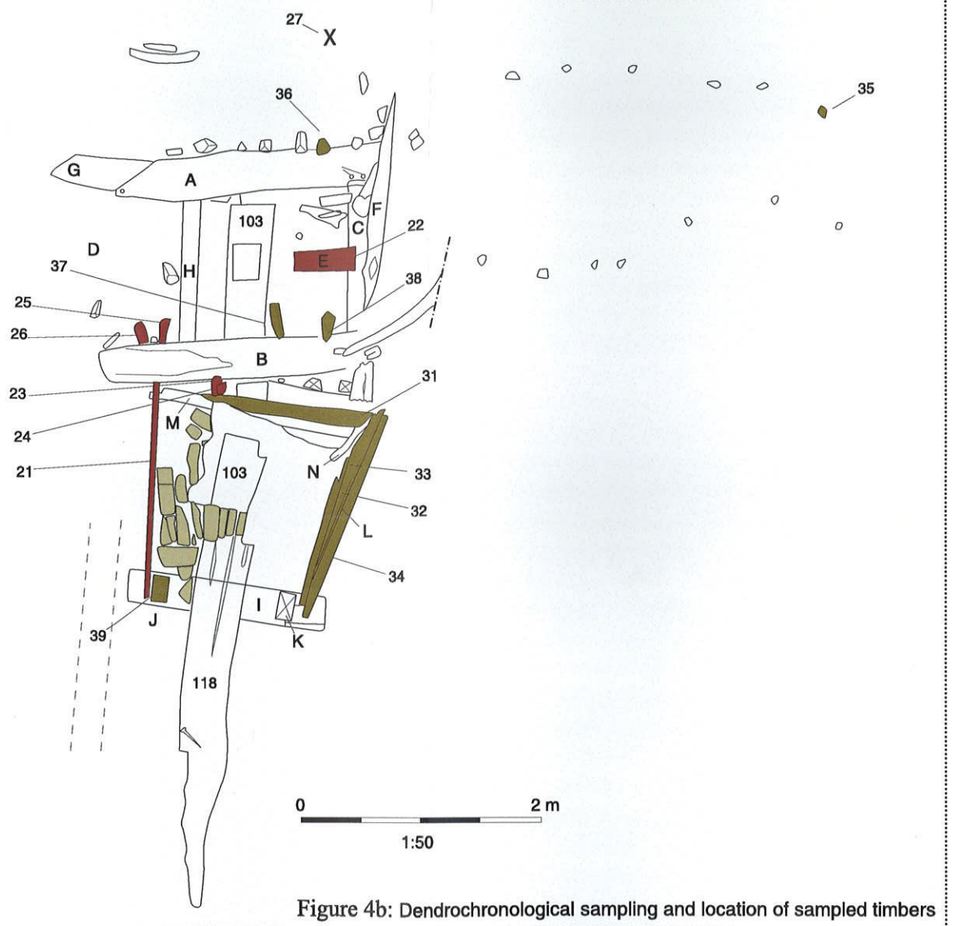


Figure 4b: Dendrochronological sampling and location of sampled timbers

Stone

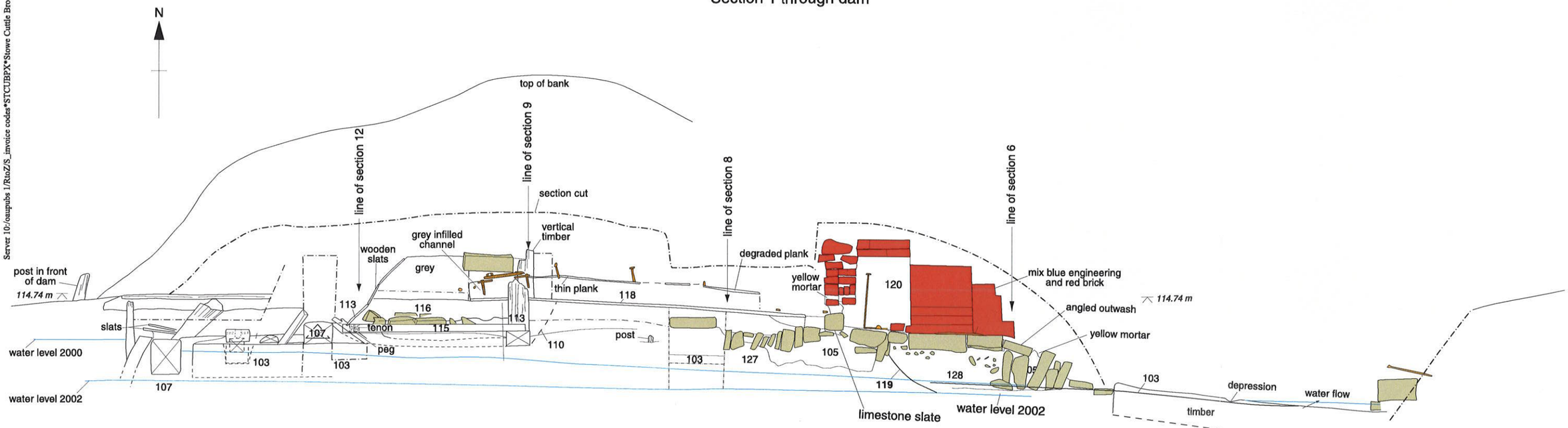
Brick

Sampled 2002

Sampled 2000
- timbers not present
in 2002 (except 22)

Figure 4a

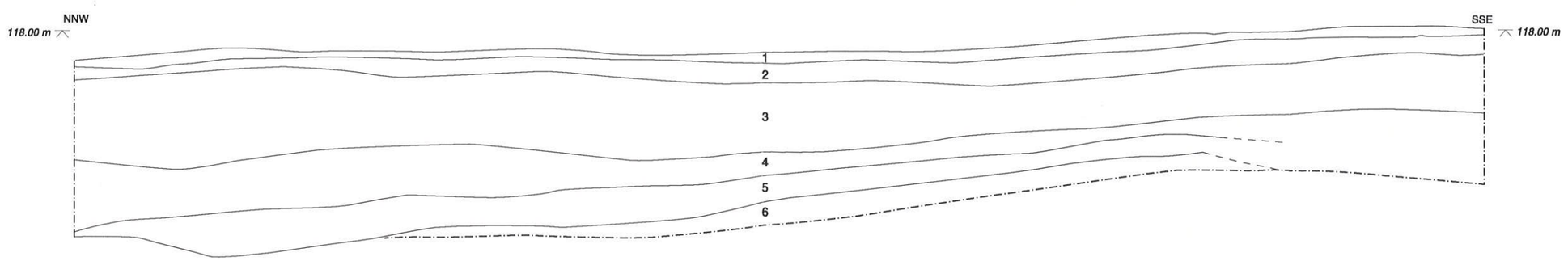
Section 1 through dam



0 2 m

1:50

Section 2 through pond deposits



0 5 m

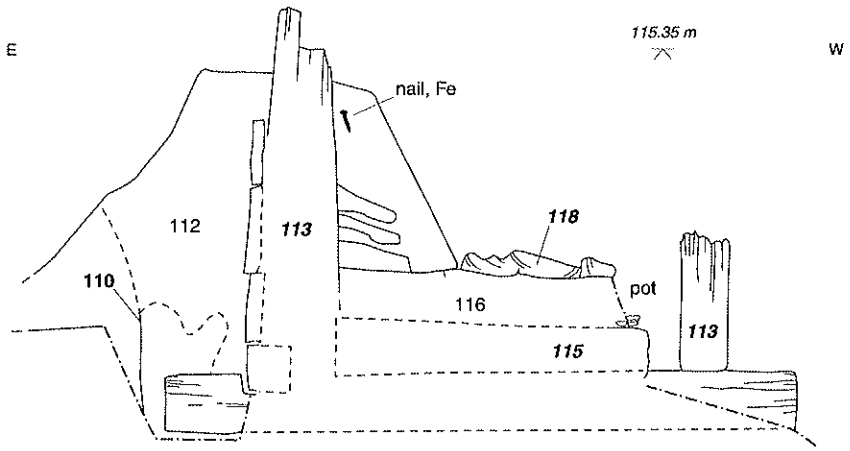
1:100

Stone

Brick

Figure 5

Section 9



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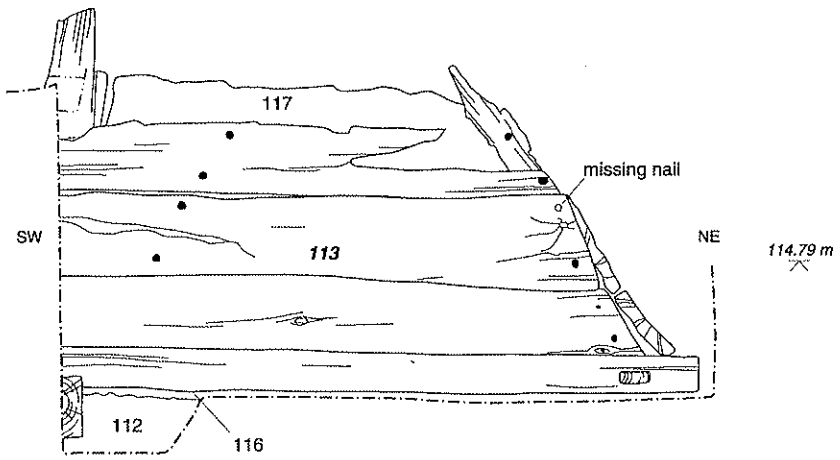

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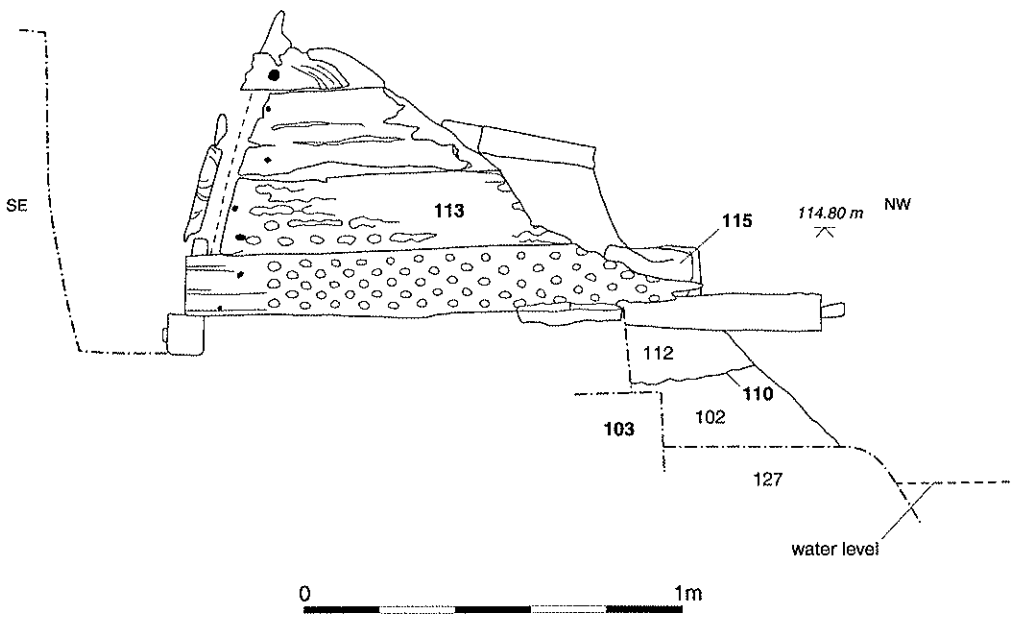
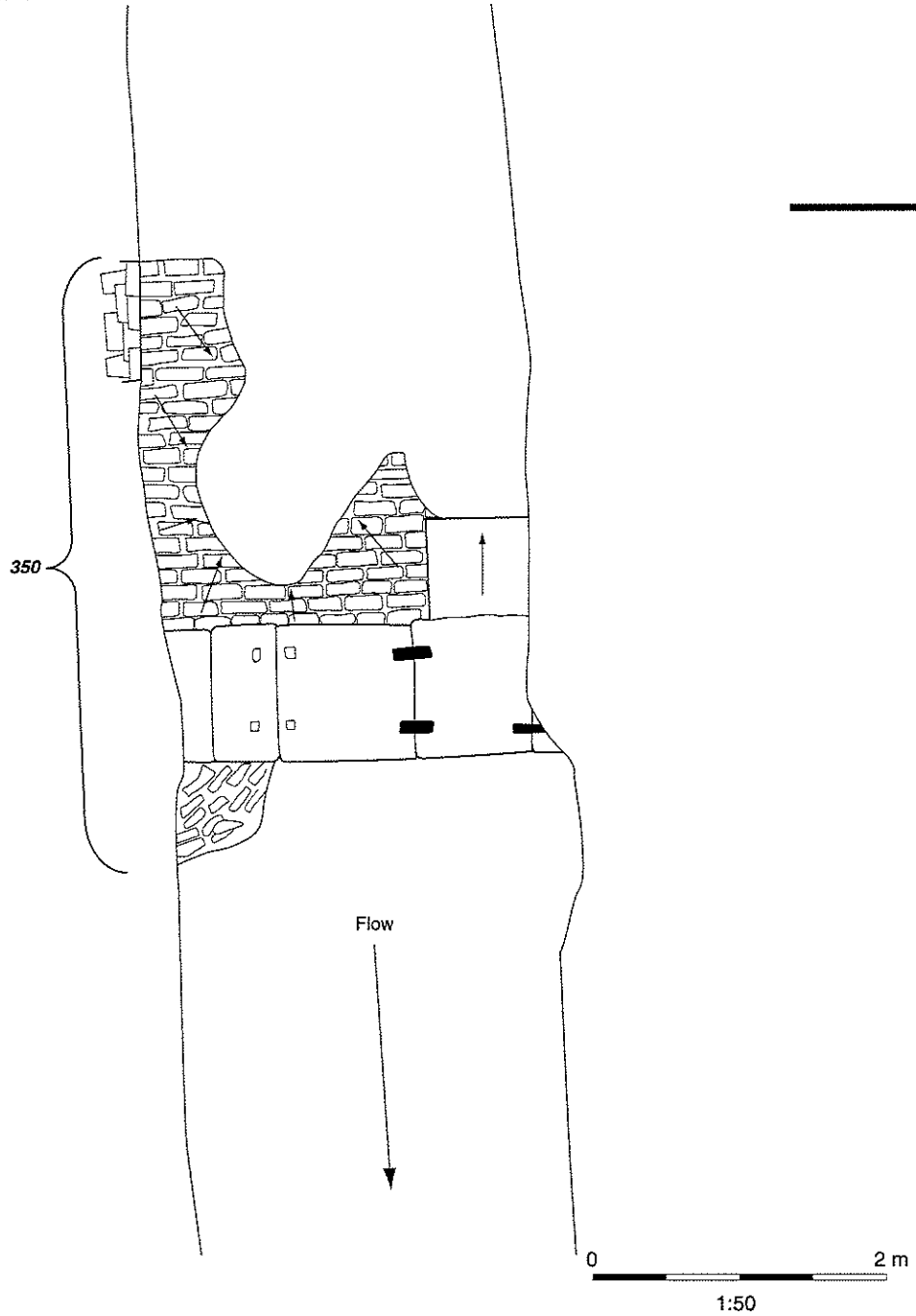


Figure 6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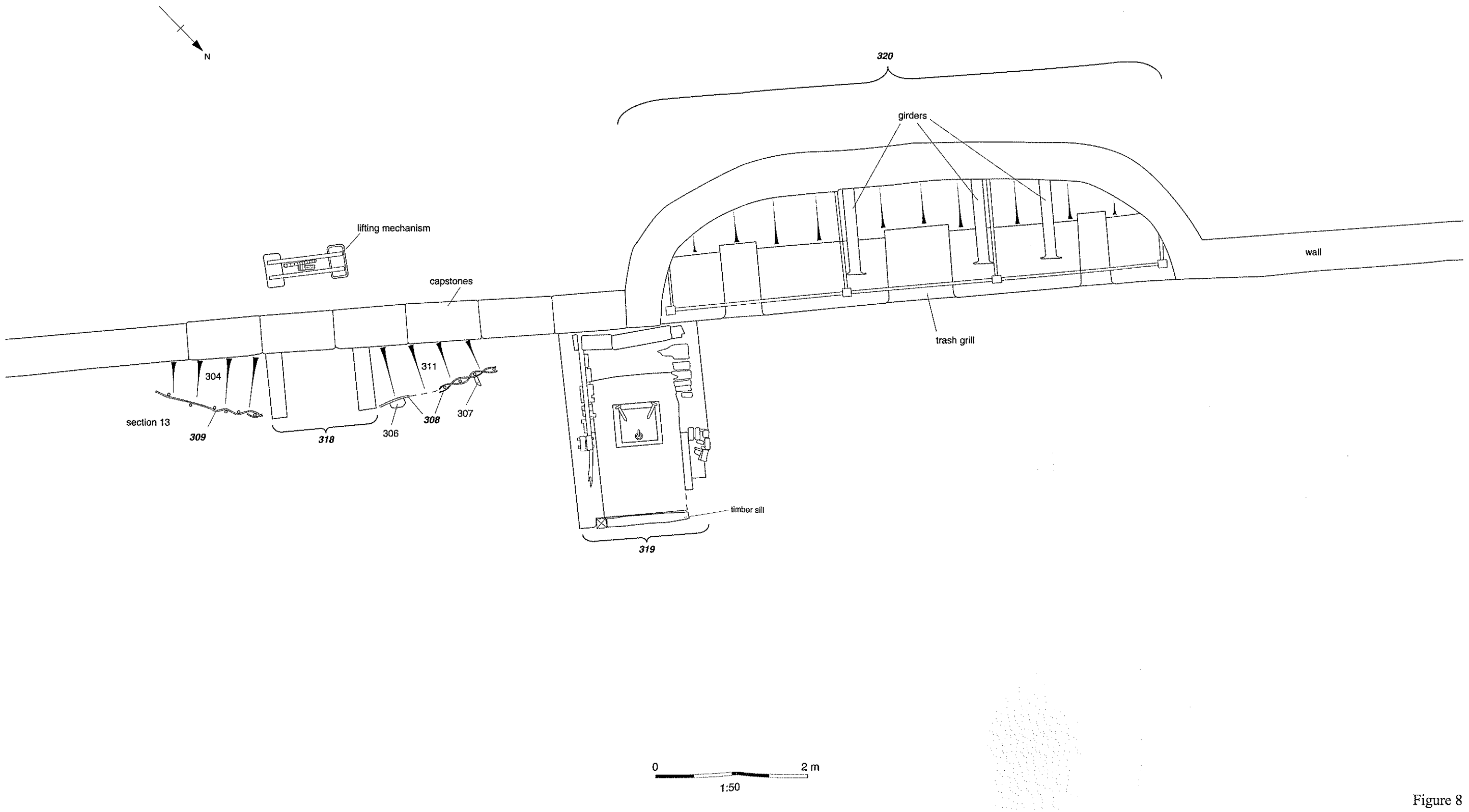
Server 10:/oaupubs1_RtoZ/S_invoice codes*STCUBPX*Stowe Cuttle Brook*ACT*12.03.03
Railings
350
Flow
0
2 m
1:50

Figure 7



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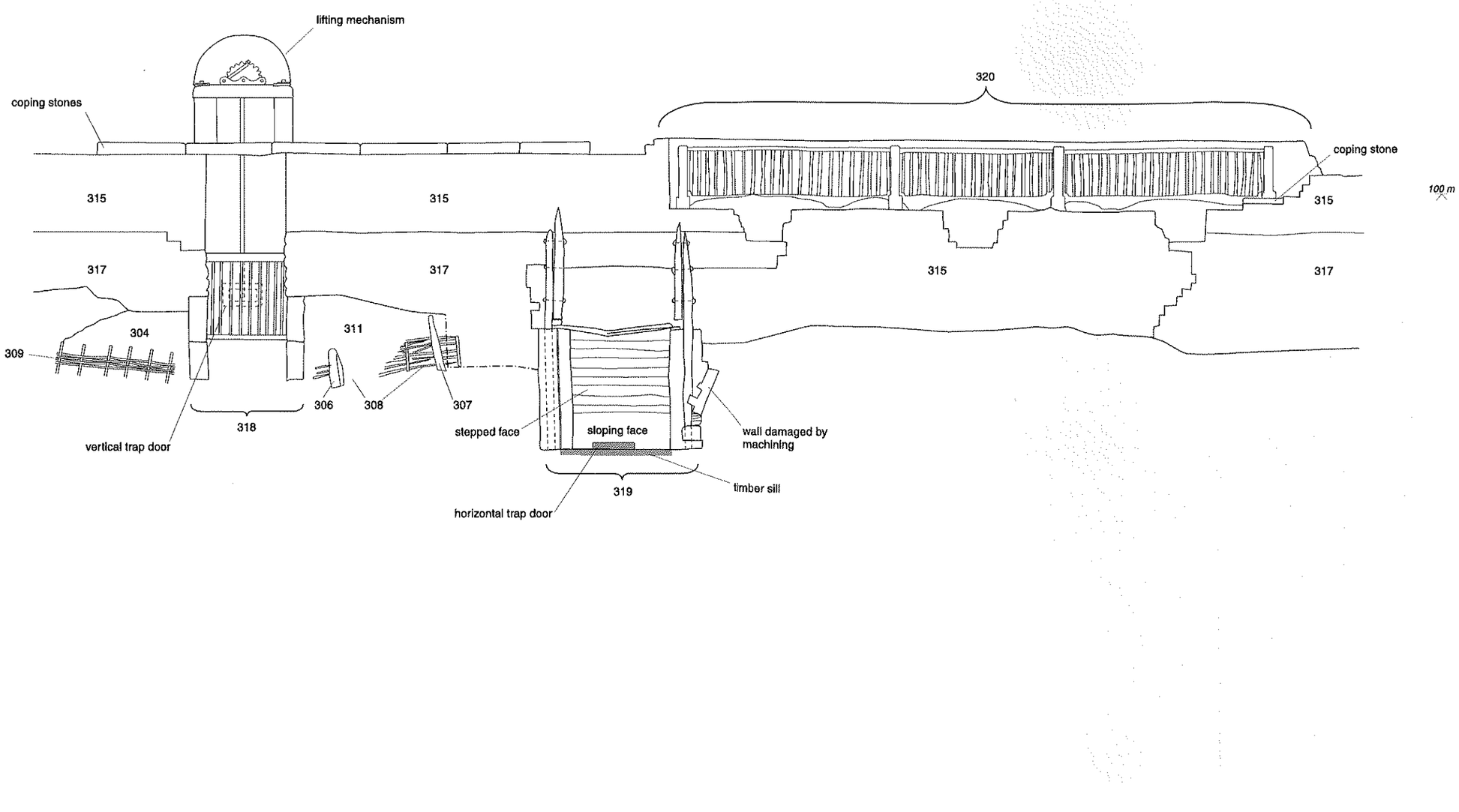
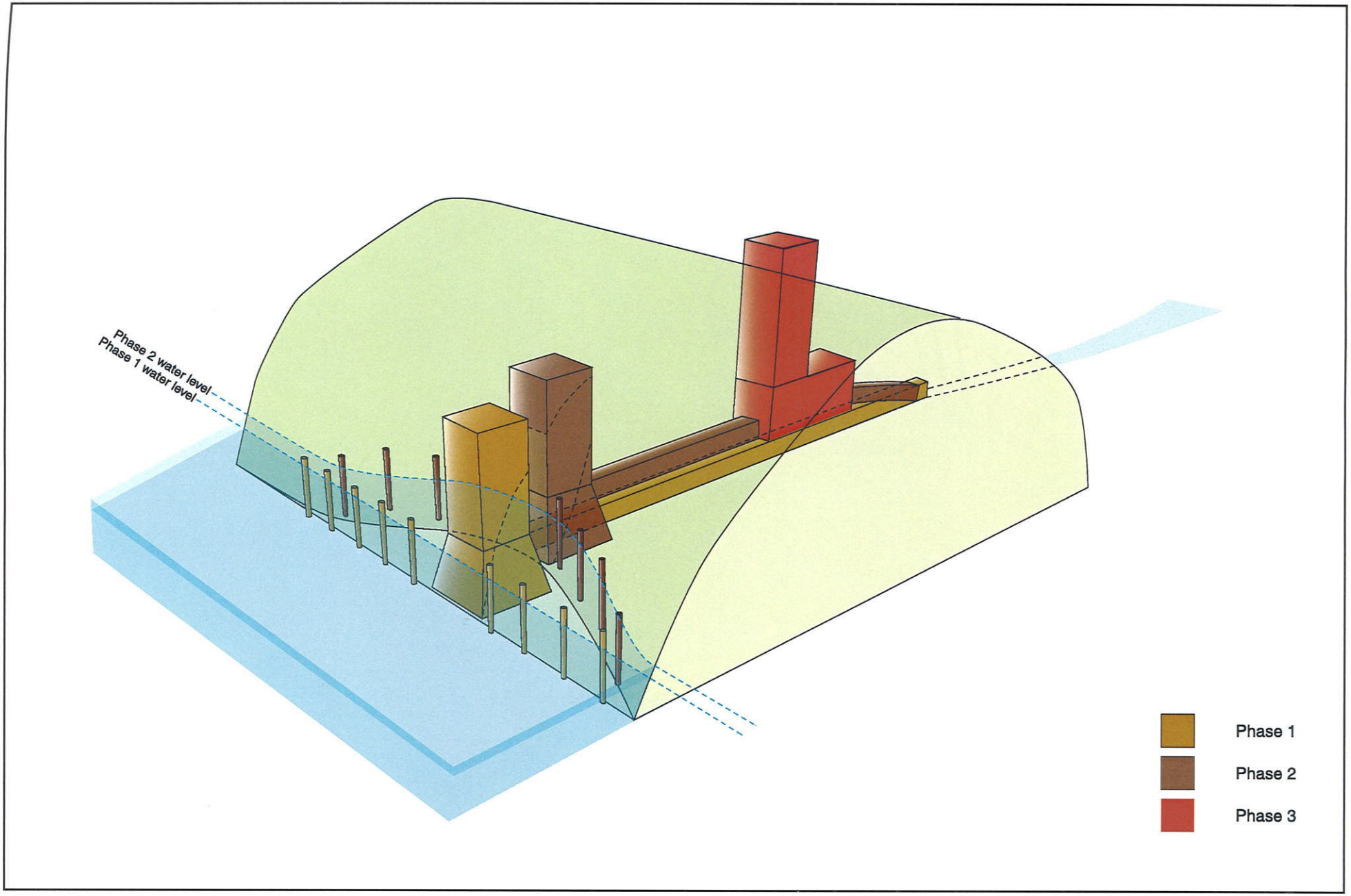


Figure 9



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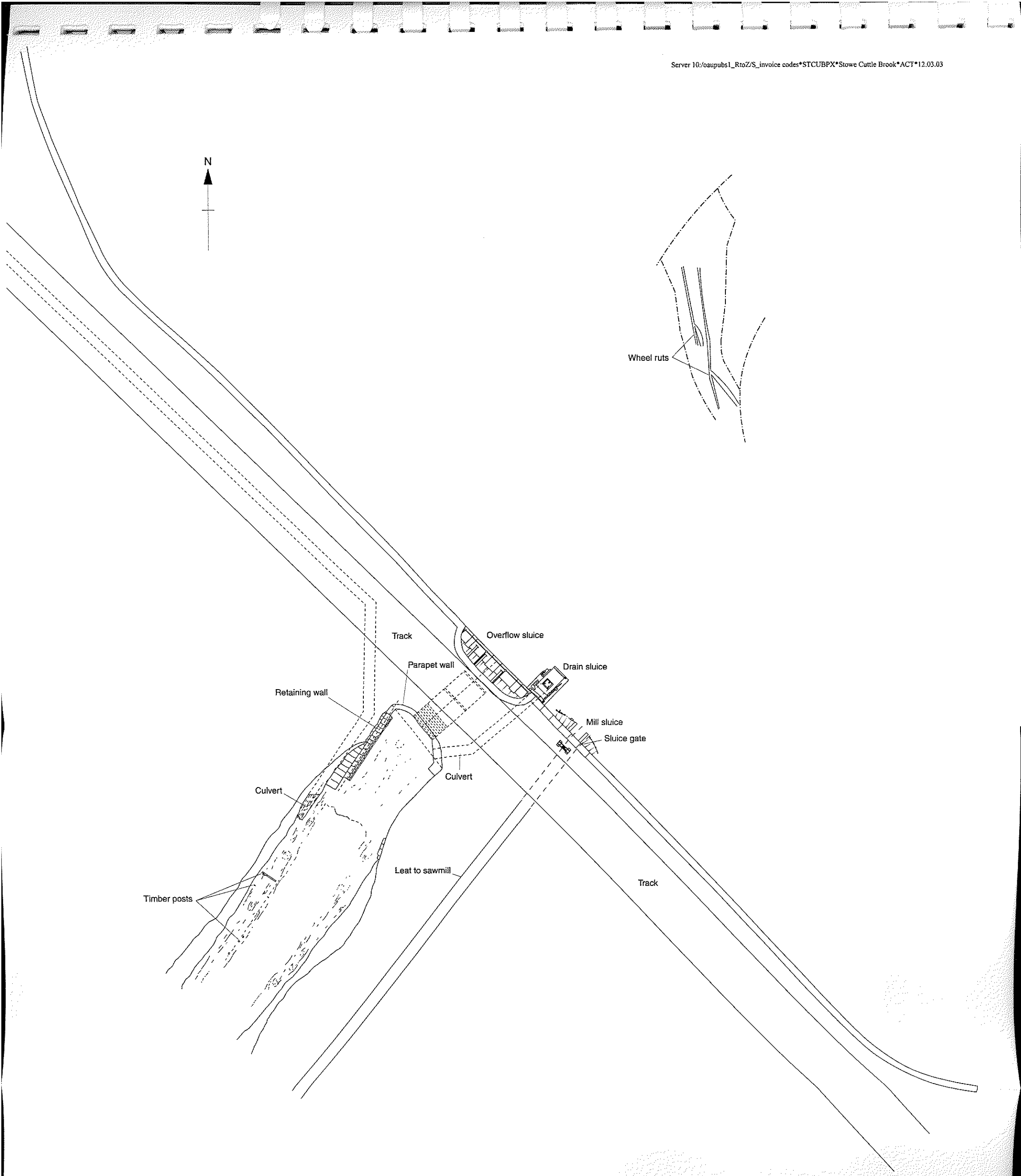

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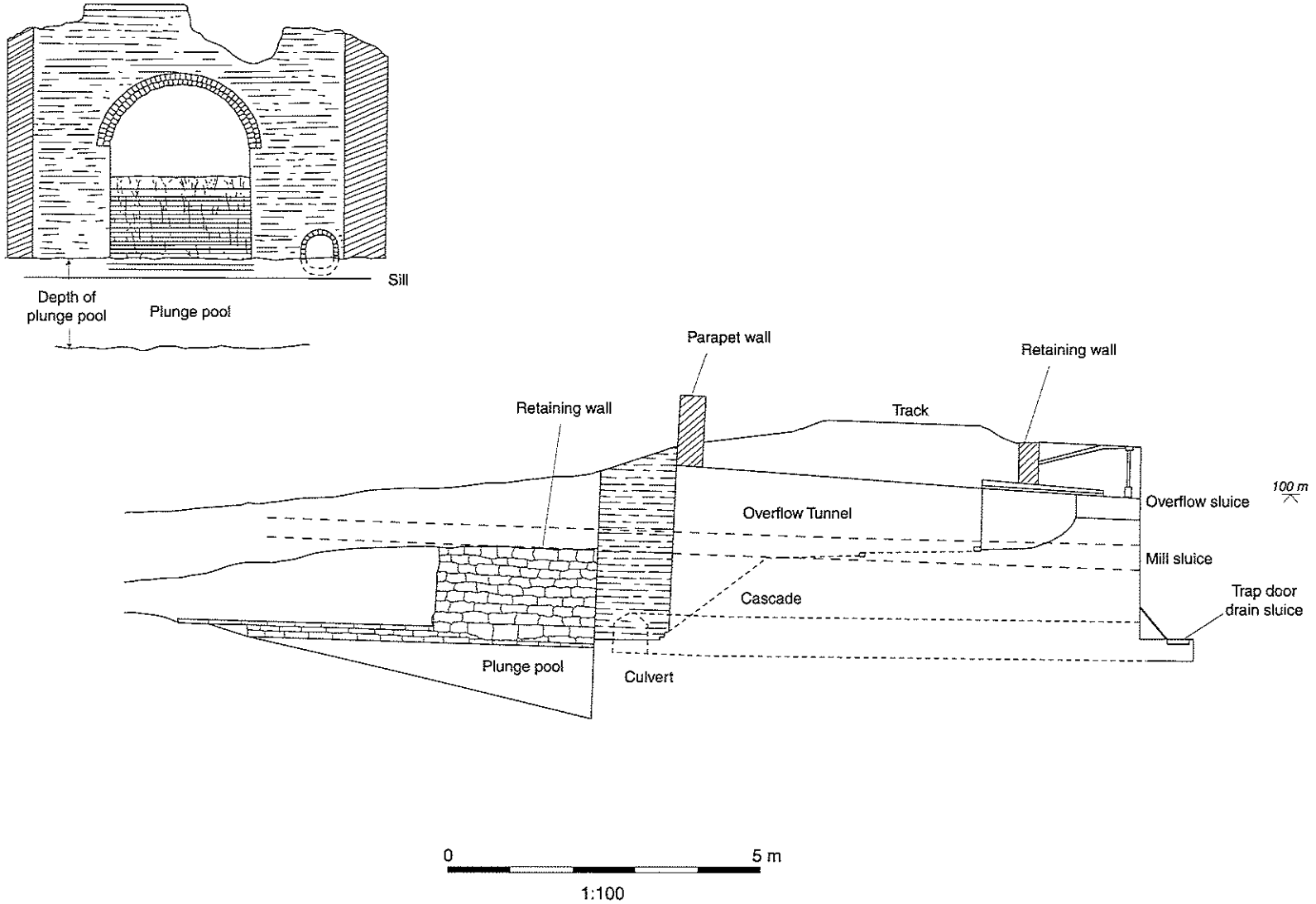

Figure 12

Plate 1

Plate 2

Plate 3

Plate 4

Plate 5

Plate 6

Plate 7

Plate 8

Plate 9

Plate 10

Plate 11

Plate 12

Plate 13

Plate 14

Plate 15

Plate 16

Plate 17

Plate 18

Plate 19

Plate 20

Plate 21

Plate 22

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