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ARCHAEOLOGICAL EXCAVATION REPORT
A LATE MEDIEVAL / EARLY POST-MEDIEVAL SALTERN AT ST. MICHAEL'S LANE, WAINFLEET ST MARY, LINCOLNSHIRE

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LCNCC Acc No. 210.98
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Summary

* *An archaeological excavation was carried out at a late medieval / early post-medieval salt-making site at St Michael's Lane, Wainfleet St Mary, Lincolnshire (Fig. 1). This phase of work followed an earlier trial trenching evaluation.*

* *Twenty one filtration units, associated waste mounds and three possible hearth areas were exposed during the excavation.*

* *Environmental sampling established the presence of a lagoon in the north east part of the site. Reference to the results of an earlier excavation by English Heritage (McAvoy 1994) at an adjacent site, have shown this to be one of a series of such features associated with each saltern.*

* *Analysis of environmental samples associated with filtration units and waste mounds revealed that the silt which was processed at the saltern was derived from the lagoon on site.*

* *Analysis of a midden deposit suggested that the salters lived close to the site and possibly operated a mixed economy combining small scale agricultural activity with salt-making.*

* *A small quantity of pottery from both local (Toynton/Bolingbroke) and imported (Raeren) sources was recovered. Brick fragments, including a glazed piece similar to those used for the diaper work on Magdalen College, Wainfleet (built 1484) were also found. These artefacts suggested a late fifteenth to sixteenth century date for the main period of activity on the site.*

1.0 Introduction

An archaeological excavation was carried out by Pre-Construct Archaeology (Lincoln) on a site to the north east of St. Michael's Lane, Wainfleet St. Mary, Lincolnshire (Fig. 1). The excavation represented the final phase of an archaeological scheme of work which followed an earlier trial trenching evaluation (Albone 1998). The archaeological work was commissioned by Hugh Bourn Developments (Wragby) Ltd. to fulfil a planning requirement issued by East Lindsey District Council (Ref. S/195/1697/97) prior to the construction of a residential housing development.

A copy of this report will be deposited at the County SMR and the City and County Museum, Lincoln, accompanied with an ordered project archive which will encompass both the evaluation and excavation results. A copy of the full report on the excavation will be published on the Internet and a short text will be submitted for inclusion in the county journal, *Lincolnshire History and Archaeology*.

2.0 Location and Description

Wainfleet St. Mary is situated in the administrative district of East Lindsey, approximately 9 km south west of Skegness and 22 km north east of Boston. The site is centred on NGR TF 4978 5773, where the mean height above sea level is approximately 4 m OD. The site lies on a broad, but low strip of land (Wainfleet Tofts) which separates the coastal marshes of the Wash from the freshwater fen and River Steeping.

3.0 Archaeological and Historical Background

3.1 Background to the Site and Wainfleet St Mary

The area of the Wash has been recognised as having a high archaeological potential (English Heritage 1996). A predominant reason for this are the extensive remains of salt-making sites which can be found around its periphery. Salt-making, the origins of which can be traced back as far as the Bronze Age (Palmer-Brown 1993), was an important industry on the Lincolnshire Coast and around the Wash.

Wainfleet St Mary lies within a band of salt-making sites along the northern edge of the Wash. Extant remains of the late medieval salt-making industry lie 350 m. to the south west of the excavation site. These earthwork remains consist of a series of long waste mounds and are a Scheduled Ancient Monument (see Fig. 1). Excavation of part of this earthwork site was carried out by the Central Excavation Unit of English Heritage in 1984. The excavation revealed a variety of features associated with the salt-making process, including filtration units, clay-lined pits, a hearth and the remains of the waste mounds themselves. Only a relatively small quantity of pottery contemporary with the salt-making activity was recovered during the excavation. Worked leather, including parts of boots and shoes, was recovered from some of the clay lined pits (McAvoy 1994).

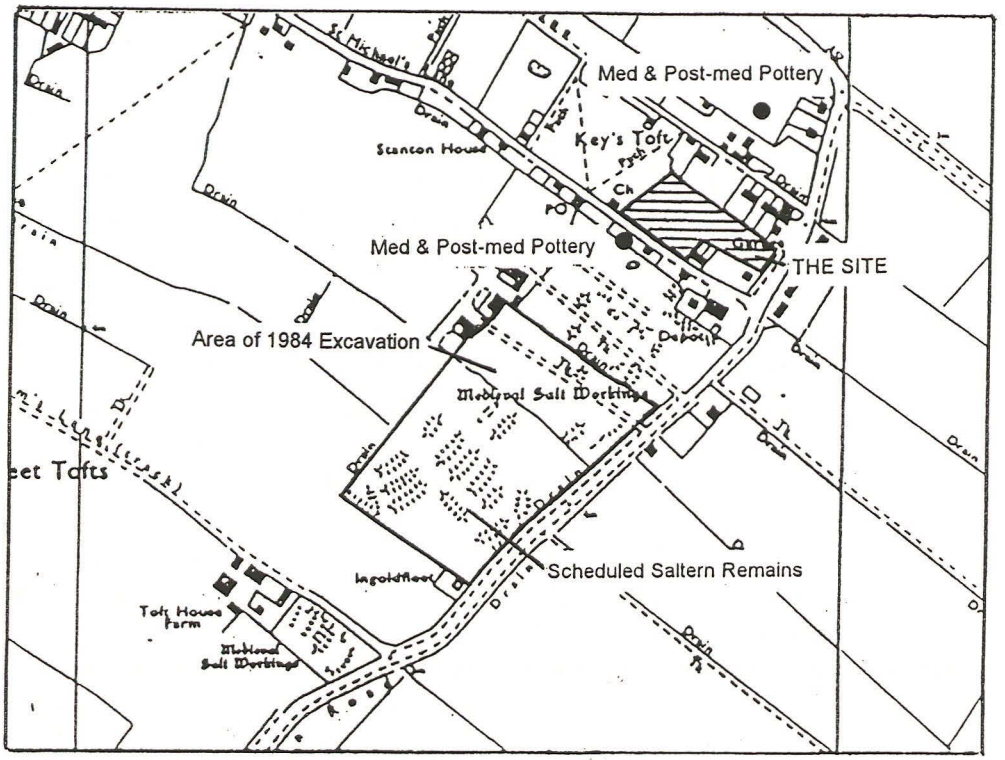

Fig. 1: Site location incorporating principal entries from the County Sites & Monuments Record (1:10000)
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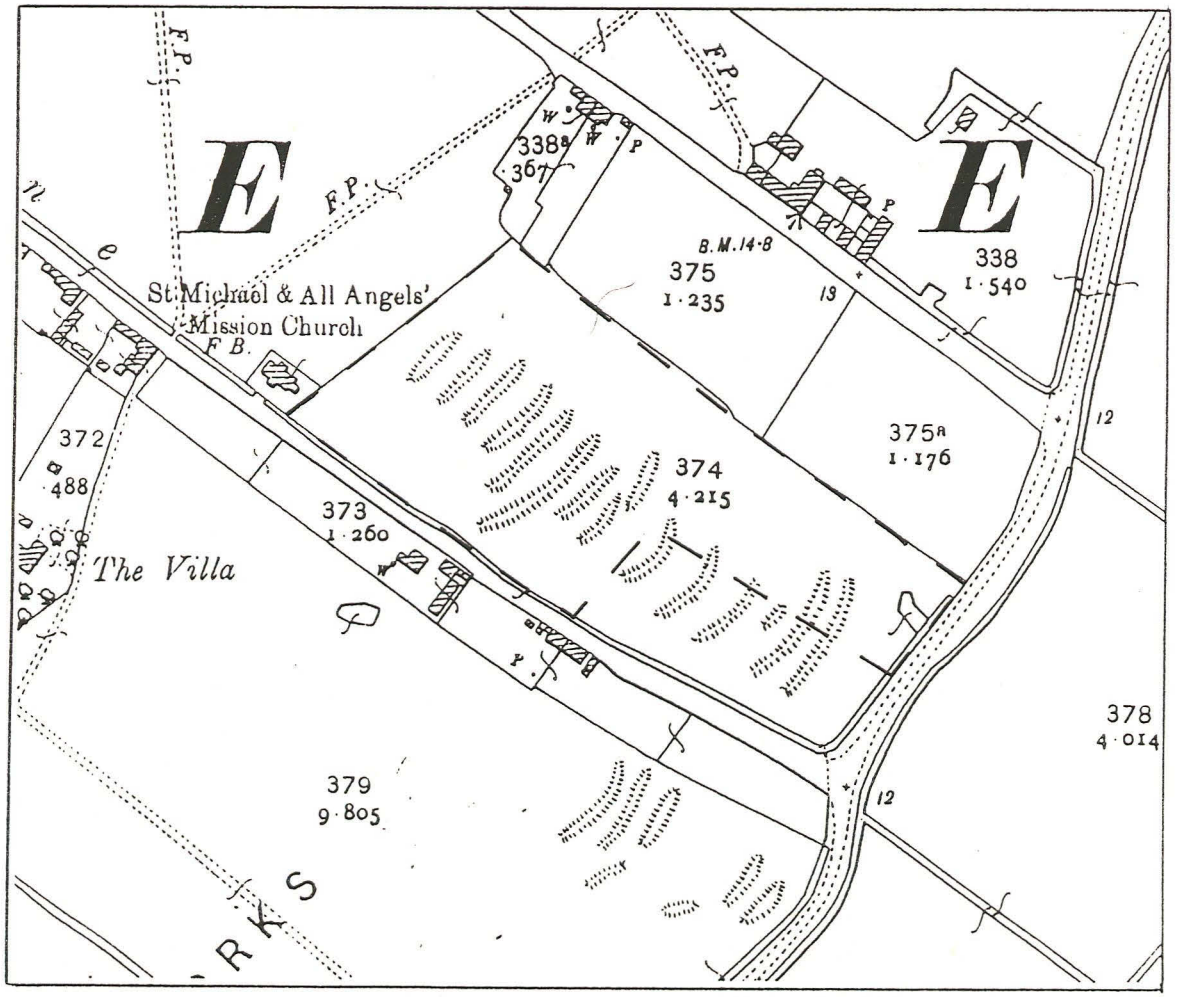


Fig. 2: Extract of the 2nd edition, 25" to the mile Ordnance Survey map of 1905, showing the extant waste mounds. The dashed line indicates the site boundary.

The excavated site dated to the fifteenth to sixteenth centuries, a time when the Lincolnshire salt industry was in decline. The exact reason for the decline of the industry is uncertain, but it has been suggested that cheaper imported salt from the Tyne and Firth of Forth (Sturman 1984, 54) or the loss of the turbaries (Hallam 1960, 112) were to blame. Evidence of earlier medieval salt-making activity at Wainfleet can be found in the Domesday Book. The survey of 1086 records eleven salterns in Wainfleet and twenty more associated with Wainfleet and other settlements (Hallam 1960, 86-87). The importance of the Wainfleet salterns during the late twelfth and thirteenth centuries is shown by the involvement of religious establishments such as the abbeys of Bardney, Revesby and Bury St Edmunds (Hallam 1960, 108-109).

An archaeological evaluation, consisting of seven trial trenches was carried out on the present site during the early autumn of 1998 (Albone 1998). This evaluation encountered the remains of four filtration units and a midden deposit which produced thirteenth to seventeenth century pottery. The site lies within an area of land known as Key's Toft where medieval and post-medieval pottery has been found (see Fig.1). The Tofts were the long narrow strips of land associated with each saltern (Hallam 1960, 110). These distinctive land units have survived to the present day (Fig. 1). The salters who owned each toft also had claim to the adjacent saltmarsh (Thirsk 1957, 20) and turbary rights (Hallam 1960). Earthworks of fifteen waste mounds are shown on the 25" to the mile Ordnance Survey map of 1905 (Fig.2) providing clear evidence of salt-making activity on the site. All of these mounds had been destroyed by housing and arable farming by at least 1980.

It has been suggested that Groose Lane and St Michael's Lane (formerly Mouse lane), to the north and south of the site, are both of medieval origin. These two lanes link the Key's Toft area to the former focus of the of settlement of Wainfleet St Mary, which lies 3 km. to the west north west. The medieval church of St Mary now stands in isolation surrounded by the earthworks of the village remains (Pevsner et al 1995, 778).

St Michael's Church, which lies immediately to the north-west of the site, is a small brick structure in the Gothic style. It was constructed in about 1880 as a mission church, consecrated in 1883 and was originally dedicated to St. Michael and All Angels (Massingberd-Mundy 1991, 52).

3.2 A Brief Summary of the Salt-Making Process

Although much has been written about the processes involved in salt-making in the medieval and early post-medieval periods, a brief summary of the existing knowledge is included here to allow the significance of the results of the excavation to be placed in context. The following summary is based principally on a recent review of salt-making in north east Lincolnshire by Grady (1998) which brought together the existing published material.

The method of salt-making used at Wainfleet St. Mary is known as sand-washing, even though the raw material involved is actually coarse silt. The origins of this technique are uncertain, but it was also used in the Adur Valley in Sussex in the

medieval period (Holden and Hudson 1981). Post-medieval documentary accounts of its use in Lancashire, Cumbria and Scotland give a fairly detailed view of the process.

The sand-washing process of salt-making consisted of three main phases; collection of the sand, its filtration and the evaporation of the resulting brine. The collection of the upper layer of sand from the beach, was carried out after the high spring tides. Only the upper layer of sand was collected as this had already experienced evaporation by the sun, thus concentrating the salt in this layer. The sand, which was called mould in Lincolnshire (Hallam 1960), was carried to the saltern site and stored until ready for processing.

The next stage was the filtration to effectively wash the salt out of the sand. The filtration units consisted of clay-lined rectangular filter beds which contained a layer of turves, rushes or straw (to act as the filter). The sloping base of the filter bed led to a pipe which ran into a round clay and turf-lined collecting vat. The salt impregnated sand was placed in the filter bed and water was poured in which carried the salt with it through into the collecting vat. The filter beds had wooden frames around them to increase the volume of sand which could be processed and to prevent overflow directly into the collecting vat.

The brine was taken from the collecting vats and boiled in large rectangular lead trays (approximately 1.2 m x 0.9 m and 0.1 m deep). These pans were raised on bricks to allow a peat fuelled fire beneath them.

4.0 Methodology

The excavation represented the final phase in an archaeological scheme of works for the St Michael's Lane site. The results of the earlier evaluation trenching had raised a number of research questions about the nature of the medieval to post-medieval salt making industry on the site. A project brief outlining these questions, and the requirements for the excavation, was issued by Lincolnshire County Council Archaeology Section (LCC 1998). The proposed objectives of the excavation can be summarised as follows:

i) To assess the date of the industry. Limited evidence from the evaluation implied that salt-making activity may have been taking place from the thirteenth to fourteenth centuries. If these dates were representative, salt-making activity was taking place on the site earlier than on the site excavated in 1984. Pottery found during the 1984 excavation suggested a fifteenth to sixteenth century date range.

ii) To provide a comparison of processing techniques. The evidence from the evaluation suggested that salt processing techniques which had been used at the site were similar with those suggested by the results of the 1984 excavation. These techniques are described in post-medieval accounts of salt-making (see 3.2 above).

iii) To examine the area surrounding a possible midden. A possible midden deposit was identified during the evaluation (Trench 4). The suggested date range of the

deposit sequence was from the thirteenth to seventeenth centuries. Further excavation would be able to confirm its date and perhaps whether the deposit sequence is associated with domestic or industrial use.

A number of possible ditch features were identified during the evaluation. These appeared to post-date the salt-making activity on the site. Excavation of larger areas of these features was considered necessary to establish their true date and relationship to the salt-making activity.

iv) To investigate the origins of St Michael's Lane. It had been suggested that St. Michael's Lane was medieval in origin. Excavation close to the present line of the road was designed to establish this, and identify any structures which may have fronted onto the lane.

v) Location within the medieval coastal salt-making complex. Cartographic sources appeared to indicate that the present site lay at the northern limit of this section of the coastal salt-making complex. Excavation along the north east boundary of the site were proposed to help confirm whether or not this was the case.

vi) Environmental sampling. The 1984 excavation revealed that a high potential for the preservation of organic and environmental remains existed on these sites. A programme of environmental sampling for the recovery of such remains would form an integral part of the excavation programme.

A Project Specification was prepared by Pre-Construct Archaeology (Lincoln) detailing an excavation strategy to address the above research agenda. Six areas were proposed for excavation. These areas are shown on Fig. 3. can be summarised as follows:

Area A. A square area measuring 20m x 20m, with off-shoot trenches to the north east and south east. The purpose of this trench was to examine the possible midden deposits revealed in evaluation Trench 4. The excavation was designed to expose a significantly wider area to determine the date of the sequence and to assess its immediate surroundings. The narrow north east trench aimed to place a section up to the northernmost limit of the site; the south eastern trench was designed to locate the possible linear features located in evaluation Trench 7.

Area B. A rectangular area of 30m x 10m. This area encompassed evaluation Trench 5, which contained a filtration unit associated with thirteenth to fourteenth pottery. The purpose of this area was be to reveal further filtration units and recover a more substantial body of dating evidence. The date of salt-making features in this area could be compared with similar features in other areas of the site.

Area C. A rectangular unit measuring 40 x 5m, with a narrow trench on the south side extending as close to existing road frontage as possible. The aim of this area was to look for evidence of structures close to St Michael's Lane and to attempt to date the origin of the road.

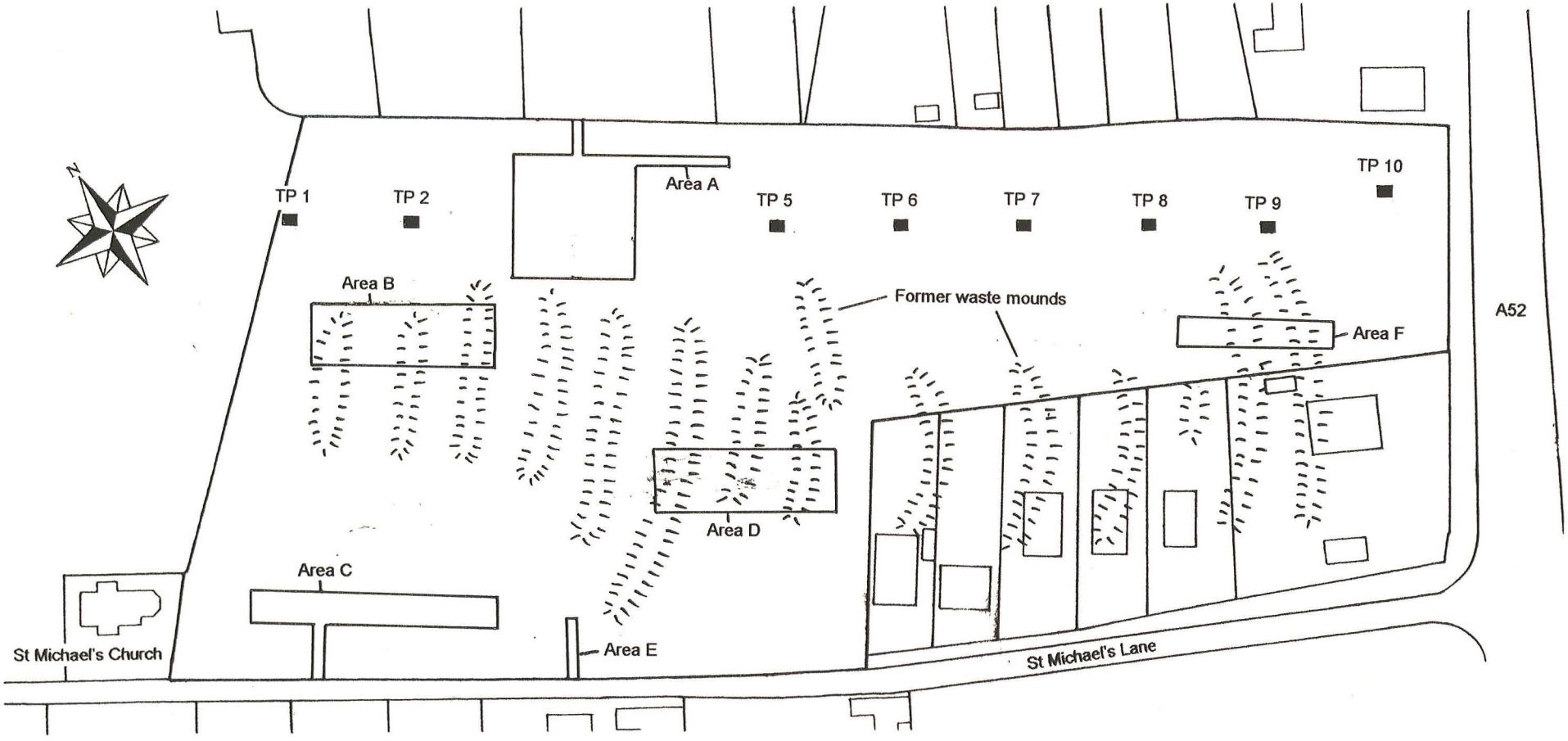


Fig. 3: Plan of the site showing the location of the excavated areas in relation to the position of the former waste mounds (1:1000)

Area D. A rectangular unit measuring 30m x 10m. This area incorporated evaluation Trench 7. It was placed to investigate the levelled saltern mounds, examine the old ground surface and the salt-making and linear features.

Area E. Small rectangular unit, approximately 10m x 2m. The aim of the small area was look for evidence of former road alignment. The 1905 Ordnance Survey map shows a minor kink in the road in this location (Fig. 2). This area was found to be located under a temporary road access to the site and was not excavated. The questions which this area was to have addressed, relating to the origins of the road and the possible presence of settlement remains, were answered by Area C.

Area F. Rectangular unit of 25m x 5m. The objective of this area was to examine a section through two saltern mounds (and associated features/structures) at the extreme south east end of the site. The primary purpose of this exercise was to undertake a comparative chronological assessment to assess, in conjunction with evidence from other areas, whether or not there was a progressive development of the industry from north west to south east.

In addition to the above, ten 1m x 1m test pits were excavated across the site at regular intervals on an north west to south east axis. The aim of these was to assess the development of the site's environment through a programme of sampling. Pits 3 and 4 were not excavated because trench A^1 in Area A provided a longer section in the same part of the site.

Recording was undertaken using standard context record sheets (incorporating physical descriptions, interpretations, and stratigraphic relationships). Features were drawn to scale in plan and section, and photographic recording was also undertaken (some prints are reproduced in this report). The drawings, and the rest of the paper record, will form the basis for a long-term project archive which will be deposited at the City and County Museum, Lincoln.

Only a small quantity of finds, including pottery, fired clay, animal bone and a few small finds were recovered during the excavation. In line with the project specification, extensive environmental sampling was undertaken. This included samples from features associated with the salt-making (filtration units, mounds etc.), the midden spread and from natural deposits in order to assess the site environment. A detailed report on the palaeoenvironment and palaeoeconomy of the site, based on the analysis of these samples, is given in Appendix 1.

The excavation was supervised by the writer assisted by a team of seven experienced field archaeologists between 23rd of November and 15th of December 1998.

5.0 Results

A range of features associated with the salt-making process were identified during the excavation. In line with expectations, these consisted mainly of filtration units and the remains of waste silt mounds. These two principal feature types are discussed in general terms below, followed by a description of the results of each of the excavated areas.

5.1 The Filtration Units

Filtration units were identified in all of the excavated areas, with a total of twenty one of these features being completely or partially exposed. Their structure and proportions were broadly similar to those excavated at the adjacent site in 1984 (McAvoy 1994, 140-141). In the interests of continuity and clarity, the same terminology has been used wherever appropriate.

The filtration units were arranged, end to end, in rows on an east to west alignment. With the exception of one unit in Area A, all of the units appeared to be organised so that either the vats or the ends of the filter beds lay together. Nearly all of the alignments of units were arranged approximately 10m apart. Only three alignments did not conform to this lay out. These arrangements of units and alignments had also been identified during the 1984 excavation (McAvoy 1994, 144).

As already described, the filtration units consisted of two main elements; a rectangular filter bed which was joined to a circular collecting vat by a short pipe. The collecting vats were circular in plan with diameters of approximately 1m. They had near vertical sides, narrowing slightly towards the base, and a domed roof. In most cases this roof structure had collapsed into the vat or had been truncated in antiquity. Where the roof structure was present, the total depth of the vats, was 1.2m. Samples of the slightly clayey silt lining of the vats were taken from two different units [2013 & 3074]. Both of these had a very low foraminifera content and one contained fragments of freshwater molluscs. This suggested that the lining material had been derived from an alluvial source and not from the site itself (Godwin; Apdx 1).

The filter beds measured between 2.9m and 3.4m in length and were between 1.1m to 1.4m wide. The similarity of the fills of the filter beds to the surrounding material made the identification of this element of the units difficult. Consequently, the true depth of the filter beds could not be ascertained in most cases. One filter bed [5008], which was sectioned in Test Pit 1, appeared to have a total depth of c.0.3m (Fig. 22); a figure comparable with the depth of those excavated by McAvoy (1994, 141). The filter beds were lined with slightly clayey silt, samples of which were taken from two separate units [3053 & 6022]. Analysis of the foraminifera contained within these samples suggested a lagoonal source for the lining material (Godwin; Apdx 1). However, it seems unlikely that the filter bed lining material would have been brought from a different source to that used in the vats. It is possible that the foraminifera in these linings were derived from the fill of the filter bed and resulted in a misleading result. The fill of the filter beds and the lower fill of the collecting vats were both silts which contained foraminifera suggesting a lagoonal source (Godwin; Apdx 1). Whether or

not these fills represent the last load of silt to be processed in the units, material washed in from adjacent waste mounds or deliberate dumping is impossible to say.

The 'turves' in the bases of the filter beds were identified in only three of the filtration units. These were observed in plan in units 1037 and 4062 where they appeared roughly rectangular and on average measured 0.22m x 0.12m In Test Pit 1 they were visible in section in filtration unit 5008. These 'turves' (5009) had a domed section (Fig. 22) and were sampled for environmental analysis. They had a banded appearance created by alternate layers of silt and clayey silt. Analysis of the foraminifera suggested that these features had a subtidal origin. The banded structure and environmental evidence did not support the interpretation of this element of the filter beds as turves, or peats as described by Duncan (1812, cited by McAvoy 1994, 140). The exact nature of this element of the filter beds remains uncertain. It is possible that they represent blocks of silty material placed in the filter beds to serve the same function as the peats in supporting the filter material. An alternative term, *silt blocks*, is proposed for this element of the filter beds and used throughout the remainder of this report. No evidence of the wooden boxes in the filter beds that were identified during the 1984 excavation (McAvoy 1994, 140 -141) were observed.

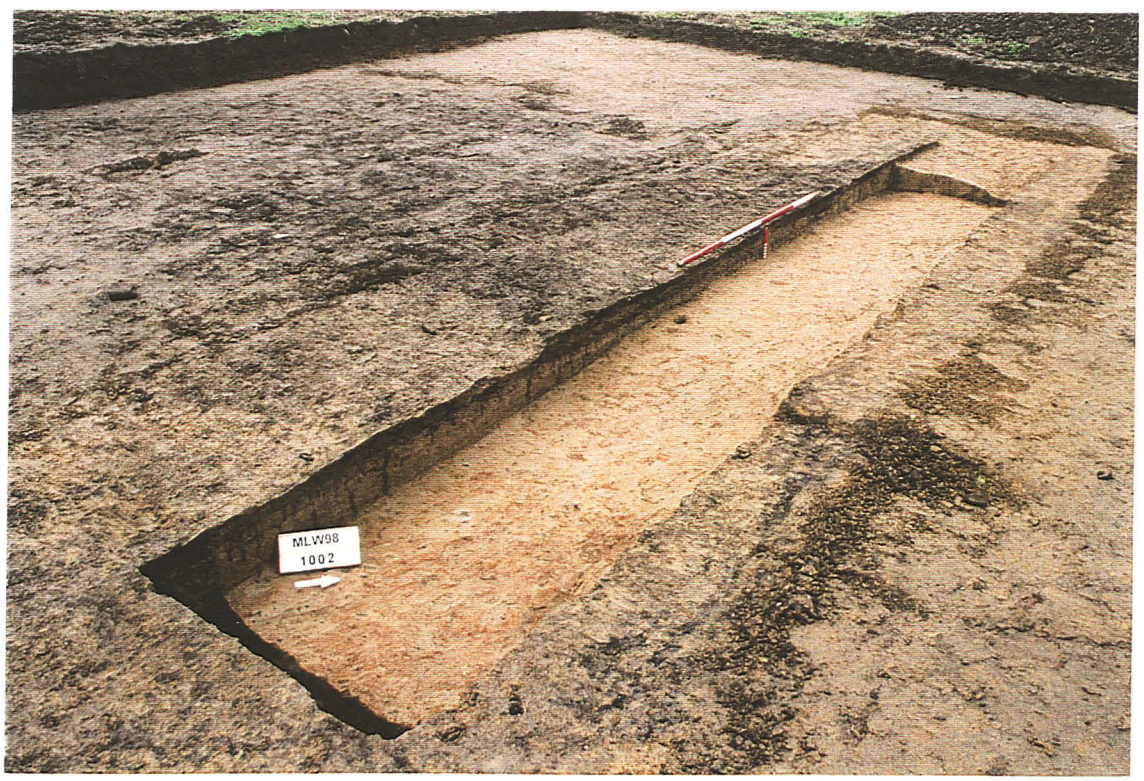
5.2 The Waste Mounds

The remains of ten waste silt mounds were identified during the excavation in Areas B, C and D. These were arranged parallel to and between the alignments of filtration units. All of the mounds on the site had been levelled at an earlier date, prior to 1905 in the case of those in the north east and south west of the site. Samples were taken from mounds in each of the areas. Analysis of these showed that the silt had also been derived from a lagoonal environment (Godwin; Apdx 1). This confirmed that the silt which was processed during the salt-making was collected from the edges of a lagoon.

5.3 Area A (Fig. 4, Pl. 1)

The principal aim of this area was to uncover a greater expanse of the midden deposit (Pl. 2.) which had been identified during the evaluation. This deposit (1002) consisted of a very dark grey silt and was situated in the middle of the western part of the area. Its extent within the excavated area measured approximately 11 m by 7 m and a machine excavated trench (A^2) revealed that it dipped towards the south east (Fig. 5). This suggested that it had been deposited in a littoral environment, presumably on the edge of the postulated lagoon, where it had subsequently been eroded and dispersed. A large quantity of animal and fish bone and the shells of edible molluscs was recovered (Rackham; Apdx 1). In addition, fragments of charcoal and both burnt and unburnt coal were retrieved. A small quantity of pottery was recovered from this deposit. This consisted mainly of Toynton / Bolingbroke wares dated to the mid fourteenth to the late sixteenth centuries. A fragment of a late fifteenth to sixteenth century imported Raeren drinking jug (Apdx 2, dr2) was found in the topsoil in this area, but cannot positively be associated with the midden deposit (Young; Apdx 2). A very worn silver long cross penny (dating to between 1247 and 1485) was also

Pl. 1: View of part of Area A looking south east. The dark area of the midden deposit (1002) is visible just to the right of centre.



Pl. 2: View of the midden deposit (1002) and Trench A[1], looking west.

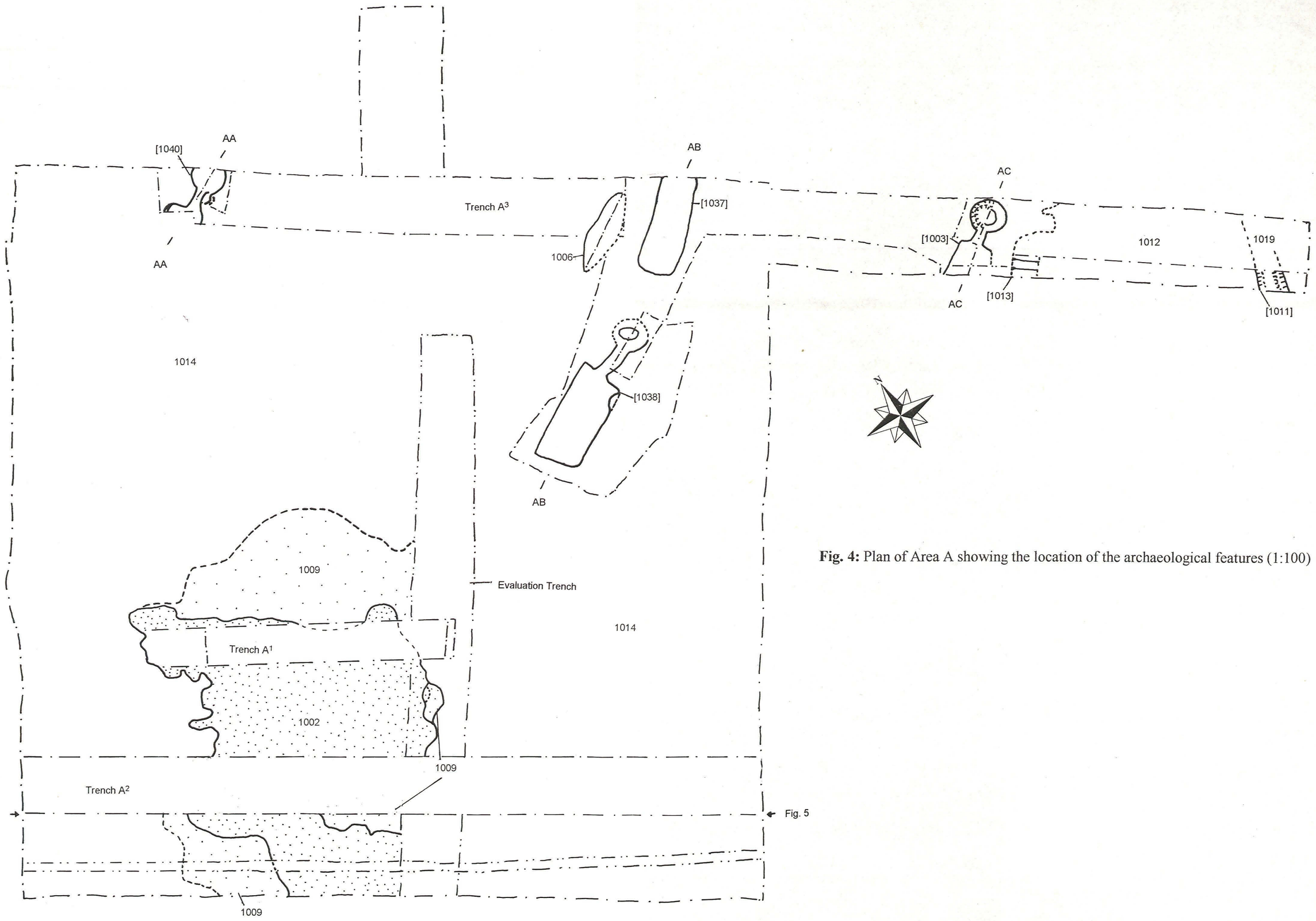


Fig. 4: Plan of Area A showing the location of the archaeological features (1:100)

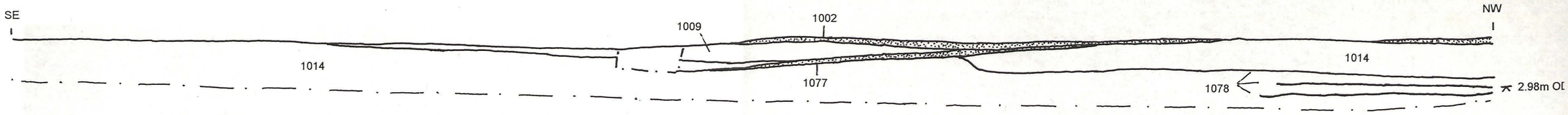


Fig. 5: Section of Trench A[2] in Area A (1:50)

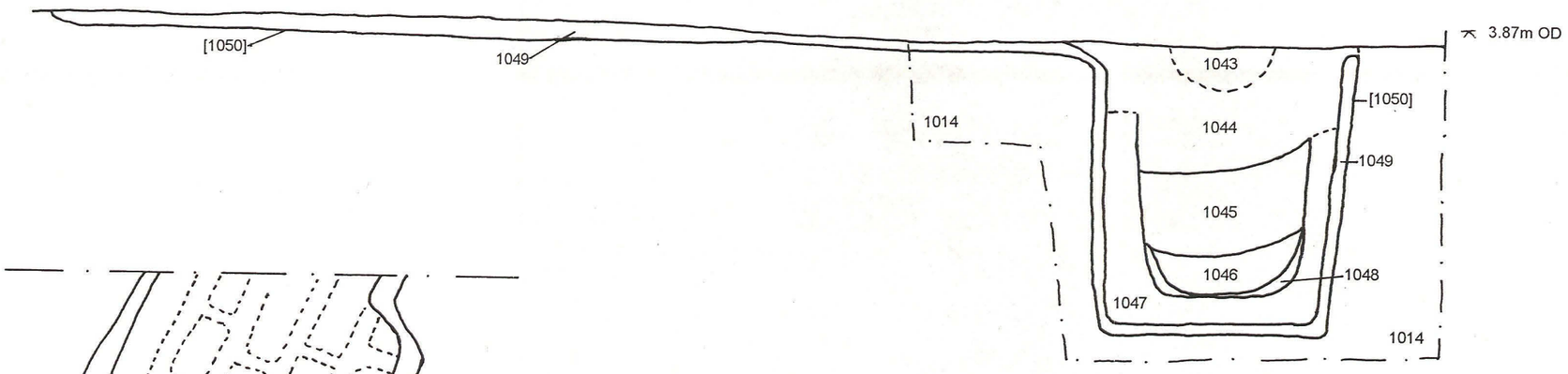


Fig. 7: Section of filtration unit 1038 (1:20)

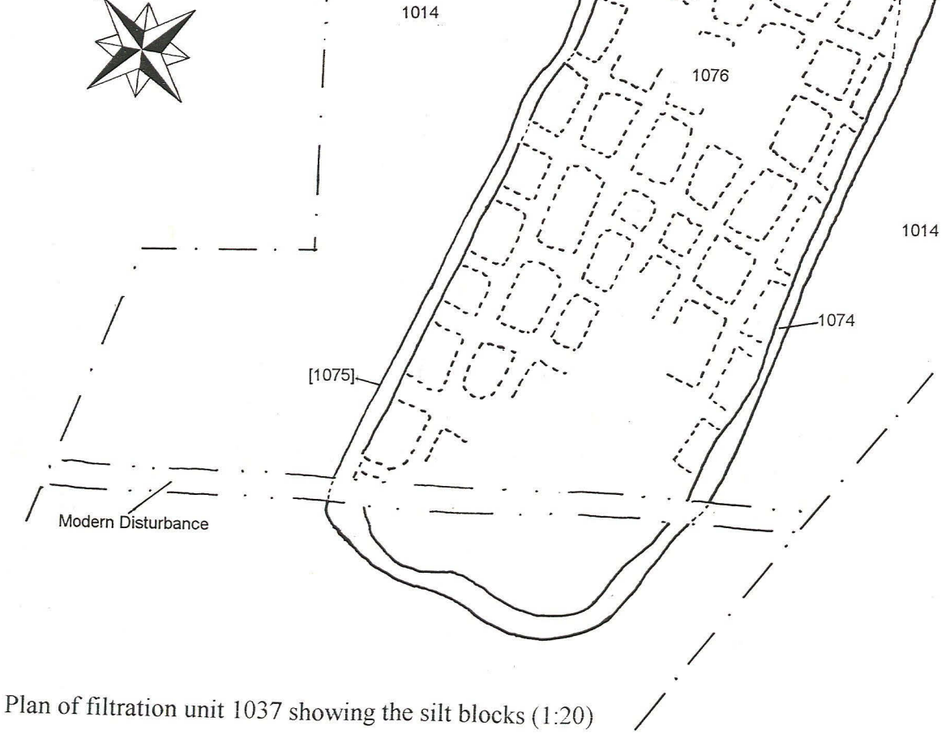


Fig. 8: Plan of filtration unit 1037 showing the silt blocks (1:20)

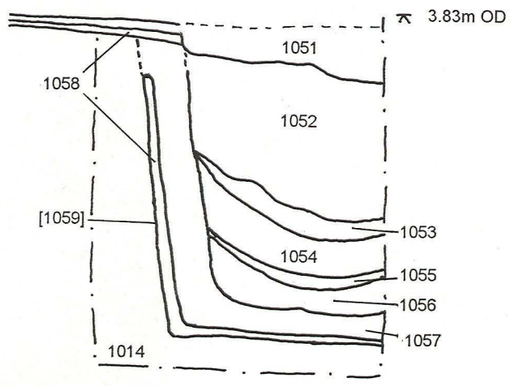


Fig. 6: Section of the collecting vat of filtration unit 1040 (1:20)

Pl. 3: The partial dog skeleton (1039) in the upper fill of the collecting vat of filtration unit 1040.

Pl. 4: Section of the collecting vat of filtration unit 1038, looking north north west.

Pl. 5: The filter bed of filtration unit 1037, looking east south east.

Pl. 6: The possible hearth area (1006), looking north north west.

collected from the surface of the dumped silts (1014) adjacent to the midden deposit (Cowgill; Apdx 3).

The eastern part of the area contained three alignments of filtration units (AA, AB & AC). These did not continue across the whole of the excavation area and, presumably, represented only the western end of the alignments. No traces of the waste mounds associated with these alignments were identified, nor were they shown on the 1905 Ordnance Survey map. These alignments of units would have related to a series of mounds orientated north to south, parallel to those along the middle of the site, and traversing what is now its north east boundary. The discovery of these salt-making features in this area of the site suggested that the processing activity extended further to the north east with at least this series of mounds having been present.

The most northerly, and earliest, of the three alignments identified in this area (AA) was located in the northern corner of the area (Fig. 4). Only a single filtration unit (1040) was identified in this alignment. A section through the collecting vat of this unit was excavated (Fig. 6) showing that it contained a series of six fills, most of which probably represented dumping after it had gone out of use. A single rim sherd of a Humber ware vessel, dated to the fourteenth to sixteenth century (Young; Apdx 2) was recovered from one of these (1053). A partly articulated dog skeleton (Rackham; Apdx 1) was recovered from the uppermost fill (Pl. 3). The domed roof of this collecting vat had partially survived, with part having collapsed in on top of the fills.

Two filtration units [1037 and 1038] were identified in the second alignment (AB). Only unit 1038 lay completely within the excavation area. A section was excavated through the collecting vat of this unit [1049] (Fig. 7, Pl. 4). Cattle and pig bones and the partial skeleton of a chicken were recovered from the deposits in this vat (Rackham; Apdx 1). This also suggested the intentional dumping of refuse in the structure when it was no longer serviceable. A small quantity of late fourteenth to early sixteenth century pottery, including part of a Toynton / Bolingbroke jug (Apdx 2, dr. 3) was also recovered (Young; Apdx 2). Only the filter bed of the second unit [1037] in alignment AB was exposed. At least 48 of the silt blocks (1076) were identified in the base of this feature (Fig. 8, Pl. 5). Immediately to the north of this alignment was an oval area of burnt silt and small quantities of charcoal (1006). This was tentatively interpreted as a hearth area associated with the boiling of brine in the salt-making process (Pl. 6). Only one hearth, located between two alignments of units, was identified during the 1984 excavation (McAvoy 1994, 146). A single sherd of late fourteenth to sixteenth century pottery was recovered from this deposit (Young; Apdx 2).

The third alignment (AC) was represented by only one filtration unit [1003]. Only the collecting vat and part of the filter bed were exposed, but this feature was completely sectioned by the end of machine trench A^3 (Figs. 9 & 10; Pls. 7 & 8). The upper fills of this feature consisted of burnt silt, which was visually similar to the possible hearth deposit 1006 adjacent to alignment AB. Samples from these deposits contained fragments of peat charcoal, possibly suggesting that this was the fuel used for the boiling process.

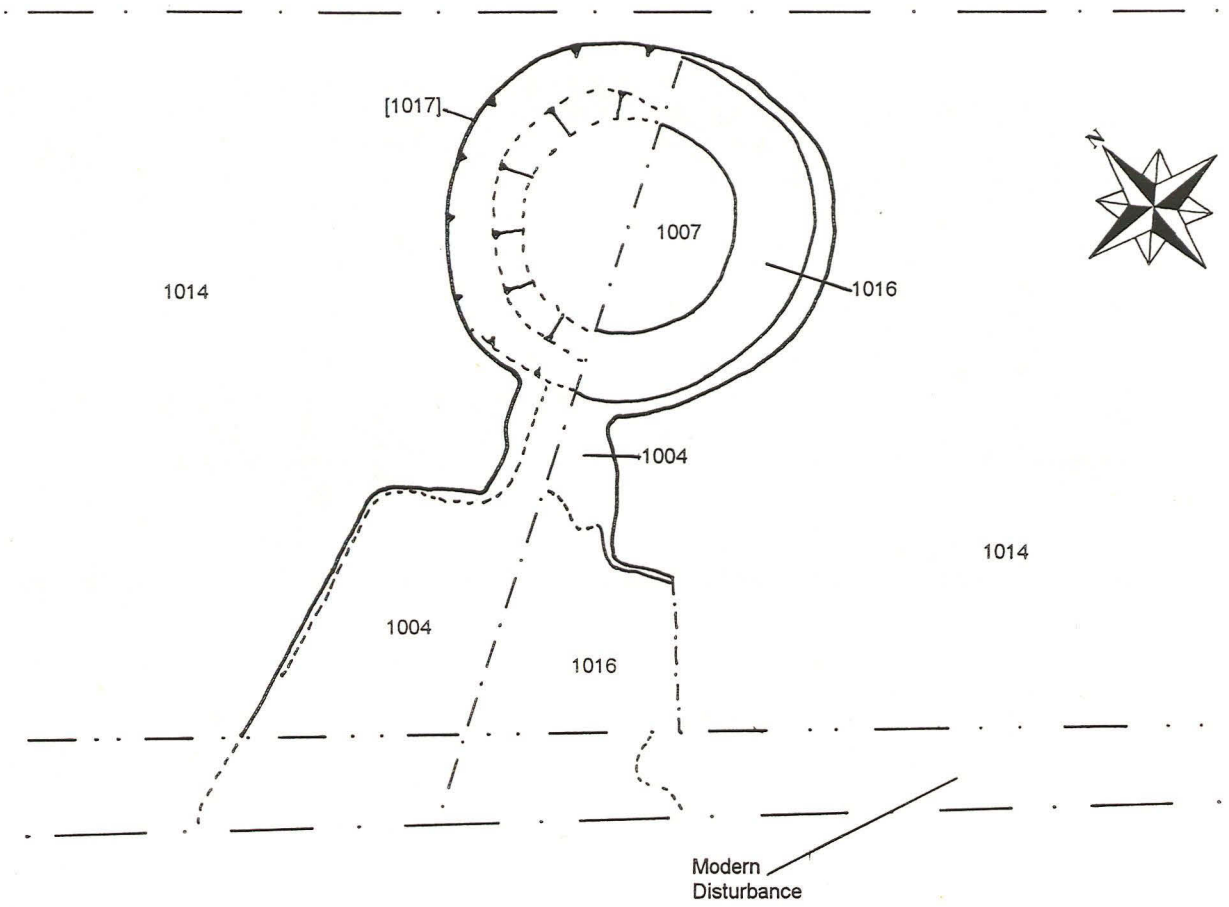


Fig. 9: Plan of filtration unit 1003 (1:20)

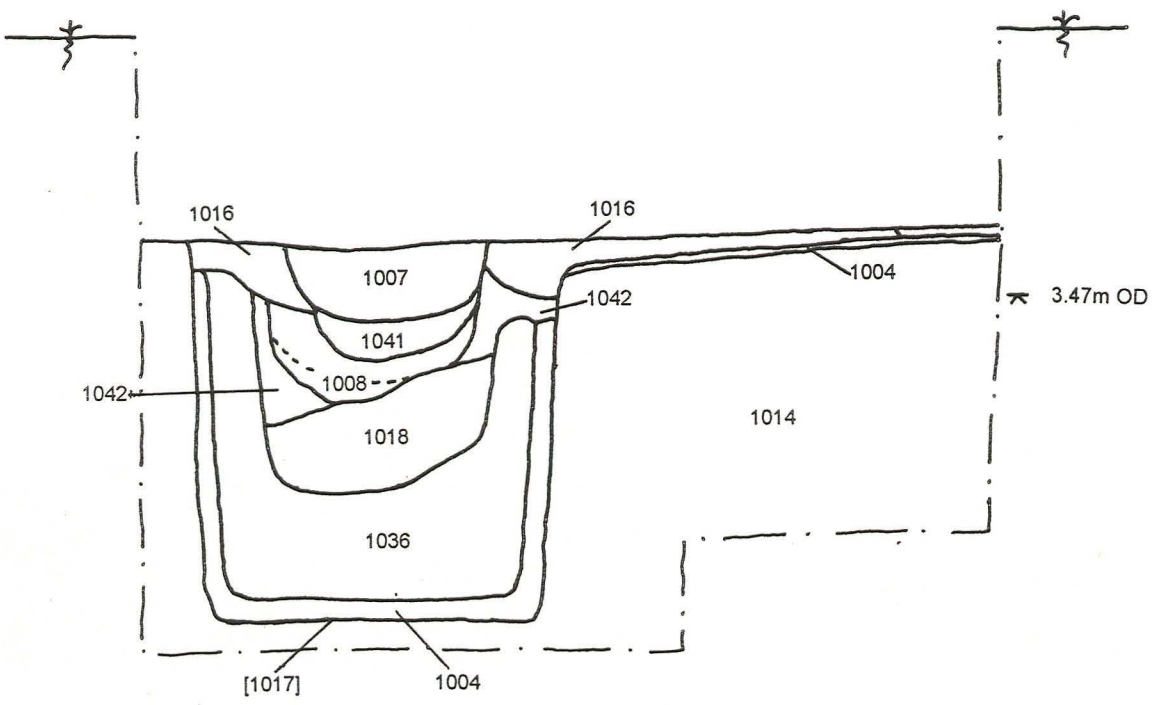


Fig. 10: Section of filtration unit 1003 (1:20)

Pl. 7: Filtration unit 1003 following excavation of the fill of the collecting vat, looking south east.

Pl. 8: Section of filtration unit 1003 at the south east end of trench A[3].

A possible field boundary ditch [1011] aligned north-east to south-west was identified at the south-west end of Area A. No artefacts were recovered from this feature.

The features in this area were cut into dumped waste silts, which were overlying laminated (water deposited) silts. The laminated silts were clearly visible in trenches A^2 and A^3. Two layers in trench A^2 (1077 & 1078), which were relatively charcoal rich, had been deposited along the margins of the tidal reach. The interpretation was clear from their relationship to the other deposits but was also supported by their mollusc fauna (Rackham; Apdx 1).

5.4 Area B (Figs. 11 & 12, Pl. 9)

Three alignments of filtration units (BA, BB and BC) and their corresponding waste mounds were exposed within this area. These were spaced approximately 10m. apart, confirming the organised arrangement identified by McAvoy (1994, 144) and discussed above. The position and orientation of the mounds conformed exactly with those shown on the 1905 edition Ordnance Survey map.

The position of alignments BA, BB and BC, close to the northern limit of the site, suggested that they may have belonged to the earliest phase of salt-making activity. The alignments were separated by their associated waste mounds [2007, 2008 & 2009]. As might be expected no artefacts were recovered from the waste mounds themselves, as these appear to have consisted entirely of processed silt. A small quantity of pottery was recovered from the lowest deposits between the mounds (2002, 2004 & 2006). These deposits would, presumably, have begun to accumulate shortly after the construction of the mounds, so the pottery could be broadly contemporary with the salt-making activity. The pottery has all been dated to the fourteenth to sixteenth centuries, although that from deposit 2006 may possibly be assigned more positively to the earlier part of this range (Young; Apdx 2). Fragments of brick, including a glazed fragment from 2004, were also recovered. The glazed brick is identical to those used in the diaper work on Magdalen College, Wainfleet which was built in 1484 (Parry-Jones 1984, 5). Assuming that bricks of this type were not present in the Wainfleet area prior to this date, this artefact provides a late fifteenth century *terminus post quem* for the inter-mound deposits. All of the filtration units in this area were cut into layers of dumped waste silt from earlier phases of salt-making.

Two filtration units were exposed in each of the three alignments. However, only two of the units [2010 & 2013] lay entirely within the excavated area and only these were fully investigated. Filtration unit 2010 was located in alignment BA. A section was excavated through its collecting vat, although the base of the feature was not reached (Fig. 13). Fragments of the lining material (2030) were contained within one of the upper fills, suggesting that the domed roof structure had collapsed after some filling of the feature had taken place. The latest fill of the vat (2011) contained sherds of late fourteenth to early sixteenth century pottery (Young; Apdx 2) and cattle and horse bones (Rackham; Apdx 1). Filtration unit 2013 was located in alignment BB, and was the most complete unit found during the excavation. The domed roof of the collecting vat [2034] was complete enabling the full profile of the feature to be shown in section

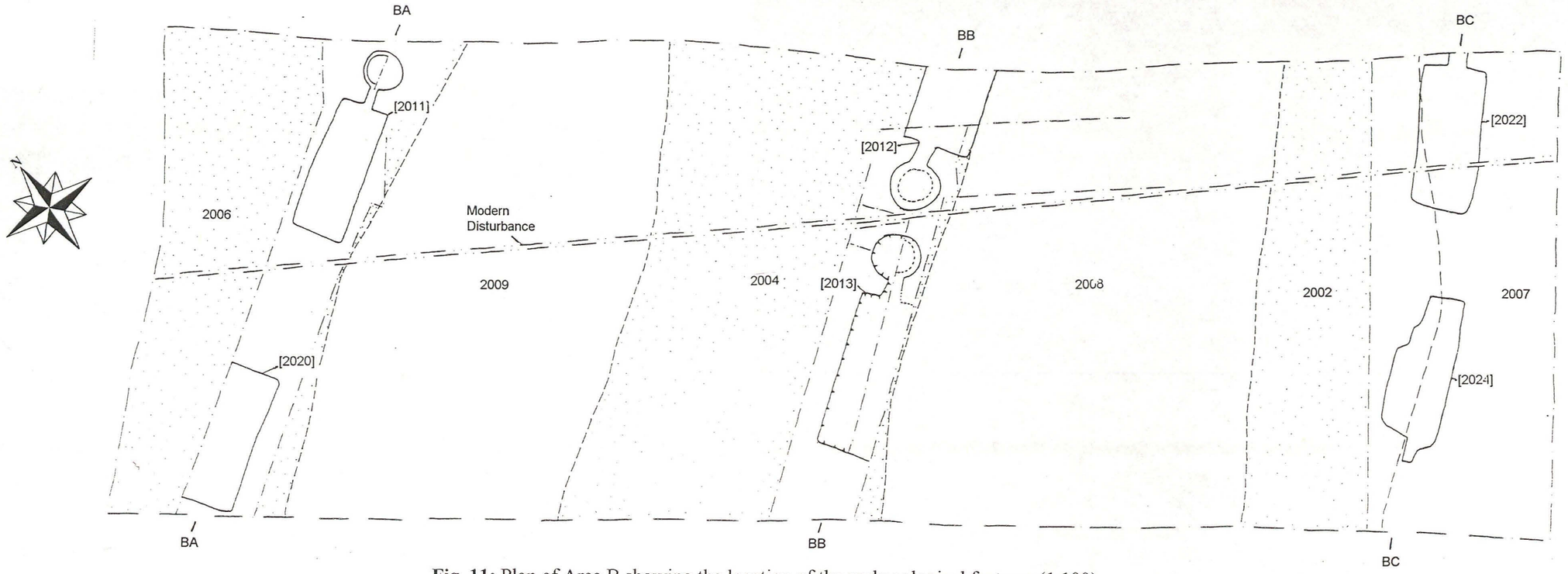


Fig. 11: Plan of Area B showing the location of the archaeological features (1:100)

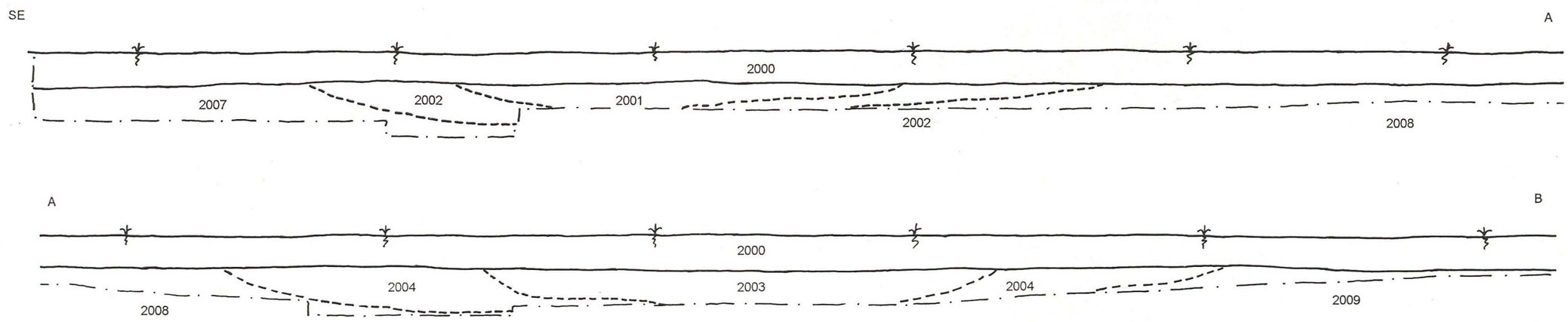
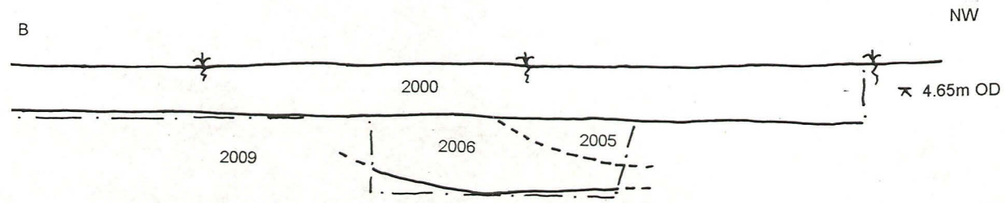


Fig. 12: South west section of Area B (1:40)



Pl. 9: Pre-excavation view of Area B, looking north west. The light areas are the remains of waste mounds with the darker inter-mound deposits in between.

Pl. 10: Filtration unit 2013 partially excavated, looking east. The domed roof of the collecting vat is clearly visible as is the truncated vat of unit 2012 beyond it.

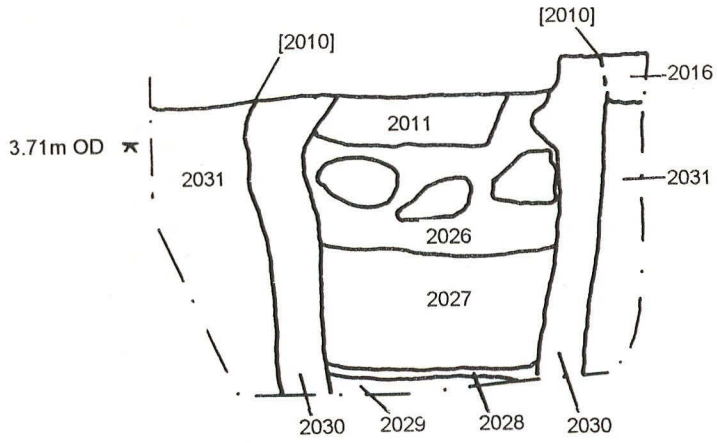


Fig. 13: Section of the collecting vat of filtration unit 2010 (1:20)

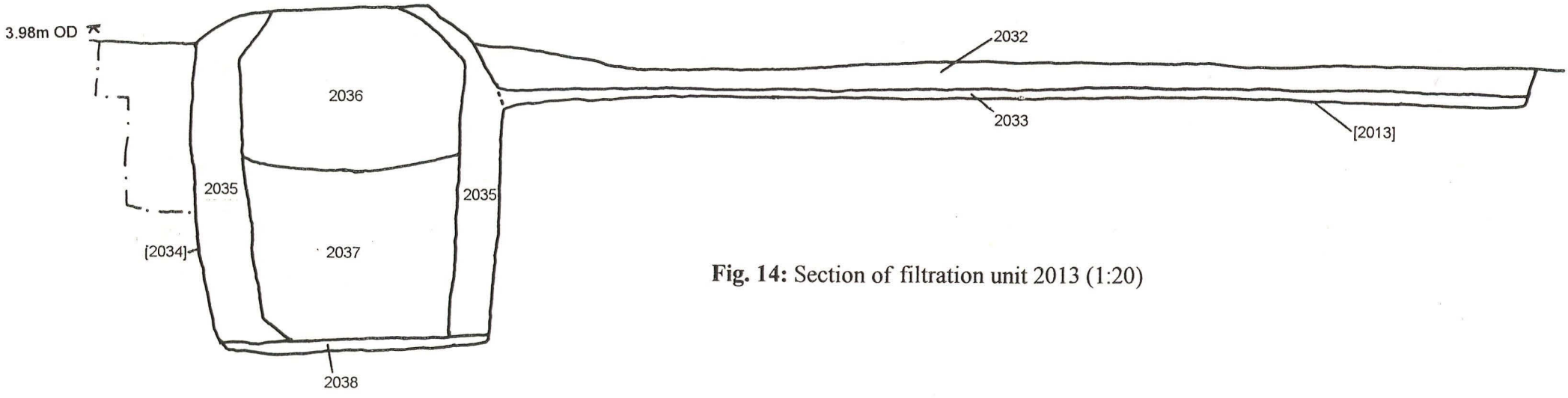


Fig. 14: Section of filtration unit 2013 (1:20)

(Fig. 14; Pl. 10). No artefacts were recovered from the fill of this feature. A section was excavated through the filter bed [2013] but no internal structures (i.e. silt blocks) were visible. Due to the similarity of the fill (2032) of this filter bed to the surrounding dumped silts, it was not possible to determine the true depth of this part of the unit. Filtration unit 2012, also in alignment BB, had been previously identified during the earlier evaluation (Trench 5 [503]; Albone 1998). Although only the upper part of the collecting vat was excavated during that phase of work, two adjoining sherds of thirteenth to fourteenth century pottery were recovered. Only the filter beds of the two units [2022 & 2024] in alignment BC were identified and no excavation of these features was carried out. The position of unit 2024 suggested that its collecting vat should have been located within the area of excavation. It is possible that this part of the structure had completely collapsed and been sealed below a layer of dumped silt.

5.5 Area C (Figs. 15 & 16; Pl. 11)

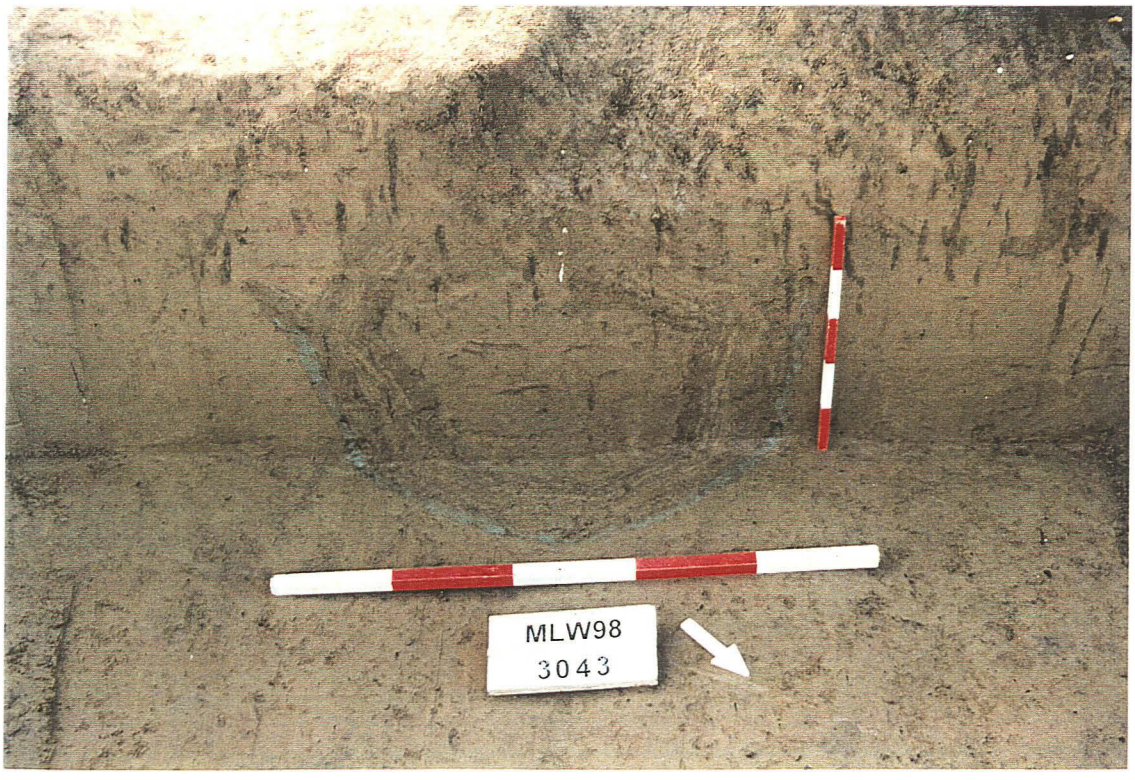
A total of five filtration units, representing three alignments (CA, CB & CC), were identified in this area. No dating evidence was recovered from any of these features. Alignment CA consisted of only part of one unit [3053]. Only the collecting vat of this unit was identified in a machine excavated trench (C^1) along the south-west side of this area. This feature had been truncated and fragments of lining material (3068) were present in the dumped silts to its south. It is possible that this represents the destruction of the unit by storm action. The filter bed of this unit was not identified and the orientation of alignment CA could not be established. It is likely that this alignment was arranged west to east, parallel to the others in this area and elsewhere on the site.

Alignment CB was situated only 4m to the south of CA. This was one of only two instances on the site where the 10m spacing between the alignments was not adhered to. It is possible that this alignment was constructed to replace CA after it had been damaged. Consequently it was not necessary, or perhaps even possible, to advance the area of processing by the usual distance. Two filtration units [3052 & 3075] were identified in this alignment. The collecting vat [3043] of unit 3075 was sectioned by trench . The lining of this vat consisted of banded silt and clayey silt (Pl. 12) suggesting that it had been cleaned out and relined on a number of occasions.

Only one filtration unit [3074] was completely exposed in alignment CC (Pl. 13). The collecting vat of this feature lay within trench C^1 and, like unit 3075 to the north, appeared to have been relined. The fill of this vat contained partial skeletons of two piglets, both of which were aged under 12 months (Rackham; Apdx 1). The edge of the filter bed of a second unit in this alignment [3030] was recorded in the section of trench C^1 (Fig. 16).

A large pit [3022] was located at the east end of alignment CC (Fig.17, Pl. 14). The fills of this feature (3023 & 3025) contained large quantities of burnt silt and a single sherd of fourteenth to sixteenth century pottery (Young; Apdx 2). This feature was probably the upper part of a larger clay lined pit similar to those identified at the ends of the waste mounds during the 1984 excavation (McAvoy 1994, 141). The position of 3022 in relation to CC, suggests that filtration unit 3074 was the most easterly in

Pl. 11: Pre-excavation view of Area C, looking south east. The light areas are the remains of waste mounds with the darker inter-mound deposits in between. The small dark patches inthe foreground are the remains of fires.



Pl. 12: Section through the vat of filtration unit 3043, looking south west.

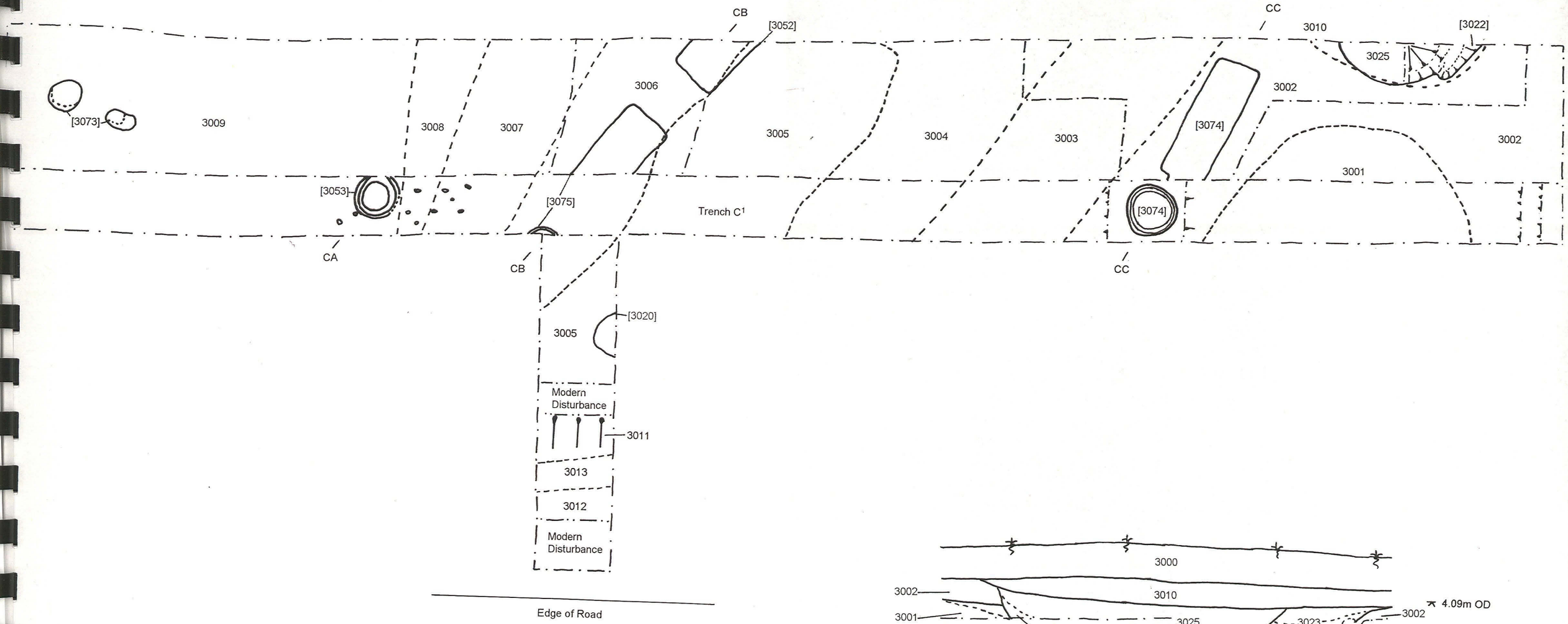


Fig. 15: Plan of Area C showing the location of the archaeological features (1:100)

Fig. 17: Section of pit 3022 (1:40)

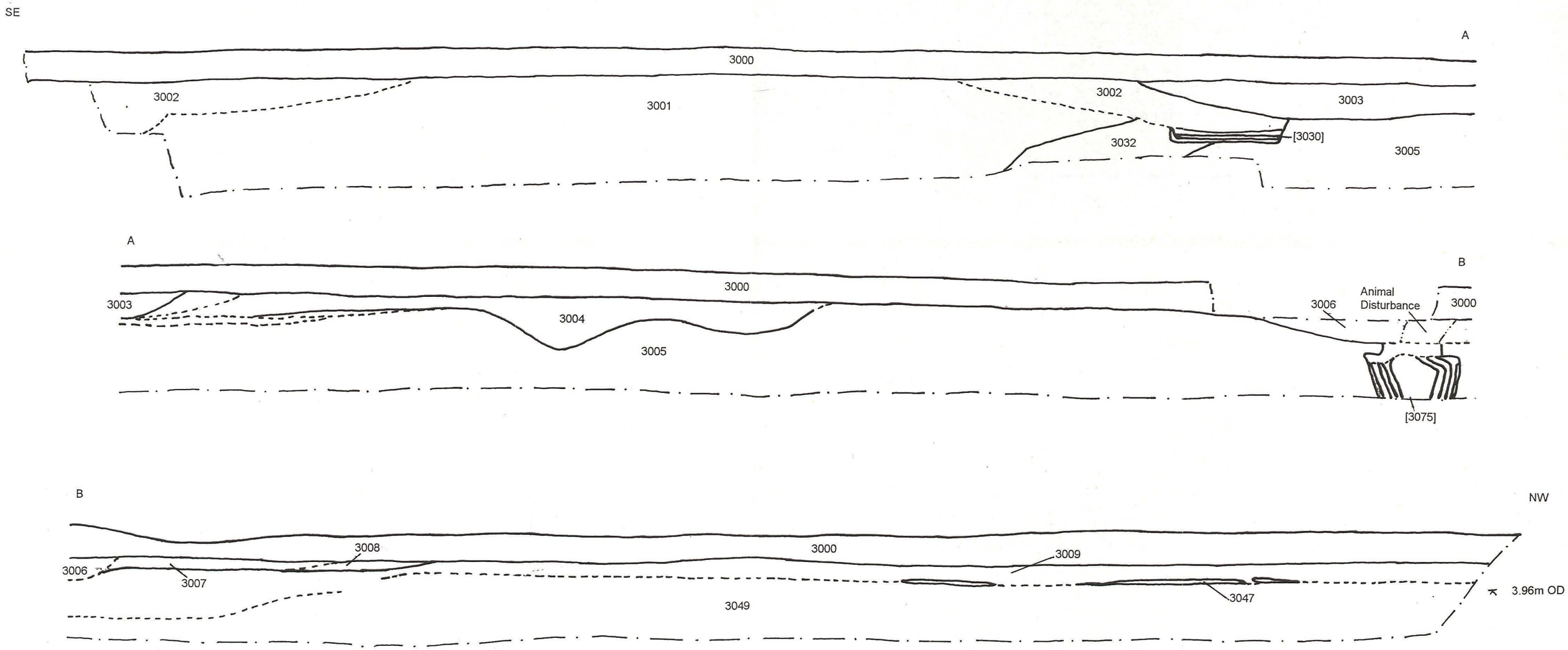


Fig. 16: Section of Trench C[1] in Area C (1:40)

Pl. 13: Filtration Unit 3075, looking south west.

Pl. 14: Pit 3022, looking north.

this alignment. Thick deposits of waste silts including the remains of waste mounds (3001, 3005 & 3009) were identified in this area. If the features encountered in this area represented the eastern in of the alignments and mounds, these would have continued under St. Michael's Lane. This suggested that it post-dated the levelling of these mounds and was clearly not contemporary with this phase of salt-making on the site.

A number of other features, all of which probably post-date the salt-making activity, were also identified. Two of these were located in the south-west spur of this area which ran up to the edge of St. Michael's Lane. These consisted of a steep-sided undated pit [3020] and a roadside field ditch [3011] which was shown on the 1905 Ordnance Survey map. Three small areas of ash and burnt silt (3073) were located immediately below the topsoil at the north-west end of the area and probably represented relatively recent bonfires.

5.6 Area D (Figs. 18 & 19, Pl. 15)

The remains of three waste silt mounds [4001, 4053 and 4054] were identified in this area. These features corresponded with the mounds shown on the 1905 Ordnance Survey map of the site (Fig. 2). No artefacts were recovered from either the waste mounds or the inter-mound areas during the excavation. These deposits had previously been sectioned by Trench 7 during the evaluation when dateable finds were retrieved. Sherds of fifteenth to seventeenth century pottery and brick fragments were recovered from 4003 and a fragment of a jawbone sledge runner was also found in 4012 (Evaluation contexts 707 / 708 & 704; Albone 1998).

Only one alignment of filtration units (DA) was positively identified in this area. This was situated on the north side of mound 4054. Part of the filter bed of one unit [4062] was identified in trench D^2 and a second one had previously been identified in the evaluation (Context 712, Albone 1998). The north-west side of both of these filtration units cut by the inter-mound deposits (4010). This indicated that erosion, possibly scouring by wave action during a storm, had occurred at some time after these units had been buried below mound 4054. It was assumed that a second alignment of filtration units existed in this area, to the north of mound 4053, but this was not identified during the excavation or the earlier evaluation.

At least sixteen pits were also identified in this area. Many of these were arranged in regular groups and were located in the area of the mounds. These were mostly roughly rectangular in plan, with vertical sides and up to 0.85m deep. Small quantities of pottery dating to the sixteenth to nineteenth centuries (Young; Apdx 2) were recovered from the fills of two of these features (4047 & 4057). The profiles of these pits suggested that they had been backfilled almost immediately after being excavated and their small size meant that it was unlikely that they had been cut through the extant mounds. It seemed likely that these pits post-dated the levelling of the mounds during the twentieth century, although their exact function remains uncertain.

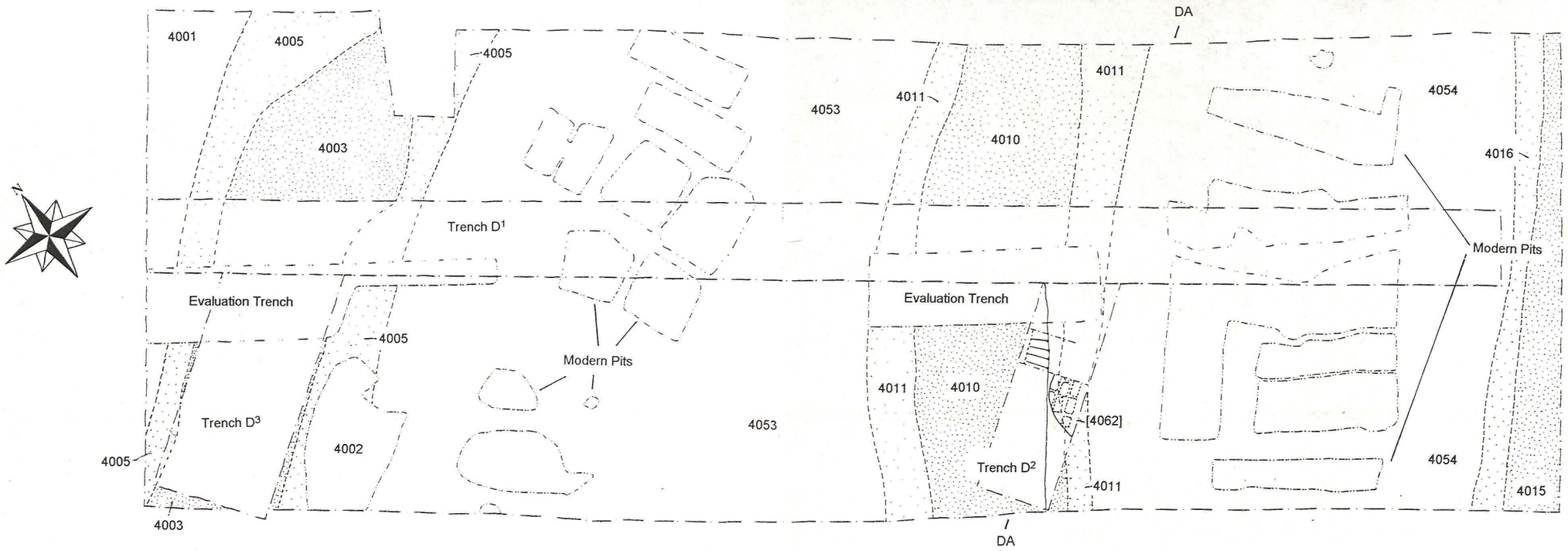


Fig. 18: Plan of Area D showing the location of the archaeological features (1:100)

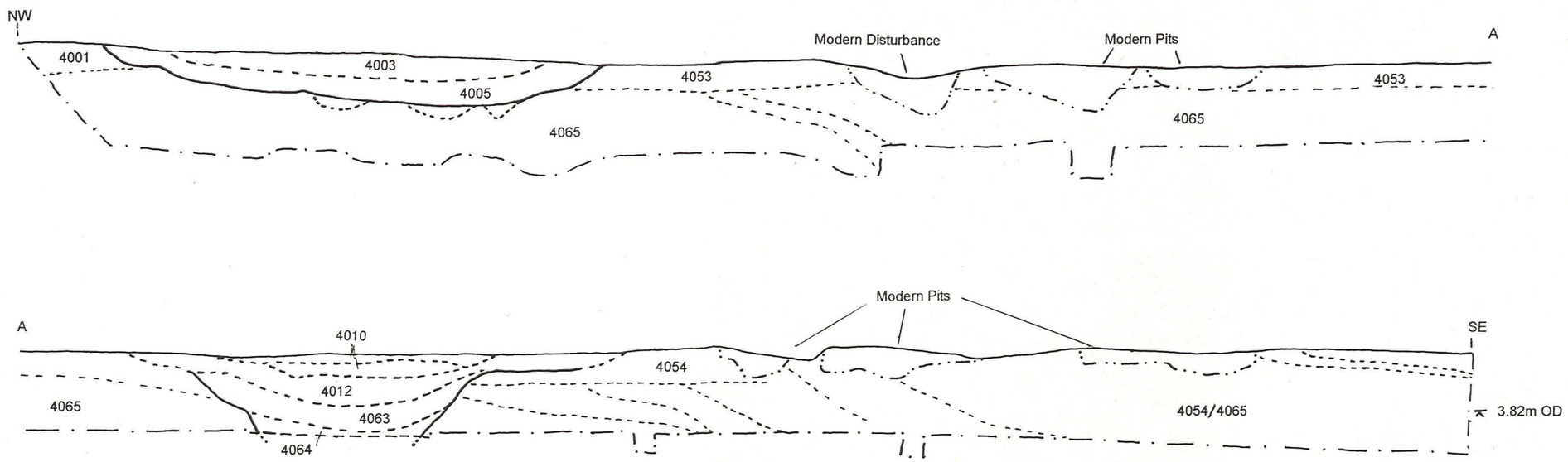
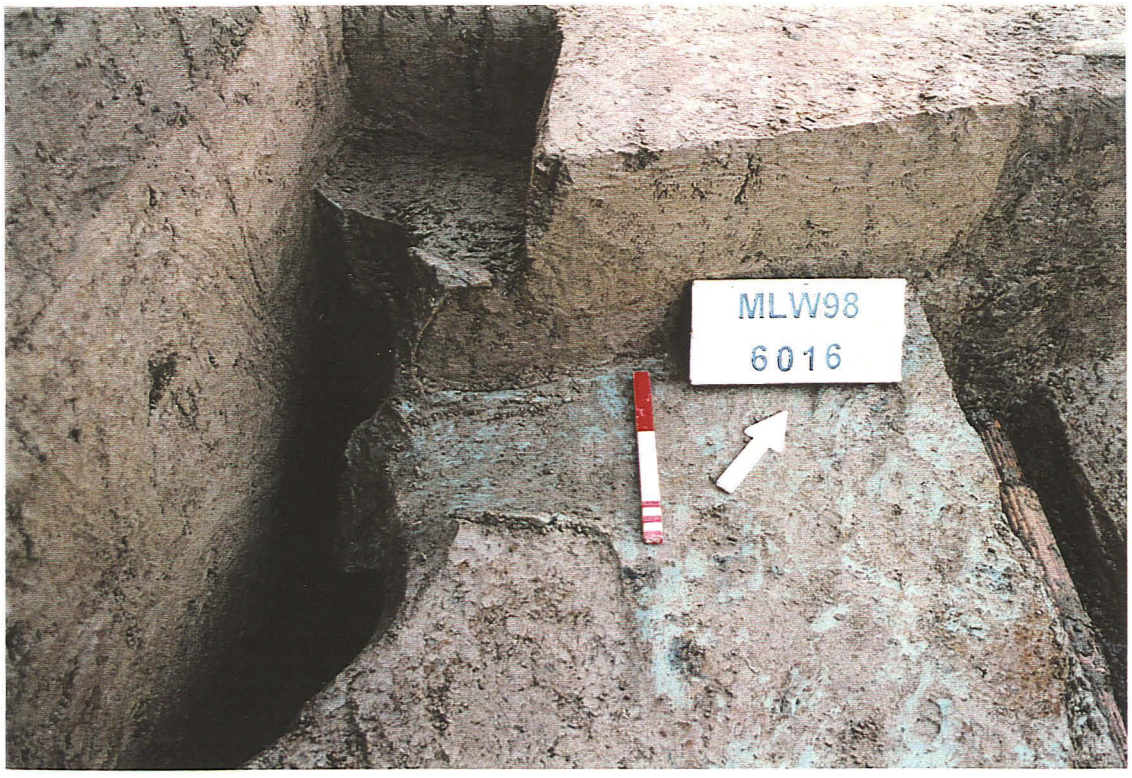


Fig. 19: Section of Trench D1 in Area D (1:50)

Pl. 15: Pre-excavation view of Area D, looking south east. The light areas are the remains of waste mounds with the darker inter-mound deposits in between. The small modern pits are clearly visible in the central mound. The dark strip beneath the number board is part of Evaluation Trench 7.



Pl. 16: The spout of the pipe leading to the vat of filtration unit 6016, looking north west.

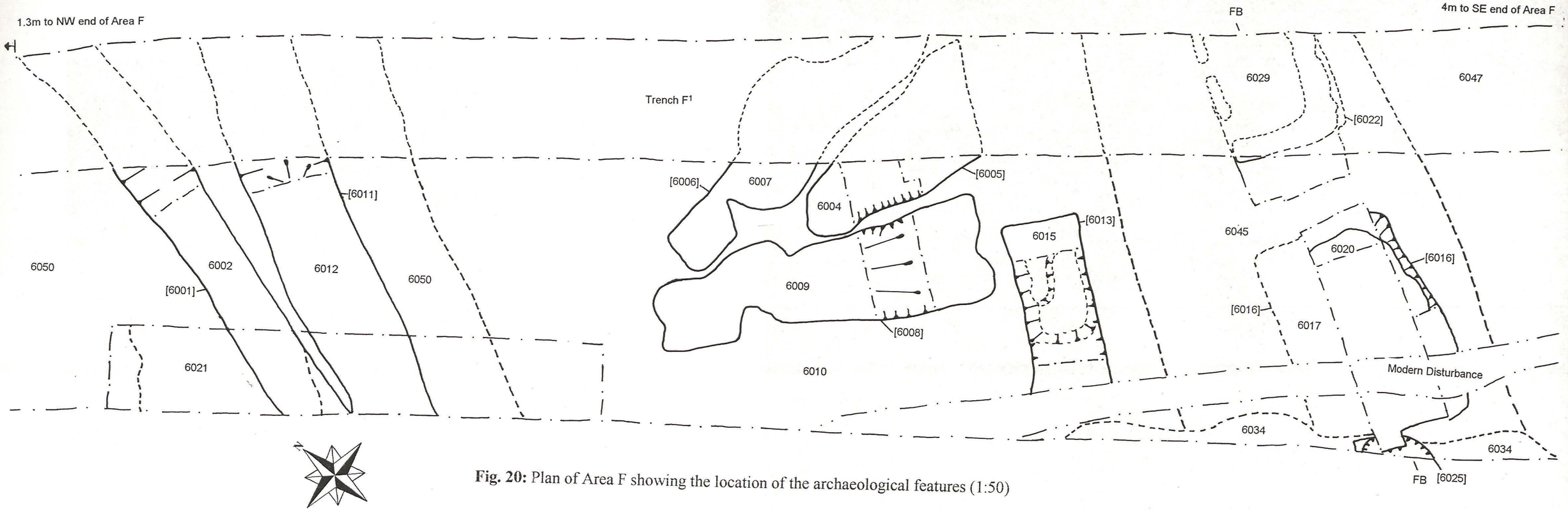


Fig. 20: Plan of Area F showing the location of the archaeological features (1:50)

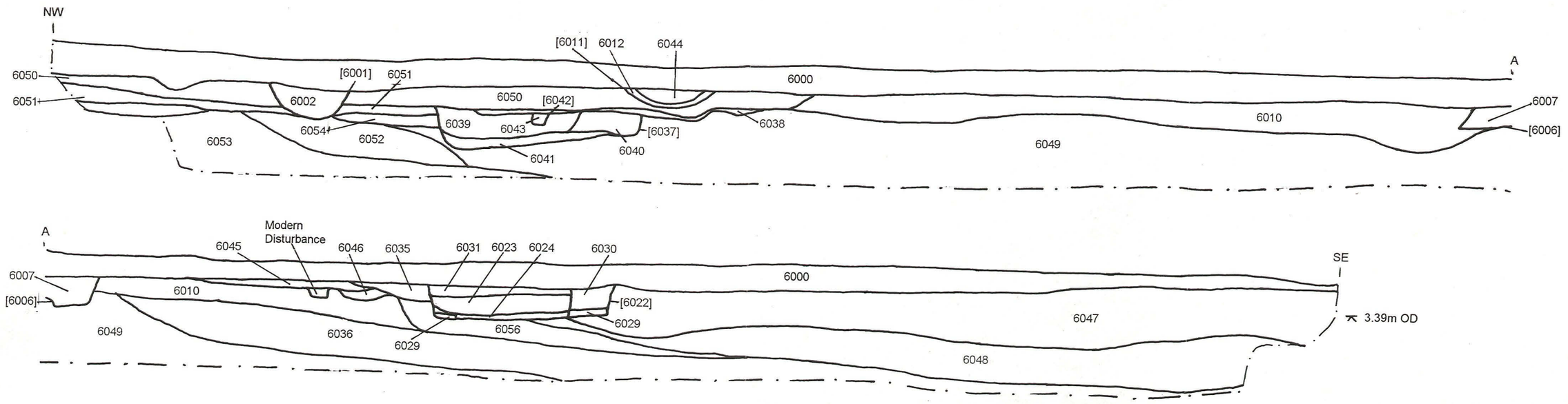
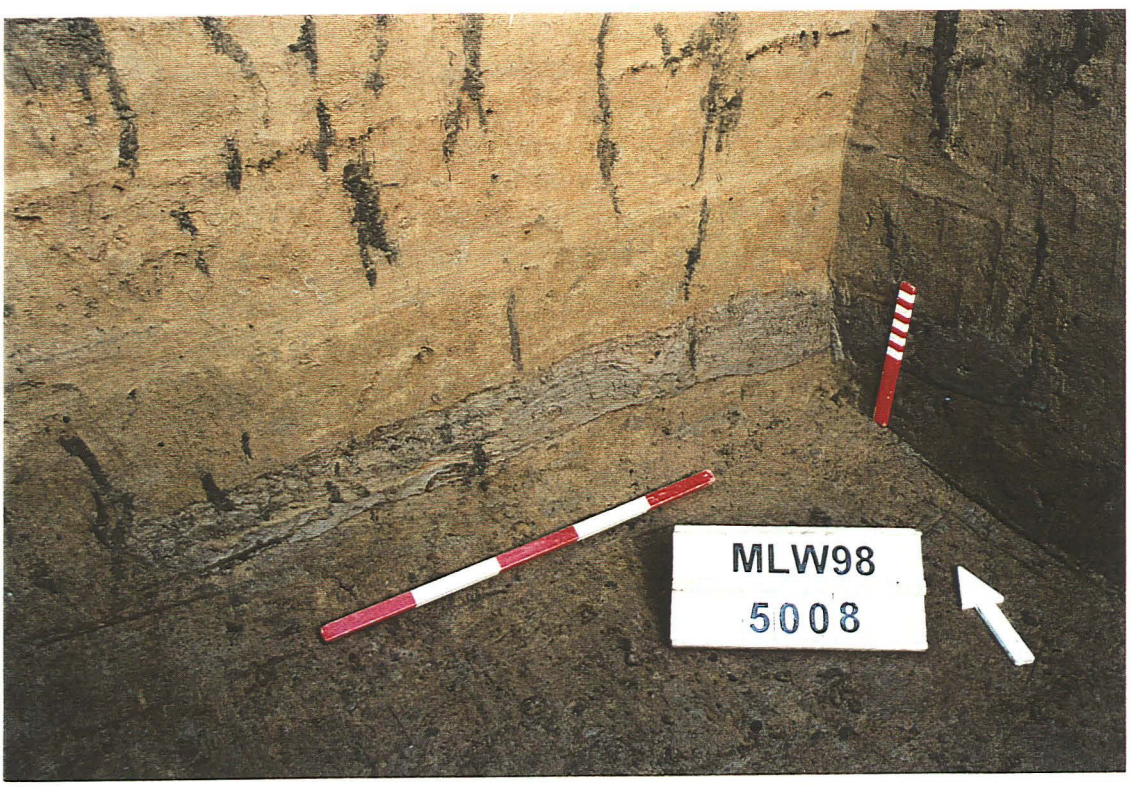


Fig. 21: Section of Trench F1 in Area F (1:40)

Pl. 17: Possible hearth deposit 6021, looking south west.



Pl. 18: Section of the filter bed of filtration unit 5008 in Test Pit 1, looking north east.

5.7 Area F (Fig. 20)

Two alignments of filtration units (FA & FB) were identified in this area. No clear evidence of the waste mounds shown on the 1905 Ordnance Survey map, or any inter-mound deposits, were discovered. All of the features in this area were cut directly into laminated silt deposits, with no dumping of silt to create a platform prior to the salt-making activity. No dateable artefacts were recovered from any of the salt-making features in this area.

Only one filtration unit [6037] was identified in alignment FA. The filter bed of this feature was observed in section in trench F[1](Fig. 21) and was sealed by a possible inter-mound deposit (6050). Alignment FB contained two filtration units [6016 & 6022], neither of which lay fully within the excavated area. The pipe connecting the filter bed and collecting vat of unit 6016 formed a spout at the vat end; an unusual detail which was not recognised in any of the other units (Pl. 16). Although waste mound deposits were not identified, the position of the alignments of units suggested that they were located on the north side of the mounds shown on the 1905 map.

Two burnt deposits (6021 & 6032), representing possible hearth areas, were identified (Pl. 17). Both of these were located to the north of alignment of filtration units and were similar in nature to the possible hearth (1006) in Area A. A small quantity of slag was recovered from deposit 6021, but was not particularly diagnostic (Cowgill; Apdx 3). Two gullies [6001 & 6011] were located at the north-west end of the area. These were aligned north-east to south-west and probably related to erosional activity between the mounds. Gully 6001 truncated the possible hearth deposit 6021.

Four pits, similar in character to those in Area D, were located in the central part of the area. Their position, between two alignments, suggested that these features were also located where a waste mound had formerly been situated. The remains of an iron vessel, probably a jug, was recovered from the fill (6004) of one of these pits. This was the only artefact associated with this group of features and was of post-medieval date (Cowgill; Apdx 3). On the basis of this date, their similarity to the pits in Area D and the assumption that they also post-dated the levelling of the mounds, it was concluded that these features were of twentieth century origin.

5.8 The Test Pits

A series of test pits were excavated a north west to south east line across the site. Although ten pits were proposed, only eight were excavated, with pits 3 and 4 being replaced by trench A[1] in Area A. Analysis of environmental samples taken from some of these pits provided conclusive evidence for the presence of a lagoon feature on this side of the site. Laminated silts, contained high salinity species of foraminifera, were present in all of the pits between 10 in the south east and trench A[1] in Area A, where the midden deposit 1002 appeared to represent their limit. The high level of salinity shown by these samples, in the range of 25-35 ppt, could only be present in a lagoon feature (Godwin; Apdx 1). Deposits in Pit 10 suggested a slightly lower salinity environment, perhaps indicating the inlet to the lagoon. This pit was excavated through these layers to reveal blue clayey mud flat deposits. These represented an

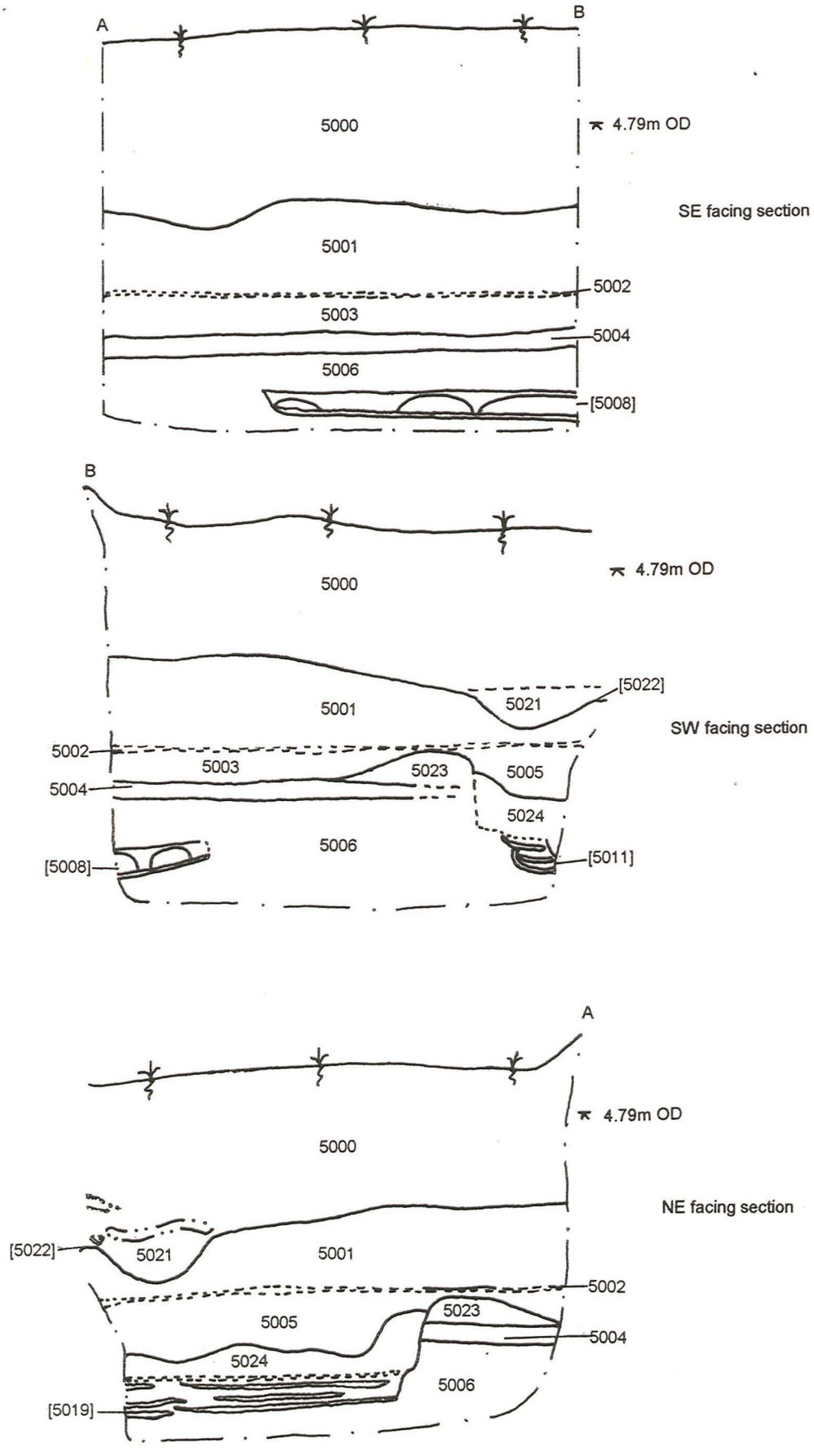


Fig. 22: Sections of Test Pit 1 (1:20)

earlier environment possibly dating to the late Roman period (Godwin; Apdx 1).A thin layer exposed in Pit 7 (5030) contained a large quantity of small coal fragments, which like the dispersed midden deposit, presumably represented a shoreline at some time during the development of the lagoon.

Earlier silt deposits, pre-dating the formation of the lagoon, were exposed in Pits 1 and 2. The filter beds of two filtration units [5008 and 5011] were also encountered in Pit 1 (Fig. 22). Due to the smaller area exposed, it was impossible to ascertain the relationship of these two features other than to note that they were broadly parallel to one another. The 'silt blocks' (5009) were clearly visible in the section in this filter bed and were sampled for environmental analysis (Pl.18).

6.0 Discussion and Conclusion incorporating comments on the palaeoenvironment and palaeoeconomy by James Rackham

6.1 The Palaeoenvironment of the Saltern

A significant quantity of new information on the environment of the late medieval and early post-medieval saltern at Wainfleet St Mary has been gained through the sampling programme during the excavation.

The foraminiferal evidence has clearly indicated a lagoonal environment in the north west part of the site and reference to McAvoy's (1994) earlier work shows a pattern of waste mounds associated with a basin of lower ground for each saltern unit within his survey. This basin, artificially scraped out, must have been within the reach of only the highest or spring tides each month and allowed an extended period for the water to drain and evaporate so that the salt concentrated in the surface silts of the basin. This could be done without the need for complicated sluices or inlets and suggests that salt production may have been possible in most months of the year since the pans may have relied as much upon drainage as upon evaporation. The eastward end of each basin presumably opened onto the saltmarsh to the seaward side of the site and the evidence for a foram assemblage suggesting an inlet or creek in Test Pit 10 would be consistent with the mouth of the basin during one phase of the salterns operation. Although the functioning part of this basin must have moved seawards as the saltern was worked and the silt waste mounds dumped on adjacent land, its shape and relative position was retained and the other salt-making activities continued to respect it, occurring around its margins. Tidal deposits along the margins and in the bowl of at least two phases of this basin were clearly visible in trench A^2 in Area A (1077) and the later coal rich sediment in Test Pit 7, several metres to the east.

It was suggested that the origin of St. Michael's Lane post-dated the salt-making activity in Area C. A series of waste mounds were identified, which would have been cut by the alignment of the road. As the industry may have been long-lived, it is possible that these mounds were levelled and the road established while salt-making was still being carried out on another part of the site. The south west boundary of the properties fronting on to St. Michael's Lane run parallel to the road and align with it further to the north west (Fig. 1). It is considered possible that this boundary represents the south western limit of a toft which extended as far as Groose Lane.

The presence of a further series of salt-making features in Area A confirmed that the mounds known to have existed along the centre of the site did not represent the north eastern limit of the industry. A filtration unit was identified during a small evaluation carried out at Groose Lane 100m to the north east of the site (McDaid 1999) providing further evidence that the industry extended in this direction.

6.2 The Palaeoeconomy and Dating of the Saltern

The environmental evidence suggested that most of the saltern was grassed and was likely to have been grazed by cattle and horses. It is probable that the salt makers

actually lived on, or immediately adjacent to, the saltern. The bones of very young cattle, horses and neonatal pigs, and the carcasses of chickens suggested that the salters kept some animals, but this may have been on a small scale and there was no evidence in the small bone assemblage that sheep were kept. Although no settlement structures were discovered, the domestic debris of the salters was evident in the midden 1002. This indicated that their diet included cereals and pulses, beef, mutton and pork, chicken, eggs, and fish and shellfish which could be gathered or caught locally along the coast. Some of the food procurement must have been carried out by the salt makers, but butchered meat, occasional large deep water fish, the coal and pottery showed local and more extended trade. The coal found in the late fifteenth to late sixteenth century midden deposit suggests that this fuel was available for domestic use by this period and possibly also for the brine boiling. The majority of the pottery used by the salters was of local origin having been produced at the Toynton and Bolingbroke kilns, located 12 and 16km. to the north west of the site. The fragment of stoneware Raeren drinking jug, imported from the Rhineland, indicated continental trade. These vessels are not uncommon finds in urban contexts, but are less usual on rural sites (Young; Apdx 2). A sherd from a similar vessel, and fragments of other imported pottery, were also found during the 1984 excavation (Healey 1994, 149).

A date range for the salt-making activity on the site was established. Although very little pottery was recovered during the excavation, a reasonably consistent range was suggested. The majority of the pottery, whether included in the midden or associated with the backfill of salt-making features, was dated to the fourteenth to sixteenth centuries (Young; Apdx 2).The presence of the glazed brick fragment in the inter-mound deposit 2004 in Area B, may suggest a late fifteenth to sixteenth century date for activity on the site. Although this date range was not conclusive, it was comparable to the pottery dates obtained during the 1984 excavation. The evidence from that excavation suggested the main period of salt-making activity on the site lay between the late fifteenth and early sixteenth century (McAvoy 1994, 160). A small quantity of earlier pottery, dating from the thirteenth century, was discovered during both excavations which perhaps suggested a small amount of previous activity at both of the sites.

6.3 The Salt-Making Process at Wainfleet St Mary

As already described, the excavated salterns at Wainfleet St. Mary used the sand-washing process. Although a range of salt-making features comparable with those identified during the 1984 excavation were revealed, some of the results showed significant differences to previously published accounts of the process.

Samples taken from the lining of the filtration units, showed that the silty clay material had been derived from an alluvial source not local to the site. There was no clear evidence for two linings in the collecting vats (clay and turf) as identified in the 1984 excavation (McAvoy 1994, 141). Although a similar construction was observed in some units (e.g. 2013) there was no evidence to support the use of turf as a lining material. The alluvial source for the lining materials did not suggest that they were turves. The banding shown by the linings of the vats in Area C was attributed to the re-lining of these features suggesting that they were used of a long period.

The exact nature of the silt blocks identified in the bases of the filter beds remained uncertain. These appeared to be neither turves nor peats as had been previously suggested (McAvoy 1994, 140; Duncan 1812 cited in McAvoy 1994, 140). It seemed likely that these were either blocks of laminated silt which were placed in the filter bed, or that they had formed in situ. Both interpretations would support the lagoonal foraminifera present in the sample taken form one of these blocks. However only the former proposal would parallel the use of peats to support a layer of filter material within the filter bed. No evidence of the wooden frames to the filter beds which were identified in the 1984 excavation (McAvoy 1994, 140) was observed and it is possible that these did not survive on this site.

It is certain, as the environmental evidence has shown, that the silt *(mould)* which was processed was obtained from a lagoon on the site. This is confirmed by the presence of lagoonal foraminifera in the waste silt mounds and in the fills of the filtration units.

Very little evidence of the boiling process was encountered during the excavation, a situation mirrored in the 1984 results (McAvoy 1994, 142). Analysis of the burnt deposits, which presumably related to hearths, showed that they contained peat charcoal. It was suggested that this may have been the fuel used in the boiling process, although this was by no means certain. The presence of the coal in the midden deposit may have indicated that it was being used as a fuel for industrial as well as domestic purposes.

6.4 Directions for Future Research

The excavation was largely successful in achieving the goals set out in the project brief. Grady (1998, 91-94) suggested a number of areas for future research in his article on the salt-making industry in north east Lincolnshire. Although the excavation took place after the publication of this work, its results address some of the of the topics which he identified.

A fifteenth to sixteenth century date has been established for the excavated part of the Wainfleet St. Mary salterns. However, salt-making is recorded at Wainfleet from the late eleventh century in the Domesday Book and by the involvement of the abbeys in the late twelfth and thirteenth centuries. The location of these salterns is unknown and establishing where these were is important to enable the development of the industry at Wainfleet to be understood. The recovery of small quantities of thirteenth century pottery during both excavations (1984 and 1998) is interesting. Does this indicate that the earlier salt-making was being carried out close to the excavated sites but the remains have yet to be located, or that some other activity was taking place?

The landscape context of the salterns is also an issue which can be applied to the sites at Wainfleet St. Mary. Although the excavation has suggested the nature of the environment and economy of the salterns further information about the Toftlands could be gained. In particular their relationship to the settlement of Wainfleet St. Mary itself could lead to a greater understanding of the agrarian and salt-making balance in the management of the medieval landscape. More detailed information should be

obtained regarding the nature and extent of the lagoons associated with each of the salterns.

A surprising amount of information is still to be gained about the sand-washing process of salt-making. In particular, the exact origin and function of the silt blocks in the filter beds remains uncertain. The type of material used as a filter, whether turf, rushes, straw or something else, has not been positively confirmed by either of the excavations. Any further excavations where filtration units are exposed should involve a programme of sampling to address these questions. The ambiguity regarding the salt-making process perhaps in part stems from a tendency to rely too heavily on the documentary sources. At best these accounts refer to salt-making being carried out in places other than Lincolnshire and at worst they are far from contemporary with the excavated evidence. Although they clearly describe a process similar to that being carried out at Wainfleet St. Mary, it would be surprising if it were exactly the same. Indeed, there is no certainty that the processing carried out at Wainfleet is even common to other Lincolnshire sites where sand-washing was carried out. As Grady (1998, 92) points out, the shape of the mounds at Wainfleet is atypical and the process which produced them may also have been different.

Significant advances in our knowledge of the late medieval and early post-medieval salt-making industry at Wainfleet St. Mary have been made as a result of this excavation. The information has opened up new avenues for future work on the Lincolnshire salt industry both into the techniques used and the environment, economy and landscape of the salterns.

7.0 Acknowledgements

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8.0 Appendices:

Appendix 8.1:

PALAEOENVIRONMENTAL AND PALAEOECONOMIC ANALYSIS OF THE LATE MEDIEVAL SALTERN AT St MICHAELS LANE, WAINFLEET ST MARY (MLW98), LINCOLNSHIRE

James Rackham, Mike Godwin, John Giorgi and Alison Locker

INTRODUCTION

A programme of environmental sampling concerned with the palaeoenvironmental history, the salt manufacturing activities and the palaeoeconomic character of the site at St Michaels Lane was instituted during the excavations of the Saltern mounds and associated features. Preservation of the environmental remains was limited to bone, shell, foraminifera, ostracods and charred plant material. In addition to the soil samples collected animal bones were recovered during the excavation.

The dateable contexts indicate a period of activity between the 14th and late 16th centuries, but many of the samples and bones derived from deposits with no directly dateable finds. Except where stated the finds from the samples and the animal bones are treated as contemporary with the dated contexts on the site and related to the late medieval salt making and associated domestic activity on the site.

Sampling

Two sets of samples were collected from the excavated deposits. A series of ten Test Pits were excavated on a transect east-west across the site and eight samples were collected from selected deposits in these trenches to establish the palaeoenvironmental context for the sediments revealed (Table 1). In addition a series of samples for foraminiferal study were taken from deposits in the main excavation trenches in order to assist in the interpretation of the functional character of the excavated features (Table 1) and a further series of bulk samples were taken for the analysis of macrofossil remains in the deposits (Table 2).

Table 1: List of samples taken for foraminiferal analysis at St Michaels Lane, Wainfleet St Marys.

Site	trench	depth	context	description	height OD *
MLW98	pit 1	136 cm	5008	wavy laminated silts in filterbed - 5008	3.69
MLW98	pit 5	85		coarse silt	2.85 est.
MLW98	pit 6	55		laminated silts	2.91 est.
MLW98	pit 7	48	5030	ash layer in laminated silts	2.74 est.
MLW98	pit 8	73		homogenised laminated silts	2.17 est.
MLW98	pit 8	100		laminated silts	1.9 est.
MLW98	pit 10	60		laminated silts	1.82 est.
MLW98	pit 10	128		blue clayey mud	1.14 est.
MLW98	Area A	90	1078	waterlain silt	3.17
MLW98	Area A	90		feather edge of laminated silts	3.32 est.
MLW98	Area B	45	2004	micaeceous coarse silt sediment dump	4.35 est.
MLW98	Area B	110a	2032	filterbed 2013 fill	3.7 est.
MLW98	Area B	110b	2008?	outer mud lining of tank 2034	3.7 est.
MLW98	Area B	110c	2035	inner mud lining of tank 2034	3.7 est.
MLW98	Area B	110d	2037	central fill of tank 2034	3.7 est.
MLW98	Area C	80	3001	dumped silts	3.74 est.
MLW98	Area C	98a		mud lining of filterbed 3051	3.57 est.
MLW98	Area C	98b	3071	fill of filterbed 3051	3.57 est.
MLW98	Area C	103a	3063/65	mud lining of settling tank 3074	3.47 est.
MLW98	Area C	103b	3066	fill of settling tank	3.47 est.
MLW98	Area D	10	4014	silt dump	4.5 est.
MLW98	Area D	50			4.14 est.
MLW98	Area F	45	6023	fill of filtration bed 6022	3.2 est.
MLW98	Area F	66	6024	clay liner of filtration unit 6022	3.0 est.
MLW98	Area F	96	6036	silts beneath clay lined filtration bed 6022	2.69 est.

* estimated heights were calculated by reference to the nearest available spot heights (a ± 0.1m error should be expected on these estimates)

Methods

The samples taken for foraminiferal analysis are discussed below. The bulk soil samples were processed in the following manner. Sample volume and weight was measured prior to processing. The samples were washed in a 'Siraf' tank (Williams 1973) using a flotation sieve with a 0.5mm mesh and an internal wet-sieve of 1mm mesh for the residue. Both residue and float were dried, and the residues subsequently re-floated to ensure the efficient recovery of charred material. The dry volume of the flots from all the samples was measured, and the volume and weight of their residues recorded. A total of 134.5 litres of soil were processed in this manner.

The residue from the samples was sorted by eye, and environmental and archaeological finds picked out, noted on the assessment sheet and bagged independently. A magnet was run through each residue in order to recover magnetised material such as hammerscale and prill. The residues were retained. The dried flot of each sample was studied under a low power binocular microscope. The presence of environmental finds (ie snails, charcoal, carbonised seeds, bones etc) was noted and their abundance and species diversity recorded on the assessment sheet. The float was then bagged. Uncharred seeds were present in a number of the samples but these are considered to be recent contaminants (see below). The float and finds from the sorted residue constitute the material archive of the samples.

The individual components of the samples were then preliminarily identified and the results are detailed below in Tables 7 and 8. Some finds were taken to full identification and post-excavation analysis.

The excavated bone has been recorded using the system employed by the Environmental Archaeology Consultancy (see Appendix) and an archive catalogue and short report produced.

Table 2: List of bulk soil samples taken at St Michaels Lane, Wainfleet St Marys.

Site	sample	context	feature	sample vol. lt	wt in kg	date
MLW98	1	1007	burnt deposit filling in filtration unit 1003	10	11	no dating evidence
MLW98	2	1008	burnt deposit filling in filtration unit 1003	4	4	no dating evidence
MLW98	3	1006	burnt deposit above/within waste spread 1014, hearth area?	5.5	7	late 14- early 16th
MLW98	4	3066	animal skeleton from filtration unit 3062	14	14	no dating evidence
MLW98	5a	1002	midden deposit?	28	38	late 15- late 16th
MLW98	5b	1002	midden	30	34	late 15- late 16th
MLW98	6	2032	fill of filterbed for filtration unit 2013	27	36	no dating evidence
MLW98	7	5030	dark 'charcoal' band in test pit 7	3	4	no dating evidence
MLW98	8	5008	'turf' from filter bed of filtration unit 50??	3	4	no dating evidence
MLW98	9	2009	silt from waste mound	29	40.5	no dating evidence
MLW98	10	1077	deposit in long section of Area A	8	9	no dating evidence
MLW98	11	1078	deposit in long section of Area A	3	3	no dating evidence

RESULTS

Those results that address the palaeoenvironmental character of the site and the possible working of the saltern are considered first. The Test Pit transect and the east-west sections of Area A illustrate a sequence of laminate silt sediments eastwards from Area A to Test Pit 10. These were recognisable immediately below the soil horizon in all these trenches and had probably continued to the turf layer in most test pits prior to their disruption of the laminate

structure by soil processes. The transect shows a west-east fall of over 2.5m in the modern ground level from a maximum height of 5.05m OD at Test Pit 1 on the western boundary of the site to a low of 2.42m OD adjacent to Test Pit 10 on its eastern boundary. This transect traverses the only part of the site where there are no silt waste mounds.

The laminae observed in these pits and sections are indicative of deposition within a cyclical regime of inundation by silt laden water that is typical of tidal environments. The results of the analyses of the samples from these sediments therefore reflect the environment and origin of the sediment and sub-fossil burden of these tidal waters. Most of the other sampled deposits on the site are re-worked and therefore include elements of their original sub-fossil burden, material subsequently introduced as a result of this re-working (for instance in the salt making process) and a new assemblage of finds and fossils that accrued after their final deposition, for instance, as a silt waste mound or fill/backfill deposit. These taphonomic aspects need consideration in the interpretation of the sampled deposits.

Foraminifera
Mike Godwin

Introduction
This saltern site is remarkable for the preservation of microfauna. Thousands of foraminifera specimens were present in many of the samples, mainly recovered less than a metre from the original ground surface. Normally at such shallow depths the assemblages are badly affected by taphonomic processes that lead to the destruction of much of the fossil material. In consequence, it has proved possible to build a comprehensive analysis of the palaeoenvironments associated with the site.

Sedimentology
All the samples taken from the site were split into two parts. 100g (wet weight) was reserved for foraminiferal analysis and the remainder was tested on a sheet of glass for clay content. The results of this informal analysis revealed that only the sample from Pit 10/128 cms had any significant clay content (*c.*20%). The clay linings of the saltern features were found to have a clay content of less than 10%, although palaeoenvironmental analysis showed they had been sourced from a different location than the other sediments on the site. This finding is supported by the fact that none of the samples required pre-soaking with hydrogen peroxide before sieving over a 125 micron mesh (fine sand grade). The sieving of all the samples demonstrated that no sample had a sand content of higher than 1%, and this was dominated by foraminiferal tests, coal fragments and mica. Quartz grains were in low abundance. The sediment was dominantly of coarse silt grade in most cases. These sediments are characteristic of tidal mud flats and could not have been derived from dunes. In fact, no such features are likely to have existed anywhere near the site during the Medieval period.

Palaeoenvironmental Analysis
The residues were split using a microsplitter and between 100 and 300 forams were counted in each sample where possible.

Abbreviations used in this report:

FDI - Fischer diversity index: a measure of the relative diversity of each assemblage (see

Murray 1991). This is useful in determining general palaeoenvironments. A range of 0-5 is typical of brackish conditions and 3-12 marine conditions (for living assemblages). In fossil assemblages it is a useful indicator of the degree of transport occurring between the inner shelf and the site.

Biozones: IIc - marsh creek; **IIIa** - high intertidal flat; **IVa** - low intertidal flat; **IVb** - subtidal flat; **FW** - alluvial

Biofacies: (Hg and Ew defined as such when dominant; Eo and Ee at 10% of population)

	Hg - *Haynesina germanica*	**Ew - *Elphidium williamsoni***
Range:	lower salt marsh to outer estuary	lower salt marsh to subtidal flats
Salinity:	0-35ppt (0-15ppt normally)	2-35ppt (15-35ppt normally)
Dissolved oxygen:	tolerant of low levels	tolerant of low levels
Current activity:	low	low to high
Sediment:	*Phragmites* and estuarine muds	creeks, sand and mud flats
Temperature:	0-20 deg C	0-32 deg C

	Eo - *Elphidium oceanensis*	**Ee - *Elphidium excavata* f. *clavata***
Range:	lagoons and subtidal flats	subtidal flats and channels
Salinity:	9-35ppt (10-20ppt optimum)	10-35ppt
Dissolved oxygen:	only abundant when levels low	intolerant of very low levels
Current activity:	low to high	medium to high
Sediment:	estuarine muds	estuarine muds and channel sands
Temperature:	10-20 deg C	0-20 deg C

Note: *Ammonia beccarii* is generally relatively rare in these sediments (except as a constituent of the marsh creek fauna). This species requires a temperature of at least 20 deg C to reproduce, indicating fairly cool conditions at the time of deposition (cooler than the present day or the Bronze Age (Godwin, 1993).

Site transect

This consisted of samples taken from Test Pits 1-10 and two samples from laminate sediments in Area A. Not all the pits were sampled, some being sited so close to others that no difference in environment was expected. The foraminifera analyses are presented in Table 3.

Pit 1 - 136cms - wavy laminated silts - context 5008 - filter bed 5019

The sediment also contained some molluscan shell fragments and rare valves of the estuarine ostracod *Leptocythere pellucida.* The assemblage has been interpreted as belonging to the subtidal flat biozone and the Ee biofacies, probably shallow, cool brackish water with moderate levels of current activity. The presence of 9% estuary mouth species indicates salinities of 25-35ppt. and the FDI indicates a low level of transportation from the distal area of the Wash.

Pit 5 - 85 cms - coarse silt

Foraminifera were very abundant in this sample. It has been assigned to the Eo/Ee biofacies (neither species being dominant over the other) and was probably shallow subtidal in nature. It is possible it represents a brackish lagoon (artificial or natural). Salinities were probably around 20-30ppt, with temperatures of at least 10 deg C.

Pit 6 - 55 cms - laminated silt

The sediment contained abundant echinoid spines and other marine debris. The assemblage also had a FDI of 6 indicating transport from the outer Wash. The assemblages more exotic constituents are mainly sourced from the turbulent zone of the littoral. The assemblage was otherwise very similar to Pit 5/85 except for the presence of the ostracods *Hemicytherura* sp.

(a marine form) and *Leptocythere psammophilia* (an outer estuarine species). These do not form a biocoenosis.

Table 3: Foraminifera: Samples from the Pit transect:

Percentage of Assemblage

Test Pit	**1**	**5**	**6**	**7**	**8**	**8**	**10**	**10**
Depth in cms below ground level	136	85	55	48	73	100	60	128
Context no	5008			5030				
Saltmarsh species								
Trochammina inflata								
Jadammina macrescens			1					
Miliammina fusca		<1						
A. beccarii f. limnetes								
Marsh creek species								
A. beccarii f. limnetes (b)		<1					10	
E. excavata f. lidoensis (b)							3	
Cosmopolitan species								
Haynesina germanica	40	29	29	43	40	60	29	27
A. beccarii f. batavus	3	7	13	10	6	6		
A. beccarii f. tepida	5	8	3	8	5		2	12
Elphidium williamsoni	23	15	19	17	18	9	31	24
E. excavata f. lidoensis	2	<1						
E. excavata f. selseyensis								<1
E. excavata f. excavata								
Sub-tidal estuarine species								
Elphidium oceanesis	2	12	10	2	7	1	4	3
E. excavata f. clavata	10	10	10	2	11	7	9	23
Estuary mouth species								
Elphidium gerthi		<1	1	2	1			2
Elphidium earlandi	6			2	1	1		<1
Elphidium incertum			1				<1	
Haynesina depressula		<1	<1	1		1		
Cibicides lobatulus	2	3	3	3	2	2	2	
Buccella frigida	1	3	1		1	4		
Marine species								
Acervulina inhaerens			1			1		
Asterigerinata mamilla			1	1				
Bolivina pseudoplicata								
Brizallina pseudopunctata							1	
Brizalina spathula			1					
Brizalina variablis								
Bulimina gibba					1			<1
Buliminella elegantissima								
Cassadulina obtusa						1		
Cyclogyra involvens								
E. macellum f. crispa		<1						
Elphidium magellanicum								
E. excavata f. magna								
Elphidium margaritaceum				2				<1
Fissurina lucida		<1				1		1
Fissurina marginata		<1		2			1	
Fursenkoinia fusiformis						4		<1
Gavelinopsis praegeri		<1	1	1		1		
Glabratella milletti		2						

Table 3: continued - Foraminifera: Samples from the Pit transect:

Test Pit	**1**	**5**	**6**	**7**	**8**	**8**	**10**	**10**
Depth in cms below ground level	136	85	55	48	73	100	60	128
Context no	5008			5030				
Globulina sp.								
Lagena clavata	3						2	<1
Lagena interrupta								
Lagena sulcata				2			1	<1
Lagena semistriata								
Oolina melo				1		1		
Oolina hexagona								<1
Nonionella turgida		<1						
P. mediterranensis		<1	<1			1		
Rosalina anomala			1					
Rosalina williamsoni			1					
Miliolinella subrotunda			1				1	
Quinqueloculina cliarensis						1		
Quinqueloculina dimidiata			1		1		2	
Quiqueloculina lata								
Quinqueloculina seminulum			1				1	<1
Planktonics and fossils								
Globigerina bulloides			1					
Globigerina quinqueloba		<1						<1
Hedbergella sp.	3	<1	2				1	
Heterohelix sp.		2			1			
Rotalipora sp.					1			
Total no. per 100g (est)	**62**	**2k+**	**2k+**	**3k+**	**2k+**	**1k+**	**350**	**2k+**
Number of species	13	23	23	16	17	15	17	19
Fischer diversity index	4	6	7	5	6	5	4	6
Biozone	IVb	IVb	IVb	IIIa	IVb	IVa	IIc	IVb
Biofacies	Ee	Eo/Ee	Eo/Ee	Hg	Ee	Hg	Ew	Ee

Pit 7 - 48 cms - ash layer in laminated silts, context 5030
This assemblage appears to have been derived from high intertidal flat levels and belongs to the Hg biofacies. It is speculated that it was deposited when the saltern was in operation as it had a large residue of charcoal fragments. The dominance of *Ammonia beccarii* forma *batavus* over forma *tepida* indicates salinities of 25-35ppt. A single valve of a marine ostracod was also noted.

Pit 8 - 73 cms - homogenised laminated silts
At this level there is a return to the conditions found in Pits 5 and 6 with a similar assemblage. Outer estuarine and marine ostracods were also noted (*Leptocythere pellucida, Cytheropteron* sp. and *Hemicytherura* sp.).

Pit 8 - 100 cms - laminated silts
This assemblage was assigned to a low intertidal flat biozone (*E. oceanensis and E. excavata* <10%) and belongs to the Hg biofacies. The *Ammonia* population is dominated by forma *batavus* (*tepida* being absent) so salinity levels are likely to have been 25-35ppt.

Pit 10 - 60 cms - laminated silt
This assemblage is generally similar to that found in Pits 1, 5, 6, and 8 with the exception of the dominance of *Elphidium williamsoni* and the presence of 13% of the marsh creek

ecotypes of *Elphidium excavata* forma *lidoensis* and *Ammonia beccarii* forma *limnetes*. This suggests that this location was subject to strong diurnal salinity fluctuations at the time of deposition (Pascal and others, 1991). As Pit 10 is located at the seaward end of the site this area may have formed an inlet to a lagoon. The sediment also included abundant sponge spicules and echinoid spines. The assemblage has been interpreted as a creek but was probably subtidal in character (cf. Cabbage Creek, Stiffkey Marshes, Norfolk).

Pit 10 - 128 cms - blue clayey mud
This sediment is entirely different in character to the other material on the site and represents a pre-Medieval phase of deposition, probably of late Roman age. The presence of 23% of *Elphidium excavata* forma *clavata* indicates a deep subtidal environment. Fragments of shell from *Hydrobia* and *Cerastoderma edule* were also present along with an estuarine assemblage of ostracods which included *Cyprideis torosa, Leptocythere castanea* and *Leptocythere pellucida.* The assemblage is assigned to the Ee biofacies but the composition of the *Ammonia* population suggests salinities were lower at 15-25ppt.

Area A - 90 cms - south section, 2m from west end, context 1078
The sediment included echinoid spines the ostracod *Hemicytherura* sp. and cockle shell fragments. *Elphidium oceanensis* dominated the assemblage (29%) indicating restricted oxygen depleted conditions. This most frequently occurs in lagoons and man-made structures such as harbour basins (Rouvillois, 1972). Such features are usually nutrient rich. The species is common in estuarine and inner shelf sediments at population levels of less than 5%. Only in the circumstances described above will the species increase in abundance. It is an opportunistic coloniser of such environments (see Jorissen, 1988). The assemblage suggests shallow (<1m) subtidal partially enclosed conditions. The exclusive presence of *Ammonia beccarii* forma *batavus* suggests that salinities were in the 25-35ppt range.

Area A - 90 cms - 11m from the west end of the north section - feather edge of the laminated silts
Echinoid spines were noted in this assemblage which contained 18% of the marsh creek ecotypes of *Ammonia beccarii* forma *limnetes* and *Elphidium excavata* forma *lidoensis*. This suggests strongly fluctuating diurnal salinities as in Pit 10/60 cms. A similar subtidal inlet is postulated here: possibly this is a continuation of the same feature seen in Pit 10.

Investigated features
A number of the features associated with the salt making process were sampled in Test Pit 1, and Areas A, B, C, D and F. The foraminifera analyses are presented in Tables 4 and 5.

Area B - 45 cms - micaeceous coarse silt, 2004, in sediment dump west of filtration unit 2013.
The sample contained a few freshwater gastropod shells and 3% of the lower salt marsh foram *Ammonia beccarii* forma *limnetes* but was otherwise similar to the other assemblages examined in the subtidal biozone and the Ee biofacies. It is concluded that the silts at the original time of deposition were in a salinity regime of 25-35ppt. The very brackish or freshwater elements may have colonised the silt after dumping. It is likely that the material was obtained from the proposed lagoon which would have been adjacent to this area.

Table 4: Foraminifera: Samples from deposits in Areas A and B

Percentage of Assemblage

Area	A	A	B	B	B	B	B
Context	1078		2004	2032	2008	2035	2037
Depth in cms below ground level	90	90	45	110	110	110	110
Saltmarsh species							
Trochammina inflata							
Jadammina macrescens							
Miliammina fusca							
A. beccarii f. limnetes			3				
Marsh creek species							
A. beccarii f. limnetes (b)		5					
E. excavata f. lidoensis (b)		13		2	3		
Cosmopolitan species							
Haynesina germanica	16	25	41	25	44	33	18
A. beccarii f. batavus	11	5	11	12	6	67	6
A. beccarii f. tepida		2	9		2		12
Elphidium williamsoni	13	14	26	17	14		33
E. excavata f. lidoensis							
E. excavata f. selseyensis			1		2		
E. excavata f. excavata			2				
Sub-tidal estuarine species							
Elphidium oceanesis	29		3	16	7		9
E. excavata f. clavata	5	17	16	14	10		8
Estuary mouth species							
Elphidium gerthi		2	3	2	2		4
Elphidium earlandi		2	5	<1			
Elphidium incertum							
Haynesina depressula		<1	4	<1	2		2
Cibicides lobatulus	2	<1	5		1		2
Buccella frigida	1		4	2			
Marine species							
Acervulina inhaerens	1	<1	4				
Asterigerinata mamilla	5		<1	<1	1		1
Bolivina pseudoplicata			<1				
Brizallina pseudopunctata							
Brizalina spathula							
Brizalina variablis							
Bulimina gibba							
Buliminella elegantissima							
Cassadulina obtusa			2		1		1
Cyclogyra involvens							
E. macellum f. crispa	1			<1			1
Elphidium magellanicum							
E. excavata f. magna			<1				
Elphidium margaritaceum		2					4
Fissurina lucida							
Fissurina marginata							
Fursenkoinia fusiformis			<1				
Gavelinopsis praegeri		<1					1
Glabratella milletti	1			<1			

Table 4: continued- Foraminifera: Samples from deposits in Areas A and B

Area	A	A	B	B	B	B	B
Context	1078		2004	2032	2008	2035	2037
Depth in cms below ground level	90	90	45	110	110	110	110
Globulina sp.							1
Lagena clavata		<1		2			1
Lagena interrupta							
Lagena sulcata		<1	1				
Lagena semistriata	1			<1			
Oolina melo	3		<1	<1	1		
Oolina hexagona		<1	<1				
Nonionella turgida							
P. mediterranensis							
Rosalina anomala	2	2		<1	1		
Rosalina williamsoni	1	<1	<1	<1	2		1
Miliolinella subrotunda	5	2					1
Quinqueloculina cliarensis							
Quinqueloculina dimidiata		4	1				
Quiqueloculina lata							1
Quinqueloculina seminulum		<1					
Planktonics and fossils							
Globigerina bulloides			1				
Globigerina quinqueloba							
Hedbergella sp.	2	2			1		1
Heterohelix sp.		<1					
Rotalipora sp.							
Total no. Per 100g (est)	**600**	**4k+**	**1k+**	**650**	**250**	**3**	**500**
Number of species	7	24	26	18	17	2	21
Fischer diversity index	5	7	8	6	5	0	8
Biozone	IVb	IIc	IVb	IVb	IVb	FW	IVb
Biofacies	Eo	Ee	Ee	Eo/Ee	Ee/Eo		Eo/Ee

Area B - 110a cms filtration unit 2013: filter bed fill - context 2032
This sample has an assemblage that is identical in composition to those found in the proposed lagoon areas (cf. Pits 5, 6 and 8) and was derived from a subtidal biozone in the Eo/Ee biofacies (probably lagoonal in nature). The salinity of the waters going into it would have been in the 25-35ppt range. This is approximately 10ppt higher than that estimated for the environment outside the complex which was 15-25ppt in the 'inlet' found in Test Pit 10.

Area B - 110b cms dumped silt 2008 into which filtration unit 2013 was cut
This sediment was basically a silt slightly more clay rich than most of the other material on the site. It appears to have been sourced from the proposed lagoon as the foraminiferal assemblage is very similar to others taken directly from the laminated silts that lie adjacent to the area.

Area B - 110c cms filtration unit 2013: inner mud lining - context 2035 - of tank 2034
This sediment was composed of around 10% clay and 2% fine sand. It appears to have had a different source from the other material on the site. It only contained 3 forams (probably contaminants) and had an assemblage of freshwater molluscs. The mud was probably transported to the site from a nearby alluvial site, which probably represented the nearest source of fairly impermeable material for the construction of the tank.

Table 5: Foraminifera: Samples from deposits in Areas C, D and F

Percentage of Assemblage

Area	C	C	C	C	C	D	D	F	F	F
Depth in cms below ground level	80	98	98	103	103	10	50	45	66	96
Context	3001		3071	3074	3066	4014		6023	6024	6036
Saltmarsh species										
Trochammina inflata		<1								
Jadammina macrescens										
Miliammina fusca										
A. beccarii f. limnetes										
Marsh creek species										
A. beccarii f. limnetes (b)										
E. excavata f. lidoensis (b)		4	9		10	2				
Cosmopolitan species										
Haynesina germanica	17	45	18	100	40	21	16	50	55	25
A. beccarii f. batavus	4	6	3			7	7	3	7	19
A. beccarii f. tepida	12	7	6		10	12	1	5		2
Elphidium williamsoni	19	17	22		30	30	27	13	15	10
E. excavata f. lidoensis	2						2		1	
E. excavata f. selseyensis										
E. excavata f. excavata										
Sub-tidal estuarine species										
Elphidium oceanesis	4	13	2			4	9	8	6	
E. excavata f. clavata	9	6	7			2	18	6	7	22
Estuary mouth species										
Elphidium gerthi	1	1	5		10	5	4	7		4
Elphidium earlandi							3	4		3
Elphidium incertum			3			1	4		1	
Haynesina depressula	1		1			4			1	<1
Cibicides lobatulus	4	<1	6				3	1	4	3
Buccella frigida			2			3	1	<1	2	
Marine species										
Acervulina inhaerens	1		1			1			1	
Asterigerinata mamilla								<1	2	
Bolivina pseudoplicata										
Brizallina pseudopunctata										
Brizalina spathula										<1
Brizalina variablis							1			
Bulimina gibba	1	<1				1				
Buliminella elegantissima						1				
Cassadulina obtusa						1		1		
Cyclogyra involvens							1			
E. macellum f. crispa	1									
Elphidium magellanicum	1		1							
E. excavata f. magna	1									3
Elphidium margaritaceum			1					<1	1	
Fissurina lucida			1				1	<1		1
Fissurina marginata								<1		
Fursenkoinia fusiformis										
Gavelinopsis praegeri	1	<1				1		<1	1	<1
Glabratella milletti								<1		

Table 5: continued - Foraminifera: Samples from deposits in Areas C, D and F

Area	C	C	C	C	C	D	D	F	F	F
Depth in cms below ground level	80	98	98	103	103	10	50	45	66	96
Context	3001		3071	3074	3066	4014		6023	6024	6036
Globulina sp.			1							
Lagena clavata	1		2				2	<1		<1
Lagena interrupta								<1		<1
Lagena sulcata	1									
Lagena semistriata										
Oolina melo	1	<1						<1		<1
Oolina hexagona		<1								
Nonionella turgida								<1		<1
P. mediterranensis										<1
Rosalina anomala	1					1				<1
Rosalina williamsoni	3							1	1	
Miliolinella subrotunda	3		3							
Quinqueloculina cliarensis			1							
Quinqueloculina dimidiata	1		1			1				
Quiqueloculina lata	1									
Quinqueloculina seminulum	1		1							
Planktonics and fossils										
Globigerina bulloides						2	1			
Globigerina quinqueloba								<1		
Hedbergella sp.	3	2	4				2	<1		1
Heterohelix sp.										
Rotalipora sp.										
Total no. Per 100g (est)	**500**	**161**	**2k+**	**1**	**10**	**400**	**1k+**	**500**	**400**	**2k+**
Number of species	29	15	24	1	4	19	18	23	14	21
Fischer diversity index	13	4	10	0	0	7	7	9	4	7
Biozone	IVb	IVb	IVa	FW	IIc	IVa	IVb	IVb	IVb	IVb
Biofacies	Ew	Eo	Ew		Hg	Ew	Ee	Eo	Ee	Ee

Area B - 110d cms filtration unit 2013: central fill - context 2037 - of tank 2034
As might be expected the foraminiferal assemblage found in the fill of the tank is very similar to those found in the proposed lagoon and the filter bed. The latter, in this particular instance, appears to have been reasonably efficient considering that the density of the foraminiferal population (per 100g) has been reduced by more than 75% . In the proposed lagoon densities are 2-3000 per 100g compared with 5-600 in the tank and filter bed.

Area C - 80 cms - centre of dumped silts, context 3001
The sediment contained abundant echinoid spines and bryozoan fragments as well as a few valves of the ostracod *Loxoconcha rhomboidea*, an outer estuarine form. The foraminiferal assemblage is very diverse with a FDI of 13 which demonstrates considerable shoreward transport of sediment. The biocoenosis (particularly the *Ammonia* population) suggests slightly lower salinities than found elsewhere on the site, 25ppt probably being the upper limit. The silt appears to have been derived from the proposed lagoon as the rest of the assemblage is comparable to the other samples referred to the lagoon and it has been placed in the subtidal biozone in the Ew biofacies.

Area C - 98a cms - mud lining of filterbed 3051
This material had a clay content of <10% and was derived from a lagoon. The assemblage, which was fairly sparse, belongs to the subtidal biozone and the Eo biofacies.

Area C - 98b cms - fill 3071 of filterbed 3051
The foraminiferal assemblage has been interpreted as belonging to the low intertidal flat biozone. Interestingly, it contains 34% estuary mouth and marine species as well as 9% of the marsh creek foram *E. Excavata* forma lidoensis (b) and has a FDI of 10 implying a large degree of landwards transport. The structure appears to have been functioning as an inlet and probably had strongly fluctuating diurnal salinities.

Area C - 103a cms - east end - mud lining - context 3063 or 3065 - of settling tank 3074
This mud contained only 1 foram and was probably derived from an alluvial source.

Area C - 103b cms - east end - fill - context 3066 - of settling tank 3074
This sediment had a very sparse assemblage of foraminifera that was assigned to the marsh creek biozone and the Hg biofacies. The sediment may have been filtered before it entered this structure. The assemblage is too small to draw any conclusions about the sediment in the tank.

Area D - 10 cms - dumped silt, context 4014
This material appears to have been derived from a low intertidal flat which had a salinity in the 15-25ppt range. It may be a spoil heap created when the features of the saltern complex were dug out during one of its many phases of development, as the assemblage has a smaller population of subtidal types, although the archaeological evidence indicates another silt waste mound.

Area D - 50 cms - filtration unit
The assemblage deposited in this structure belongs to the subtidal biozone and the Ee biofacies. It would appear to have been derived from a pond or lagoon. Salinities would have been in the 25-35ppt range.

Area F - 45 cms - filtration unit 6022: fill - context 6023 of filter bed
The ostracod *Loxoconcha elliptica* was noted in this sample (an outer estuarine form). The assemblage is subtidal and lagoonal in character and belongs to the Eo/Ee biofacies. Notably the assemblage appeared to have a living assemblage of *Elphidium gerthi* which is known to graze on algae (Wefer, 1976). It can tolerate salinities as low as 18ppt but is probably intolerant of diurnal fluctuations.

Area F - 66 cms - filtration unit 6022: clay liner - context 6024 - of filter bed
This material appears to have been derived from a pond or lagoon.

Area F - 96 cms - filtration unit 6022: sample from context 6036 beneath mud liner
The assemblage here is subtidal in character and belongs to the Ee biofacies. *Elphidium oceanensis* is entirely absent so lagoonal conditions cannot be inferred at this spot. The sediment may represent a natural phase of mud flat deposition which predates the saltern complex.

Conclusions

The sedimentology of the site indicates that coarse silt was the dominant fraction of most of the sediment. The site was so poor in clay that lining materials had to be imported from a, presumably, nearby alluvial site.

The saltern appears to have been constructed on an area previously mud flats. The estuary waters at the time had a diurnal salinity range of 15-25ppt. The chosen area was dug out and included an inlet and a shallow lagoon where the water could be ponded up until evaporation elevated the salinity to 25-35ppt. This was then fed into the various filter beds and tanks for processing. As the sediment was dominantly silt any current flow would have made the waters extremely turbid and filtration would cause numerous problems. It can be seen that most of the structures readily silted up and the whole site may have had to have been reconstructed on an annual basis. The inlet and lagoon whose retaining walls (if any were needed) would have been constructed of silt and also would have been subject to winter storm damage.

The evidence for an artificial lagoon/pond is conclusive as *Elphidium oceanensis* is not at all abundant in any other circumstances and such structures do not naturally occur in the Wash. The only other sites where the population of this species exceeds 5% in the region of the Wash (appearing in the 20-30% range as on this site) are in abandoned Roman canals. The seaward end of these features became silted up, ponding the water up.

The molluscs
James Rackham

The only other element of the environmental data that can contribute to a consideration of the palaeoenvironment of the site and the workings of the saltern are the mollusca. The presence of freshwater or other mollusca were noted above in the foraminifera samples but the bulk of the data were obtained from the bulk soil samples (Table 6). Three of these samples duplicated layers that were sampled for foraminifera, context 5008 the laminated features on the base of the filter bed sectioned in Test Pit 1, one waterlain sediment from the laminated sequence of deposits on the southern section of Area A, and a 'charcoal' rich waterlain lens in Test Pit 7, context 5030.

The primary character of all these samples is the abundance of terrestrial snails that are typical of open grasslands (Table 6). Those taxa found in shaded or woodland habitats are very limited and a general picture of a well grassed silt soil and silt mounds is indicated by the fauna in most of the samples. There is very limited evidence for damper habitats, and the general absence of shells of *Vallonia costata*, the species in this genus associated with dryer habitats, from all but the sample from the silt waste mound suggests that the grassland may have been rank. The abundance of *Pupilla muscorum* the other dominant grassland taxa and a species typical of light, dry and unstable ground, but also tall grassland supports this interpretation. Apart from the shells of *Hydrobia ulvae* which we can consider as introduced in most of these deposits (see the discussion below) none of this fauna can be associated with a salt marsh habitat and the silt mound and associated workings must have lain above the limits of the salt marsh.

The abundance of the blind snail, *Cecilioides acicula*, deserves some discussion. This species burrows and can occur in considerable numbers at depths up to, and over, 1m (Evans 1972).

It is therefore not a good indicator of past environments although it is typically found in dry pastures and grassy places. Since it burrows the shells of dead individuals can reach fairly high concentrations in sub-turf layers without the erosional loss that occurs in shells deposited at the surface. High concentrations in buried archaeological horizons may therefore indicate an extended period of time over which the taxa has occupied the site. Although generally more abundant than other taxa *Cecilioides* density is not great, 14.3 shells per litre is the maximum (Table 6), and relative depth may be contributing more to its abundance in a deposit than any historical dimension.

Table 6: Mollusc taxa from the bulk samples. Wainfleet St Mary, MLW98

context	1007	1008	1006	3066	1002	2013	5030	5008	2009	1077	1078
sample no.	1	2	3	4	5	6	7	8	9	10	11
volume in l.	10	4	5.5	14	28	27	3	3	29	8	3
date			1 14-e16		1 15-1 16						
Open country taxa											
Cecilioides acicula	113	11	76	68	6	11	3	43	294	7	
Vertigo pygmaea	1				9	3			2		
Vertigo sp.	1										
Pupilla muscorum	86	9	5	1	13	3	25	2	42	3	
Vallonia sp.	49	8	14	4	67	56			52	3	
Vallonia pulchella											
Vallonia costata									2		
Vallonia excentrica	36	6	13	7	87	17	4		55	10	1
Catholic taxa											
Cochlicopa lubrica	5		3	2	16	9	1		7	2	
Hygromia striolata									1		
Hygromia hispida	6		4	1	33	18	3	4	37	5	1
Woodland/shaded taxa											
Discus rotundatus					1						
Vitrina sp.	1										
Punctum pygmaeum									2		
Columella eduntula					1						
Aquatic taxa											
Valvata cristata					3						
Lymnaea truncatula					7					1	
Estuarine taxa											
Hyrdrobia ulvae	3	1	14	58	66	9	8	6	74	58	26
Indeterminate	3	1	2			5	3		4	4	
Total non *Cecilioides* shells	188	24	53	73	303	115	41	12	274	82	28
Density *Cecilioides*/litre	11.3	2.75	13.8	4.9	0.2	0.4	1	14.3	10.1	0.87	0
Density non *Cecilioides* /litre	18.8	6	9.6	5.2	10.8	4.25	13.7	4	9.4	10.25	9.33
% *Hydrobia* of non *Cec.*shells	1.6	4.2	26.4	79.4	21.8	7.8	19.5	50	27	70.7	92.9
Hydrobia shells/ litre	0.3	0.25	2.5	4.1	2.4	0.33	2.7	2	2.55	7.25	8.7

Broad ecological groups are based upon Evans 1972, Macan 1976 and Cameron and Redfern 1976

Contexts 1077 and 1078 in Area A were relatively charcoal rich sediments deposited as lenses within a laminated tidal silt sequence. That these two layers were both formed as a result of deposition along the margins of the tidal reach is suggested both by their stratigraphy (see Section 00) and by the dominance (70-93%), and its density, of the gastropod *Hydrobia ulvae*, a species typical of estuaries and saltmarsh (Macan 1977) and washed up in abundance on tidal strand lines along the east coast of Lincolnshire today (Table 6). Only in one other context is the frequency of this taxa comparable with these levels. The foraminifera sample from 1078 suggested a salt water lagoon and it may be appropriate to view the repeatedly 'bayed' pattern of the 3.5 and 4.0m contours along the eastern margin of the silts mounds (McAvoy 1994) as an illustration of this lagoonal pattern.

If this is the case then the line of Test Pits on the northern side of the St Michaels Lane site, from which the foraminifera show clear high saline lagoonal conditions would traverse (east to west) the next bay (or lagoon) immediately north of the silt mounds.

Salt making features

Bulk samples were collected from the filtration beds (2032 - sample 6), the so-called 'turves' from the filter bed of filtration unit 5008 (5009 - sample 8), the fill of the tank of filtration unit 3062 (3066 -sample 4) and bulk sample 9 from one of the silt waste mounds (2009). Of these samples only those from within the tank 3062 produced a high percentage of *Hydrobia* (Table 6), but since this is a backfill deposit, clearly suggested by the presence of a pig skeleton (see below), the frequency of *Hydrobia* is unlikely to be related to the salt making function of the tank. The filter bed (2032) and 'turves' (5008) produced some *Hydrobia* but in no great abundance or density, although the latter was fairly poor in mollusca despite a lagoonal foraminifera assemblage. This may in part be attributable to the relative size of the foraminifera and mollusc shells, the latter being very much larger are unlikely to progress through the salt making progress and should be discarded with the waste silt. Their occurrence in a tank suggests backfill using silt waste rather than a product of the processing. The filterbed deposit shows relatively low densities of terrestrial snails and a low proportion of *Hydrobia* neither of which appears to help to clarify its functional stage in the salt making process. The so called 'turves' that were sampled were laminate *in situ*, a clear indication that they were not turves but were waterlain. Apart from the probably intrusive *Cecilioides* shells the snail fauna is at a very low density and comprises equal concentrations of *Hydrobia* and terrestrial taxa, again not supporting an interpretation as 'turves'. The foraminifera have indicated a sub-tidal flat biozone with estuarine taxa a further indication that these sediments derive from the salt making process and not terrestrial turves.

The last group of bulk samples relate to the 'midden' deposits and the burnt hearth backfills in the tank of filtration unit 1003 and a possible hearth area adjacent to filtration unit 1037. These deposits clearly relate to subsequent stages of the salt making process or domestic activity on the site (see below). The mollusc assemblages of the two burnt backfill layers is the typical grassland fauna of the site with few *Hydrobia* shells. The hearth and midden spreads are similar although with a larger *Hydrobia* component suggesting that the matrix of these layers is composed of the waste silt from the saltern. The snails offer little specific interpretation for these deposits.

Palaeoeconomic Evidence

The palaeoeconomic environmental evidence is derived from the bulk samples and the excavated animal bone. The finds from the bulk samples are summarised in Tables 7 and 8. The archaeological finds included coal, clinker, fuel ash slag, fired earth, 'silt brick', animal bone and pottery. The latter was only recorded from the midden sample. Fired and baked silts were present in a number of the samples and the weights noted on Table 7 record the fragments sorted from the >7mm residue. In samples 3 and 5 much of the finer residue was composed of burnt silts but this was not separated from the other materials in the residue and weighed independently.

Two major fuel types are indicated by the samples. The midden deposit produced 40 grammes of unburnt coal and some burnt shalely coal and the waterlain black layer sampled from Test Pit 7 produced over 300 grammes of unburnt coal. The latter was presumably

washed from dumps such as the midden, 1002, along the high tide line. Very small quantities of tiny fragments were recovered from other samples and are clearly incidental and accidentally introduced into these deposits, possibly as a result of movement down through the soil. The second major fuel is peat. This is present in the burnt fills of filtration unit 1003 in Area A (samples 1 and 2) and in the waterlain sediments of 1077 in the south section of Area A. Very small quantities are present in some of the other deposits (Table 7). Visual observation of the peat remains in these samples indicates that it is 'peat charcoal' (see Estyn Evans 1957; Fenton 1974). Whether the peat was prepared as peat charcoal or merely became carbonised in a reducing environment in the peat fires on the site is difficult to establish, but the quantity of this material in sample 2, 1008, might suggest the former. The burnt peat (ie that reduced to an ash in an oxidising environment) that must have been associated with these hearths has been largely lost as a result of leaching from these silt sediments. Small quantities of charcoal were present in some of the layers (Table 8) but this could have derived from the peat in all except the midden sample, 1002, where larger fragments suggest that wood was used either as well as the coal or as tinder. Whether this difference in fuel can be attributed to functional use, ie the peat for salt boiling while the coal was domestic fuel, or possibly a chronological distinction can only be hazarded. However the peat charcoal is found backfilling a filtration unit, while the charcoal occurs in direct association with domestic debris. The association of the burnt layers, samples 1 and 2, with the filtration unit 1003, and the 'hearth' spread with filtration units 1037 and 1038, perhaps indicates that the boiling process may have been using peat or peat charcoal and taking place adjacent to the filtration units. A similar picture was proposed by McAvoy (1994) on the basis of his findings in Area 2 on the adjacent site. Perhaps more extensive excavation and sampling of one of these complexes will in future confirm or correct these conclusions.

The remainder of the finds from the bulk samples largely considers the evidence for the domestic activities and diet of, presumably, the salt makers. The bulk of the evidence has been recovered from the midden deposits and is discussed by material below.

The Charred Plant Remains
John Giorgi

The plant remains were studied in order to establish the source of fuel used and the botanical material from the domestic rubbish deposits provide some information on the diet of the inhabitants. The former has been dealt with above.

Identification methods
The charred plant remains were sorted from the flots and the sorts and flots presented to the author for analysis. Identification of the plant material (with the exception of the charcoal) was carried out using a binocular microscope together with modern and charred reference material and reference manuals. The charred plant items (except charcoal and indeterminate items) were quantified. The sorted flots were also scanned for possible additional information.

Results
The results are tabulated in Table 9. Only four of the 11 samples produced identifiable charred plant remains with the quantity of material in most of the samples being very low, with a total of only 431 plant items. The exception was sample 5 from the midden (1002) which produced a significant quantity of charred plant remains with 387 items or almost 90%

of the total assemblage studied. Most of the charred plant material consisted of cereal grains plus a little evidence for cultivated pulses and a few wild species. Small charcoal fragments were found in variable quantities in all the samples.

Seeds of waterlogged plant remains were found in virtually all the samples with a remarkable consistancy in the range of represented species. Thus, almost all the samples included evidence for elder (*Sambucus nigra*), chickweed (*Stellaria media*), goosefoots etc./oraches (*Chenopodium/ Atriplex* spp.), small nettle (*Urtica urens*) and field penny crest (*Thlapsi arvense*). Other less frequent species were stinging nettle (*Urtica dioica*), bedstraw (*Galium* sp.), milk-/sow-thistle (*Sonchus* sp.) and black nightshade (*Solanum nigrum*). These plants are mainly indicative of disturbed (including cultivated) ground and waste places and are largely high seed producers. It is unlikely that these seeds, however, are contemporary with the deposits given the soil conditions at the site; modern roots in the samples also suggest that these seeds could be intrusive.

Cereals

Cereals were present in all the productive samples and were represented entirely by grains, mainly of wheat (*Triticum* spp.) and barley (*Hordeum sativum*) (Table 9). The well preserved wheat grains were identified as free-threshing wheats, which may be either hexaploid, eg. bread wheat (*Triticum aestivum* s.l), or tetraploid wheats, eg. rivet wheat (*T. turgidum*), durum wheat (*T. durum*). These species are distinguishable by their rachis fragments although none were found in the samples. Barley was represented by both straight and twisted grains which indicates the presence of six-row hulled barley. Only five oat (*Avena* spp.) grains were found in the samples while the absence of floret bases means that it was not possible to establish whether these were wild (*A. fatua*) or cultivated (*A. sativa*) oats. The majority of the cereal grains in the midden deposit sample were too poorly preserved (distorted and fragmentary) for further identification although their general morphology and size suggests that the majority of these grains are probably either wheat or barley.

Free-threshing wheats and barley are two of the four main cereals (the others being oat and rye - *Secale cereale*) found on medieval and post-medieval sites in southern England albeit in variable quantities (Greig 1991, 321). Wheat was the main bread grain and was also used for pies and pastries (Campbell *et al* 1993, 24). Barley may have also been used for bread as well as in brewing and as animal fodder. It was not possible to determine whether the oats were cultivated or weeds although oats were grown and used during this time, together with other cereals in bread, for biscuits and also in brewing and as animal feed. All three cereals may have also been used in a stew known as pottage (Wilson 1991).

Pulses

Pulses were represented by a small number of seeds in three of the samples. Only one cultivated species was tentatively identified, ?broad bean (cf. *Vicia faba*). The remaining large legume fragments in the midden deposit 1002 probably also belong to cultivated species although the absence of the hilum meant that further identification was difficult. Pulses were important for restoring nitrogen to the soil and were used as both animal and human food. For example, beans were used for horsebread, used as feed for horses and possibly also eaten by the less well-off (Campbell *et al* 1993, 27).

Wild plants

A small number of charred seeds and other plant items were also found in the samples. The charred seeds included a small number of wetland plants, sea club-rush (*Scirpus maritimus*), which grows in shallow water at the muddy margins of tidal rivers and in ditches and in ponds near the sea (Clapham *et al* 1987), great fen-sedge (*Cladium mariscus*), which is found in base-rich areas in fens and by streams and ponds (Stace 1991) and ?hornwort (cf. *Ceratophyllum* spp.), a plant of ponds and ditches. A small number of alder (*Alnus glutinosa*) catkins were also found in one sample; this is also a wetland species. This group of plants, which occurs predominantly in the burnt layer, 1008 and hearth 1006, both closely associated with the saltern activity, presumably derive from the peat or peat charcoal used as a fuel.

Table 9: The charred plant remains from St. Michaels Lane, Wainfleet St Mary (MLW98)

	Period		l.14th-e.16th C.	l.15th-l.16th C.		total charred remains
	context	1008	1006	1002	1077	
	sample	2	3	5	10	
	vol.soil (l)	4	5.5	28	8	
	flot vol (ml)	100	5	48	16	
species						
Cereal grains						
Triticum spp..	free-threshing wheat		2	12		**14**
cf. *Triticum* spp.	?free-threshing wheat			25	1	**26**
Triticum spp.	wheat	1		10		**11**
Hordeum sativum L.	barley	1	3	10		**14**
cf *H. sativum*	?barley			18	1	**19**
Avena sp(p).	oat		2	3		**5**
indeterminate cereals	indet. grains > 2mm		3	112	5	**120**
indeterminate cereals	indet. grains < 2mm			181(e)		**181(e)**
Legumes						
cf *Vicia faba* L.	?broad bean		1	4	1	**6**
Legume indet.	indet. large frags			4		**4**
Other plants						
cf. *Ceratophyllum* spp.	?hornwort	4				**4**
Trifolium sp.	clover,trefoil		1			**1**
Rumex spp.	dock			5		**5**
Alnus glutinosa.(L.) Gaertner	alder catkins	11				**11**
Anthemis cotula L.	stinking mayweed		1			**1**
Scirpus maritimus L.	sea club-rush		1	2		**3**
Cladium mariscus (L.)Pohl	great fen-sedge	1	2			**3**
Lolium sp.	rye-grass			1		**1**
Poaceae indet.	small grass seeds		2			**2**
indet plant items	-	+		+		+
charcoal fragments(small)	-	++++	+++	+++	+	++++
total number of quantified charred plant items		**18**	**18**	**387**	**8**	**431**
density of quantified charred items per litre of soil		**4.5**	**3.2**	**13.8**	**1**	

Key: Period:l. = late; e=early

Frequency: +=1-10 items; ++=11-50 items; +++=51-150 items; ++++=>151; (e)= estimate

The remaining seeds were from wild species that may grow in a range of habitats - disturbed (including arable) ground and waste places and grassland, eg. stinking mayweed (*Anthemis cotula*), docks (*Rumex* spp.), clover, trefoil (*Trifolium* sp.), rye-grass (*Lolium* sp.) and small-seeded grasses (Poaceae). Some of these seeds, eg. stinking mayweed, a characteristic arable weed prefering heavy clay soils, may have been imported with the cereal grains while others, eg. clover, trefoil, grasses, may represent grassy areas on and around the site.

Discussion

The quantity of charred remains in each of the four samples (excluding charcoal and indeterminate material) ranged from eight to 387 plant items with a density of between one and 13.8 per litre of soil. Three of the four samples, however, contained only 18 plant items or less, and therefore, can provide very little detailed information on the features from which they were recovered.

The fill sample 2 (1008) from the filtration unit 1003 contained a small number of wild plants including the wetland species, great fen-sedge, ?hornwort and the alder catkins. These remains could represent the residues of plant remains from peat cut from fen or turbaries for use as fuel in the salterns. On the other hand, the presence also of cereal grains in the samples suggest that they could derive from domestic fires; indeed, it is unlikely that the assemblage is directly associated with the use of the feature since it derives from a backfill. The hearth deposit, 1006, contained cereals and pulses, as well as a few charred seeds of wetland and disturbed ground weeds. The wetland elements probably derive from peat fuel.

The plant remains in the midden, 1002 - sample 3, contained a large assemblage of burnt grains and a few pulses, which probably became accidentally charred while being dried before milling or being cooked over open fires. Finds in the sample residue suggest that the midden was used primarily for the disposal of a range of domestic (eg. bone, pot) refuse, although some may be associated with the salt production process.

The remaining productive sample from a tidal edge deposit, 1077, contained evidence for a few food plants (cereals, pulses) but no other identifiable seed material.

Conclusions

The general paucity of charred plant remains from the site limits detailed interpretation and comments on the sampled features. The few plant remains in the filtration unit did include potential evidence for peat fuel used in the saltern, although the presence of a few cereal grains could also imply that the deposit had a domestic origin. Nevertheless, on a more general level, the cereals (free-threshing wheats, barley, possibly oat) and few pulses (?broad bean) from the various samples, in particular from the midden, does provide useful information on the range of plant foods used at the site.

The Fish Bones
Alison Locker

Fish were recovered from sieved samples mainly from 15th/16th midden deposits associated with salt production. One context 1002, produced most of the fish, with little fish from the other two samples and one hand collected bone.

The following species were identified; eel (*Anguilla anguilla*), Clupeidae, c.f. smelt (*Osmerus eperlanus*), pike (*Esox lucius*), cod (*Gadus morhua*), whiting (*Merlangius merlangus*), Gadidae, stickleback (*Gasterosteus aculeatus*), plaice/flounder (*Pleuronectes platessa/Platichthys flesus*), flounder (*Platichthys flesus*) and halibut (*Hippoglossus hippoglossus).*

The identified fish are shown in the Table 10 below and includes the vertebrae which could not be identified to species.

Table 10: The fish bones from samples and hand collected, Wainfleet St Mary

Context	**1002**	**1002**	**2009**	**1077**	**3023***	**Total**
Sample	**5a**	**5b**	**9**	**10**		
Sample size	**28**	**30**	**29**	**8**		
Eel	9	2				11
Clupeid	3	1				4
Smelt		1				1
Pike		1				1
Cod	2	5				7
Whiting	4	16				20
Small gadid	117	12	2			131
Large gadid		2				2
Stickleback	4	1				5
Plaice/flounder	9	8				17
Flounder		1				1
Halibut	4				1	5
Flatfish	15	15				30
Indet vert	12	5		1		18
Total	179	70	2	1	1	253

* hand excavated

Small gadids, mainly immature cod and whiting dominate the sample, these are from small fish of around 10-12 cm and suggest, together with small flatfish, inshore netting for young fish. The flatfish were all small except for a large halibut preopercular hand collected from 3023. Immature halibut was also identified from three caudal vertebrae and a fragmentary premaxilla in 5a.

Sticklebacks can be found in freshwater, marine and intermediate conditions and may have been an incidental catch.

Both eel and smelt (tentatively identified from a single caudal vertebra) are migratory species, the only true fresh water fish present is pike, a small specimen of around 12-15 cms in length identified from a single precaudal vertebra.

Large fish were also eaten at the site as apart from the halibut preopecular the fragmented remains of two bigger vertebrae which could only be attributed to large gadid were identified in 5b.

The preponderance of immature fish in this small sample could represent small scale nettings probably indicating acquisition of the fish element of the diet from very local sources.

Mammals and edible marine shell
J.Rackham

This report summarises the results from both the evaluation and the main phase of excavation. A total of 140 fragments of bone and four partial skeletons were recovered by hand excavation and an uncounted number of small bone fragments from the bulk soil samples in addition to two partial skeletons. The identified species are listed in Table 11. Although not all of this material was found with dateable archaeological finds it can be confidently associated with the period of saltern activity at the site and lies between the 14th and late 16th centuries, except for four bones from contexts 4026 and 4042 of possible modern date.

Table 11: Animal bone and shell taxa in the excavated and sampled assemblages, from the evaluation and main excavation, contemporary with the saltern

Species	Excavated No. fragments	Minimum no. units *	Samples No. samples
Horse	9	2	
Cattle	46	4	1
Cattle size	25		
Sheep/goat	24	3	1
Sheep	1		
Pig	20	3	1
Pig skeleton			1
Sheep size	2		2
Dog	1	2	
Dog partial skeleton	2		
House mouse, *Mus musculus*			1
Chicken	3	3	
Chicken partial skeleton	2		
Frog/toad			1
Unidentified bone	5		10
Cockle, *Cardium edule*			8
Mussel, *Mytilus edulis*			2
Oyster, *Ostrea edulis*			2
Rough winkle, *Littorina saxatilis*			1

* - most frequent zone of a limb element irrespective of left or right side

Marine shells were only recovered from the samples and in some of these it is possible that the few fragments of identifiable shell are merely part of the 'natural' sub-fossil components of the tidal silts that make up the site. Only in the midden deposits (Table 8) where whole shells were present does this material clearly derive from food waste. All these species are historically abundant in the waters of the Wash (McMillan 1968; Younge 1960) and were therefore available locally to the Wainfleet saltmakers.

The sample of animal bones is insufficient to sustain detailed analysis and interpretation but some remarks can be made. Bone fragments of cattle predominate among the excavated remains (Table 11) although this is less pronounced when considering the most frequent element. Cattle appear therefore to have contributed the bulk of the meat eaten at the site. Despite the small sample size elements of most parts of the cattle skeleton are present (Table 12), although the sample is too small for comment in the other species. No goat remains were recognised in the assemblage and it is considered that all the ovicaprid remains probably derive from sheep.

Approximately 20% of the bone fragments show visible evidence of butchery, and since four of these fragments were sawn, a practice probably largely restricted to professional butchers who are more likely to possess a saw, at least some of this meat was purchased from the market rather than self produced or obtained from local farmers. Ten percent of the sample showed clear evidence of gnawing by canids, and burial/disposal of at least two dog carcasses on site illustrates the keeping of these animals. One of these dogs, in context 1039, was an adult animal with a shoulder height of approximately 0.48m (humerus length- 146.5mm; femur length - 161mm; using Harcourt's (1974) factors), a medium sized animal which may have been a functional animal, such as for stock management, or merely a scavenger or a pet. The second dog skeleton derived from context 1053, the fill of filtration tank 1040. This was a partial skeleton of an immature animal with the tibia and metapodials unfused.

Table 12: Bone element fragment frequency for each taxa, excavated sample

name	horse	cattle	cattle size	sheep/goat	sheep	pig	sheep size	dog	chicken	un-ident-ified
skull		2	1							
maxilla		1								
mand. canine						1				
mand. molar 1						1				
mand. molar 2		1				1				
mandible	2	1		1		1				1
atlas		1		1						
axis		1				1				
cervical vert		2				1				
thoracic vert	1	2	3							
lumbar vert			1							
vertebra							1			
rib			16				1	1		
costal cartilage			1							
scapula		3		4						
humerus		4		4		1				
radius		3		4		1				
ulna		2				1				
radial carpus		1								
metacarpus		1								
carpo-metacarpus									1	
innominate	1	3		2		2				
femur	2	3		1		2			2	
patella	2									
tibia	1	3		7		4				
calcaneum		1		1		2				
astragalus		1								
centroquartal		2								
metatarsus		9			1					
metatarus 4						1				
phalanx1		1								
long bone frag			4							
unidentified										4
Total	9	48	26	25	1	20	2	1	3	5
skeleton								2	2	

The domestic cattle assemblage indicates the presence of adults and immature beasts, with four bones indicating small calves. The latter may have been natural deaths at the site and also indicate occupation in the late spring or summer at least. In contrast not one of the sheep bones can be attributed to a juvenile or immature animal. The pig bones indicate immature animals although three bones from context 2027 probably derive from a neonatal animal or

small piglet. Even among the horse bones a femoral shaft from context 706 from the evaluation indicates the presence of a young foal. This evidence suggests that cattle, pig and horses were kept on the site, probably grazing the grasslands on the waste mounds and surrounding area. Partial skeletons of chickens in contexts 1045 and 1050 suggests chickens living on the site.

There is an unusually large number of partial skeletons on the site for such a small bone assemblage, two dogs, two chickens and at least three pigs. Five of these were discarded into filtration tanks. These were clearly viewed as convenient receptacles for animal casualties on the site when they ceased their original function. The pigs that were recovered in sample 4, the fill (3066) of filtration tank 3074, included one juvenile with a deciduous dentitionm the first molar only just erupted, and the proximal radial and distal humeral epiphyses unfused, an animal of less than 12 months; and a second individual that was a neonate or a young piglet death. Domestic animals must have been kept close by the site for such regular disposal.

CONCLUSIONS

The environmental evidence from these excavations has successfully addressed elements of the original objectives of the study.

The foraminiferal evidence has clearly indicated a lagoonal environment on the northwest of the site and reference to McAvoy's (1994) earlier work shows a pattern of waste mounds associated with a basin of lower ground for each saltern unit within his survey. This basin, presumably the salt pan, artificially scraped out must have been within the reach of only the highest or spring tides each month and allowed an extended period for the water to drain and evaporate so that the salt concentrated in the surface silts of the basin. This could be done without the need for complicated sluices or inlets and suggests that salt production may have been possible in most months of the year since the pans may have relied as much upon drainage as upon evaporation. The eastward end of each basin presumably opened onto the saltmarsh to the seaward side of the site and the evidence for a foram assemblage suggesting an inlet or creek in Test Pit 10 would be consistent with the mouth of the basin during one phase of the salterns operation. Although the functioning part of this basin must have moved seawards as the saltern was worked and the silt waste mounds dumped on adjacent land its shape and relative position was retained and the other salt-making activities continued to respect it, occurring around its margins. Tidal deposits along the margins and in the bowl of at least two phases of this 'salt pan' at St Michaels Lane were clearly visible in the southern section of Area A (layer 1077) and the later coal rich sediment in Test Pit 7, several metres to the east.

The basins would be very vunerable to storms and floods and a flood of 1571 has been suggested as responsible for the destruction of some of the salterns (Holinshed in Rudkin and Owen 1960), while a rising relative sea level innundating the turbaries and preventing their continued exploitation cutting off the fuel supply and making the salt making process uneconomic (using wood or coal as fuel) is offered by Hallam (1960). Land reclamation and commercial factors may also have had some influence.

The environmental evidence has not assissted much in the other areas of the salt making process although there is evidence for the use of peat or peat charcoal as a fuel, presumably for boiling the brine.

It seems clear that the working area of the saltern, apart from the salt pan itself, lay above the salt marsh and was grassed and probably grazed by cattle and horses, with the probability that the salt makers actually lived on the saltern. The bones of very young cattle, horses and neonatal pigs, and the carcasses of chickens suggest that the salt makers kept some animals, but this may have been on a small scale and there is no evidence in this small sample that sheep were kept. Their domestic debris is evident in the midden, 1002, and indicates that their diet included cereals and pulses, beef, mutton and pork, chicken, eggs, and fish and shellfish which could be gathered or caught locally along the coast. Some of the food procurement must have been carried out by the salt makers, but butchered meat, occasional large deep water fish and the coal show local and more extended trade. The coal found in the late 15 - late 16th midden deposit suggests that this fuel was available for domestic use by this period and possibly also for the brine boiling.

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Fish Identifications.

1002 5a

Eel	7 vert
	2 basioccipitals- 1 is burnt
Stickleback	2 dorsal spines
	1 spine attachment
	1 fragment
Whiting	2 sm otoliths (2 indiv) tl = 6.8 10-12 cms fish
	2 premaxilla frags
Small Cod	1 post temporal (approx 30cms tl fish)
	1 maxillary frag v small
Small Gadid	1 sm maxillary frag
	3 burnt vert frags
	62 v small caudal vert
	39 v small precaudal vert
	12 broken sm vert
Clupeid	1 otic bulla
	2 vert frags
Indet	12 sm vert
Halibut	1 small l premaxilla frag from a fish of approx 10-15 cms?
cf halibut	3 extreme caudal vert
Plaice/Flound	1 1st anal pterygiophore
	8 precaudal vert
Flatfish	15 small vert

1002 5b

Eel	2 vert
Stickleback	1 spine
Pike	1 sm vert 12-15cm fish?
Cf smelt	1 caudal vert
Whiting	1 otolith tl 8 mm same as 10 cm fish
	1 broken vert
	14 caudal vert
Cod	1 v sm l dentary wheeler meas 0.5mm
	1 l premaxilla wheeler meas 3.8mm
	1 sm maxillary
cf cod	2 broken sm otoliths
Sm gadid	12 sm vert
L gadid	2 frags vert
Clupeid	1 vert
Plaice/flound	2 sm otoliths tl 3.5mm
	1 sm quadrate
	5 precaudal vert
Flounder;	1 preopercular 10-12 cms fish
Flatfish	2 1st anal pterygiophore
	4 caudal vert
	11 vert frags
Indet	5 sm vert
Burnt	5 frags fin rays

2009 9

Sm Gadid (immature whiting/cod	1 precaudal vert less 10cms fish
	1 caudal vert

?1007 10

Indet	1 precaudal vert

3023

Halibut 1 broken preopercular

THE ENVIRONMENTAL ARCHAEOLOGY CONSULTANCY

Key to codes used in the cataloguing of animal bones

SPECIES

BOS	cattle
CSZ	cattle size
SUS	pig
OVCA	sheep or goat
OVI	sheep
SSZ	sheep size
EQU	horse
CER	red deer
CAN	dog
MAN	human
UNI	unknown
CHIK	chicken
GOOS	goose, dom
LEP	hare
UNB	indet bird
MALL	duck, dom.
GULL	gull sp.
FISH	fish
UNIB	bird indet
UNIF	fish indet
GSZE	goose size
BEAV	beaver
CORV	crow or rook

BONE

SKL	skull
TEMP	temporal
FRNT	frontal
PET	petrous
PAR	parietal
OCIP	occipital
ZYG	zygomatic
MAN	mandible
MAX	maxilla
ATL	atlas
AXI	axis
CEV	cervical vertebra
TRV	thoracic vertebra
LMV	lumbar vertebra
SAC	sacrum
CDV	caudal vertebra
SCP	scapula
HUM	humerus
RAD	radius
MTC	metacarpus
MC1-4	metacarpus 1-4
INN	innominate
ILM	ilium
PUB	pubis
ISH	ischium
FEM	femur
TIB	tibia
AST	astragalus
CAL	calcaneum
MTT	metatarsus
MT1-4	metatarsus 1-4
PH1	1st phalanx
PH2	2nd phalanx
PH3	3rd phalanx
LM1-LM3	Lower molar 1 - molar 3
UM1-UM3	upper molar 1 - molar 3
LPM1-LPM4	lower premolar 1-4
UPM1-UPM4	upper premolar 1-4
DLPM1-4	deciduous lower premolar 1-4
DUPM1-4	deciduous upper premolar 1-4
MNT	mandibular tooth
MXT	maxillary tooth
LBF	long bone
UNI	unidentified
STN	sternum
INC	incisor
TTH	indet. tooth
CMP	carpo-metacarpus
SKEL	skeleton

SIDE

W - whole
L - left side
R - right side
F - fragment

FUSION

Records the fused/unfused condition of the epiphyses
P - proximal; D - distal; E - acetabulum;
N - unfused; F - fused; C - cranial; A - posterior

TOOTH WEAR - Codes are those used in Grant, A. 1982 The use of tooth wear as a guide to the age of domestic animals, in B.Wilson, C.Grigson and S.Payne (eds) *Ageing and sexing animal bones from Archaeological sites, 91-108.*

Teeth are labelled as follows in the tooth wear column:

h ldpm4/dupm4	f ldpm2/dupm2
H lpm4/upm4	g ldpm3/dupm3
I lm1/um1	
J lm2/um2	
K lm3/um3	

ZONES - zones record the part of the bone present.
The key to each zone on each bone is on page 2

MEASUREMENTS - Any measurements are those listed in A.Von den Driesch (1976) *A Guide to the Measurement of Animal Bones from Archaeological Sites*, Peabody Museum Bulletin 1, Peabody Museum, Harvard, USA

PRESERVATION
1 - enamel only surviving
2 - bone very severely pitted and thinned, tending to break up teeth with surface erosion and loss of cementum and dentine
3 - surface pitting and erosion of bone, some loss of cementum and dentine on teeth
4 - surface of bone intact, loss of organic component, material chalky, calcined or burnt
5 - bone in good condition, probably with some organic component

ZONES - codes used to define zones on each bone

SKULL -
1. paraoccipital process
2. occipal condyle
3. intercornual protuberance
4. external acoustic meatus
5. frontal sinus
6. ectorbitale
7. entorbitale
8. temporal articular facet
9. facial tuber
0. infraorbital foramen

MANDIBLE
1. Symphyseal surface
2. diastema
3. lateral diastemal foramen
4. coronoid process
5. condylar process
6. angle
7. anterior dorsal acsending ramus posterior
8. mandibular foramen

VERTEBRA
1. spine
2. anterior epiphysis
3. posterior epiphysis
4. centrum
5. neural arch

SCAPULA
1. supraglenoid tubercle
2. glenoid cavity
3. origin of the distal spine
4. tuber of spine
5. posterior of neck with foramen
6. cranial angle of blade
7. caudal angle of blade

HUMERUS
1. head
2. greater tubercle
3. lesser tubercle
4. intertuberal groove
5. deltoid tuberosity
6. dorsal angle of olecranon fossa
7. capitulum
8. trochlea

RADIUS
1. medial half of proximal epiphysis
2. lateral half of proximal epiphysis
3. posterior proximal ulna scar and foramen
4. medial half of distal epiphysis
5. lateral half of distal epiphysis
6. distal shaft immediately above distal epiphysis

ULNA
1. olecranon tuberosity
2. trochlear notch- semilunaris
3. lateral coronoid process
4. distal epiphysis

METACARPUS -
1. medial facet of proximal artciulation, MC3
2. lateral facet of proximal articulation, MC4
3. medial distal condyle, MC3
4. lateral distal condyle, MC4
5. anterior distal groove and foramen
6. medial or lateral distal condyle

FIRST PHALANX
1. proximal epiphysis
2. distal articular facet

INNOMINATE
1. tuber coxae
2. tuber sacrale + scar
3. body of illium with dorso-medial foramen
4. iliopubic eminence
5. acetabular fossa
6. symphyseal branch of pubis
7. body of ischium
8. ischial tuberosity
9. depression for medial tendon of rectus femoris

M3

FEMUR
1. head
2. trochanter major
3. trochanter minor
4. supracondyloid fossa
5. distal medial condyle
6. lateral distal condyle
7. distal trochlea
8. trochanter tertius

TIBIA
1. proximal medial condyle
2. proximal lateral condyle
3. intercondylar eminence
4. proximal posterior nutrient foramen
5. medial malleolus
6. lateral aspect of distal articulation
7. distal pre-epiphyseal portion of the diaphysis

CALCANEUM
1. calcaneal tuber
2. sustentaculum tali
3. processus anterior

METATARSUS
1. medial facet of proximal artciulation, MT3.
2. lateral facet of proximal articulation, MT4
3. medial distal condyle, MT3
4. lateral distal condyle, MT4
5. anterior distal groove and foramen
6. medial or lateral distal condyle

Wainfleet St Mary, MLW98 - Animal Bone Archive Catalogue

site	context	species	bone	no.	side	fusion	zone	butchery	gnawing	toothwear	measurement	path.	comment	pres'v-ation
MLW98	1002	BOS	AXI	1	F								ANT PROTION OF CENTRUM- 2 PIECES	4
MLW98	1002	BOS	FEM	1	L		3	CH	DG				PROX HALF SHAFT WITH 3RD TROCH- EPI CHEWED OFF-MIDSHAFT CHOPPED	4
MLW98	1002	BOS	MAX	1	R					J15K14			LOOSE TEETH	4
MLW98	1002	BOS	MTT	1	R		12	CH			Bp-45 Dp-42.2		PROX HALF-DISTAL SHAFT CHOPPED	4
MLW98	1002	BOS	MTT	1	F	DN	5	B					DISTAL SHAFT FRAGMENT-CALCINED	4
MLW98	1002	BOS	MTT	1	R		12	CH					PROX THIRD- EPI UNFORMED-CALF-MIDSHAFT CHOPPED	4
MLW98	1002	BOS	RAD	1	F			CH					MIDSHAFT FRAGMENT-CHOPPED	4
MLW98	1002	BOS	TRV	1	L	CNAN		CH					CENTRUM-CHOPPED DOWN MIDDLE	4
MLW98	1002	CAN	RIB	1	F								MIDSHAFT	4
MLW98	1002	CSZ	LBF	1	F								SHAFT FRAG	4
MLW98	1002	CSZ	RIB	1	L								PROX SHAFT FRAG	4
MLW98	1002	CSZ	RIB	1	L	PN							PROX END- 2 PIECES	4
MLW98	1002	EQU	MAN	1	R					HIJ			MOLARS WELL WORN-PART HORI RAMUS- 3 PIECES	4
MLW98	1002	OVCA	ATL	1	L		4	CH					VENTRAL LATERAL HALF-POST CHOPPED	4
MLW98	1002	OVCA	FEM	1	L	DF	4567	CH			Bd-34.4 Dd-44.1		DISTAL END	4
MLW98	1002	OVCA	HUM	1	R	DF	690						DISTAL HALF SHAFT	4
MLW98	1002	OVCA	RAD	1	L	PFDF	123456				GL-145 Bp-30.8 Dp-15.9 SD-16.2 Bd-28.2 Dd-18.7		COMPLETE	4
MLW98	1002	OVCA	TIB	1	F								PROX SHAFT FRAG	4
MLW98	1002	OVCA	TIB	1	L		4	CH	DG				PROX HALF SHAFT-PROX SL CHEWED-DIST SHAFT CHOPPED	4
MLW98	1002	OVI	MTT	1	R	DF	12345				GL-149 Bp-20.8 Dp-21.1 SD-12.4 Bd-25.1 Dd-17.6		COMPLETE-HIGH WAISTED	4
MLW98	1002	SSZ	RIB	1	L								SHAFT	4
MLW98	1002	SUS	CAL	1	R		23		DG				PROX END CHEWED OFF	4
MLW98	1002	SUS	LC	1	L								MALE CANINE	4
MLW98	1002	SUS	MT4	1	R	DN	12						DISTAL EPI LOST	4
MLW98	1002	UNI	MAN	1	L								MEDIAL FRAG HORI RAMUS-WITH DEC ALVEOLI-POROUS	4
MLW98	1009	BOS	ULN	1	F								DISTAL SHAFT FRAG	4
MLW98	1009	CSZ	RIB	1	F								SHAFT FRAG	4
MLW98	1009	CSZ	RIB	1	L			CH					SHAFT-DISTAL CHOPPED- 1ST RIB- SL POROUS	4
MLW98	1009	SUS	TIB	1	L		4		DG				SHAFT-DISTAL END CHEWED	4
MLW98	1014	BOS	AST	1	L		1						COMPLETE-POROUS-UNFORMED-CALF	4
MLW98	1014	SUS	ULN	1	R		3						MIDSHAFT FRAG- 3 PIECES	4
MLW98	1021	BOS	CAL	1	R		2						SUSTENTACULUM	4
MLW98	1021	OVCA	HUM	1	L	DF	78						DISTAL CONDYLE	4
MLW98	1025	BOS	HUM	1	L		69						DISTAL SHAFT	3

MLW98	1025	CSZ	RIB	1	L								PROX SHAFT FRAG- 1ST RIB	4
MLW98	1025	OVCA	TIB	1	R								MIDSHAFT-SL POROUS-2 PIECES	4
MLW98	1032	SUS	CEV	1	F	CNAN	45						CENTRUM AND ARCH	4
MLW98	1032	SUS	FEM	1	L	PN	3						PROXIMAL SHAFT	4
MLW98	1039	CAN	SKEL	1	W								LARGELY COMPLETE-ALL EPIPHYSES FUSED HUM GL-146.5 FEM GL-161	4
MLW98	1043	CSZ	RIB	1	F			CH					SHAFT FRAG-DISTAL CHOPPED	4
MLW98	1045	BOS	ATL	1	F								FRAG POST ARTIC	4
MLW98	1045	BOS	CQ	1	W		1						COMPLETE	4
MLW98	1045	BOS	HUM	1	F	PN							PART OF PROX EPIPHYSIS	4
MLW98	1045	BOS	MTT	1	F			CH					FRAG DISTAL SHAFT-SHAFT CHOPPED	4
MLW98	1045	CHIK	SKEL	1	F								PARTIAL SKELY- FEM GL-82.5 HUM GL-72.8 TIB GL-113 ULN GL-70.3 - SKL/INN/RIB/ULN	4
MLW98	1045	CSZ	TRV	1	L	CNAN		CH					CENTRUM-CHOPPED DOWN MIDDLE	4
MLW98	1045	SUS	MAN	1	L		7			J7K3			POST FRAG HORI RAMUS	4
MLW98	1050	CHIK	CMC	1	L						GL-41.8		COMPLETE	4
MLW98	1050	CHIK	FEM	1	R								SL DAMAGE GL-96.7	4
MLW98	1050	CHIK	FEM	1	L								PROX SHAFT	4
MLW98	1050	CHIK	SKEL	1	P								PARTIAL SKELY- INN/FEM/MTT/HUM/PHALS/TIB/CMC/ULN/COR/RAD MTT GL-83.6 FEM	4
MLW98	1053	BOS	INN	1	L		4		DG				PUBIC FRAG OF ACETAB	4
MLW98	1053	BOS	LM2	1	R					J11			ROOTS BROKEN OFF	4
MLW98	1053	CAN	SKEL	1	P								PARTIAL SKELY- JUVENILE-DIST TIB AND METAPODIALS UNFUSED-ADULT TEETH UP	4
MLW98	1053	CSZ	CC	1	F								8 PIECES	4
MLW98	1053	CSZ	RIB	1	F								8 PIECES	4
MLW98	1053	UNI	UNI	1	F								INDET	4
MLW98	2004	BOS	HUM	1	R		69						DISTAL SHAFT-POROUS-CALF?	3
MLW98	2004	BOS	MTT	1	L	DF	345						DISTAL END- IN 6 PIECES	3
MLW98	2004	BOS	RAD	1	R	DF	456	CH			Bd-67 Dd-40.5		DISTAL END-CHOPPED TRANSVERSELY THRU DISTAL EPI	4
MLW98	2004	CSZ	RIB	2	F								SHAFT FRAG	3
MLW98	2004	CSZ	RIB	1	L								PROX HALF SHAFT	3
MLW98	2004	OVCA	MAN	1	R		7			GH12I15J 12K12			HORIZONTAL RAMUS WITH TOOTH ROW	3
MLW98	2004	OVCA	TIB	1	R	DF	56						BROKEN DISTAL END	4
MLW98	2004	SUS	LM1	1	W					I8			COMPLETE	4
MLW98	2006	BOS	CQ	1	W		1						SLIGHT DAMAGE	3
MLW98	2006	BOS	MAN	1	L		45						POST PART ASC RAMUS WITH CORONOID AND CONDYLE- 4 PIECES	3
MLW98	2006	BOS	MTT	1	F				DG				SHAFT- 7 PIECES-POROUS-CALF	3
MLW98	2006	BOS	TIB	1	R								MIDSHAFT	3
MLW98	2006	CSZ	LBF	2	F								SHAFT FRAG	4
MLW98	2006	OVCA	INN	1	L								ISCHIAL PART OF ACETAB	4
MLW98	2006	SUS	CAL	1	R	PN	2						PROX SHAFT	3

MLW98	2006	UNI	UNI	1	F								INDET	3
MLW98	2011	BOS	CEV	1	F	CNAN	1245						ANT EPI LOOSE- 2 PIECES	4
MLW98	2011	BOS	FEM	1	L	PJ	13	CH	DG				PROX END WITH TROCH MAJOR CHEWED OFF AND UNFUSED-CHOPPED ACROSS CAPUT	4
MLW98	2011	BOS	SCP	1	R								CRANIAL MARGIN OF BLADE WITH BASE SPINE	4
MLW98	2011	BOS	SKL	1	L		90						MAX AND PREMAXILLA FRAG - 7 PIECES	4
MLW98	2011	BOS	TIB	1	L								ANT MIDSHAFT FRAGMENT	4
MLW98	2011	EQU	FEM	1	R	PFDF	1234578						DISTAL END DAMAGED- 2 PIECES	4
MLW98	2011	EQU	TIB	1	L	PFDF	1234567				GL-335 Bp-89.5 SD-37.7 Bd-69.2 Dd-41.3		COMPLETE-SLIGHT DAMAGE TO PROX END	4
MLW98	2027	BOS	FEM	1	R	DF	6						PART OF DISTAL END	4
MLW98	2027	BOS	INN	1	R	EF	7						ANT ISCHIUM WITH PART OF ACETAB	4
MLW98	2027	BOS	INN	1	R	EF	459	CH					ACETABULUM-CHOPPED THRU ILIUM-CUT ACROSS ACETAB - 3 PIECES	4
MLW98	2027	BOS	MTT	1	F	DN	5						DISTAL SHAFT-EPI LOST	4
MLW98	2027	BOS	SCP	1	L		3	CH					DISTAL END OF SPINE-CHOPPED JUST DISTAL TO SPINE	4
MLW98	2027	EQU	TRV	1	F	CFAF	1345						SOME DAMAGE	4
MLW98	2027	SUS	FEM	1	L	PN	3						PROX SHAFT-VERY SMALL PIGLET-SAME ANIMAL AS ABOVE-NEONATAL?	3
MLW98	2027	SUS	INN	1	L	EN	239						ILIUM-SMALL PIGLET	3
MLW98	2027	SUS	TIB	1	F	DN	7						VERY SMALL-SHAFT-SAME PIGLET AS ABOVE-NEONATAL?	3
MLW98	2027	UNI	UNI	2	F								INDET	4
MLW98	3021	SUS	TIB	1	R		4						MIDSHAFT- 4 PIECES	3
MLW98	3023	BOS	CPR	1	W		1						COMPLETE	4
MLW98	3023	BOS	SCP	1	L		345						BLADE AND NECK-POROUS-CALF - 2 PIECES	3
MLW98	3023	CSZ	RIB	1	F			CH					MIDSHAFT-DISTAL CHOPPED- 2 PIECES	4
MLW98	3023	FISH		1									LARGE COD SIZE BONE	4
MLW98	3025	BOS	MTT	1	L	DN	34						DISTAL EPIPHYSIS	4
MLW98	3025	BOS	PH1	1	L	PF	12						COMPLETE	4
MLW98	3025	CSZ	TRV	1	F	CFAF	234		DG				CENTRUM ONLY-CHEWED	4
MLW98	3025	OVCA	SCP	1	R		45						BLADE	3
MLW98	3025	OVCA	TIB	1	R	DF	567						DISTAL HALF- EPIPHYSIS BROKEN	4
MLW98	3025	SUS	RAD	1	L	PF	123		DG				PROX END AND SHAFT-SL CHEWED	3
MLW98	4026	BOS	ULN	1	L	PF	1	CH					OLECRANON-CHOPPED ABOVE SEMILUNARIS	4
MLW98	4042	CSZ	LBF	1	F								SHAFT FRAG	4
MLW98	4042	OVCA	HUM	1	L		60						MID AND DISTAL SHAFT	3
MLW98	4042	OVCA	RAD	1	L	PF	13						DAMAGED PROX END AND SHAFT	3

Wainfleet St Mary, MLW98 - Animal Bone Archive Catalogue

site	context	species	bone	no.	side	fusion	zone	butchery	gnawing	toothwear	measurement	path.	comment	pres'v-ation
MLW98	227	BOS	SKL	1	L		2						OCCIPITAL CONDYLE-SL POROUS	4
MLW98	400	BOS	TIB	1	F			SW					DISTAL SHAFT-PROX END SAWN THROUGH- VERY LARGE	4
MLW98	400	CSZ	RIB	1	F								SHAFT FRAG	4
MLW98	400	CSZ	SKL	1	F								FRAG CRANIAL VAULT-? HORSE	4
MLW98	400	EQU	PAT	1	F		1						DAMAGED AND ERODED	3
MLW98	400	OVCA	SCP	1	R			SW					PART CAUDAL MARGIN-BOTH ENDS SAWN THROUGH	3
MLW98	400	SUS	LM2	1	W					J7			COMPLETE	5
MLW98	401	CSZ	RIB	1	L			KN					PROXIMAL SHAFT-SHAFT CUT	4
MLW98	401	OVCA	INN	1	L	EF	39						ILIAL SHAFT AND PART ACETABULUM	4
MLW98	401	SUS	AXI	1	F	AN	45		DG				CENTRUM AND ARCH-SPINE CHEWED OFF	4
MLW98	407	CSZ	LMV	1	L			CH					TRANSVERSE PROCESS-CHOPPED ALONG LEADING EDGE	4
MLW98	501	CSZ	RIB	1	L								PROXIMAL SHAFT	4
MLW98	704	BOS	CEV	1	F	CNAN	145						CENTRUM AND ARCH-SL POROUS-SMALL	4
MLW98	704	BOS	MTT	1	L				DG				PROXIMAL HALF SHAFT-POROUS-IMM-PROX END CHEWED OFF	4
MLW98	704	EQU	INN	1	R	EF							ACETABULAR FRAGMENT	4
MLW98	704	EQU	MAN	1	R		6						ANGLE-VENTRAL EDGE WORN AND POLISHED SMOOTH-POSSIBLE SLEDGE!	4
MLW98	704	OVCA	RAD	1	L		3						PROXIMAL SHAFT	4
MLW98	704	OVCA	TIB	1	F								DISTAL SHAFT FRAGMENT	4
MLW98	704	OVCA	TIB	1	L		4						MIDSHAFT	4
MLW98	706	EQU	FEM	1	R	DN	48						DISTAL SHAFT- 2 PIECES-SMALL-JUVENILE-FOAL	4
MLW98	707	BOS	MTC	1	L		12				Bp-65.4 Dp-40.6		PROX HALF-LARGE AND ROBUST	3
MLW98	707	BOS	TRV	1	L	CNAN		CH					CENTRUM AND TRANS PROCESS-CHOPPED THRU MIDDLE	3
MLW98	707	OVCA	HUM	1	L	DF	689	SW					DISTAL HALF-LARGE-ROBUST-SAWN THROUGH MIDSHAFT	4
MLW98	707	SUS	HUM	1	L	DJ	6789						DISTAL HALF	4
MLW98	708	OVCA	CAL	1	R	PF	123				GL-60.8		COMPLETE	4
MLW98	708	OVCA	RAD	1	L		3						PROX MIDSHAFT	4
MLW98	708	SSZ	VER	1	L	CN		CH					LEFT SIDE-CHOPPED DOWN MIDDLE	4
MLW98	708	SUS	INN	1	L	EN	7		DG				ISCHIAL SHAFT-POST CHEWED	4
MLW98	717	EQU	PAT	1	F		1		DG				DAMAGED-CHEWED	4
MLW98	720	BOS	RAD	1	R		6		DG				DISTAL SHAFT-DIST CHEWED OFF	3
MLW98	720	SUS	TIB	1	R		4	SW					PROX SHAFT-MIDSHAFT SAWN THRU-LARGE	3
MLW98	721	OVCA	SCP	1	R		235	B					GLENOID-NECK AND PART BLADE-BLADE CHARRED	3
MLW98	722	BOS	HUM	1	R	DF	6789	CH			BT-74.3 HT-42.4		DISTAL END- 2 PIECES-HEATED-CHOPPED ACROSS CONDYLE AND THRU DIST SHAFT	4
MLW98	722	CSZ	RIB	1	L			CH					PROX SHAFT-DISTAL END CHOPPED	4

MLW98	722	CSZ	RIB	1	F								SHAFT FRAG	4
MLW98	722	CSZ	TRV	1	F	CNAN	45						LAST THORACIC VERT-V SMALL-POROUS-CALF?	4
MLW98	722	OVCA	SCP	1	L		235						GLENOID NECK AND MOST OF BLADE	4

Appendix 8.2:

Pottery from MLW 98

Jane Young

Introduction.

An assemblage of 93 sherds of post-Roman pottery representing at least 79 vessels was recovered from the site. The pottery ranges in date from the medieval to early modern periods. The majority of sherds are of undiagnostic Toynton / Bolingbroke types (TB) dating to between the 14th and 18th centuries, with only 13 vessels of other fabric types occurring over the whole site.

Toynton or Bolingbroke Ware

Much of the Toynton / Bolingbroke material is of indeterminate date although some vessels are typical of certain periods of manufacture. Vessels of both late medieval and post – medieval production are present.

By the late medieval period it becomes difficult to distinguish sherds of jug form from those of jars as the profiles of both vessels are similar. A total of only four jugs and a single jar could be positively identified with a further 21 vessels being of either form. The second most common type of vessel form found were bowls with 22 occurrences. Sherds from two small drinking jugs and eleven bunghole jugs or jars were also present.

Other Wares

Of the thirteen vessels not positively identified as Toynton or Bolingbroke types, four were possible variant types of late medieval Toynton production (LMLOC), and two of medieval production (MEDLOC). The remaining material includes only one sherd of note, the rim of an imported Raeren (RAER) drinking jug. These Rhenish stoneware jugs are not uncommon on urban sites in late 15th to 16th century deposits but are less commonly found on rural sites.

Discussion

The pottery found on the site represents domestic material from the medieval to post - medieval periods. The pottery mainly comprises of plain undecorated vessels from a limited number of sources. The material indicates that the site was in use from the medieval to post – medieval periods, with most of the pottery dating from the 14th to later 16th centuries.

pottery dates mlw98

context	*earliest horizon*	*latest horizon*	*date range*
1000			
	mh10	pmh3	late 15th to late 16th
1002			
	mh10	pmh3	late 15 to late 16th
1002A			
	mh7	mh10	mid 14th to late 15th
1006			
	mh8	pmh1	late 14th to early 16th
1009			
	mh8	pmh1	late 14th to early 16th
1014			
	pmh3	pmh8	late 16th to 18th
1043			
	mh9	mh10	15th?
1045			
	mh7	pmh1	late 14th to early 16th
1053			
	mh7	pmh3	14th to 16th
2002			
	mh7	pmh1	mid 14th to early 16th
2004			
	mh7	pmh3	14th to 16th
2006			
	mh6	mh8	14th?
2011			
	mh8	pmh1	late 14th to early 16th
3023			
	mh8	pmh3	14th to 16th
4047			
	emh	emh	late 18th to 19th
4057			
	pmh3	pmh8	16th to 18th
5005			
	pmh5	pmh3	13th to 16th

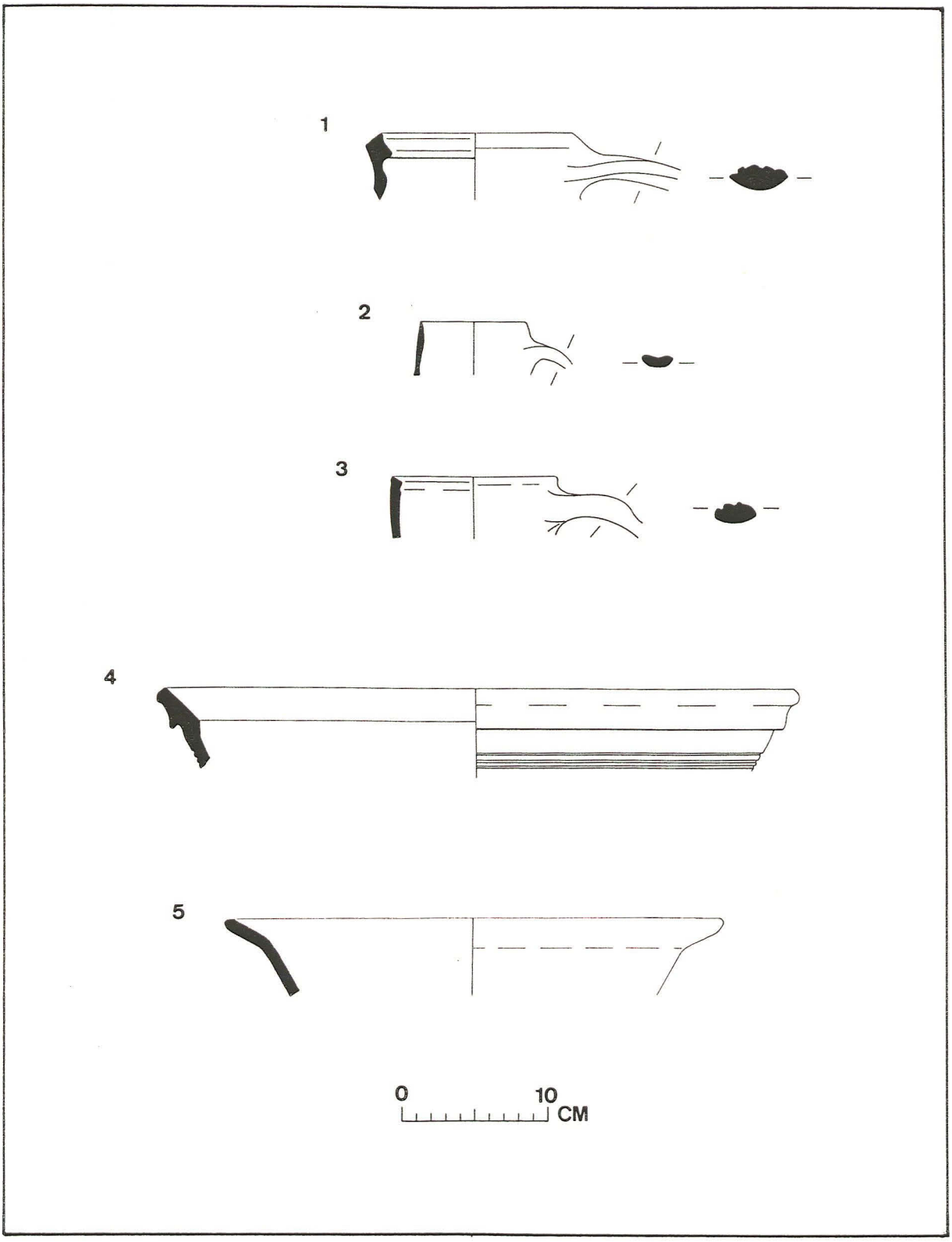

Fig. 1: Late medieval and post-medieval pottery (Numbers refer to the reference number in the archive).

mlw98

sitecode	*context*	*cname*	*form*	*nosh*	*nov*	*part*	*refno*	*description*
mlw98								
	1000							
		TB	bowl	1	1	bs		int glze
		TB	jug/cistern	1	1	rim/handle	dr1	hollow rim;l15/16th
		TB	bowl	1	1	rim		int glze
		TB	bowl	1	1	base		spalled underneatth;int glze;thick base
		TB	bowl	1	1	bs		int glze
		TB	bowl	1	1	bs		int glze
		TB	bowl	1	1	bs		int glze
		TB	bowl	1	1	rim		int glze
		TB	?	1	1	base		
		TB	jug/cistern	1	1	handle		lhj
		TB	jug/cistern	1	1	bs		lmed/epmed
		TB	jug/cistern	1	1	bs		lmed/epmed
		TB	jug/cistern	1	1	bs		lmed/epmed
		TB	jug/cistern	1	1	bs		lmed/epmed
		RAER	jug	1	1	rim/handle	dr2	
		TB	jug/cistern	1	1	handle		grooved
	1002							
		LMLOC	jug	1	1	bs		white slip;fine fabric;could be TB
		TB	jug/jar	1	1	bs		

sitecode	context	cname	form	nosh	nov	part	refno	description
		TB	jug/jar	1	1	bs		
		TB	jug/jar	1	1	bs		
		TB	bowl	1	1	bs		
		TB	bowl	1	1	rim	dr5	15th?
		TB	jug/jar	1	1	bs		
		TB	jug/jar	1	1	bs		
		TB	bowl	7	1	base & bs		
		LMLOC	jug	1	1	bs		prob TB but slightly gritty
		LMLOC	jug/jar	1	1	bs		could be TB but slightly gritty
		TB	small bowl	1	1	rim		everted rim
		TB	bowl	1	1	bs		
		TB	jug/cistern	1	1	handle		
	1002A							
		TB	bowl	1	1	bs		
		TB	bowl	1	1	bs		
		TB	jug/cistern	1	1	handle		
		TB	jug/jar	1	1	bs		
	1006							
		TB	small jug	1	1	bs		lmed?
	1009							
		TB	bowl	2	1	rim & bs		lmed
		TB	jug	1	1	bs		
		TB	jug	1	1	bs		
		TB	small jug	3	1	base		lmed

sitecode	context	cname	form	nosh	nov	part	refno	description
		TB	bowl?	1	1	bs		burnt scrap
		TB	bowl	1	1	bs		
		TB	bowl	1	1	bs		
	1014							
		TB	bowl	1	1	rim	dr4	late 16-18th
	1043							
		TB	small jug	2	1	rim & handle	dr3	oval groovedhandle;15th?
	1045							
		TB	jug/jar	1	1	bs		worn
		TB	bowl	1	1	rim		
		TB	jug/jar	1	1	bs		worn
		LMLOC	jug	1	1	bs		? TB but gritty fabric;spots yellow glze
	1053							
		HUM	?	1	1	rim		
	2002							
		TB	jug/jar	1	1	base		
		TB	jug/jar	1	1	bs		splashed glze;14/15th
		TB	jug/jar	1	1	bs		
	2004							
		TB	jar/pipkin	1	1	bs		int glze;soot
		TB	jug/jar	1	1	bs		
	2006							
		MEDLOC	jar	1	1	rim		hard fired;TOY?

sitecode	context	cname	form	nosh	nov	part	refno	description
		TB	jug	1	1	bs		14th?
		TB	?	1	1	bs		scrap
		MEDLOC	jug?	1	1	bs		white slip;similar to TOY
	2011							
		TB	jug	1	1	bs		lmed
		TB	jug/jar	1	1	bs		lmed
	3023							
		TB	jug/cistern	1	1	bs		
	4047							
		LPM	dish	4	1	rim & bs		? Pearlware
	4057							
		BERTH	?	1	1	bs		int glze;16-18th
	5005							
		TB	?	2	1	bs		scraps could be TOY
	u/s98							
		TB	bowl	1	1	bs		
	u/sB							
		TB	jug/cistern	1	1	handle		ribbed;late 15th+
		TB	jug/jar	1	1	bs		
		MISC	?	1	1	bs		fine red earthenware;no surfaces
		TB	jug/jar	1	1	bs		
		TB	jug/jar	1	1			
		TB	jug/jar	1	1	bs		

sitecode	*context*	*cname*	*form*	*nosh*	*nov*	*part*	*refno*	*description*
		TB	jug/jar	1	1	bs		
	u/sD							
		TB	jug/jar	1	1			
		TB	jug/jar	1	1	bs		
		TB	bowl	1	1	bs		
		TB	bowl	1	1	base		
		BS		1	1	bs		19/20th
		BERTH	bowl	1	1	rim		18th
		TB	jug/jar	1	1	bs		

Appendix 8.3:

FINDS REPORT FOR THE EXCAVATION AT ST MICHAELS LANE, WAINFLEET ST MARY (MLW98: LCCM 210.98)

Jane Cowgill©
April 1999

Introduction

A late medieval – post medieval saltern was investigated by Pre-Construct Archaeology during November – December 1998. The presence of the site had been recorded some time previously because mounds of sand typical of salterns were clearly visible. The pottery from the site is dated broadly from the 14th – 16th century.

Methodology

A quantity of brick, fired clay and slag (Table 1) and six registered finds were submitted for recording. The metal finds had previously been X-Radiographed (MLW 1 - 11.1999) to aid the identification of the objects. All the finds were recorded on *pro forma* recording sheets and the information on the brick, fired clay and slag was entered into a single Microsoft Access database using the following encoded fields: Context; Type; Count; Weight; Comments (Table 2). The registered finds are catalogued below.

Table 1. The quantity of 'bulk' finds.

Type	Count	Weight (g)
Brick	29	3111
Fired clay	33	1157
Slag	10	85
Tile	1	109

Judging by the amount of slag and fired clay that was recovered in the environmental samples (pers comm DJ Rackham) the quantity that was hand collected is probably a small fraction of that which existed on the site. This will certainly be the case with the slag much of which was very small in size and not an easily discernable colour (particularly during a wet winter excavation).

The Bricks.

Fragments of twenty-nine bricks were found at the site, none of which were complete. They are made in a range of fabrics and all but one was probably commercially made. Where surfaces or edges have survived these appear in some instances to be irregular and rough and one piece has a partially rounded corner (context 2004). The distorted nature of the bricks is perhaps also indicated by the range of thickness' present (39 – 78mm) and the fact that one piece has a thickness range of 58 – 78mm along an intact side (context 2004). Eleven pieces are very hard and highly, if not over, fired including one that is vitrified (context 2004). It is therefore probable that these were brick wasters, perhaps from local kilns which were certainly present in the area later in the post-medieval period (pers comm J Young). The only exception to this group is the remains of a brick that may have been locally made. It is made from a low-fired, reduced, soft-silty fabric and has a mass of organic, including one grain, imprints all over one surface (the top or base).

None of the bricks have any mortar on them and none appear to have any worn surfaces (although few surfaces are present amongst this small group). Two pieces have traces of a black, possibly sooty, material on their surfaces, one of which is the low fired possibly locally made fragment. There is no indication as to whether they were associated with the salt production.

The Fired clay

The fired silty-clay assemblage is a heterogeneous collection but some consistent types can be identified. Although quite a few pieces have the pink/mauve colouration that is often associated with salt production the salt content of the local silty-clays will also produce this colour when heated. This colouration, therefore, cannot be used as an indicator that the pink/mauve pieces were associated with the saltern.

The only clays that are slagged and vitrified are a distinctive grey colour and have a thin vitrified surface (contexts 3025 and 6021; also noted in sample <1> context 1007) but with little penetration of the impact of this heat into the body of the clay. The underside of all the pieces is unfired. The maximum-recorded thickness is 28mm and one piece appears to end in a straight edge (context 3025). This is, perhaps, the remains of a lining material. The quality of the clay, and the relative lack of silt in the fabric, suggests that it may have been imported onto the site for a particular function.

The only fired silty clay that appeared to have had temper added to it, in the form of ?reeds or coarse straw, was from pit 3022. There are no extant surfaces on any of the fragments and they are all made in a soft silty-clay oxidised fabric. Although occasional organic inclusions are present in some of the other fragments that are also made from a soft-silty clay, these are probably natural.

The largest fragments of fired silty clay amongst the assemblage are pieces of completely unworked (*ie* unwedged) clay. Most of these pieces are irregularly fired with oxidised and reduced areas blending into each other with zones of grey seemingly, unfired areas, also present. The silty clay is extremely hard and dense. Only one flat straight edge survives on one piece apparently at an oblique angle. The larger pieces seem to be fired at a greater depth (*c.* 22mm) than one would expect if they represent natural soils burnt *in situ*. They could, therefore, possibly represent objects that were cut out of a silty-clay source and then fired rather than being worked by hand.

The most interesting piece is from sample <5>, which was taken from midden deposit 1002. Although it is in very poor condition it may possibly be the remains of a large rim with a minimum thickness of 38mm and a surviving height of *c.* 60mm. It is made from a silty clay which has oxidised to a pink/mauve colour. It is impossible to deduce anything about its original form or whether it originally came from a vessel or was perhaps a hearth rim because so little of the original outer surface is present. Although this cannot be described as briquetage it may have been associated with the saltern.

The Slag

Only ten pieces of slag were hand collected during the excavation (the majority from ?hearth 6021), however, a much larger assemblage is available for study from the environmental samples. The majority is small glassy and a matt grey-green colour and resembles fuel ash slag but generally has less voids and in some instances is chunkier. This slag could have been generated by any high temperature process but is unlikely to have been made in a domestic hearth.

Conclusion

None of the finds catalogued or discussed in this report can be directly associated with the saltern. Although there is a variety of fired/baked clays there is no true briquetage and only one piece that maybe from a vessel or structure (sample <5>, context 1002). The slag is from a high temperature process but it is questionable as to whether salt making generated temperatures high enough to produce this slag.

Catalogue of the Registered Finds

Context 6004; RF 1. IRON VESSEL. Post medieval.
Probably a jug. The object was lifted in a soil block and excavated in the County Council Heritage Services Conservation Laboratory (treatment record 34 – 1999). It is now in 42 pieces and is incomplete. Made from ?three sheets of metal, possibly tinned, comprising the base, handle and body (there appears to be evidence for only one side seam – see piece 37). All the seams seem to be folded with no clear evidence for solder except in the areas where the handle was attached. The rim is rolled as are the sides of the large strap handle (height c. 120 – 130mm). The vessel was crushed when buried and was also probably broken when discarded. At least two circles of solder, 35mm across, are apparent on the vessel body (not visible on the main X-Radiograph MLW 2.1999). These may have attached decorative features but perhaps more likely attached plaques bearing the makers' name. Height c. 170mm; diameter too distorted to record.

Context 1000/1014; RF 2. SILVER COIN. Medieval
An extremely worn long cross penny 1247 – 1485. OBV: totally blank. REV: traces of three large pellets in each quarter and the very worn remains of a few letters of the inscription.

Context 1002; RF 3. IRON NAIL
Rectangular head; shank length 40mm.

Context 3032; RF 4. IRON ROD.
Length 77mm, circular section with a 3mm diameter.

Context unstratified; RF 5. IRON.
Probably a structural fitting or some type of collar. Diameter 103mm; length of attachment or projection 50mm.

Context 1000; RF 6. STONE HONE.
Large but incomplete quartz hone (weight 426g), tapers towards extant end. Odd wear pattern with irregular shallow grooves on many of the surfaces. Surviving length 135mm; maximum width 50mm; maximum thickness 48mm.

Table 2. Catalogue of the brick, fired clay and slag.

Context	Type	Count	Weight (g)	Comments
999	BRICK	1	146	EDGE; TH: 54MM;
999	BRICK	1	101	SILTY FABRIC; TH: 39MM
999	TILE	1	109	FLOOR TILE; DENSE FABRIC; TH:23MM
999	BRICK	4	62	3 DIFFERENT FABRICS
1000	BRICK	2	115	SANDY
1000	BRICK	1	15	SILTY
1000	BRICK	4	237	PURPLE FABRIC; HIGH FIRED
1002	BRICK	1	23	PINK - NOT FROM SALT
1002	BRICK	3	623	PURPLE FABRIC; HIGH FIRED; TH: 60MM; W: ?112MM
1006	FIRE	1	53	MOST REDUCED; UNWORKED CLAY - INCLUSIONS PROBABLY NATURAL
1015	BRICK	1	223	PINK/ORANGE FABRIC
1045	BRICK	2	16	PURPLE FABRIC; HIGH FIRED
1045	BRICK	1	43	BROWN/ORANGE; HIGH FIRED
1045	BRICK	1	19	
2002	BRICK	1	23	PROBABLY BRICK; BROWN/ORANGE FABRIC
2004	FIRE	1	5	OXIDISED BUT FACE REDUCED; UNWEDGED CLAY - NATURAL?; PINK/MAUVE
2004	BRICK	1	236	CORNER; TH: 45MM; BASE + TOP IRREGULAR - WASTER?
2004	BRICK	1	166	ROUNDED IRREGULAR CORNER
2004	BRICK	1	447	VITRIFIED - OVER FIRED; TH: 58 - 78MM; BLACK/PURPLE FABRIC
2006	BRICK	1	249	BROWN/ORANGE FABRIC; UPPER SURFACE IRREGULAR
2006	BRICK	1	201	REDU; SOFT SILTY FABRIC; LOW FIRED; BLACK SOOTY MATERIAL; TOP MASS ORGANIC IMPRINTS
2027	FIRE	1	241	OXIDISED- REDUCED; UNWEDGED; IRON PANNED; DENSE; TH 70MM; FLAT SURFACE
3023	FIRE	15	300	SILTY CLAY; MASS ORGANIC ?REED TEMPER; NO SURFACES
3025	FIRE	2	317	OXIDISED-REDUCED - SOME GREY BUT HARD; UNWEDGED; TH: C 60MM
3025	FIRE	8	128	GREY; 3 WITH SLAGGED UPPER SURFACE- LOWER NOT FIRED; 1 STRAIGHT EDGE; TH: 22 – 28MM
3025	FIRE	3	95	OXIDISED; ALL 1 FLAT SURFACE; NO TEMPER
5021	BRICK	1	166	ORANGE/BROWN FABRIC; TH: 55MM; BLACK ? SOOTY MATERIAL
6021	FIRE	1	12	OXIDISED; 1 FLAT SURFACE; NATURAL TEMPER
3023	SLAG	1	11	GLASSY STRUCTURE BUT MATT GREY - BLACK SOME GREEN + PURPLE
6021	SLAG	4	44	GLASSY STRUCTURE BUT MATT GREY - BLACK SOME GREEN PURPLE
6021	SLAG	1	4	GREEN + GLASSY
6021	FIRE	1	6	OXIDISED; SILTY CLAY; MOST PINK/MAUVE; UNWEDGED
6021	SLAG	3	11	VERY SLAGGED GREY CLAY
6021	SLAG	1	15	VERY SANDY MOST PURPLISH - FIRED CLAY?
6021	SOIL	0	12	ASH RICH SEDIMENT?

Abbreviations: FIRE: fired clay; TH: thickness; W: width

Appendix 8.4: References (main text)

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