



CENTRAL SECTION PROJECT

FIELDWORK REPORT

Archaeological Evaluation & Watching Brief

Broadgate Ticket Hall (XSM10)

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Non technical summary

This report presents the results of an archaeological field evaluation and watching brief carried out by the Museum of London Archaeology (MOLA) on the site of the Broadgate Ticket Hall, Liverpool Street, London EC2M, within the City of London. The site consists of the proposed utilities corridor and Broadgate Ticket Hall construction worksite. It incorporates the western end of Liverpool Street and its north and south pavements. The report was commissioned from MOLA by Crossrail Ltd.

The results of the watching brief, three evaluation trenches and four excavated evaluation trenches broadly confirm anticipated findings. Natural terrace gravels are overlaid by 'weathered' natural deposits of alluvial clay and brickearth, interspersed with occasional bands of gravel. While no prehistoric remains were discovered, evidence has been found for several phases of Roman extra-mural activity and occupation from the c 1st century to the 3rd century, including drainage ditches, pits, dump layers, a beam slot and several ground or floor surfaces. However, although disarticulated human bone was found in Roman contexts, no in situ Roman burials have yet been discovered.

The post-Roman period may be characterised as one of abandonment. While residual medieval finds were recovered, no medieval deposits or features have been confidently identified. Moreover, no medieval remains associated with St Mary Bethlehem Hospital have been found. The Roman sequence was overlain by semi-terrestrial marshy waste ground. These deposits were sealed across the whole site by early post-medieval reclamation deposits, deliberately laid down to create higher dry ground for the establishment of Bethlehem Burial Ground. Within the burial ground, a total of 244 in situ post-medieval burials were found and recorded, and 213 skeletons exhumed. The burial ground was sealed by a horizon comprised of disturbed cemetery soil, containing disarticulated human bone, and possible consolidation dumping, associated with the urbanisation of the area in the mid to late 18th century. This layer and the top of the cemetery contained a large and rare assemblage post-medieval worked animal bone and ivory waste, as well as glass slag waste. This may indicate the type of industrial activity in the surrounding area during the latter days of the cemetery and immediately after the closure of the cemetery. Post-cemetery features include several brick structures (c 18th-century). Finally, a disused Victorian brick sewer was discovered running west to east on the south side of Liverpool Street, tunnelled through the Roman and lower post-Roman archaeology.

The site represents a rare chance to explore Roman extra-mural activity within this area. The site also has potential to document an important post-medieval cemetery, made even more significant by its association with the Hospital of St Mary Bethlehem (Bedlam). In addition, 16th to 18th-century burials such as these are a hitherto underrepresented archaeological subject and their excavation will help further our knowledge and understanding of society, life, death and burial during this time.

The archaeological results from the evaluation trial work at Liverpool Street will be used by the Crossrail archaeologist to revise and finalise the mitigation strategy for the site.

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1 Introduction

Crossrail is a new cross London rail link project which will provide transport routes in the south east and across London. The proposed development will include the construction of seven stations within central London which will have interchange with other public transport modes including the London Underground, National Rail and the London Bus service; the development will also include the renewal and/or upgrade of existing stations outside central London. The route itself will link Maidenhead and Heathrow in the west with Shenfield in the north-east and Abbey Wood in the south-east.

As part of these works a new station is required running from Moorgate to Liverpool Street. The Broadgate Ticket Hall worksite (site of a new ticket hall and utilities corridor to the south) consists of an area in the road and pavement of Liverpool Street, to the east of Blomfield Street and to the south and east of the existing ticket hall/sub-station.

The Crossrail mitigation response to archaeology is described in the Crossrail Generic WSI (Crossrail 2009) and the detailed desk based assessment (DDBA; Crossrail 2008), and can be summarised as follows:

- In the event that intact and important archaeological remains are identified at Crossrail worksites through this process, it may be preferable, where practicable, to preserve these where they are found (ie preservation in situ).
- However, because of the nature of major works projects such as Crossrail, experience of other similar projects suggests that preservation by record is usually the most appropriate method of dealing with archaeological finds.
- Following an extensive Environmental Impact Assessment (EIA) supporting the Crossrail Bill, and the production of site-specific DDBAs, appropriate mitigation measures were scoped and specified in detail in individual project designs (site-specific WSIs – Written Schemes of Investigation) which were prepared in accordance with the principles set out in the Generic WSI, and developed in consultation with the relevant statutory authorities.
- Archaeological information that is gained from fieldwork will be followed by analysis and publication of the results and will be transferred to an approved public receiving body.

This report covers three groups of archaeological investigation carried out at the location of the Broadgate Ticket Hall, Liverpool Street, by C257 Museum of London Archaeology (MOLA), see Figure 1.

All fieldwork was conducted, as instructed by Crossrail and described in Framework Design Consultant (FDC) Notifications, between 20/02/10 to 27/07/11. It was supervised by MOLA Senior Archaeologist Robert Hartle, and included the following:

Task	FDC Notification	Principal Contractor	Date
<ul style="list-style-type: none"> • General Watching Brief on a structural trial pit in the basement of the 	C138-0010	JP Riney	07/03/11



Railway Tavern.			
• Evaluation Trenches 5, 6 and 9 within Liverpool Street.	C138-0005	JP Riney	20/02/10 to 14/03/11
• Excavated Evaluation Trenches 1, 2, 7 and 13.	C138-0005	JP Riney	07/03/11 to 27/07/11

Table 1: Fieldwork conducted between 20/02/10 to 27/07/11.

All grid coordinates in this report are cited as both the National Ordnance Survey and London Survey Grid, and all levels cited as both Ordnance Datum (m OD) and Above Tunnel Datum (m ATD)(ATD = OD +100m).

The event code (sitecode) is **XSM10**.

2 Planning background

The overall framework within which archaeological work will be undertaken is set out in the Environmental Minimum Requirements (EMR) for Crossrail (<http://www.crossrail.co.uk/therailway/getting-approval/parliamentary-bill/environmental-minimum-requirements-includingcrossrail-construction-code>). The requirements being progressed follow the principles of Planning Policy Guidance Note 16 on archaeology and planning (1990). Accordingly the nominated undertaker or any contractors will be required to implement certain control measures in relation to archaeology before construction work begins.

Schedules 9, 10 and 15 of the Crossrail Bill (2005) concern matters relating to archaeology and the built heritage and allows the dis-application by Crossrail of various planning and legislative provisions including those related to listed building status, conservation areas and scheduled ancient monuments (Schedule 9). Schedule 10 allows certain rights of entry to English Heritage given that Schedule 9 effectively dis-applied their existing rights to the Crossrail project, and Schedule 15 allows Crossrail to bypass any ecclesiastical or other existing legislation relating to burial grounds.

Notwithstanding these disapplications, it is intended that agreements setting out the detail of the works and requiring relevant consultations and approvals of detail and of mitigation arrangements will be entered into by the nominated undertaker with the relevant local planning authorities and English Heritage in relation to listed buildings and with the Department of Culture, Media and Sport (DCMS) and English Heritage in relation to Scheduled Ancient Monuments (SAMs).

3 Origin and scope of the report

This report has been commissioned from Museum of London Archaeology (MOLA) by Crossrail Ltd. The report has been prepared within the terms of the relevant standard specified by the Institute for Archaeologists (IFA, 2001). It considers the significance of the fieldwork results (in local, regional or national terms) and makes appropriate recommendations for any further action, commensurate with the results.

This report will be made available from The London Archaeological Archive and Research Centre (LAARC) in due course.

4 Previous work relevant to archaeology of site

The principal previous Crossrail studies are as follows:

- Crossrail, Assessment of Archaeological Impacts, Technical Report, Part 2 of 6, Central Section, Report Number 1E0318-C1E00-00001, 2005.
- Crossrail, Archaeological Programming Assessment, Report Number 1E0318-G0E00-00006 (Rev B), 2006

- Crossrail, Archaeology Generic Written Scheme of Investigation, Document Number CRPN-LWS-EN-SY-00001, 2007, 2007.
- Crossrail, Archaeological Detailed Desk Based Assessment Liverpool Street Station, Report No CR-SD-LIV-EN-SR-00001, 2008 [DDBA].
- Crossrail, MDC3 Archaeology Updated Baseline Assessment, Document Number 20032008-87MB-YYK5, 2008.
- Crossrail, Archaeological Monitoring of Ground Investigations, Borehole Package 13, September 2009.
- Crossrail, Central Section Project Interim Statement Archaeological Watching Brief and Evaluation Broadgate Ticket Hall - XSM10, Document Number C257-MLA-X-RGN-CRG02-50036 v2, 10/08/2011 [MOLA].
- Crossrail, C257 Archaeology Central, Survey Report, Archaeological Evaluation, Broadgate Ticket Hall (XSM10), Document Number C257-MLA-X-RGN-CRG02-50067 v1, 10/11/11 [MOLA].

The fieldwork was carried out in accordance with:

- A Crossrail **Site-specific Written Scheme of Investigation** (SS-WSI): Liverpool Street Station, Site-specific Written Scheme of Investigation, Doc. No. C138-MMD-T1-RST-C101-00001 Version 2, 29.04.10, the addendum to the SS-WSI, Doc. No. C138-MMD-T1-RST-C101-00004, Revision 1.0, August 2010.
- An **Archaeological Method Statement**: MOLA, *C257 Central Method Statement for Archaeological Evaluation and Watching Briefs Broadgate Ticket Hall (XSM10)*, Doc No: C257-MLA-X-RGN-CRG02-50002, Version 3, 17.02.11 and Version 4, 30.06.11. The MOLA method statement was prepared in line with the Principal Contractor's (JB Riney) method statement.

The Written Scheme of Investigation (WSI) and Method Statements will be available from the LAARC.

5 Geology and topography of site

The geological and topographical setting was covered in detail in the SS-WSI – *Liverpool Street Station Design Package 138*, Crossrail, April 2010, Document No C138-MMD-T1-RST-C101-00001, Revision 2.0, and is summarised below.

The drift geology on this site consists of Pleistocene terrace gravels of the third (Taplow) Thames terrace, laid down approximately 128-280,000 BP (Before Present). While establishing its new path during the course of the last ice-age, the Thames river eroded its valley, creating a series of sand and gravel terraces of which this is one. The archaeological potential of the Terrace Gravel deposits is considered to be very low.

The river terrace deposits are thought to be largely overlaid locally by alluvium, possibly deposited by the River Walbrook. The River Walbrook is a tributary of the Thames and formed a broad, shallow valley into which a number of smaller streams ran. The alluvium also potentially seals these tributary stream channels. The Walbrook is now entirely built over and has been diverted into underground culverts. Indeed, much of the Walbrook

had been covered over and built upon by the time John Stow published his survey of London in 1598. Where examined at the Broad Street Station site (LSS85) the Walbrook channel cut down to 6.3m OD (106.3m ATD), and it was also clear that the course of the stream had shifted within its valley over time. Within the Broadgate Ticket Hall site, the original course of the Walbrook is thought to have ran approximately north to south in a position which is now the line of Blomfield Street, potentially within the western edge of the site.

Sporadic deposits of brickearth have been known to occur in areas of the site, as recorded at MoLAS site LNA99, overlying the river terrace gravels and sealed by the alluvium. However, no brickearth deposits were noted in recent boreholes (Mott McDonald investigations, Crossrail September 2009). Information from borehole records and the levels of deposit survival recorded at sites in the area (BSP91; BDC03; LSS85; VLT85; LVB05 & NEB87) indicate that brickearth and terrace gravels have been truncated by activity during the Roman and later periods. River terrace gravels were shown to slope down toward the predicted location of the River Walbrook, from c 9.25m OD (109.25m ATD) in the east to 7.00m OD (107.00m ATD) in the west.

5.1 Archaeological and Historical Background

The historic background and archaeological potential of the Liverpool Street Broadgate Ticket Hall site is summarised below, and covered in detail in the DDBA (Crossrail 2008, section 1.4) and the WSI (SS-WSI, Crossrail 2010).

The site of the Broadgate Ticket Hall lies c 120m north of the Roman and medieval City walls, within the upper Walbrook valley, immediately east of the River Walbrook. The construction of the City wall between c AD 180 and 225 was one of many factors which influenced the development of the upper Walbrook valley. Although the stream was conducted through the wall in a conduit, the wall did significantly impede the natural drainage of the upper Walbrook, and an area of distinctly marshy land formed in the valley outside the city wall. Excavations in the nearby area, in Old Broad Street, New Broad Street, and Blomfield Street, have shown evidence for significant Roman extra-mural activity, including the control and management of the River Walbrook with revetment and dumping, with land-reclamation activity including drainage ditches, and burials (sitecodes BDC03, BRO90, CAP86, NEB87, COLS3, GM122, LLS85, and FIN81). In addition, a Roman road was discovered to the west of the site, running west to east toward Bishopsgate, a course that, if it continued, would take it through the north area of the Broadgate Ticket hall site (BDC03).

Fitzstephen in the late 12th-century described this area as a 'great fen or moor'. Recent work associated with the Crossrail development at Finsbury Circus has located the Moorfields marsh deposits overlying earlier Roman pits (MOLA unpublished evaluation report). Later medieval urbanisation north of the City wall was initially only characterised by ribbon development along Bishopsgate, to the east. As a result, the area within the site remained a marginal area and was open land.

In 1568/9, the City established the 'New Churchyard', the first of the early modern non-parochial churchyards (Harding 2002). The burial ground would later become more commonly known as the 'Bethlehem Burial Ground' because of its association with the medieval Bethlehem Hospital (see Figure 12). The priory and hospital of St Mary (of) Bethlehem had been founded on the western side of Bishopsgate in 1247, on a site now beneath the present Great Eastern Hotel, and the burial ground was established on 1

acre of land belonging to the hospital. However, the site had not initially be intended for the exclusive use of the hospital but as an 'overflow', relieving pressure on the increasingly crowded burial grounds within the City. In 1563 there had been an outbreak of plague and, consequently, the City had sort to increase burial capacity in case of further epidemics. The extent of the 'New Churchyard' is shown on various historic maps (see Figure 12 to Figure 14). During the mid 19th-century, Liverpool Street was widened to incorporate the southern part of the burial ground. The Broadgate Ticket Hall site is located within the south-west of the cemetery, in what is now the western half of Liverpool Street's carriageway and pavements.

In 1985, excavations at Broad Street Station (LSS85) immediately north of the site, investigated burials which had survived the construction of the station within the development footprint of Broadgate. The excavation trench was located under what had been the cab ramp immediately in front of the station building itself. Within the main excavation trench over 400 partial or complete burials were encountered at a density of up to 8 per m³ of ground and 200 more came from further test-pits. More recent utility related excavations have continued to confirm the presents of human remains within the Broadgate Ticket Hall site (LVB06 and XRF09).

5.1.1 Summary of Archaeological Potential

The site has:

- High potential for post-medieval remains in the form of both disarticulated human remains and *in situ* burials relating to the Bethlem hospital burial ground within the carriageway of Liverpool Street, and the later post-medieval urbanisation of the area;
- High potential for Roman remains (possibly in the form of land reclamation and burials), in areas where these have been sealed by surviving Moorfields Marsh deposits;
- Moderate potential for quarrying and reclamation dumps from the medieval period;
- Low potential for archaeological remains of Saxon date, owing to the presence of the Moorfields Marsh;
- Low potential for prehistoric activity, which is likely to be limited to stray finds and sporadic truncated features.

6 Research objectives and aims

6.1 Objectives of the fieldwork

The overall objectives of the investigation are to establish the nature, extent and state of preservation of any surviving archaeological remains that will be impacted upon by the development.

The task-specific aims and objectives from the Addendum to the WSI (Doc. No. C138-MMD-T1-RST-C101- -00004 Revision 1.0, see section 2.2) are:

- The watching brief, trial trench evaluation and excavation will refine the extent and significance of the archaeological resource and inform further mitigation measures.

Specifically, the archaeological investigations at the Liverpool Street (Broadgate Ticket Hall) work-site have the potential to recover:

- Archaeological remains of Roman date relating to extra-mural activity, including burials;
- Medieval remains associated with St Mary Bethlehem Hospital;
- Post-medieval rubbish dumps and remains associated with the urbanisation of the area;
- Post-medieval burials within the known burial ground that lies beneath the carriage way of Liverpool Street in the Broadgate Ticket Hall area;
- Waterlain deposits with the potential for organic preservation and palaeoenvironmental remains.

6.2 Research Aims

The original aims and objectives were listed in the SS- WSI Liverpool Street Station (Doc. No., C138-MMD-T1-RST-C101-00001 Version 2, see section 4) and stated that 'Archaeological investigation and mitigation within the Crossrail worksites for Liverpool Street Station have the potential to contribute to the research themes set out below':

Evidence relating to the Walbrook, its tributaries and Moorfields Marsh deposits may provide data relevant to the following themes:

- Understanding London's hydrology, river systems and tributaries and the relationship between rivers and floodplains;
- Understanding how water supply and drainage provision were installed and managed;
- Refining our understanding of the chronology and function of the landward and riverside defences and extramural evidence of defensive or military structures in the Roman period;
- Understanding the relationships between urban settlements and royal villas or religious estates;

- Examining the proposal that there was an ideological polarity between town and anti-town systems: Roman towns did not so much fail as were discarded;
- The end of the Roman occupation: developing explanatory models to explain socio-political change and considering the influence of surviving Roman structures on Saxon development; and;
- Examining the use in any one period of materials from an earlier period (e.g. Saxon use of surviving Roman fabric) and the influence on craftsmanship, manufacture and building techniques.

Evidence relating to the Medieval Bethlehem Hospital precinct and cemetery, bisected by Liverpool Street, may provide data relevant to the following themes:

- Understanding the differences, if any, between burial practices in the city and outlying cemeteries;
- Understanding life expectancy, origins and belief, seen through studying health, diet and disease, and preparing models for future research;
- Considering the relationship between cemeteries and major or minor roads, in terms of symbolism, status, privacy and convenience; and
- Synthesising data on known religious sites and buildings, their chronology, use and influence locally, regionally and nationally.

7 Methodology of site-based and off-site work

7.1 General

All archaeological excavation and recording during the evaluation was carried out in accordance with the *Archaeological Site Manual* (MoL 1994).

Trenches 5, 6, and 9 (see Figure 1 for all trench locations) were only excavated to the surface of the burial ground. The purpose of these evaluation trenches was to provide information on the presence or absence, character, extent, date, preservation, and importance of the archaeological remains predicted to exist at the site, in order to inform future mitigation of potential impacts of the Crossrail works. However, this phase of works also offered an opportunity for localised full excavation (Trenches 1, 2, 7 and 13), which would provide information on the full sequence of remains down to natural geology. The selection of trenches for full excavation was undertaken in conjunction with the Crossrail Archaeologist and Principal Contractor.

The purpose of the Watching Brief (Railway Tavern trial trench) was to mitigate the impact of that trial pit upon archaeological remains, by making an adequate record of them during the construction ground works.

The site finds and records can be found under the site code XSM10 in the MOLA archive. They will be stored there pending a future decision over the longer-term archive deposition and public access process for the wider Crossrail scheme.

7.1.1 Excavation and Recording of Human Remains

It was anticipated that human remains would be present on this site and an application was made to the Ministry of Justice for an exhumation licence:

- MOLA received a burial licence for the authority to exhume human remains for archaeological purposes for the evaluation, detailed excavation and watching briefs listed in section 1 (Licence number 11-0013, 17th February 2011). This was forwarded to the Design Archaeologist and Project Archaeologist for distribution to the Principal Contractor and any others who required them. A copy was kept on site with the MOLA site supervisor.
- In a letter of the 24 May 2011, amending the conditions of the above licence, the Ministry of Justice permitted that 'spoil which may contain disarticulated human remains shall be stored safely, privately and decently by JB Riney & Co Limited, London under the control of a competent member of staff'.

The methodology employed for the excavation of human remains is set out in the sections below, and in more detail in the SS-WSI and the MOLA Framework Method Statement (Technical Submission 2.4, section 4.6).

7.2 Evaluation methodology (Trenches 5, 6, and 9)

The Principal Contractor (J B Riney) marked out the trenches according to the restrictions of existing services and their permit to dig. The Principal Contractor then

machine excavated and removed modern overburden down to the first significant archaeological deposit within three evaluation trenches (Trenches 5 (see 8.1.1), 6 (see 8.1.2), and 9 (see 8.1.3)) under supervision of MOLA Senior Archaeologist Robert Hartle. In the case of Trenches 6 and 9, the underlying archaeological deposits were excavated to the level of the burial ground and *in situ* human remains. These horizons were then recorded (cleaned, location recorded and photographed) by MOLA (C257) to identify their survival, extent and significance. In the case of Trench 5, modern truncation was considerably deeper and reduced to earlier deposits. Trench 5 was not shored to enable access, consequently, the trench was recorded from the ground level, with deposits examined closely after they were extracted by the machine. A written and drawn record of all archaeological deposits encountered was made in accordance with the principles set out in the Museum of London site recording manual (MoL 1994)(see 8.1.1, 8.1.2, and 8.1.3). Within evaluation Trenches 6 and 9, significant archaeological strata and features (any complete or semi-complete articulated burials) were left *in situ* pending a decision with regard to an appropriate mitigation strategy (see Figure 3). Therefore, prior to backfilling, *in situ* human remains which had been uncovered in Trenches 6 and 9 were left *in situ* and covered with terram and a layer of clean sand (at least 200mm in thickness), under MOLA supervision.

7.2.1 Human Remains

All disarticulated human bones were collected, counted and examined by a MOLA Human Osteologist on-site. This allowed for the calculation of a minimum number of individuals (MNI) based on the presence of repeated elements. Furthermore, a note was made of any intrusive animal bone, staining or observations of any pathological conditions and age, where possible (see 18.7). These *ex situ* human bones were then bagged up and reburied in the trench in which they were found before it was backfilled (3 bags in Trench 6 at 11.16m OD (111.16m ATD) and 8 bags in Trench 9 at 10.90m OD (110.90m ATD)). No disarticulated human bone was found in Trench 5 and, therefore, no bags were re-interred in that trench. Similarly, if any of the contractor's excavated spoil was thought to contain further disarticulated human bone it was not removed from site but re-filled by the Principal Contractor into the trenches on completion.

The locations of the trenches were recorded by MOLA Geomatics by optical survey. The survey utilised Crossrail London Survey Grid control stations, which were then tied into the OS.

7.3 Excavation methodology (Trenches 1, 2, 7 and 13)

The Principal Contractor (J B Riney) marked out the trenches according to the restrictions of existing services and their permit to dig. The Principal Contractor then machine excavated and removed modern overburden within four trenches (Trenches 1, 2, 7, and 13) down to the first significant archaeological deposit under supervision of the MOLA Senior Archaeologist. The trenches were then hand excavated by MOLA. Excavation included the full archaeological sequence in all trenches except Trench 7, where excavation was limited to c 1m above an active sewer which ran below (7.69m OD (107.69m ATD)).

A written, drawn and photographic record of all archaeological deposits encountered was made in accordance with the principles set out in the Museum of London site recording manual (MoL 1994)(see 8.2.1, 8.2.3), 8.2.4 and 8.2.5, Figure 7, Figure 8, Figure 9, and Figure 10).

The locations of the trenches, as dug, were recorded by MOLA Geomatics by optical survey. The survey utilised Crossrail London Survey Grid control stations, which were then tied into the OS.

7.3.1 Human Remains

All disarticulated human bones were collected, counted and examined by a MOLA Human Osteologist on-site. This allowed for the calculation of a minimum number of individuals (MNI) based on the presence of repeated elements. Furthermore, a note was made of any intrusive animal bone, staining or observations of any pathological conditions and age, where possible (see 18.7). All disarticulated human bone recovered during excavation of Trenches 7 and 13 was re-interred at the base of those trenches (46 bags in Trench 7 at 8.90m OD (108.90m ATD) and 16 bags in Trench 13 at 7.20m OD (107.20m ATD)). However, disarticulated human remains recovered during the excavation of Trenches 1 and 2 were retained and passed to JB Riney for storage until the appointment of an exhumation contractor, who would then rebury the remains in accordance with the terms of the burial licence.

Where detailed excavation of *in situ* burials was undertaken, the following processing methodology was employed:

- All remains and samples were treated to professional standards and in accordance with United Kingdom Institute for Conservation guidelines.
- Inhumations were washed over a 1mm mesh using a spray hose. Any block lifted remains such as those of neonates, were processed using a flotation tank with a 1 mm mesh to ensure complete recovery.
- The remains were washed and packaged.
- The remains were transferred to a purpose-built facility where they were slowly air dried.
- The remains were then packaged to archive standard under the direction of the Senior Osteological Processor. Human bone were not be marked.

Following processing, see above, the following assessment scanning methodology was employed (see 18.7):

- Inhumations were assessed by a MOLA Human Osteologist. Assessment of all stratified deposits of human remains was carried out according to English Heritage Centre for Archaeology Guidelines 2002 and MOLA standards (Powers, unpublished).
- Assessment data was recorded in an Excel worksheet. For each context, the level of preservation and completeness was estimated and a basic catalogue (by body area, not bone, ie skull, dentition, arms, legs etc) was compiled.
- The remains were rapidly scanned to provide basic demographic data. Remains were classified as adult or subadult. Subadults were subdivided into age groups based on the timings of the eruption of the molar teeth. Basic observation on adult sex was made.
- Gross pathological changes were noted using a coding system compatible with that used at analysis.
- The minimum number of individuals within each context was noted.

- A summary catalogue of disarticulated bone was produced, to aid in establishing the minimum number of individuals within each trench.

7.3.2 Environmental archaeology investigation methodology

The sampling strategy for the Liverpool Street sub-site is summarised below, but is covered in more detail within the MOLA Method Statement, Crossrail document number C257-MLA-X-RGN-CRG02-50002.

In general, sampling was undertaken by the archaeologists excavating each trench, in the form of 40 litre bulk samples. However, a geoarchaeologist was on call to visit the site, advise and where necessary record and take samples from selected deposits, using continuous monolith tins and bulk samples. Samples were then processed and analysed off-site by archaeo-botanical and archaeo-zoological specialists. The initial environmental results from these samples can be found in Appendices 18.8 and 18.10.

Selected Roman negative features, such as pits and ditches, as well as deposits potentially relating to the Walbrook channel and the Moorfields Marsh were targeted for environmental sampling. The aim of this sampling was to evaluate the degree of preservation and range of environmental remains preserved within the archaeological deposits, assess their potential to address the overall site objectives and identify any additional research aims that might also be addressed by the surviving archaeological deposits on the site.

The environmental procedures outlined in the *Archaeological Site Manual* (MoL 1994) and *Environmental archaeology: a guide to the theory and practice of methods, from sampling and recovery to post-excavation* (English Heritage 2002) were followed.

7.4 Watching brief methodology (Railway Tavern Trial Trench)

One exploratory trial trench (see 8.3), was excavated to 9.32m OD (109.32m ATD), a depth of 1m below ground level (bGL), within the basement of the Railway Tavern public house.

The general watching brief consisted of a basic monitoring presence, by MOLA Senior Archaeologist Robert Hartle, to observe works carried out by the Principal Contractor (J B Riney). Excavation was conducted by hand by J B Riney, and further manual cleaning, investigation and recording were then undertaken by the MOLA Senior Archaeologist. A written and drawn record was made in accordance with the principles set out in the Museum of London site recording manual (MoL 1994)(see 8.3). The Principal Contractor supplied MOLA Geomatics with the co-ordinates of the trial trench.

8 Results and observations including stratigraphic report and quantitative report

Task	Date	Figures	Photos
<ul style="list-style-type: none"> Evaluation Trenches 5, 6 and 9 (see 8.1). 	20/02/10 to 14/03/11	Figure 1, Figure 3, and Figure 11	Photo 1, Photo 2, and Photo 3.
<ul style="list-style-type: none"> Excavated Evaluation Trenches 1, 2, 7 and 13 (8.2). 	07/03/11 to 27/07/11	Figure 1 to Figure 11	Photo 4 to Photo 21
<ul style="list-style-type: none"> General Watching Brief on a structural trial pit in the basement of the Railway Tavern (see 8.3). 	07/03/11	Figure 1	Photo 22

Table 2: Archaeological investigations

8.1 Evaluation Trenches

See Figure 1 for trench locations

8.1.1 Trench 5



Photo 1: Trench 5 - Early 20th-century subterranean toilet block tiled brick walls (left) and concrete backfill (right), truncating organic deposits [235] and [236] (seen in a sondage at the centre)(looking south).

Trench 5 (Figure 1 and Figure 11)	
Location	The approximate centre of the west end of Liverpool Street. Furthest trench west.
Dimensions	2.2m wide (north to south) x c 4.0m (east to west) x 4.9m deep
London Survey grid coordinates	83373 36295
OS National grid coordinates	533024 181610
Modern Ground Level	12.52m OD (112.52m ATD)

Modern subsurface deposits	Road surface 100mm thick, over concrete 400-500mm thick. Toilet block structure and concrete backfill between 11.92 and 8.17m OD (111.92 and 108.17m ATD)
Level of base of archaeological deposits observed and/or base of trench	7.62m OD (107.62m ATD)
Natural observed	Not reached
Extent of modern truncation/overburden	From above, there was a 20th-century truncation across whole trench to 8.17m OD (108.17m ATD/4.35m bGL). Also, from below, the archaeology had been removed by a tunnelled sewer, at 7.62m OD (107.62m ATD) and below.
Archaeological remains	Dating Evidence, Finds, and Samples
[235], a mid grey brown silt clay and organic material (30:70), with occasional shell and leaves, twigs etc., overlying [236], a dark grey black silt clay and organic material (40:60), occasional shells and charcoal between 8.17m and 7.62m OD (108.17 and 107.62m ATD).	No finds.
Interpretation and summary	
<p>The archaeology, including any burials, was almost completely truncated, from above by an early 20th-century toilet block and from below by a tunnelled Victorian sewer. Only a small band, approximately 600mm thick, survived between the two. This was a sequence of two damp humic deposits [235] and [236]. There was no dating evidence, although, at this depth it is most likely Roman. Unfortunately, given the restricted nature of the sondage, it is impossible to determine the nature of these deposits, even, for example, if they are fills or layers. It was also not possible to obtain uncontaminated samples of these deposits as the trench could not be entered (see 7.2) and was machine excavated. The early 20th-century subterranean toilet block is first seen on the 1913 OS map and last seen on the 1951 OS map. It does not appear on the 1963 OS map and had presumably been closed by this time.</p>	

8.1.2 Trench 6



Photo 2: Trench 6 - Burial stacks (looking north-east)

Trench 6 (Figure 1 and Figure 3)	
Location	To the west of the site and at the approximate centre of the roadway.
Dimensions	2.35m wide (north to south) x 4.0m long (east to west) x 1.4m deep
London Survey grid coordinates	83384 36292
OS National grid coordinates	533036 181607
Modern Ground Level	Road surface at 12.57m OD (112.57m ATD)
Modern subsurface deposits	Road surface 100mm thick, over concrete 400–500mm thick, above crushed concrete and other modern material 400mm thick.
Level of base of archaeological deposits observed and/or base of trench	Limit of excavation at 11.16m OD (111.16m ATD).
Natural observed	Not reached

Extent of modern truncation/overburden	Approximately 1.0m to >1.5m deep (a modern truncation in the SE corner extended beyond the trench limits)
Archaeological remains	Dating Evidence, Finds, and Samples
[21] – Cemetery soil cut by numerous burials. Contained significant amounts of residual disarticulated human bone. Nineteen articulated burials, all with coffins, were identified and recorded within this layer 11.52m OD (111.52m ATD).	No datable finds associated with any of the burials. These burials, given their position at the surface of <i>in situ</i> burials, are presumably of late 17th or early 18th-century date.
[20] – Re-deposited cemetery soil and/or dumping, including animal bone and moderate amounts of disarticulated human bone. 11.60m OD (111.60m ATD).	<p>Pottery – 1763 to 1800.</p> <p>Worked bone and ivory (c 18th-century).</p> <p>Glass and glass slag – 1750 to 1790.</p> <p>Brick and tile – 1730 to 1800.</p> <p>Clay tobacco pipes – 1730 to 1760.</p> <p>Undated corroded metal items.</p>
Interpretation and summary	
This trench was only excavated to the surface of <i>in situ</i> burials. It revealed a moderate to high density of burials, with confined skeletons arranged in parallel rows and in vertical stacks. The upper burials showed signs of disturbance and truncation, and were covered by a possible levelling dump [20] containing moderate amounts of disarticulated human bone. In addition, the area has also been partially truncated by c 20th-century activity (most likely utility trenches).	

8.1.3 Trench 9



Photo 3: Trench 9 - Burials and charnel pit [6] (bottom left), cutting into cemetery soil [1] and cut by modern truncation (left)(looking east).

Trench 9 (Figure 1 and Figure 3)	
Location	The approximate centre of the west end of Liverpool Street. Evaluation trench furthest to the east in the site area.
Dimensions	2.15m (north to south) x 2.15m (east to west) x 1.8m deep
London Survey grid coordinates	83403 36287
OS National grid coordinates	533054 181603
Modern Ground Level	12.71m OD (112.71m ATD)
Modern subsurface deposits	Road surface 100mm thick over concrete 500mm thick, above crushed concrete and other modern material 600mm thick.
Level of base of archaeological deposits observed and/or base of trench	10.90m OD (110.90m ATD)
Natural observed	Not reached
Extent of modern truncation/overburden	>1m deep – base of modern truncation

	not reached.
Archaeological remains	Dating Evidence, Finds, and Samples
[2] – Cemetery soil cut by numerous burials. Contained significant amounts of residual disarticulated human bone. Seven articulated burials, all with coffins, were identified and recorded within this layer.	No datable finds associated with any of the burials. These burials, given their position at the surface of <i>in situ</i> burials, are presumably of late 17th to early 18th-century.
[6] - A charnel pit which cut burials below. The fill was comprised exclusively of re-deposited human bone [5].	Post-cemetery or within the later use of the cemetery – c late 17th to early 18th-century.
[1] - Re-deposited cemetery soil and/or dumping, including occasional animal bone and moderate amounts of disarticulated human bone. 11.55m OD (111.55m ATD).	Pottery – medieval (1380 to 1500) and post-medieval (1763 to 1800). Worked bone and ivory (c 18th-century). Clay tobacco pipes – 1730 to 1760.
Interpretation and summary	
<p>This trench was only excavated to the surface of <i>in situ</i> burials. It revealed a moderate to high density of burials, with confined skeletons arranged in parallel rows and in vertical stacks. The top burials showed signs of disturbance and truncation, and were covered by a possible levelling dump [1] containing moderate amounts of disarticulated human bone. The charnel pit [6] was the only one found during this phase of investigation. The pit may have been part of a later strategy to deal with ever-increasing amounts of disarticulated human bone, disturbed during the digging of later graves through older ones. Alternatively, the pit may relate to the disturbance of the cemetery during the construction of post-cemetery buildings. In addition, the area has also been partially truncated by c 20th-century activity (most likely utility trenches).</p>	

8.2 Excavated Evaluation Trenches

See Figure 1 for trench locations

8.2.1 Trench 1



Photo 4: Trench 1 - Profile of sewer [535] with a 0.5m scale. During the excavation it was backfilled and bricked up westward, and largely broken out within the trench (looking west).

Trench 1 (Figure 1, Figure 2, Figure 3, Figure 5, Figure 6 and Figure 7)	
Location	South-west corner of Liverpool Street. The south edge was positioned at the north of a known utility truncation, as seen in Trench 1a (see Figure 11).
Dimensions	2.96m wide (north to south) x 4.3m long (east to west) x between 5.16m deep
London Survey grid coordinates	83377 36290
OS National grid coordinates	533028 181605
Modern Ground Level	Road surface at 12.28m OD (112.28m ATD)
Modern subsurface deposits	Road surface 100mm thick, over concrete 500mm thick, above crush/rubble and other modern material 600mm thick.
Level of base of archaeological deposits observed and/or base of trench	Limit of excavation: Within the whole trench - 7.40m OD (107.4m ATD) Within a <i>sondage</i> - 7.12m OD (107.12m ATD). Within auger holes – 6.27m OD (106.27m ATD).
Natural observed	Weathered natural bands of gravel and clays ([717], [718] and [719]) were observed between 7.52m and 7.32m OD (107.52 and 107.32m ATD). Undisturbed natural terrace gravels [720] began at 7.32m OD (107.32m ATD).and overlay natural London clay [522] at 7.01m OD (107.01m ATD). Natural London Clay [522]. The surface was between 6.86m and 7.01m OD (106.86 and 107.01m ATD) within auger holes.
Extent of modern truncation/overburden	Approximately 1m to >5m deep
Archaeological remains	Dating Evidence, Finds, and Samples
Natural terrace gravels [720], overlain by [718] and [719] - Weathered natural clay layers. At 7.52m OD and 7.45m OD (107.52 and 107.45m ATD), respectively.	No finds.

[717] - Weathered natural gravels. 7.57m OD (107.57m ATD).	No finds.
[716] - Purple grey sandy clay dump deposit. 7.74m OD (107.74m ATD).	Pottery - AD 120 to 150. Also included a disarticulated human bone.
[715] - Orange yellow gravelly clay dump deposit. 8.18m OD (108.18m ATD).	Pottery - AD 140 to 160. Brick and tile – AD 60 to 160. Also included a disarticulated human bone.
[712] - Orange grey clay. 8.58m OD (108.58m ATD)	Pottery - Roman (c 2nd-century).
[713] - Pit cut with fills [709] and [714]. 8.58m OD (108.58m ATD)	Pottery, including amphora, coarse wares such as black-burnished and Verulamium white wares, and a large proportion of fine wares such as Samian. Roman (2nd century). Animal bone. Roman CBM (ceramic building material - Tegula, imbrex and brick) and stone mortar – AD 50 to 160. Iron nails (Roman). Leather fragments, including a shoe. Samples taken, including monoliths samples {21} and {22}, and bulk samples {26} and {27}.
[711] - Clay layer. 8.68m OD (108.68m ATD).	No finds.
[710] - Ditch cut with fills [707] and [708]. 8.68m OD (108.68m ATD).	[707] – Pottery AD 120 to 160, building material AD 100 to 160, and animal bone. [708] - Pottery AD 120 to 160. Samples taken, including monoliths samples {21}, {22} and {23} and bulk samples {24} and {25}.
[533] - Dump layer of dense organic material in dark grey black silt clay with sand lenses. 9.33m OD (109.33m ATD)	Leather fragments, including shoes (Tudor). Copper wire, a chain and pins. Medieval to early post-medieval.

<p>[507] – Grey brown clay silt moderate charcoal flecks, occasional CBM fragments, animal bone, small stones and oyster shell. 9.83m OD (109.83m ATD)</p>	<p>Pottery – 1580 to 1600. CBM – Roof and floor tile – 1480 to 1600.</p>
<p>[493] - Light grey brown sandy silt, containing frequent building material fragments (brick and tile), chalk fragments, oyster shells, and mortar and charcoal flecks. 10.43m OD (110.43m ATD)</p>	<p>Pottery - medieval (1240 to 1350) and post-medieval (1630 to 1650). Peg tile – 1180 to 1480 This layer is most likely a consolidation dump layer, laid down sometime before 1568 in order to establish the cemetery.</p>
<p>[492] - Cemetery soil cut by numerous burials. Contained significant amounts of residual disarticulated human bone. 10.88m OD (110.88m ATD).</p>	<p>Pottery – medieval (1270 to 1300), post-medieval (1630 to 1650). CBM (peg tile) – 1180 to 1480. Clay tobacco pipe – 1680 to 1710.</p>
<p>Sixty-four articulated burials, mostly with coffins, were identified and recorded cut into layer [492]. Between 10.88m OD and 9.46m OD (110.88 and 109.46m ATD).</p>	<p>Necklace ([349], <171>), from a burial of a child aged 1-5 years, undated (see 18.5). Otherwise, no finds associated with any of the burials. Dated to within the use of the cemetery (1568 to mid 18th-century).</p>
<p>[336] – Demolition layer? Dark grey sandy silt with frequent brick and tile fragments, and moderate disarticulated human bone. 11.14m OD (111.14m ATD)</p>	<p>No finds.</p>
<p>[325] - Red brick wall. 11.35m OD (111.35m ATD)</p>	<p>Post-medieval</p>
<p>[332] - Red brick wall built on a foundation course of re-used worked stone [431], cut by and associated with wall [330] and floor [329]. 11.29m OD (111.29m ATD)</p>	<p>Brick samples: [332] brick – 1666 to 1900 [330] brick – 1450 to 1600 [431] - masonry fragments included a post-medieval millstone and Portland stone architectural elements, dated 1600 to 1800 (see Photo 6).</p>
<p>[335] - Robber trench. Fill [334] contained large amounts of disarticulated human bone. 10.80m OD (110.8m ATD)</p>	<p>Unknown – post-medieval to modern</p>
<p>[321] - Brick drain with stone and brick cap stones. 11.30m OD (111.3m ATD)</p>	<p>17th to 18th-century</p>

[324] - Robber cut and fill [323]. 11.28m OD (111.28m ATD)	18th-century to modern. Worked animal bone
[535] - Brick sewer/culvert built with shallow frogged red and yellow London stock bricks. 8.89m OD (108.89m ATD)	Victorian Bricks: 1830 to 1900/1950.
[328] - Modern cut to access the Victorian sewer, which truncates all the archaeology between the surface and the sewer. 11.29m OD (111.29m ATD)	c 20th-century – cut through a late 19th or 20th-century ceramic drain pipe.

Interpretation and summary

At the base of the trench, weathered, possibly alluvial, natural bands of gravel and clays ([719], [718] and [717]) were observed overlying undisturbed natural terrace gravels [720], which overlay natural London Clay [522].

Above these layers were two Roman dump layers ([715] and [712]) which contained disarticulated human bone fragments, as well as Roman pottery and CBM. These early Roman layers were cut by a large, approximately circular, pit [713] (see Photo 9), which contained large amounts of Roman material, including leather fragments. Above this, a build up of clay [711] could indicate short period of inactivity. Truncating this, the eastern side of a large ditch [710], aligned north-south, cut this earlier pit at the west end of the trench (see Photo 9).

Above this, a heavily organic waterlain or semi-terrestrial deposit [533], including well-preserved leather and metal finds. Overlaying this layer were accumulated medieval to early post-medieval dump layers [507] and [493]. Layer [493] (see Photo 8) is part of a layer deliberately laid down across the whole site to provide stable ground for consolidation and the establishment of the cemetery (also including layers [650], [211] and [277] in Trenches 2, 7 and 13, respectively, see Photo 15, Photo 16, and Photo 18), although it is possible [507] may also be part of this event.

Within this trench, 64 articulated burials, mostly found in coffins, were identified and recorded, cut into cemetery soil [492]. The burials were arranged in parallel rows and in vertical stacks, albeit with frequent intercutting and re-positioning.

The cemetery was truncated by post-medieval features, including several robber cuts ([324] and [335]), brick buildings with an associated floor ([325], [332], [330] and [329]) and by a brick drain [321] (see Photo 5).



Photo 5: Trench 1 - Post-medieval brick structures, including wall [325] (left), drain [321] (centre to centre right), wall [332] (top), floor [329] (centre bottom) (looking east).



Photo 6: Trench 1 - Re-used masonry fragments from the foundation [431] of post-medieval brick wall [332] (seen here cleaned and not in situ), including millstones and Portland stone architectural elements.



Photo 7: Trench 1- Bead necklace ([349], <171>), from the neck of a burial of a child aged 1 to 3 years (found scattered and seen here reassembled)(see 18.6).



Photo 8: Trench 1 - Base of grave cuts, cutting layer [493](looking south-west).



Photo 9: Trench 1 - Ditch cut [710] (dark grey/black), cutting pit [713] (grey fills) which truncates dump deposits [712] and [715] (orange deposits in the foreground). The Roman deposits are cut by Sewer [535] (bottom right) (looking south-west).

8.2.2 Trench 1a (Figure 1 and Figure 11)



Photo 10: Trench 1a – Gas pipe (right) and telecommunication cables (white pipes), with a deeper utility trench (ceramic pipes) truncating the south half of the trench (centre and left)(looking west).

Originally designated as Trench 1, this trench was abandoned shortly after it was broken out. Excavation was not viable due to the number of services which restricted access (right in Photo 10). The archaeology was not reached within this trench, although *in situ* burials were noted with the south-facing section of a modern truncation in the southern part of the trench.

8.2.3 Trench 2



Photo 11: Trench 2 - Skeletons [616] (left) and [622] (right), with traces of wood from coffins (north at top).

Trench 2 (Figure 1, Figure 2, Figure 3, Figure 4, Figure 6 and Figure 8)	
Location	Centre and south of the site, and immediately north of the pavement
Dimensions	2.83m wide (north to south) x 6.45m long (east to west) x between 5.63m deep
London Survey grid coordinates	83398 36285
OS National grid coordinates	533049 181601
Modern Ground Level	Road surface at 12.29m OD (112.29m ATD)
Modern subsurface deposits	Road surface 100mm thick, over concrete 500mm thick, above crushed concrete and other modern material 600mm thick.

Level of base of archaeological deposits observed and/or base of trench	<p>Limit of excavation:</p> <p>Within the whole trench - 7.76m OD (107.76m ATD)</p> <p>Within a <i>sondage</i> - 6.66m OD (106.66m ATD).</p> <p>Within auger holes – 7.25m OD to 6.44m OD (107.25m ATD to 106.44m ATD).</p>
Natural observed	<p>[706] – Natural terrace gravels. 7.25m OD (107.25m ATD).</p> <p>Gravels overlain by [705] – Archaeologically sterile, weathered natural clay. 7.95m OD (107.95m ATD).</p>
Extent of modern truncation/overburden	Approximately 1m to >5.5m deep
Archaeological remains	Dating Evidence, Finds, and Samples
[704] – A dump layer of red brown mixed brickearth. 8.07m OD (108.07m ATD).	Roman pottery AD 120 to 160.
[703] – A probable ground surface. Green grey gravel with sandy clay silt. Very compacted at the top - 8.25m OD (108.25m ATD).	Roman pottery. A medium-sized assemblage (65 sherds), dated AD 120 to 160. Mostly composed of oxidised coarse wares and samian.
[702] – Yellow grey silty clay dump layer with demolition material. 8.40m OD (108.40m ATD).	Contained Roman material including pottery AD 150 to 200, CBM (Tegula, imbrex, flue tile) AD 50 to 160, Opus signinum, painted wall plaster fragments, and daub.
[699] – Light grey silty clay. 8.90m OD (108.90m ATD).	No datable finds.
[694] – Humic sticky silty clay. 9.09m OD (109.09m ATD).	Bulk sample {18}.
[698] – A linear feature (fill [697]) seen on the north edge of the trench. Possibly a ditch. 9.03m OD (109.03m ATD).	[697] – Pottery AD 120 to 160, CBM (Tegula) AD 50 to 160, and animal bone. Bulk sample {20} taken of fill [697].
[701] - Pit with fill [700], which truncated an unidentified shallow cut feature [696] and it's fill [695]. 9.06m OD (109.06m ATD).	[700] - Pottery AD 100 to 140 and building material AD 120 to 250. Bulk sample {19} taken of fill [695]. No finds from [695].
[693] – Mixed dump deposit of dark black brown clay silt, with frequent gravel, and animal bone fragments. 9.42m OD (109.42m ATD).	Pottery – 1480 to 1550. CBM – 1350 to 1480.

[651] - Silty dump layer. 10.11m OD (110.11m ATD)	Pottery – Residual Roman, medieval 1270 to 1400, post-medieval 1580 to 1600. BM – 1480 to 1600.
[650] - Dump layer of light grey brown sandy silt and building material, chalk fragments, oyster shells, and charcoal flecks. 10.42m OD (110.42m ATD).	Pottery – Provisionally late medieval to 16th-century.
[390] - Cemetery soil cut by numerous burials. Contained significant amounts of residual disarticulated human bone.	Dated to within the use of the cemetery (1568 to mid 18th-century). Clay Tobacco Pipe – 1730 to 1760.
Sixty-six articulated burials, mostly found with the remains of coffins, were identified and recorded. Between 11.19m OD and 9.83m OD (111.19m and 109.83m ATD).	No datable finds directly associated with any of the burials.
[494] – Probable wall foundation, made of re-used masonry.	Re-used masonry fragments, including a gravestone, c 18th-century.
[414] – The truncated base of a red brick wall.	Brick – AD 1666 to 1900
[413] – The truncated base of a red brick wall.	Brick – AD 1666 to 1900
Brick sewer [535], built with shallow frogged red and yellow London stock bricks. As seen in Trench 1.	Victorian (mid to late 19th-century)
Interpretation and summary	
<p>Natural terrace gravel [706] was identified at the base of the trench, overlain by a weathered, possibly alluvial, natural clay deposit [705]. These natural deposits were overlain by a layer of disturbed, possibly re-deposited, brickearth [704] containing Roman material. This dump was covered by a very compacted dump of silty gravel [703], probably a ground surface, similar to the level and character of a gravel floor surface seen in Trench 13 [312] (see Photo 12 and Photo 19). This was sealed by further dump deposits [702], [699], and [694]. Several features cut these layers, including an unidentified shallow cut feature [696], itself truncated by a pit [701], and a linear feature [698] on the north edge of the trench which may have been the south edge of a ditch. These features also contained Roman material.</p> <p>The ground beneath the cemetery was made up of several thick dump layers ([693], [651] and [650]), laid down sometime between the Roman period and the 16th century. The last layer [650] is part of a layer found beneath the cemetery across the whole site (also including layers [493], [211], and [277], in Trenches 1, 7 and 13, respectively, see Photo 8, Photo 15, Photo 16, and Photo 18).</p>	

This trench contained 66 articulated burials within the cemetery horizon, all of which were found with coffins. The burials were arranged in parallel rows and in vertical stacks, albeit with frequent intercutting and re-positioning. Compared to other trenches, this trench may contain a high number of unusually positioned burials, including, five with the head positioned at the east and two prone burials (the body laid face down) (see Photo 11).

As in Trenches 1 and 7, the cemetery was truncated by post-medieval brick walls [413] and [414], of which only the lowest courses of the foundations survived. These walls were probably part of, or associated with, properties built on the site during and/or after the closure of the cemetery. Wall foundation [494] was constructed with re-used masonry fragments, including a gravestone (dated c 18th-century). These lay immediately below, and were truncated by, the modern overburden.

Finally, Victorian sewer [535], previously found in Trench 1, was found to continue east and also crossed this trench, again tunnelled through the archaeology 1m beneath the burial ground (see Photo 12 and Photo 13).



Photo 12: Trench 2 - Ground surface [703], truncated by sewer [535] (centre - partially removed)(looking west).



Photo 13: Trench 2 - Interior of Victorian brick sewer [535] (looking east).

8.2.4 Trench 7



Photo 14: Trench 7 - Brick structure [58], burials cut into cemetery soil [4], and a well preserved coffin [61] with stud decoration (right)(looking north-west).

Trench 7 (Figure 1, Figure 2, Figure 3, Figure 4, Figure 5 and Figure 9)	
Location	The approximate centre of the roadway at the west end of Liverpool Street.
Dimensions	2.2m wide (north to south) x 4.1m long (east to west) x between 3.96m and 4.94m deep
London Survey grid coordinates	83395 36289
OS National grid coordinates	533047 181605
Modern Ground Level	Road surface at 12.63m OD (112.63m ATD)
Modern subsurface deposits	Road surface 100mm thick, over concrete 500mm thick, above crush/rubble and other modern material 600mm thick.
Level of base of archaeological deposits observed and/or base of trench	Limit of excavation at 7.69m OD (107.69m ATD).
Natural observed	Not reached

Extent of modern truncation/overburden	Approximately 1m to >5m deep.
Archaeological remains	Dating Evidence, Finds, and Samples
[242] – Light yellow grey silt clay with moderate rounded stones, occasional charcoal and animal bone fragments. Not excavated and continued below base of trench at 7.69m OD (107.69m ATD).	No datable finds. Bulk sample {8} and monolith sample {5}.
[241] – Light blue grey sandy clay, with frequent charcoal flecks, moderate terrestrial and marine mollusc shells, and occasional CBM fragments. 8.12m OD (108.12m ATD).	Roman pottery – AD 120 to 160. Monolith samples {5} and {6}.
[231] - Dump layer of light brown grey silt clay, including terrestrial molluscs and oyster shell fragments and animal bone. Cut by ditch [229] to the south and ditch [240] to the north. 8.71m OD (108.71m ATD).	Roman Pottery - AD 120 to 160. Building material (flue tile, brick and tegula) - brick dated to AD 100 to 160. Bulk sample {7} and monolith samples {4} and {5}.
[240] - Ditch with fills [239] and [245]. 8.71m OD (108.71m ATD)	[239] – Pottery AD 150 to 300 and building material AD 120-250. Bulk samples {9} from [245] Bulk sample {3} and monolith sample {6} from [239]
[230] - Dump layer of light brown grey silt clay, including terrestrial shells, oyster shell fragments and animal bone. Cut by ditch [229] to the south. 8.83m OD (108.83m ATD).	Pottery – AD 120-160 CBM (tessera, tegula, brick), and daub. AD 120–250. Two bone skates were found within the top of this layer, immediately below [213].
[229] - Ditch with fills [214], [237] and [238]. 8.83m OD (108.83m ATD).	[214] - Pottery AD 150 to 400, and CBM (Brick and Tegula) – AD 120 to 250. Bulk sample {1} from [214] and {2} [237]. Monolith sample {4} through [214], [237], [238] and [231].
[213] – Dump layer of mid yellow grey silty clay, with occasional, oyster shells, animal bone, charcoal and mortar flecks. 9.74m OD (109.74m ATD).	Pottery – A medium sized group of 69 sherds dated to AD 140 to 160 (early Antonine period), which includes sherds of a selection of rarer amphora variants, black-burnished wares, and Highgate Wood ware C (HWC) vessels. CBM (Roman tegula and imbrex fragments), dated AD 140 to 300.

<p>[212] – Dump layer of mid brown grey clay silt, including occasional mortar flecks, moderate charcoal flecks, animal bone, building material and oyster shells. 10.35m OD (110.35m ATD)</p>	<p>Pottery – Roman (AD 270 to 400), medieval (1270 to 1500) and post-medieval (1550 to 1575) CBM (imbrex)(1480 to 1600)</p>
<p>[211] - Dump layer of light grey brown sandy silt, containing frequent building material, chalk fragments, animal bone, oyster shells, and mortar and charcoal flecks. 10.64m OD (110.64m ATD).</p>	<p>Pottery – medieval (1270 to 1350) and post-medieval (1550 to 1600). BM (Brick) – (1450 to 1700).</p>
<p>[4] – Cemetery soil cut by numerous burials. Contained significant amounts of residual disarticulated human bone. 11.22m OD (111.22m ATD).</p>	<p>Pottery – medieval (1340 to 1450) and post-medieval (1701 to 1711). Clay tobacco pipe – (1730 to 1760). CBM – 1630 to 1670.</p>
<p>Sixty-three articulated burials, mostly found with the remains of coffins, were identified and recorded cut into layer [4]. Between 11.22m OD and 10.09m OD (111.22m and 110.09m ATD).</p>	<p>No datable finds could be directly associated with individual burials. Dated to within the use of the cemetery (c 1568 to mid 18th-century).</p>
<p>[3] – Re-deposited cemetery soil and/or dumping, including animal bone and moderate amounts of disarticulated human bone. 11.5m OD (111.5m ATD).</p>	<p>Mid 18th-century. Pottery – medieval 1270 to 1350 and post-medieval 1720 to 1750. Worked bone and ivory waste – c 18th-century BM (brick and floor tile) –1680 to 1750. Clay tobacco pipe –1730 to 1760. Coin - unknown</p>
<p>[58] – The corner of a brick structure of uncertain form or function, the construction cut [59] cut layer [3] and cut burials below. 11.32m OD (111.32m ATD).</p>	<p>Brick sample taken (1666 to 1900).</p>
<p>[176] - Unidentified cut, possibly a pit, which truncated several burials below. 11.18m OD (111.18m ATD).</p>	<p>No finds.</p>

Interpretation and summary

The lowest deposits again may provide evidence of Roman extra-mural land management, and be deliberate reclamation or consolidation dumps ([231], [241] and [242]).

Above this were two Roman drainage ditches, the later [229] seemingly replacing the earlier [240] (see Photo 17). This would appear to be an escalation of earlier attempts at land management, with the provision of drainage instead of, or possibly along side, dumping. These ditches may also relate to two phases of Roman features discovered in Trench 13, found at corresponding levels.

These features were sealed by further dump layers. The first of these [213] contained only Roman finds, while the later layers, [212] and [211], contained early post-medieval finds. It is likely that [211] (see Photo 15 and Photo 16) was part of a layer specifically laid down across the entire site to provide stable ground for the establishment of the cemetery (also including layers [493], [650], and [277] in Trenches 1, 2 and 13, respectively, see Photo 8, and Photo 18).

This trench contained 63 articulated burials. These burials were mostly found with the remains of coffins, except for a small number at the bottom of the sequence (see Photo 15). The burials were arranged in parallel rows and in vertical stacks, albeit with frequent intercutting and re-positioning.

Above the cemetery, this trench also contained the corner of a brick structure [58] (see Photo 14). Unfortunately, it can only be loosely dated to between the 17th and 19th-century, while its form and function also remain unclear. It may perhaps be a wall along a garden boundary, as seen on Horwood's map of 1799 (see Figure 14).



Photo 15: Trench 7 - The last burial [209] to be excavated, cut into layer [211]. This burial was without a coffin, like many at the base of the cemetery (south at top).



Photo 16: Trench 7 - The base of the cemetery and top of dump/consolidation layer [211], as cut by grave cuts (south at top).



Photo 17: Trench 7 - Ditch [229] (top) and ditch [240] (bottom) (south at bottom).

8.2.5 Trench 13



Photo 18: Trench 13 - Burials at the base of the cemetery sequence, cutting layer [277], including a possible mass grave cut [263] (top left), skeleton [268] and grave cut [269] (top right), skeleton [270] and grave cut [271] (middle right), and skeleton [272] and grave cut [273] (bottom). All are without coffins (north at top).

Trench 13 (Figure 1, Figure 3, Figure 4, Figure 5, Figure 6 and Figure 10)	
Location	North on Liverpool Street. Half in the roadway and half on the pavement.
Dimensions	This trench was originally intended to be 4.4m x 2.5m. However, the size of the trench was subsequently reduced (to the western half of the original area) in order to avoid services. Dimensions as excavated - 2.3m wide (north to south) x 2.16m long (east to west) x between 6.1m deep
London Survey grid coordinates	83403 36292
OS National grid coordinates	533054 181608

Modern Ground Level	Road surface between 12.76m OD and 12.85m (112.76m ATD and 112.85m ATD) Pavement between 12.92m OD and 13.07m OD (112.92m ATD and 113.07m ATD)
Modern subsurface deposits	Road surface 100mm thick, over concrete 500mm thick, above crushed concrete and other modern material 400mm thick.
Level of base of archaeological deposits observed and/or base of trench	Limit of excavation at 6.9m OD (106.9m ATD).
Natural observed	Natural clays [317] and [319] at 7.97m OD and 7.87m (107.97m and 107.87m ATD), respectively. Natural orange gravel [320] at 6.9m OD (106.9m ATD).
Extent of modern truncation/overburden	Approximately 1m thick
Archaeological remains	Dating Evidence, Finds, and Samples
[313] – possible dump layer of grey yellow gravel clay. 8.43m OD (108.43m ATD)	No finds.
[312] – very firm metallated floor surface of grey yellow silt gravel. 8.50m OD (108.5m ATD).	No finds.
[311] – dump layer of green grey silt gravel, cut by [308]. 8.68m OD (108.68m ATD).	No finds.

<p>[310] - Ditch and its re-cut [308] (fills from top, for [310] – [309], [315], [316] and [318], for [308] - [306], [314] and [307]. 8.08m OD and 8.59m OD (108.08m and 108.59m ATD), respectively.</p>	<p>From ditch cut [310]:</p> <p>[309] – Pottery AD 140 to 160. Bulk and monolith samples taken.</p> <p>[315] – No finds. Bulk and monolith samples taken.</p> <p>[316] – No finds. Monolith sample taken.</p> <p>[318] – Pottery AD 120 to 160, including a near complete Highgate Wood ware C poppy-head beaker. Also, a residual disarticulated human femur.</p> <p>From ditch re-cut [308]:</p> <p>[306] – Roman Daub AD 50 to 400.</p> <p>[314] – No finds. Bulk and monolith samples taken.</p> <p>[307] – No finds.</p>
<p>[303]/[305] – levelling dump layer. 8.57m and 8.68m OD (108.57m and 108.68m ATD).</p>	<p>No finds.</p>
<p>[304] – possible floor surface. 8.69m OD (108.69m ATD).</p>	<p>No finds.</p>
<p>[302] - Beam slot (fill [301]). 8.65m OD (108.65m ATD).</p>	<p>[301] - Pottery (Roman) AD 150 to 200.</p>
<p>[300] - metallised firm grey green gravel floor surface, with moderate charcoal flecks and occasional oyster shells. 8.85m OD (108.85m ATD).</p>	<p>Pottery – 37 sherds, dated AD 150 to 250. CBM (Tegula, tessera, brick) AD 140 to 300.</p> <p>Coin (AD 228 to 231).</p> <p>Also contained nails, copper alloy metal fittings, a, double spiked loop and three iron styli. All Roman.</p>
<p>[299] – layer of organic dark grey black silt clay with sand lenses. 9.42m OD (109.42m ATD).</p>	<p>Pottery - AD 120 to 250.</p> <p>BM (Brick, tegula) - AD 50 to 160.</p>
<p>[298] – dump layer of mid black grey silt clay, with animal bone, oyster shells and moderate charcoal. 10.11m OD (110.11m ATD).</p>	<p>Pottery - 1550 to 1600.</p> <p>BM (tegula, imbrex, brick) - AD 50 to 80.</p> <p>Painted wall plaster fragments and daub AD 50 to 400.</p>
<p>[285] - Cut features (fill [284]) and [297] (fill [286]) – possible pits. 10.11m OD and 10.10m OD (110.11m and 110.10m ATD).</p>	<p>[284] – Pottery – AD 50 to 160 and Daub - AD 50 to 400.</p> <p>[286] – Pottery (Roman) – AD 90 to 170.</p>

<p>[283] – dark brown organic deposit, with occasional oyster shells and charcoal and frequent twigs and leaves. 10.11m OD (110.11m ATD).</p>	<p>Pottery - 1550 to 1600. Peg Tile - 1480 to 1800. Bulk sample taken.</p>
<p>[279] – dump layer of mid grey brown clay silt, with moderate charcoal and mortar flecks. 10.45m OD (110.45m ATD).</p>	<p>Pottery - 1550 to 1580.</p>
<p>[277] – dump layer of mid grey brown sandy silt, with occasional oyster shell, charcoal flecks and animal bone. 10.83m OD (110.83m ATD).</p>	<p>Pottery – 1550 to 1600. CBM (including floor tile) – 1250 to 1310.</p>
<p>[217] – Cemetery soil cut by numerous burials. Contained significant amounts of residual disarticulated human bone. 11.46m OD (111.46m ATD).</p>	<p>Pottery – 1748 to 1775. Glass and glass slag (16th to 18th-century).</p>
<p>22 articulated burials, mostly in coffins, were cut into layer [217]. A further 5 coffins were without skeletons, the skeletons either truncated or beyond the limits of the trench. Between 11.46m OD and 10.02m OD (111.46m and 110.02m ATD).</p>	<p>No datable finds directly associated with any of the burials. Dated to within the use of the cemetery (1568 to mid 18th-century).</p>
<p>[216] – Re-deposited cemetery soil and/or dumping, including moderate amounts of disarticulated human bone. 11.87m OD (111.87m ATD).</p>	<p>Pottery – 1700 to 1760. Clay tobacco pipe - 1730 to 1760. Worked animal bone – c 18th-century</p>

Interpretation and summary

Within this trench there is evidence for three phases of Roman activity, and possible occupation, c late 1st to mid 3rd-century, beginning immediately above the weathered natural clay. Firstly, a re-cut ditch ([310] and [308]) and an adjacent metallated gravel floor surface [312], then a timber building indicated by a beam slot [302] with possible associated internal floor surface [304](see Photo 21), and finally, an external metallated gravel yard surface [300] (see Photo 19). Fortunately, the final phase has a *terminus post quem* in the form of a silver denarius of Severus Alexander, dating AD 228 to 230, discovered on floor surface [300] (see Photo 20). The later two phases may also be associated with parallel ditches discovered in Trench 7, as they were found at corresponding levels.

These features were then sealed by post-Roman, probably medieval, waterlain flood deposits of organic rich silts and clay ([299] and [298]). These deposits were cut by unidentified features, possible pits [285] and [297], themselves then sealed by medieval or post-medieval dumps ([283] and [279]). The highest and final dump deposit was an early post-medieval reclamation dump [277] (see Photo 18), comprised mostly of building material. This layer was part of a layer specifically laid down to provide stable ground for the establishment of the cemetery, and is associated with layers [493], [650], and [211] in Trenches 1, 2 and 7, respectively

(see Photo 8, Photo 15 and Photo 16).

Within the cemetery [217], this trench contained 22 articulated burials, most of which were found with the remains of coffins, and a further 5 coffins without skeletons (the skeletons were either truncated or beyond the limits of the trench). The burials were arranged in parallel rows and in vertical stacks, albeit with frequent intercutting and re-positioning. As with other trenches, the cemetery was sealed by a layer of re-deposited cemetery soil and/or dumping [216], containing disarticulated human bone.



Photo 19: Trench 13 - Floor surface [300], looking north-west.



Photo 20: Trench 13 - Items discovered on the surface of floor [300]. The two top items are perhaps decorative fittings or fastenings. The coin is a silver denarius of the emperor Severus Alexander, dated c AD 228 to 231.



Photo 21: Trench 13 - Beam slot [302] (looking south-east).

8.3 General Watching Brief on trial pit in basement of Railway Tavern, Liverpool Street.

See Figure 1 for trench location



Photo 22: Railway Tavern Trial Trench - Foundations of the Railway Tavern with to 19th-century walls, disused machinery, and construction backfill (north at top)

Railway Tavern Trial Trench (Figure 1)	
Location	North-east in the basement of the Railway Tavern, Liverpool Street.
Dimensions	1.2m long (east to west) x 1.0m wide (north to south) x 1.0m deep
London Survey grid coordinates	83436.3 36267
OS National grid coordinates	533088.1 181583.5
Modern Ground Level (adjacent to pit)	10.32m OD (110.32m ATD)

Modern subsurface deposits	Floor surface and concrete 300–400mm thick. Rubble and soil (dark brown clay silt) backfill, with building material and rubbish (glass bottles) – 19th or 20th-century.
Level of base of archaeological deposits observed and/or base of trench	Base of trench: 9.32m OD (109.32m ATD)
Natural geology observed (truncated/not truncated ?)	Not reached
Extent of modern truncation	Whole area of trench, greater than 1m deep
Archaeological remains	Date
None	N/A
Trench interpretation and summary	
No archaeology survived within the limits of this trench and at this depth. All archaeology appears to have been completely truncated by the construction of the Railway Tavern in the 1870s.	

9 Assessment of results against original expectations and review of evaluation strategy

GLAAS guidelines (English Heritage, 1998) require an assessment of the success of the evaluation 'in order to illustrate what level of confidence can be placed on the information which will provide the basis of the mitigation strategy'. The recommendations suggest that there should be:

Assessment of results against original expectations (using criteria for assessing national importance of period, relative completeness, condition, rarity and group value)(Guidance Paper V, 4 7).

Department of the Environment guidelines for assessing the importance of individual monuments for possible Scheduling include the following criteria: *Period; Rarity; Documentation; Survival/Condition; Fragility/Vulnerability; Diversity; and Potential*. The guidelines stress that 'these criteria should not be regarded as definitive; rather they are indicators which contribute to a wider judgement based on the individual circumstances of a case'.

Corporation of London guidelines (CoL 2004) also require an 'Assessment of results against original expectations (using criteria for assessing national importance of; period, relative completeness, condition, rarity, and group value) and review of evaluation strategy.

9.1 Reliability of results

The results of the evaluation trenches are generally consistent and show similar archaeological sequences. The Broadgate Ticket Hall site has an area of approximately 1500m². The estimated total area of surviving cemetery is c 1000m².

The four evaluation trenches that were completely excavated covered an area of c 50m² (c 3.3% of the site and c 5% of the surviving cemetery), and those that were only excavated to the surface of the burials a further c 22m² (c 1.47% of the site and c 2.2% of the surviving cemetery). In total, the evaluation covered c 72m², approximately 4.8% of the area of the site and approximately 7.2% of the surviving cemetery.

It was not possible to evaluate a larger proportion of this site, as it lies in an active roadway (Liverpool Street), beneath which the dense services prevented some trenches being dug (proposed Trenches 1a (formerly 3), 4, 8, 10, 11 and 12), and forced others to be reduced in size (Trenches 1 and 13). Furthermore, the eastern extent of the site was not evaluated due to the proximity of LU assets.

The internal consistency of these results indicates that confidence can be placed in them as a representative sample of the Broadgate Ticket Hall site. However, the channel of the Roman and earlier Walbrook stream, and the hypothesised Roman road, were not located, nor was the western edge of the Bethlem burial ground present in the trenches. It therefore remains uncertain whether the stream and road will be present in the remainder of the site.

9.2 Research aims

The original research objectives were met as follows; information was recovered on:

- *Archaeological remains of Roman date* relating to extra-mural activity, although no burials have yet been found. Remains potentially date from the 1st to 3rd centuries;
- There were no *medieval remains associated with St Mary Bethlehem Hospital*;
- Medieval to post-medieval waterlain deposits with the potential for organic preservation and palaeoenvironmental remains were discovered.
- Post-medieval rubbish dumps and remains associated with the establishment of the cemetery and later reclamation and urbanisation of the area were found;
- Post-medieval burials within the known burial ground that lies beneath the carriage way of Liverpool Street in the Broadgate Ticket Hall area were excavated.

9.3 Assessment criteria

Criterion 1: period

The remains fall into the following groups,

- No prehistoric features
- Roman remains, including finds, structural features, drainage ditches, pits and dump layers.
- Ill-defined post-Roman to post-medieval dump and waterlain/flood deposits.
- Post-medieval burials within the known Bethlem burial ground (c 1568 to c 1720).
- 18th-century remains - mostly structural brick walls and foundations.
- 19th-century remains, including a brick sewer.

Criterion 2: rarity

While archaeological excavations within the extra-mural area north of the Roman city are not uncommon, this site offers an opportunity to investigate this precise locality, which is a relatively unexplored area situated north of the Roman city wall, and between known Roman burial grounds and roads. The selection of Roman pottery fabrics present is also slightly unusual for a City site (see 18.2).

Early 16th to 18th-century burials are a hitherto archaeologically underrepresented subject, and their excavation on this site will help further our knowledge and understanding of society and burial during a time when the City and population was greatly expanding.

Archaeological post-medieval worked animal bone waste is not common. The assemblage found within the cemetery soil and within the layers sealing the cemetery appears to be the largest group of this type from post-medieval London, and the total number of fragments recovered from the evaluation outnumbers all other post-medieval

bone-working assemblages from London recorded on the MOLA ORACLE database combined. It is likely to be of national interest (see 18.6).

Criterion 3: documentation

While the opening of the Bethlem burial ground is detailed in John Stow's Survey of London, the majority of documentation only survives from the 17th-century and later. The modern Bethlem Royal Hospital does not hold detailed information concerning the burial ground. However, it does hold a range of administration records, which include the admissions register from 1683 (after the hospital had moved to Moorgate) and the minutes of the court of Governors. Unfortunately, much of the other material dates from the 18th and 19th centuries, after the period of use of the Broadgate Ticket Hall site.

The burial ground was established for use by initially the parish of St Botolph's without Bishopsgate and also as an 'overflow' for all other City parishes. Thus, useful information may be contained within the individual parish burial registers. References to burials within the site are known, for example, in St Botolph's without Bishopsgate burial register 1558 to 1657.

The cemetery is drawn on several plans and maps from the late 16th to 18th-century. After the closure of the cemetery, 18th-century plans and maps refer to individual structures within the site and their ownership. In both cases, contemporary drawings can be scaled and compared with excavated remains.

The ground within the Crossrail Broadgate Ticket Hall worksite is likely to contain the last untruncated remains from within the original footprint of the cemetery. Given the absence of detailed historical records, this makes these finite remains an even more important and valuable archaeological resource. Excavation during the Crossrail works will allow an opportunity for full archaeological investigation.

Criterion 4: group value

The Roman extra-mural activity can be compared, and contrasted, with that seen in Crossrail fieldwork at Finsbury Circus, Moorgate, and Blomfield Street, as well as a large number of earlier archaeological sites in the area, notably near by Finsbury Circus, Eldon Street (BSP9 and ENS03), New Broad Street (NEB87) and Riverplate House (RIV87). This will help to characterise the varied activities being conducted in the area less than 150m from the City wall.

The remains of the Bethlem burial ground not only have obvious group value with those excavated from the same cemetery immediately north (LSS85), but also with other post-medieval burial grounds, such as Cross Bones, Red Cross Way (REW92), St Botolph, Billingsgate (BIG82) and St Brides Lower Cemetery, 75-82 Farringdon Street (FAO90). This evaluation may be compared and contrasted to these other investigations to provide information about burial practices and populations across London and beyond.

The 18th and 19th-century remains add to a large corpus of such material from other fieldwork, helping to supplement historical records of occupation in this area.

Criterion 5: survival/condition

The major causes of truncation on this site include the modern road surface, underlying utilities, building and developments north and south of Liverpool Street (see 11.8)

Except for areas truncated by the two sewers, there is good survival of Roman remains, (which included dump layers in all trenches, ditches in Trenches 1, 2 and 7, a pit in Trench 1, ground/ floor surfaces in Trenches 2 and 13, structural remains in Trench 13). These deposits and features did yield significant individual finds, including well preserved leather and metal items, such as shoes and a coin.

While these trenches have shown some modern truncation from above, the majority of the Bethlem burial ground also survives intact. Furthermore, the majority of skeletons have good levels of bone preservation, and coffin survival ranges from poor to good.

Post-cemetery 18th-century remains are largely structural and survive in places to just above foundation level. Deep features such as wells and cess pits may exist elsewhere on site but were not exposed during the evaluation. In addition, 18th-century finds were recovered from consolidation dumps sealing the burial ground, including important worked animal bone and industrial glass waste. In particular, the bone waste was well preserved.

Criterion 6: fragility

Most of the archaeological deposits seen in the evaluation are of similar vulnerability to the majority of archaeological remains seen in central London, but the *in situ* burials are inherently more vulnerable to disturbance.

Criterion 7: diversity

The site sequence possesses a variety of features and periods. The Roman remains represent a building, land reclamation, drainage, and potentially burials in the surrounding area which may extend to the site. The medieval to post-medieval marsh and reclamation dumps represent more consistent activity across the evaluated area. Sealing the sequence is the post-medieval burial ground extending across the site, and fragmented remains of 17th to 18th-century buildings, possibly a mixture of domestic and commercial properties.

Criterion 8: potential

No pre-Roman remains have yet been found. Thus, the potential for prehistoric activity remains low. Any remains are likely to be limited to stray finds and sporadic truncated features.

The potential for further Roman remains is very high. The site represents a rare opportunity to explore extra-mural Roman activity within this area, and to broaden our knowledge of Roman life during the Roman period. Most of the features discovered so far, such as drainage ditches and pits, have yet to be fully exposed and understood. In addition, one building has already been discovered in the north of the site, where a beam slot and ground surface were found (See Trench 13 - 8.2.5), and this may not be an isolated structure. Furthermore, while no *in situ* burials have been discovered, there is still a moderate potential for them. Several possible *ex situ* funerary goods have been

found on site as well as disarticulated human bone (see 18.2 and 18.7). Significant burial grounds are known of within the immediate area, west, east and south, as well as the occasional isolated burial.

The site also has a high potential to contribute to the understanding of an important post-medieval cemetery, made even more significant by its association with the Hospital of St Mary Bethlehem (Bedlam). As a hitherto archaeologically underrepresented subject, the excavation of these early 16th to 18th-century burials will help further our knowledge and understanding of society and burial during a time when the city and population was greatly expanding. Valuable comparisons are likely to be drawn with contemporary assemblages in London and nationwide. In addition, analysis may also reveal new information on burial practices of this period, for example the positioning of burials, zoning and general cemetery management. While the preservation of coffins and coffin furniture was generally poor, there were occasional examples of moderate preservation, which could also offer important insights into the burial customs of the period.

10 Statement of potential archaeology

The watching brief and evaluation has demonstrated the following:

10.1 Known remains, demonstrated to be present on the site:

- Roman remains, including land reclamation, ditches, pits, ground and floor surfaces, and buildings, indicated by a possible beam slot;
- Reclamation and refuse dumps from the medieval to early post-medieval period;
- Post-medieval remains in the form of both disarticulated human remains and *in situ* burials relating to the Bethlehem hospital burial ground;
- Post-medieval urbanisation and development, for example 18th-century terraced housing, including foundations, occupation/clearance deposits;

10.2 Potential for further remains:

- High potential for post-medieval remains in the form of both disarticulated human remains and *in situ* burials relating to the Bethlehem hospital burial ground within the carriageway of Liverpool Street, and the later post-medieval urbanisation of the area;
- High potential for Roman remains (possibly in the form of land reclamation, road(s) and burial);
- Moderate potential for quarrying from the medieval period;
- Low potential for archaeological remains of Saxon date, owing to the presence of the Moorfields Marsh;
- Low potential for prehistoric activity, which is likely to be limited to stray finds and sporadic truncated features.

11 Conclusions

11.1 Geology

London clay [522] was reached only in Trench 1, at 7.01m OD (107.01m ATD), while natural Thames Terrace gravels were reached in Trenches 1, 2 and 13 ([720] at 7.32m OD (107.32m ATD), [706] at 7.25m OD (107.25m ATD), and [320] at 6.90m OD (106.9m ATD), respectively). This would seem to suggest that there is little change in the level of natural terrace gravel west to east across the south of the site, between Trenches 1 and 2, but a slight drop toward the north, in Trench 13. This appears to contradict previous expectations of a general downward slope toward the predicted location of the River Walbrook in the west (see 5). However, this may indicate that the course of the Walbrook lay further west than previously expected, perhaps even outside the site. Alternatively, these results may represent nothing more than natural localised undulation of gravel deposits. Unfortunately, it is impossible to come to any decisive conclusions from this data, given the limited areas and locations seen in evaluation.

Terrace gravel was overlain by possible alluvial 'weathered' natural deposits of clay, interspersed with occasional bands of gravel ([317], [319], [705], [719], [718] and [717]), which showed signs of root action and bioturbation. These deposits appeared to be archaeologically sterile and devoid of any anthropogenic disturbance. No stream channels belonging to the historic River Walbrook were found.

The expected truncation and disturbance of the brickearth on this site by Roman activity appears to have been confirmed. Brickearth was found in Trench 2 but only survived as a 120mm thick weathered layer [705] overlaying natural gravel [706], which was sealed by a heavily disturbed re-deposit of brickearth [704] at 8.07m OD (108.07m ATD), containing Roman finds. No brickearth was found in either Trench 1 or 13, where Roman dumps [716] and [313] overlay natural gravels [717] and clay [317] in Trenches 1 and 13, respectively.

11.2 Prehistoric remains

No prehistoric remains were found within the evaluation trenches. If originally present, any pre-historic features or deposits must have been entirely truncated by later deep features, such as the Roman pits and drainage channels or the two known Victorian sewers. However, there remains a low potential for prehistoric features or deposits in the areas of the site not seen in evaluation.

11.3 Roman remains

(see Figure 4, Figure 5 and Figure 6)

The Roman archaeology was found at a fairly consistent level across the site (at 108.85m ATD (8.85m OD)(c 5m bGL)) and was approximately 1m thick. Roman features included dump layers, four east to west aligned ditches (see Photo 17), one north to south aligned ditch (see Photo 9), a possible beam slot (see Photo 21), floor/ground

surfaces (see Photo 12 and Photo 19) and pits. Provisional dating places Roman activity within this area from the 1st century to the 3rd century AD.

Despite the site's location being within the general area of the northern cemetery of the Roman City, no *in situ* Roman burials have yet been discovered. However, several finds have been found which are of types commonly associated with graves, including an almost complete poppy-head beaker from context [318], and a fragment of a late Roman copper-alloy bracelet <218>, [707] with a notched zigzag pattern decoration (late 3rd or 4th-century)(see 18.2 and 18.6). In addition, several disarticulated human bones were found in Roman contexts ([318], [715] and [716])(see 18.7). It is likely the bone and finds represent residual material washed along drainage channels from nearby burials.

Evidence of Roman extra-mural land management is clear. The Roman sequence begins with deliberate reclamation or consolidation dumps. These layers were then cut by the drainage ditches, which were perhaps an escalation of earlier attempts at land management, with the provision of drainage instead of dumping, designed to keep the area dry by directing and draining water away westward toward the Walbrook. Environmental samples from these ditches show large assemblages of aquatic plants and invertebrates, mainly from aquatic and wetland habitats, which indicate that the ditches were water-filled for much of the year (see 18.10).

Evidence of buildings and ground/floor surfaces may be the first indications possible of industrial activity or domestic occupation within the area, and, therefore, explain the efforts to kept the land dry at this time. A coin, nails, copper alloy metal fittings, a double spiked loop and three iron styli were all found on floor surface [300] in Trench 13. Moreover, samples from re-cut ditch ([310] and [308]) in Trench 13 indicates agricultural and industrial activities taking place on or near the site, including evidence of stabling waste (see 18.10).

11.3.1 Provisional Phasing

The current evidence is not sufficient to provide more than tentative provisional phasing across the evaluation site. Unfortunately, the size and localised nature of the evaluation trenches, and the dating evidence (which currently appears to have much residual pottery of mid first to mid second-century date), currently limit site wide interpretations. However, a basic comparison of trench sections tentatively suggests potential associations (see Figure 4, Figure 5 and Figure 6), based on corresponding sequences, dating and levels. However, until further excavation is conducted across the whole site, providing further datable finds and linking stratigraphic information, it will not possible to be confident how the features in each trench relate to each other. For example, the course of the ditches suggest that some may be contemporary and potentially connected. However, the ditches may be sequential, representing a process of silting/backfilling followed by re-cutting and re-positioning.

Provisional Phase	Tr 1	Tr 2	Tr 7	Tr 13
1st to early 2nd century AD ?	Dump layers [716](pot AD 120–150), [715] (pot 140–160) and [712] with disarticulated human bone. Cut by large pit [713] (pot 140–160).	?Re-deposited, brickearth [704] (pot 120–160). Overlain by gravel surface [703] (pot 120–160).	Reclamation/consolidation dumps [231] (pot 120–160), [241] (pot 120–160) & [242]	Ditch [310] & re-cut [308]. Adjacent gravel surface [312].
2nd century AD ?	<i>Build up of clay</i> [711]. Large N-S ditch [710] (pot 120–160).	Dump deposits [702] (pot 150–200), [699], and [694]	Drainage ditch [240] (pot 150–300). Later dumping [230] (pot 120–160).	<i>Build up of clay</i> [303/305]. Cut by a beam slot [302] (pot 150–300). Overlain by gravel surface [304].
3rd century AD ?	None	<i>Shallow cut feature</i> [696] etc. <i>Truncated by pit</i> [701], and ?ditch [698] (pot 120–160).	Later drainage ditch [229] (pot 150–400; CBM 120–250). Sealed by dump layer [213] (pot 140–160; CBM 140–300).	Gravel surface [300] (coin 228–230; Pot 150–250; CBM 140–300)

Table 3 Provisional Phasing of selected features
(only significant spot dates shown)

11.3.1.1 Explanation

In Trench 1 there is evidence of several phases. Two Roman dump layers ([715] and [712]) overlay natural and contained disarticulated human bone fragments, as well as Roman pottery and CBM. These early Roman layers were cut by a large, approximately circular, pit [713] (see Photo 9), which contained large amounts of Roman material, including leather fragments. Above this, a build up of clay [711] could indicate short period of inactivity. Finally, the eastern side of a large ditch [710], aligned north-south, truncated [711] at the west end of the trench.

The natural deposits in Trench 2 were overlain by a layer of disturbed, possibly re-deposited, brickearth [704] containing Roman material. This dump was overlain by gravel floor surface [703] (see Photo 12). This was sealed by dump deposits [702], [699], and [694]. Several features cut these layers, including an unidentified shallow cut feature [696], itself truncated by a pit [701], and possible ditch [698]. These cut features also contained Roman material.

Natural was not reached in Trench 7, however, the lowest deposits may be deliberate Roman reclamation or consolidation dumps ([231], [241] and [242]). Above this were two Roman drainage ditches, the later [229] seemingly replacing the earlier [240] (see Photo 17). These features were sealed by dump layer [213], which contained only Roman finds.

Within Trench 13 there is evidence for at least three phases of Roman activity, c late 1st to mid 3rd-century, beginning immediately above the weathered natural clay. Firstly, a re-cut ditch ([310] and re-cut [308]), the initial ditch [310] associated with adjacent metalled gravel floor surface [312]. Above this, a build up of clay [303/305] could indicate short period of inactivity, before it is cut by a beam slot [302] and overlain by gravel floor surface [304] (see Photo 21). Finally, (Figure 6). An external metalled gravel yard surface [300] (see Photo 19 and Figure 4) is at the top of the Roman sequence. Fortunately, this floor surface has a *terminus post quem* in the form of a silver denarius of Severus Alexander, dating AD 228 to 230 (see Photo 20).

11.4 Medieval remains

The post-Roman period on this site may be characterised as one of abandonment. No Saxon or medieval features or structures were identified. In particular, no medieval remains associated with St Mary Bethlehem Hospital have been found.

In Trenches 1, 2, 7 and 13, deposits [533] (109.33m ATD), [693] (109.42m ATD), [212] (110.35m ATD), and [298] (110.11m ATD), respectively, are the first deposits to contain post-Roman finds. However, while deposits [213] (beneath [212])(109.74m ATD) and [299] (beneath [298])(109.42m ATD) from Trenches 7 and 13 respectively, contained only Roman finds, this material may prove to be residual. This is supported by the discovery of potentially Saxon to medieval bone skates (<70> and <71>) immediately below [213] in Trench 7 at c 8.90m OD (108.90m ATD). The most usual range for dated examples of bone skates from England is the 8th to 13th-century (see 18.6).

Post-Roman deposits all contained a very high organic content (see 18.8), with medieval to early post-medieval finds and refuse ([533], [693], [212] and [298]). The high organic nature of these deposits suggest that the land of the post-Roman to the post-medieval period was marshy semi-terrestrial ground, with seasonal flooding and ponds or pooling, which was frequently used as waste ground. Interestingly, there were no cut features, such as drains, dated to after the Roman period. The apparent absence of drainage supports the hypothesis that the land remained waterlogged or at least semi-terrestrial through to the end of the medieval period. However, while the ground may have been seasonally wet (with possible skating in the winter, see above), these deposits do not directly parallel the very distinctive peaty marsh deposits found during recent evaluations at Finsbury Circus (MOLA unpublished evaluation reports). It is possible that the edge of the true Moorfields Marsh may not have extend much beyond the eastern bank of the River Walbrook.

11.5 Post-medieval remains

(see Figure 3)

11.5.1 Pre-cemetery

Post-Roman deposits were sealed across the whole site by a rapidly-deposited post-medieval dump(s). A layer(s) including large amounts of rubbish and building material waste ([211], [277], [493] and [650], c 0.3 to 0.6m thick at 10.83m to 10.42m OD (110.83 to 110.42m ATD)(c 1.9 to 2m bGL)) which was deliberately laid down to raise and consolidate the ground, presumably, to prevent flooding and establish the cemetery in 1568/9 (see Photo 8, Photo 15, Photo 16, Photo 18). However, it seems likely that many of the underlying dump deposits ([283], [507], and [651]) may also belong to this event, as they can be dated by finds to a similar early post-medieval date. Of course, further excavation, by producing a larger finds assemblage and highlighting any intrusive or residual material, will help refine this dating and distinguish these consolidation deposits from the earlier post-Roman to medieval deposits. Deeper analysis of fieldwork results should allow a refinement of this sequence and a more precise dating, which should lead to a more thorough understanding of the post-Roman, reclamation of marsh during the late medieval to early post-medieval period.

11.5.2 Bethlehem Burial Ground

Burials were found between 11.52m OD to 9.46m OD (111.52m ATD to 109.46m ATD or c 1 to 2.8m bGL). Within the burial ground, a total of 244 *in situ* post-medieval burials were found, recorded and, where required, the skeletons exhumed (see Photo 2, Photo 3, Photo 11, Photo 15 and Photo 18). A total of 215 *in situ* articulated burials were exhumed: 64 burials from Trench 1, 66 from Trench 2, 63 from Trench 7 and 22 from Trench 13 (see 18.7 and Table 4). In addition, the analysis of the disarticulated bone produced estimates for minimum numbers of individuals (MNI) of 127 from Trench 1, 261 from Trench 2, 26 from Trench 6, 158 from Trench 7, 26 from Trench 9 and 48 from Trench 13. This provided a total MNI of 646 individuals from the total disarticulated bone (see 18.7).

11.5.2.1 Burial practice

The earliest burials were without coffins and were relatively few in number. These burials were most likely in shrouds. Later burial practice appears to be markedly different, with wooden coffins, arranged in distinct rows and stacks, aligned, according to convention, west to east. Stacks rarely included more than three burials. No burial vaults or brick lined graves were found, however, Trench 13 contained a possible mass pit burial (see Photo 18).

One burial [349] did include a bead rosary or necklace, discovered *in situ* with the skeleton of an infant (see Photo 7 and 18.5). This is notable because post-medieval burials very rarely contain grave goods of any kind.

11.5.2.2 Coffins

All coffins were the standard 'kite' shape (widest around the shoulder area and tapering to both head and feet). Coffin survival was generally poor to occasionally moderate. The majority of coffins appear to have been of plain wood, which in most cases survived as little more than fibrous traces, and in the better preserved examples ([61] in Trench 7

and [281] in Trench 13) survived in larger relatively solid fragments. The best preserved coffins also included remains of decoration and fittings, including, for example, stud work consisting of single or double rows of upholstery pins around the edges (see Photo 14 of coffin [61]). However, no textiles survived from coffin coverings or linings. Many of the coffins burials also had grips and coffin plates. Unfortunately, while the remains were sufficient to acknowledge the presence of coffin plates, all were too badly corroded and fragmented to read any inscriptions or identify recognisable forms. Similarly, coffin grips had not survived well enough to be comparable to known types.

11.5.2.3 Cemetery management

The intercutting of graves was frequent, and overcrowding meant that the end of graves in one row overlapped with those in the next. While the basic sequence of burial was discernable, intercutting left many skeletons badly truncated, with displaced bone and coffin fragments reburied in the backfill of new graves. Unfortunately, as a consequence of the intense intercutting, identifying individual grave cuts and fills was impossible until lower in the sequence, where they cut the distinctive pre-cemetery layers. The evaluation did not find any cemetery features, such as the boundary wall or internal paths.

A charnel pit [6] was found at the top of the burial sequence in unexcavated Trench 9 (see Photo 3). The pit may have been part of a later strategy to deal with ever-increasing amounts of *ex situ* human bone. Alternatively, the pit may relate to the disturbance of the cemetery during the construction of post-cemetery buildings (see 11.6).

There is little evidence of plots or patterns of zoning, based on, for example, age, gender, or social status. However, Trench 1 (in the west of the site) did contain a greater percentage of sub-adults to adults, particularly in the 1 month to 6 years range, which accounted for 21.9% of the burials (see 18.7). Of course, analysis of spatial patterning within the cemetery is limited at this point by the size and isolated nature of the trenches. Genuine patterns, if they exist, may only be discernable after full excavation.

Trench No	<i>In situ</i> bodies	Disarticulated - minimum number of individuals (MNI)	Notes	Trench - Length/m	Trench - Width/m	Trench - Depth/m	Level at top of <i>in situ</i> burials/m ATD	Level at base of <i>in situ</i> burials/m ATD	Volume burials/m ³	Density of <i>in situ</i> burials/bodies per m ³	Thickness of burials/m
T1	64	127		4.31	2.96	5.16	110.88	109.46	18.12	3.53	1.42
T2	66	261		6.45	2.83	5.63	111.19	109.83	24.83	2.66	1.36
T5	0	0	No burials or bone	3.41	2.33	4.90					
T6	19	26	Burials identified at surface only	4.24	2.35	1.41	111.52				
T7	63	158	9 burials identified at surface	4.10	2.20	4.95	111.22	110.09	10.19	6.18	1.13
T9	7	26	Burials identified at surface only	2.15	2.15	1.81	111.12				
T13	22	48		2.30	2.15	6.10	111.46	110.02	7.12	3.09	1.44
Totals	241	646									
Averages							111.23	109.85		3.87	1.34
= Fully excavated evaluation trenches											

Table 4: Burial ground data

11.6 17th to 18th-century remains

(see Figure 2, Figure 12, Figure 13 and Figure 14)

Burial within the cemetery certainly continued to at least 1714, which is the date of the latest datable burial (Jenkes family vault (LSS85)). Unfortunately, the precise date of the burial ground's closure is still unknown. It remains unclear if the closure of the cemetery was swift or a more gradual encroachment involving decommissioning and development. Ogilby and Morgan's map of 1676 (see Figure 12) is the first known map to show a building within the burial ground area, in south-west corner of the site. There is still a building in this corner of the cemetery in Rocque's map of 1746 (see Figure 13). However, Rocque's map is the first known map to also show buildings within and around the majority of the cemetery's remaining periphery, along the north and east sides of the cemetery. Of course, at this point, it seems unlikely that burial would continued between the buildings, with properties in such close proximity. However, there is no clear evidence to confirm this until Horwood's map of 1799, which again shows these properties but also identifies the area across the centre of the cemetery as 'gardens' and shows the continuation of property boundary lines (see Figure 14). Thus, while it seems very likely the burial ground closed sometime in the 1720s or 1730s, it had certainly been completely abandoned as a cemetery by the late 18th-century.

The horizon immediately below the modern overburden and above the *in situ* burials (in Trenches 9, 7, 6, and 13 ([1], [3], [20], [216] - 11.87 to 11.50m OD (111.87 to 111.50m ATD)(c 0.9 to 1.2m bGL), respectively)), contained moderate amounts of disarticulated human bone, and is likely at least partially formed of burial cuts and their backfills. However, given the higher concentrations of building debris and refuse material, this horizon may have been subjected to post-cemetery dumping and disturbance, incorporating some re-deposited cemetery soil. Interestingly, this post-cemetery horizon contained worked animal bone and ivory waste, as well as glass slag waste. However, much of this material had also been worked into the cemetery horizon within grave fills, indicating that the site had become a place for dumping rubbish even before the burial ground closed. The post-medieval bone-working waste is of particular interest and offers excellent potential for exploring the post-medieval economy of the area and providing insights into post-medieval bone-working technology (see 18.6).

Brick structure [58] (Trench 7) was cut into post-cemetery deposit [3], while structures [321], [330], [332]/[431],[325], [413] and [414] (in Trenches 1 and 2) were truncated to a level were they directly cut the underlying cemetery horizon (see Photo 5 and Photo 14). The brick samples taken from these structures have been dated as 1666 to 1900, with the exception of [330], which has been dated 1451 to 1600. Given their stratigraphic position and brick dates, the majority of these structures are likely to be part of post-cemetery buildings, yard structures or boundaries, as seen on 18th-century maps (see above). However, if not reused, the bricks from wall [330], found in the south-west of the site, date the wall to contemporary with the use of the cemetery. This wall may be a fragment of an earlier initial 17th-century building, as first seen on Ogilby and Morgan's map of 1676 (see Figure 12). Of course, understanding these post-cemetery features is limited at this time by the isolated and limited nature of these investigations. Further excavation will reveal more of these walls and structures, and will most likely uncover additional features, which will help clarify how these walls relate to each other, their phasing and the nature of these properties.

11.7 19th-century remains

(see Figure 1)

The latest archaeological feature identified was a disused Victorian brick sewer or culvert [535]. This was tunnelled east to west across the whole site in an area c 2m high x 1.5m wide, at between approximately 9.00m to 7.00m OD (109.00m and 107.00m ATD)(c 3.5m bGL), through natural and the Roman to lower post-Roman levels of the archaeology (see Figure 8, Photo 4, Photo 12 and Photo 13). This structure was connected to later tunnelled ceramic drainage pipes (see Figure 7). The pipe are no longer active but, presumably, were once connected to former buildings along the south side of Liverpool Street. In addition, shafts, likely 20th-century in date, appear to have been tunnelled vertically down through the entire archaeological sequence in order to access this sewer. This sewer may have been rendered redundant by the construction of the Queen Victoria tunnel and thus superseded by the known sewer, which is still active a few metres deeper and to the north.

11.8 19th to 20th-century truncation

(see Figure 1, Figure 2 and Figure 11)

The evaluation has confirmed several major causes of truncation on this site, including:

- Along the southern edge of the site, the basements of the buildings, as seen in the Railway Tavern trial pit (see Photo 22), which suggests that the construction of the property in the late 19th-century has truncated all the archaeology in that area to at least a depth of 9.32m OD (109.32m ATD).
- The construction of the modern road and installation of utilities within the carriageway of Liverpool Street, which have disturbed archaeological deposits to at least the depth of 11.30m OD (111.3m ATD))(see Photo 5, Photo 10, and Photo 14) and, in many areas, deeper into the cemetery, for example, a depth of 1.9m bGL in Trench 13 (see Photo 18).
- An early 20th-century subterranean toilet block at the western end of the site, at the junction of Liverpool Street and Blomfield Street, which truncates to 8.17m OD (108.17m ATD/4.35m bGL) in an as yet undefined, but sizable, area (c >4m²)(see Photo 1). This structure is first seen on the 1913 OS map and last seen on the 1951 OS map. It does not appear on the 1963 OS map and had presumably been closed by this time.
- Two tunnelled c 19th-century brick sewers (one previously unknown) which span the entire length of the site, running west to east and parallel to the roadway. These have truncated medieval to Roman and natural deposits along their routes, between approximately 3.5m and 5m below the road surface. The higher, newly discovered, sewer [535] (see Figure 8, Photo 4, Photo 12 and Photo 13) is also connected to tunnelled pipes (see Figure 7), which rise to the surface toward the buildings on the south side of Liverpool Street. Several vertical shafts (c 20th-century) have also been dug to access the sewer, and have truncated through the entire archaeological sequence (see Figure 1 to Figure 3).
- A utility trench which completely truncates the burial ground and underlying archaeological deposits to more than 3m bGL and may run the entire length of

Liverpool Street parallel to and under the south curb line, as seen in Trench 1a and at the south edge of Trench 1 (see 7.3, Photo 10 and Figure 11).

Other causes of truncation, anticipated within the site but not encountered within the locations of the evaluation or watching brief trenches, included:

- The construction of the disused ticket hall and Queen Victoria Tunnel beneath the carriageway of Liverpool Street is likely to have disturbed archaeological remains at the eastern edge of the site.
- The Broad Street railway station and later Broadgate development, long the northern edge of the site. Significantly, this zone of truncation was not encountered within Trench 13, the northern most trench in the evaluation, which suggests the edge of this disturbance lays at the north of the northern Liverpool Street pavement, or beyond.

12 Recommendations for appropriate mitigation strategy

It is clear that the Roman archaeology on this site warrants significant further excavation. All of the features discovered so far have yet to be fully exposed and thereby understood. Moreover, there remains a high potential for further discoveries. Further excavation will help to define the nature of this extra-mural activity, the land management techniques used here, including, for example, the relationship and sequencing of the many drainage ditches which cross the site, and the reason for their presence. In addition, evidence for one building has already been discovered in the north of the site, where a beam slot and ground surface were found (see Trench 13, section 8.2.5). This may not be isolated. These features may be the first signs of greater industrial activity or domestic occupation within the immediate area. Indeed, the selection of Roman pottery fabrics found on this site is slightly unusual for a City site. Fine wares form a very high proportion of this small assemblage, and this may signify more activity within this area that was previously expected (see 18.2). Further excavation may also find the Walbrook river, the hypothesised Roman road, or perhaps associated activities such as revetment, road side buildings or burials (see 5.1).

Early 16th to 18th-century burials are a hitherto archaeologically underrepresented subject, and their continued excavation on this site will help further our knowledge and understanding of society and burial during a time when the city and population was greatly expanding. Valuable comparisons are likely to be drawn with contemporary assemblages in London and nationwide. The association with the Hospital of St Mary Bethlehem (Bedlam) also gives this site an unusual and much broader social significance. In addition, analysis may also reveal new information on burial practices of this period, for example the positioning of burials, zoning and general cemetery management. While the preservation of coffins and coffin furniture was generally poor, there were occasional examples of moderate preservation, which could also offer insights into the burial customs of the period. In addition, further excavation within the cemetery may produce further valuable information and discoveries, including finds, well-preserved coffins with readable name plates, as well as brick lined burials or vaults.

Further excavation is also likely to reveal more 17th to 18th-century post-cemetery brick structural remains, in particular, within the south-west corner of the site, where building

can be seen on maps from the late 17th-century onward. Other 18th-century finds discovered on the site also require further investigation. In particular, it would be valuable to learn more about the post-medieval worked animal bone waste found deposited within and across the entire the cemetery horizon and post-cemetery layers, which in itself is a rare archaeological resource and likely to be of national interest.

The Crossrail design archaeologist will produce recommendations for further work and refine the mitigation strategy for Crossrail works at Liverpool Street.

12.1 Revised and new objectives for further fieldwork

12.1.1 Roman

- Characterise and understand the extra-mural Roman activity and land use, including potential occupation in the form and date of any buildings, as well as the function and date of drainage features and how they relate to the Walbrook and Moorfields Marsh. Do these vary across the site ?
- Identify the location of the River Walbrook and its predecessors (or if it lies outside/west of the site), any crossing points (bridge, ford ?), and any waterlain deposits with the potential for organic preservation and palaeoenvironmental remains;
- Does the hypothesised Roman road cross the site and, if so, how does it relate to other Roman activity within the area ?
- Are there Roman burials within the site area, if so, how are they distributed in relation to cotemporary activity ?

12.1.2 Medieval and early 16th-century

- What is the character and extent/depth of the Moorfields Marsh in this area ? What do finds from within the marsh deposits indicted about activities taking place within the marsh, or in the surrounding area ?
- Characterise and date the sequence of medieval to post-medieval dumping and reclamation associated with the urbanisation of the area, in particular the land raising that pre-dates the burial ground;

12.1.3 Bethlehem cemetery

- Characterise and refine the sequence and dating of burials, in particular the date at which the cemetery went out of use;
- Characterise burial practice and identify any indications of organisation/management and zoning. In particular, is the higher proportion of sub-adults in Trench 1 reflected in the wider cemetery population; are there more multiple burial pits like that in Trench 13 ?
- Can grave stones/ledger slabs provide evidence which will identify individuals, and can these be correlated with documentary sources ?

- What is the date and taphonomy of deposition of the important worked bone assemblage? EG is it residual in the later deposits, or does it represent continued deposition over long periods? In particular, was it deposited during the use of the burial ground? What is the spatial and chronological division of the different types of bone artefact across the site? (see 18.6.2.3)

13 Publication and dissemination proposals

The watching brief and evaluation results will initially be disseminated via this report; the supporting site archive of finds and records (including digital data). Any publication proposals will be considered in relation to later fieldwork on this site, and also the wider context of archaeological potential and results within the Crossrail scheme.

14 Archive deposition

The site archive containing original records and finds will be stored temporarily with MOLA pending a future decision over the longer-term archive deposition and public access process for the wider Crossrail project.

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16 Acknowledgements

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17 NMR OASIS archaeological report form

17.1 OASIS ID: molas1-111282

Project details

Project name	Broadgate Ticket Hall
Short description of the project	Archaeological Evaluation and Watching Briefs carried out at the location of the Broadgate Ticket Hall, Liverpool Street, by the C257 Museum of London Archaeology (MOLA). Including a GWB on one trial pit, three evaluation trenches and four excavated evaluation trenches. Modern road surface over post-medieval (1569-c.1720) burial ground (c.11.5m OD to 9.70m OD), over post-Roman to early post-medieval dumps/consolidation and marsh deposits, over Roman deposits (c.8.85m OD).
Project dates	Start: 20-02-2010 End: 27-07-2011
Previous/future work	Yes / Yes
Any associated project reference codes	XSM10 - Site code LSS85 - Site code
Type of project	Field evaluation
Site status	Area of Archaeological Importance (AAI)
Current Land use	Transport and Utilities 1 - Highways and road transport
Monument type	SEWER Post-medieval
Monument type	CEMETERY Post-medieval
Monument type	DITCHES Roman
Monument type	BEAM SLOT Roman
Monument type	PITS Roman
Significant Finds	SKATE Early Medieval
Significant Finds	COIN Roman
Methods & techniques	'Environmental Sampling', 'Targeted Trenches', 'Test Pits'



Development type	Railway Infrastructure
Prompt	Crossrail Act
Position in the planning process	After full determination (e.g. As a condition)

Project location

Country	England
Site location	GREATER LONDON CITY OF LONDON CITY OF LONDON Liverpool Street (Broadgate)
Postcode	EC2M 7NH
Study area	750.00 Square metres
Site coordinates	0 0 533028 00 00 N 181610 00 00 E Point
Site coordinates	0 0 533054 00 00 N 181603 00 00 E Point
Height OD / Depth	Min: 6.44m Max: 7.32m

Project creators

Name of Organisation	MoL Archaeology
Project brief originator	Crossrail
Project design originator	Crossrail
Project director/manager	Nicholas Elsdon
Project director/manager	Elaine Eastbury
Project supervisor	Robert Hartle
Type of sponsor/funding body	Developer

Name of sponsor/funding body
Crossrail

Project archives

Physical Archive recipient	LAARC
Physical Contents	'Animal Bones','Ceramics','Environmental','Glass','Human Bones','Leather','Metal','Worked bone','Worked stone/lithics'
Digital Archive recipient	LAARC
Digital Contents	'Stratigraphic'
Digital Media available	'Images raster / digital photography','Survey','Text'
Paper Archive recipient	LAARC
Paper Contents	'Stratigraphic'
Paper Media available	'Context sheet','Correspondence','Diary','Drawing','Map','Matrices','Notebook - Excavation',' Research',' General Notes','Photograph','Plan','Report','Section','Survey ','Unpublished Text'

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	CENTRAL SECTION PROJECT FIELDWORK REPORT Archaeological Evaluation and Watching Brief Broadgate Ticket Hall - XSM10
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Date	2011
Issuer or publisher	Museum of London
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18 Appendices:

18.1 Building materials

Ian M Betts

Summary Note on Building Materials

A total of 130 fragments of building material were recovered from 34 contexts from XSM10. These comprise Roman, medieval and post-medieval ceramic building material, Roman wall plaster and daub and a post-medieval stone moulding.

The building material from XSM10 has been fully recorded and the information added to the Oracle database.

Listed below is a summary of the building material in each context:

Context	Fabric	Type	Context Date
[3]	2504, 2894	Floor tile	1680 to 1750
[3]	3067	Wall tile	
[4]	2196	Floor tile	c 1630 to 1670
[20]	3110	Stone moulding	1730 to 1800
[20]	3067	Wall tile	
[58]	3032	Brick	1666 to 1900
[211]	3046	Brick	1450 to 1700
[212]	2815	Imbrex	1480 to 1600
[212]	3046	Brick	
[212]	2271	Peg roofing	
[212]	2810, 2323, 2504, 3246	Floor tile	
[213]	3291	Tegula	AD 140 to 300
[213]	2453	Imbrex	
[214]	2459B	Brick	AD 120 to 250
[214]	2815	Tegula, brick	
[216]	2586, 2273	Peg roofing	1350 to 1390
[216]	2894	Floor tile	
[217]	2273	Peg roofing	1180 to 1480

[230]	2815	Tessera, tegula, brick	AD 120 to 250
[230]	2458B	Brick	
[230]	3102	Daub	
[231]	2815	Brick	AD 100 to 160
[231]	3058?	Flue tile	
[231]	2454	Tegula or brick	
[239]	2459B	Tegula	AD 120 to 250
[239]	2815	Tegula or brick, tessera	
[239]	3100	PWP	
[239]	3104	<i>Opus signinum</i>	
[277]	2199	Floor tile	1250 to 1310
[283]	2276	Peg roofing	1480 to 1800
[298]	2454	Tegula, imbrex, brick	AD 50 to 80
[298]	3102	Daub	
[298]	3100	PWP	
[299]	2815	Brick, tegula	AD 50 to 160
[300]	2815	Tegula, tessera, brick	AD 140 to 300
[300]	2453	Tegula	
[306]	3102	Daub	AD 50 to 400
[330]	3033	Brick	1450 to 1600
[332]	3032	Brick	1666 to 1900
[492]	2586	Peg roofing	1180 to 1480
[493]	2271	Peg roofing	1180 to 1480
[507]	2271	Peg roofing	1480 to 1600
[507]	2199, 3063	Floor tile	
[535]	3032, 3035	Brick	1830 to 1900/1950
[651]	2497, 2894, 3074	Floor tile	1450 to 1550
[651]	2271	Peg tile	
[651]	3046	Brick	
[651]	2276	Ridge tile	

[693]	1810, 2320	Floor tile	1350 to 1480
[697]	2815	Tegula	AD 50 to 160
[700]	2459B	Tegula	AD 120 to 250
[702]	2815	Tegula, imbrex, flue tile	AD 100 to 160
[702]	2454	Imbrex	
[702]	3104	Opus signinum	
[703]	2815	Brick, imbrex	AD 50 to 160
[703]	2454	Imbrex	
[707]	2815	Tegula	AD 50 to 160
[707]	3018?	?	
[714]	2815	Tegula, imbrex, brick	AD 50 to 160
[715]	2815	Tegula	AD 50 to 160
[715]	2454	Tessera	
[715]	3125	Tessera	

18.1.1 Roman

The majority of Roman building material comprises 1st to mid 2nd century roofing tile and brick from the London area (fabric group 2815) and north Kent (fabric 2454). There are also a few pieces of worn red tesserae, probably from a plain tessellated floor. Contexts [231] and [702]) also produced combed box-flue from a building, or buildings, with a hypocaust heating system. One ([231]) was made at an unknown tiliary outside London.

Later building activity on or near the site is represented by roofing tile and brick believe to be from a kiln site situated north-east of London (fabric 2459B) (contexts [214], [230], [239], [700]) and calcareous roofing tile imported in via the Thames from an unknown location (fabric 2453) (contexts [213], [300]) (Betts and Foot 1994, 33–4).

Other Roman building material includes *opus signinum* with a white plaster surface (contexts [239], [702]), daub and two pieces of painted wall plaster. One piece of plaster is plain red, while the other, although abraded, seems to show a border area in red, white and dark red (both from context [239]). The plain red plaster is of poor quality with the paint applied to a very uneven plaster surface. Also from the site is a solitary hard chalk tessera.

18.1.2 Medieval

There are a number of fragments of glazed peg tiles. These can only be given a general 1180 to 1480 date, but the presence of a more uniform glaze covering would suggest they are more likely to be 12th to 13th-century in date.

Three types of medieval glazed floor tiles are present. The earliest are London-made 'Westminster' tiles dating to around 1250 to 1310. The most significance is the tile from context [492] (<129>) which has part of an unpublished design. Another tile from the same group shows Betts (2002, 52) design W18 (context [507] <193>), whilst a further example (context [277]) is triangular in shape with a plain black glaze.

From contexts [3], [212], [216] and [651] are a total of seven decorated Penn floor tiles from the village of the same name in Buckinghamshire. These have Eames (1980) design types: 1827 (Hohler 1942, type P73), 2070 or 2071 (two tiles), 2334 (Hohler 1942, type P74) and 2388 (Hohler 1942, type P64). One tile has its surface removed by wear whilst a further tile ([651] <221>) has an unpublished design. These Penn tiles were probably brought into London during the period 1350 to 1380.

A plain brown glazed medieval Flemish floor tile was found in context [651] with nail holes visible in the two surviving corners. A green glazed Flemish tile was recovered from context [693]. Flemish tiles were probably used in London during the 15th-century when fresh supplies of 'Westminster' and Penn tiles were no longer available.

All these floor tile types probably originate from a parish church or monastic building. Vast number of Penn and 'Westminster' tiles in particular have been found associated with churches and monasteries in the London area.

Also of medieval date is a reused large red brick from context [330]. The brick, which measures 251 x 115–118 x 55–59mm, is similar in size to bricks recently discovered at Holywell Priory in north-east London. They are probably of 15th-century date.

18.1.3 Post-medieval

The post-medieval building material comprises predominantly London-made roofing tile (peg and ridge tile) and brick. Both pre-1666 (contexts [211], [212], [330]) and post-1666 bricks (contexts [58], [332], [535]) were collected. One brick from [535] has what appears to be a very unusual tree-shaped emblem in the base of the frog, possibly the mark of the individual brickyard.

Of probable 1480 to 1600 date are a number of plain dark green, light brown and yellow glazed Low Countries ('Flemish') floor tiles. Again these probably derive from either a parish church or a monastic building. Vast number of plain glazed Low Countries floor tiles flooded into London during the late 15th to 16th-century. This may be because there does not seem to have been any English floor tile manufactures within easy reach of London during this period.

Dated to around the mid 18th-century is a blue-on white tin-glazed floor tile ([4] <176>) with a slightly worn Tudor rose pattern, This tile is unusual in being only 10–11mm thick, suggesting it may have been intended to be used as walling, but was used as flooring instead. Most tiles with the Tudor rose design, a very common pattern in London, were used as flooring.

Probably from a fireplace surround in the prosperous domestic residence are two decorated tin-glazed 'delft' wall tiles One (context [3] <66>) shows part of a mounted figure in blue on white with fleur-de-lis corner decoration. It is undoubtedly a Dutch import and is similar in style to delft tiles with mounted military figures brought into London around 1680 to 1750 (Betts and Weinstein 2010, 157, nos 334–336). The other tile (context [20] <177>) is probably also Dutch. Only the top edge survives, but the four

sided border suggests it was similar to certain blue on white mid to late 18th-century landscape tiles illustrated by Betts and Weinstein (2010, 144–145, nos: 281–283).

Of probable mid 17th to 19th-century date is a white Portland stone moulding from context [20].

18.1.4 Discussion

The building material from XSM10 shows a wide range of different form type dating from the Roman to the post-medieval period. Higher status material is represented by the Roman tesserae and painted wall plaster, the medieval floor tiles and the post-medieval floor tile and delft wall tiles.

18.1.5 References

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18.2 Roman pottery

Fiona Seeley and Amy Thorp

18.2.1 Introduction

The pottery was spot-dated and recorded in accordance with current MOL archaeology procedure, using standard fabric, form and decoration codes. The data was entered onto the Oracle database, including quantification by sherd count, estimated number of vessels and weight in grams. The evaluation has produced an assemblage of 593 sherds (weight 13377 g) of Roman pottery from 36 contexts. Ten sherds are from wet sieved samples, 583 are hand collected. Only where no hand collected pottery was retrieved from a context was the wet sieved pottery examined. Approximately a third of these groups also contained post-Roman material.

18.2.2 Roman Pottery

The majority of the contexts are dated to the Hadrianic to early Antonine period with a few late Roman groups. There is a relatively high number of sherd and/or vessel links between contexts. Several of the late Roman groups are dated AD 150 to 400 on the presence of sherds of Nene valley colour-coated ware, but contain a variety of material that suggests the truncation of original features or the presence of residual pottery.

The selection of Roman fabrics present is slightly unusual for a City site. Fine wares form a very high proportion of this small assemblage; samian wares representing 28% (by sherd count) as well as six sherds of Cologne colour-coated ware (KOLN) and 14 sherds of Nene valley colour-coated ware (NVCC). This feature of the assemblage should be addressed in any further work on the material. A range of amphorae is present indicating the use of the olive oil and wines from different areas of the empire. From context [703] there is the foot or a Dressel 2-4 amphora (CAMP 8DR2-4). The fabric of this vessel contains black sand which suggests a source in Campania although it is not identical to either of the two fabrics from this region presently categorised in the London type series (CAMP1, CAMP2).

Despite the proximity of the site's location within the western section of the Northern cemetery of the City, there is only one vessel that can be considered as a possible burial; an almost complete (albeit semi-broken) Highgate Wood ware C poppy-head beaker (HWC 3F) from context [318]. Another vessel which may have a ritual connection is a face pot from context [714]. These enigmatic vessels have an unusual distribution and it has been suggested that they are indicative of veteran settlement (Braithwaite 2007, 348). The XSM10 example is in the fabric Verulamium region white ware and is likely to be 2nd century in date. Only one of the small cups which would have been adhered to the rim of the jar is present. The majority of the pottery shows evidence of being used in the preparation and consumption of food such as limescale and sooting evident on cooking jars and the rims of lids where they have been used on a hearth. The samian is generally not sooted, supporting the idea that it is primarily used to serve and consume food. Overall, the state of the pottery suggests domestic use.

Groups of particular interest include contexts [213] and [300]. Context [213] is a medium sized group of 69 sherds dated to AD 140 to 160 (early Antonine period), which includes sherds of a selection of rarer amphora variants, black-burnished wares, and Highgate Wood ware C (HWC) vessels. Context [300] produced 37 sherds and is dated AD 150 to 250. The group has a high proportion of sherds from samian ware vessels, including part of a possible lion head spout from a Dragendorff form 45 mortarium (7DR45), and Nene valley colour-coated ware (NVCC). A beaker with barbotine scale decoration (SCD) provides a vessel link with context [298].

Context [703] is a medium-sized assemblage (65 sherds) which is dated AD 120 to 160. It is mostly composed of oxidised coarse wares and samian. Sherd size is medium to large.

Context [714] is a large-sized group (160 sherds) dated to AD 140 to 160. As with context [703] samian is well represented and includes a signature (incomplete) on the base of a bowl. The signature reads CR (retrograde) and is either the signature of the mould maker or the mould owner. The condition of the pottery from this context demonstrates the difference between the functions of the different types of vessels with the jars and cooking bowls being sooted while the flagons, which would have been used primarily for the serving of liquids, being unburnt.

18.2.3 Recommendations

Thin-section of the Dressel 2-4 amphora from context [703] to source this vessel.

If this material is further analysed the beaker from context [318] and the face pot from context [714] are suitable for illustration.

18.2.4 Bibliography

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18.3 Post-Roman pottery

Lyn Blackmore

18.3.1 Introduction

The post-Roman pottery assemblage amounts to 957 sherds (729 ENV, 34.492kg) from 19 contexts ([1], [3], [4], [20], [211], [212], [216], [217], [277], [279], [283], [298], [323], [327], [492], [493], [507], [651], [693]). Of these, 627 sherds were recovered in the first phase, the remainder in the second. The sherds were examined macroscopically and using a binocular microscope (x 20), and recorded on paper and computer using standard Museum of London codes for fabrics, forms and decoration. The numerical data comprises sherd count, estimated number of vessels and weight. A few finds merit illustration. The data can be accessed on the Oracle database and also in an excel spreadsheet.

18.3.2 Medieval wares

A total of 34 sherds (34 ENV, 627g) of medieval pottery were found, all residual (contexts ([1], [3], [4], [20], [211], [212], [217], [277], [279], [327], [492], [493], [651])). The earliest are single sherds of early Surrey ware and early medieval sand-and-shell-tempered ware from [217], which date to the 11th or 12th-century. Five sherds are of London ware (both fine and coarse variants), while 21 are Surrey whitewares, with a mix of coarse Surrey-Hampshire border ware (CBW) and Kingston-type ware; some of the latter are very coarse and could also be CBW, although the jug forms are typical of the Kingston industry. Also present are three sherds of South Herts-type greyware and one of late medieval Hertfordshire glazed ware.

18.3.3 Post-medieval wares

Post-medieval wares are present in all contexts (918 sherds, 695 ENV, 33.865kg). Redwares from London area and Essex are the most common category. The coarser fabrics, mainly from the London area, amount to 395 sherds (283 ENV). The most common types are early post-medieval redware (PMRE, c 1480 to 1600) with 152 sherds (118 ENV) and London-area early post-medieval slipped redware (PMSR/G/Y, c 1480 to 1650; 85 sherds, 62 ENV). In third place is London-area post-medieval redware (PMR), which dates from c 1580 until c 1900 (116 sherds, 67 ENV), followed by London-area bichrome glazed ware (PMBR, 1480 to 1600), with 39 sherds (34 ENV). Most sherds are from heavy duty vessels, mainly associated with the storage, preparing, cooking and serving of food, but including part of a PMSRG goblet ([283]), two flower

pots in PMRE ([492]) and PMR ([3]), two possible industrial vessels in PMRE ([493]; all-sided rim) and PMR ([3]; cucurbit?) and part of a PMRE drain pip ([651]). The most complete vessel is a large PMR storage jar with thumbled cordon, combed horizontal and wavy line decoration and two large applied thumbled rosette pads ([20]) probably from Woolwich. Two thick-walled sherds in a reduced fabric with dull green glaze appear to be from the base of a very large vessel with kiln scars on the outer wall ([211]). Another rim is from a jar with thumbled basket handle ([4]). Of particular note is part of a PMSRY dish with graffito decoration in the Dutch style, showing the body and legs of a rather crudely drawn bird ([507]; cf Hurst et al 1986, 148, pl 23), which merits illustration.

In addition, there are 77 sherds (42 ENV) from Essex, of which 67 sherds are of fine post-medieval redware (PMFR, 1580 to 1700); the others are of post-medieval black-glazed ware (PMBL, 1580 to 1700) and Metropolitan slipware (METS, 1630 to 1700). The most complete is a two-handled dish in PMFR from [20].

In second place are wares from Surrey (143 sherds, 119 ENV), of which two sherds are of early Surrey-Hampshire border (EBORD), 91 are in the white fabric (BORDG/O/Y) and the remainder are in the redware equivalent (RBOR), the latter including three dishes with painted slip decoration (RBORSL). Most of the whiteware forms are table wares (bowls, dishes, porringers, drinking jugs and a possibly cup), but a few sherds are from chamber pots, costrels, skillets, tripod pipkins; one is part of a saucer candlestick, while two are the knobs from money boxes. Most of the redware sherds are from more robust dishes, with a few from chamber pots and cooking vessels. Of note are sherds from a salt ([1]) and what appears to be a double dish ([20]), unusually a standard dish form with central partition rather than the more common form of two small dishes joined together, and a salt with pedestal base ([1]). Details of form types can be found in Pearce (1992; 2007).

Imports are well-represented on the site and numerically the third most common category, with a total of 137 sherds (119 ENV). As usual most are German stonewares, mainly from Raeren (57 sherds) including three complete bases from [693] and part of a mug with incised and stabbed face ([507]; cf Hurst et al 1986, 196, fig 84.302). Some sherds recorded as Raeren could in fact be from Langerwehe. Frechen stonewares amount to 37 sherds, while the remainder are from Siegburg, Cologne and Westerwald. Those recorded as Cologne have oak and rose leaf decoration, while one has an acanthus leaf and another has a portrait medallion. Other imports from northern Europe comprise German whitewares (three sherds from [4] and [211]), Dutch redwares (DUTR: nine sherds from four cauldrons/pipkins, a jar and a dripping dish), Dutch slipwares (DUTSL: three sherds), South Netherlands maiolica (SNTG), Dutch tin-glazed ware (DTGW), and part of a Beauvais graffito ware dish (BEAU1). One sherd of SNTG has an all over blue glaze ([212]), while the other is from the base of an Italian-style vase/altar vase with polychrome decoration ([507]). One sherd from a dish made at Montelupo (MLTG), Italy, is present ([212]), but most south European imports are from the Iberian Peninsula, including one sherd of Portuguese tin-glazed ware. Spanish wares comprise part of an Isabella polychrome ware dish (ISAB; [507], cf *ibid*, 54–7, figs 24–5), two sherds of olive jar (OLIV), and four from one or two large dishes in Spanish green-glazed ware (SPGR; [507]) of the type known as lebrillo (cf *ibid*, 65, fig 29.78). Also present are two sherds of Chinese porcelain, one from the neck of a miniature garniture vase ([216]).

Tin-glazed wares, mainly forms that would be used at the table, are the fourth most common category by sherd count (99 fragments, 85 ENV), although the sherds are much smaller. It is likely that most are from factories along the south bank (Britton 1987; Noël Hume 1977; Tyler et al 2008). A range of different decorative styles is represented,

with fairly even mix of 17th-century and 18th-century wares. The former comprise wares with blue and white or polychrome decoration (TGW D, date 1630–80; 35 sherds, 32 ENV), and one with Chinaman in grasses decoration (TGW F, 1670–90; 3 sherds, 2 ENV). The latter include two sherds with ‘Lambeth polychrome decoration (TGW G, 1701–11), 11 sherds with blue on blue decoration (TGW H, 1680–1800), 18 recorded as TGW, most with typical 18th-century-style decoration, and two from plates with sponged decoration (TGW SPNG). Of particular interest is the base of a small fluted bowl in TGW G with what appears to be the number ‘13’ on the underside of the base ([4]). Vessels with a plain white glaze (TGW C; 28 sherds, 22 ENV) were produced from c 1630 to 1846 and so are difficult to date precisely, but most are from chamber pots and should date to after c 1650.

Other English ware types include 22 sherds from 14 Cistercian ware mugs, one substantially complete ([507]), 15 sherds of assorted Staffordshire wares, 28 sherds of English stoneware (various types) and the base of a Bow white porcelain tea bowl with applied sprig decoration ([217]).

18.3.4 Discussion

The site would appear be within the precinct of the Hospital of St Mary Bethlehem, and the medieval pottery was presumably used within the hospital. Contexts [211], [212], [277], [279], [283], [298], [507], [651] and [693] all contain pottery that falls within the date range of c 1550 to 1600 and so could represent material discarded at the Dissolution (total 257 sherds, 9.374kg).

The largest group is from [507] (83 sherds, 4.162kg), which contains a number of imported wares, 54 sherds from [211] and 45 sherds from [212]. Contexts [323], [492] and [493] date to the mid/late 17th-century, while all other contexts contain pottery dating to the 18th-century and must reflect the later development of the site; the largest group is from [20], which contained 215 sherds (10.450kg) with a date range of 1763 to 1800. The assemblages of each period are typical for London, but, as noted above, the post-medieval wares include a few unusual forms that merit comment in any publication of the site; six of these could be illustrated.

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18.4 Clay tobacco pipes

Jacqui Pearce

18.4.1 Introduction

The clay tobacco pipe assemblage from XSM10 was recorded in accordance with current MOL Archaeology practice and entered onto the Oracle database. The pipe bowls have been classified and dated according to the Chronology of London Bowl Types (Atkinson and Oswald 1969), using the prefix AO. Quantification and recording follow guidelines set out by Higgins and Davey (1994; Davey 1997).

18.4.2 The clay pipes

A total of 76 fragments of clay tobacco pipe were recovered from seven numbered contexts. Overall, there are 70 bowls and six stem fragments, with no mouthpieces. Eight pipes have been accessioned, all of them with makers' marks; there are no decorated pipes. All pipe bowls identified are typical of London manufacture and most of the pipes have been smoked.

Ctxt	TPQ	TAQ	B	S
1	1730	1760	10	6
3	1730	1760	22	
4	1730	1760	8	
20	1730	1760	16	
216	1730	1760	6	
390	1730	1760	2	
492	1680	1710	6	
Total			70	6

Table 5: Dating and quantification of clay pipes

A relatively diverse range of pipes was recorded, spanning the mid 17th to mid 18th centuries. The presence of type AO25, which can be subdivided into types OS10 to 12, has given a similar date of c 1730–60 for all but one context. This is based on type OS11, which is the most common type identified in the material. Types AO20, AO21 and AO22 (12 examples) date to c 1680 to 1710 and overlap with the earlier 18th-century pipes. There are also 16 pipes dated to c 1660–80 (types AO13, 15 and 18), and eight dated to c 1640 to 1660/70 (types AO9 to 12 inclusive). These earlier pipes are doubtless residual, except possibly in context [492], in which they are the latest examples recorded. Some of the 17th-century pipes are milled around the top of the

bowl, but none are burnished. The overall quality is no more than average, with no decorated or marked 17th-century pipes recognised.

The eight marked pipes all have makers' initials or symbols moulded in relief on the sides of the heel. All date to the 18th-century, with six examples of type OS11, and one each of types OS10 and 12. Six of the marked pipes also come from the same context (context [20]), with the other two from context [3]. Two pipes are marked with crowns on the sides of the heel, one with the additional initials WM, which stands for William Manby, one of a well known family of London pipe makers. He is recorded in Green Dragon Alley, Limehouse in 1719–63 (Oswald 1975, 142). It is possible the other crowned pipe was also made by Manby. One pipe simply has raised dots on the heel, and two type OS11 bowls have the initials IS. Identification of the other pipe makers will be carried out at analysis.

Ctxt	Acc	Form	ED	LD	B	Mark	Type	Meth	Pos
20	11	OS11	1730	1760	1	CROWN WM	R	M	SH
20	12	OS12	1730	1780	1	CROWNS	R	M	SH
20	15	OS10	1700	1740	1	DOTS	R	M	SH
20	10	OS11	1730	1760	1	IS	R	M	SH
20	13	OS11	1730	1760	1	IS	R	M	SH
20	14	OS11	1730	1760	1	MD	R	M	SH
3	65	OS11	1730	1760	1	WL?	R	M	SH
3	64	OS11	1730	1760	1	WN	R	M	SH

Table 6: Decorated and marked pipes

18.4.3 Potential and significance

The pipe assemblage may hold some potential for further chronological refinement, and is valuable in clarifying the site sequence. The material is chiefly relevant in the local context. Further research may uncover the identity of the various pipe makers represented.

18.4.4 Recommendations

The present note could be adapted to form part of a full site report with further information on identifiable pipe makers. Estimated specialist time: 0.5 day.

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18.5 Glass

Lyn Blackmore

18.5.1 Introduction

All finds have been recorded in accordance with current MOLA practice and entered onto the Oracle database. Accessioned finds other than glass are considered separately.

18.5.2 Bulk glass

Eight pieces of glass (675g) were recovered from context [20]. Possibly the earliest is the rim and part of the neck of a squat/early cylindrical bottle, which has a high rounded string set just below the slightly narrower rounded mouth; the fact that neither are bevelled suggests a date in the 1760s or 1770s. Two bases and two body sherds are from two early cylindrical bottles. All these are in dark green glass; two sherds in a paler glass are probably from a squat cylindrical bottle. Also present is the neck of a large cylindrical phial. Taking the various forms together, the group dates to 1750 to 1790, which agrees well with the dating of the pottery (1760 to 1800). Context [492] contained the complete rim and part of the shoulder of a bell-shaped phial made of natural blue glass a form typical of the second half of the 17th-century (cf Noel Hume 1969, fig 17.8).

18.5.3 Accessioned glass

Two pieces of vessel glass and 16 fragments (284g) of glass waste were found in three contexts, of which [216] is dated by the pottery and pipes to 1730 to 1760; context [217] mainly contains later 16th to 17th-century ware types, but also a piece of Bow porcelain which, if stratified, dates the group to 1748 to 1775. The waste in both groups is mainly of natural blue-green glass, the same in character, and doubtless of the same date.

18.5.4 Waste

No cullet or other evidence such as frit was found that would indicate the preparation of the glass metal was found. The other waste represents different stages of glass production, but there is a large lump of glass slag, or gall [327] (<105>; 392g), the by-product of the first melting of the prepared frit (Tyler and Willmott 2005, 42, fig 40), and another piece from [216] (<83>) that combines slag/gall with lump metal. Five fragments (168g) of lump glass/pot metal were found, of which <77>, <79> and <83> are from [216], while <96> and <98> are from [217]; of these <98> is in colourless glass with a yellowish tinge.

Two fragments (16g) from [216] (<76>, <82>) both contain abundant very fine bubbles and are probably drops, produced by dipping an iron into the crucible and letting the glass drop from it in order to test the readiness of the metal for blowing working (Tyler and Willmott 2005, 49). Two others, one from [216] <78>, the other from [217] (<97>) are pulls, or excess trimmed off (ibid, 49); <97> is a broad strip (L 72mm, W 90mm) that tapers to a narrow thin trail at one end, while <78> comprises two twisted thin rods with evidence for pincering that may be waste from applied decorative elements such as base rings for beakers. The same may apply to <204> ([430]), which comprises two short, thin arched trails, one springing from the other (L 31mm, max diameter c 3mm). Accession <100> from [217] is probably a moil (an accumulation of glass around the mouth of the inflating iron; Egan 2000, 43, 46). A small oval-shaped nugget ([217] <99>) is too small for a gather but difficult to fit into any other category (12 x 17 x 15mm); there is a tiny flat surface where it may have been split from the blowing iron.

18.5.5 Other glass

Also present are four spherical lumps of glass (75g), three complete (<80>: Diam c20x23mm, weights c 13.5 and 15.5g; <81>: 22x28mm); and one incomplete (<84>; Diam 23x28mm). The function of these objects is unclear but as they appear to be finished they may have been intended as toys (early marbles).

18.5.6 Vessel and other glass

It is difficult to know whether the vessel glass from [217] represents production waste. Both are in colourless glass with a grey tinge and in the Venetian style and could be from the same vessel. Accession <95> appears to be part of the bowl of a goblet, while <95> comprises the merese and part of the bowl and stem of a vessel with *latticinio* decoration of two layers of fine white canes spiralling out from the centre (cf Willmott 2002, 61, fig 59a). Accession <94> is from the bowl of a goblet, which has applied *vetro a retorti* decoration of a lattice band between narrow bands of plain white (*lattimo*) glass; the surface is marvered but slightly convex. The third find, from [20] (<8>) is the greater part of a small stopper from a perfume bottle with flattened oval knop, cylindrical shank; the narrower probe for dipping has sheared off.

18.5.7 Composite bracelet

Of some interest is a part of a necklace ([349], <171>), from the neck of a burial of a child aged 1 to 3 years (see discussion). The composition of the beads should be verified as and when the finds are analysed.

<171> [349] composite necklace

Total L as reconstructed 165mm. The 20 graduated beads were found scattered around the neck area of the skeleton but are listed below in the order they have been restrung, starting from the ends and working to the centre.

1, 2, 3, 20, 19, 18. Bone/ivory: three small drum-shaped beads at each end (L 6–7mm, Diam 7–8mm)

4, 17. Amber. Small spherical beads (L c 6mm, Diam c 8mm)

- 5, 16. Glass. Spherical beads of pale blue glass ((L 7–8mm, Diam 8mm)
- 6, 15. Amber. Spherical beads (as above), one cylindrical form with faceted wall (L 5mm, Diam 8mm)
7. Glass/limestone. Roughly spherical bead, opaque matt grey colour (L 7mm, Diam 9mm).
14. Amber. Spherical bead (L 7mm, Diam 8.5mm)
8. Amber/glass? Convex-sided cylindrical bead; marbled yellow-brown opaque with decayed surface (L 11mm, max Diam 11mm),
13. Agate? Spherical bead, banded pale yellow colour (L 11mm, Diam 12mm)
9. Glass. Ovoid bead, opaque matt brown colour with decayed surface (L 13mm, max Diam 10mm)
12. Amber/glass? Ovoid bead, opaque matt brown colour (L 11mm, max Diam 9mm)
10. Amber/glass? Ovoid bead, opaque marbled yellow-brown with matt surface (L c 15mm, max Diam c 11mm)
11. Amber. Ovoid bead with matt surfaces (L c 15mm, max Diam c 11mm)

18.5.8 Discussion

The area of the site is of interest to glass specialists as it is possible that the factory established by Verzelini in 1575, following the destruction of his first factory at the Crutched Friars, was located in the former Augustinian Friary that fronted onto Broad Street, although it could also have been in Broad Street, Ratcliffe (Watts 2009, 27, 61, 64). The site was later taken over by Robert Mansell for the manufacture of *crystallo* drinking glasses, under the management of William Robson, and later James Howell (ibid, 51; Willmott 2005, 99–101, 107). Whether these early factories were in the city or not, Pepys, writing in the 1660s, refers to glass manufacture at Broad Street within the City, while glass waste was found in 1990 during the excavation of Boston House, Broad Street (Schofield with Maloney 1998, 300; Mortimer 1995). The archive report on this assemblage (Shepherd 1992) should be consulted for any report on the waste from the present site, Most of Mansell's glasshouses were coal-fired, but that at Broad Street used wood, as required by the City. From c 1617 barilla soda was used in place of wood ash, which was in short supply (ibid, 52, 57). A key question for a future study is how residual the glass waste might be, given that the pottery assemblages contain both to 17th- and 18th-century material. Scientific analysis should be carried out to compare the finds with the earlier material and also from recent work at Mariner House, by the site of Verzelini's first factory at the Crutched Friars (Blackmore in prep).

The beads from the later inhumation cemetery on the site are of interest as a similar, but larger cluster of 42–7 beads was found in the burial of an adolescent in the New Bunhill Fields burial ground, Southwark (Richardson in prep)

18.5.9 Bibliography

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18.6 Other finds

Michael Marshall

incorporating comments on the animal bone from *Mr Alan Pipe* and *Dr James Morris*

18.6.1 Introduction

The finds include accessioned (Table 7) and bulk (Table 8) (Table 9) finds as summarised below. The assemblage is discussed by period and has been recorded in detail in a separate archive catalogue. The post-medieval bone-working waste is tabulated and summarised. Further batches of material from the site will be dealt with separately and the conclusions made here may need to be extended or modified at this stage. The accessioned glass, clay tobacco pipes and building material are all reported on separately.

Material	Roman	Medieval	Post-medieval	Unknown	Material total
Stone	1	0	0	1	2
Ceramic	2	0	3	0	5
Iron	5	0	3	1	9
Copper-alloy	3	0	17	6	26
Lead	0	0	1	1	2

Silver	1	0	0	0	1
Bone	0	2	105	1	108
Ivory	0	0	12	0	12
Tortoiseshell	0	0	2	0	2
Wood	0	0	1	0	1
Composite	0	0	3	0	3
Period total	12	2	147	10	171

Table 7: Summary of accessioned finds excluding post Roman coins, glass, clay tobacco pipes, stamps and building material

Context	Period	Number of nails
227	Unknown	3
239	Unknown	1
300	Roman	35
714	Roman	18
533	Post-medieval	7
Total		64

Table 8: Number of bulk iron nails by context and period

Context	Period	Fragments
309	Unknown	1

Table 9: Number of bulk leather fragments by context and period

18.6.2 Discussion

18.6.2.1 Roman

A small group of Roman finds were recovered (12 finds) These seem primarily to have been concentrated in context [300], although they are also found in [714]. [300] has a useful *terminus post quem* in the form of a silver denarius of Severus Alexander <85> dating AD 228 to 231. This may help to refine or support any associated pottery dates.

Three iron styli came from this group: two examples of Manning type 2/3 <91>, <92> and <88> a decorated example of Manning type 4 (1985, 85.). These provide evidence of literacy in the area. The remainder of the iron is structural; <90> is probably a type 2 nail and <93> was a double spiked loop. 35 iron nails were also recovered from this context in a variety of sizes ranging from 40–101mm in length. The lengths of the measurable examples are recorded below (Table 10).

Two copper-alloy objects were also recovered from this context. The first is a strip perforated at each end, with a wire loop threaded through one perforation <86>. Its function is obscure, but it is possible it could have been some sort of tie or binding

The more interesting of the two <87>, [300] is a flat plate consisting of two perforated circles joined by a lozenge shaped panel. No exact parallel for this object is known although the style of concentric circle decoration is common in the Roman period. Arguably this is not a single object at all but two unfinished circular mounts joined by a fragment of the sprue and trimmed off a larger run of studs. They were presumably discarded when it was noticed that one of the two is not well formed. If this is accepted it provides evidence for sheet copper-alloy working in the area.

Context [714] contained a small group of domestic material a piece of a stone mortar <226> and two sherds of natural green blue vessel glass. One <227> cannot be assigned to a form while the other <229> is a handle from a jug, probably a globular form dating to between the late 1st and early 3rd century AD. [714] also produced a group of 18 bulk iron nails of probable Roman date: 13 small/medium nails (40 to 60mm) and three large nails (85 to 105mm)

Of the remaining finds, two are made from recycled Roman pot sherds. <173>, [213] is probably a gaming counter while <223>, [702] is larger and could be a lid. A fragment of a late Roman copper-alloy bracelet <218>, [707] is a light bangle of late 3rd or 4th-century date and is decorated with a notched zigzag pattern (Cool 1983, 152, type XXII). These are commonly found in graves and it is possible that it has come from a disturbed burial. While the majority of the burials on the site appear to be post-medieval some disarticulated Roman human remains have been found from contexts close in number to [707].

Length of nail in mm	Number of nails
40	1
46	1
52	4
54	1
55	2
56	1
60	1
61	1
63	1
65	2
67	1
69	1
79	1

90	4
92	2
101	1

Table 10: Approximate lengths of measurable Roman nails from Context [300]

18.6.2.2 Medieval

There are two probable medieval finds from the site, two bone skates <70> and <71> come from the same context [230] and are of the same basic form. Both are made from cattle bones, although they are of different skeletal elements and clearly do not form a pair. These objects cannot be closely dated, ranging from the Bronze Age to the 19th-century in some parts of Northern Europe (MacGregor 1985, 141-4), however the most common range for dated examples from England is the 8th to 13th century (MacGregor 1976) This is the most likely date range for these examples, subject to confirmation from their stratigraphic relationships and association.

Stratigraphic note (R Hartle): these skates may be early within that date range or even possibly older. They were found at the top of Roman dump [230], beside Roman ditch [229], and sealed by [213], a layer which contained only Roman material. Further excavation may well confirm their date. Roman material found in [229] or [213] may prove to be residual. If not, these skates could be Saxon or even late Roman.

18.6.2.3 Post-medieval

The post-medieval assemblage is large at 147 finds. The majority of closely dated finds are 18th-century in date however many cannot be intrinsically dated with greater precision than to the post-medieval period. The post-medieval material is dominated by waste from the manufacture of artefacts of bone and other skeletal materials (Table 7). The presence of this material is not surprising as the eastern part of the late medieval and post-medieval city is a known focus for bone, ivory and horn working (Yeomans 2007), however, archaeological post-medieval bone waste is not common. The total number of fragments recovered from XSM10 outnumbers all other post-medieval bone-working assemblages from London recorded on the MOLA ORACLE database combined. For the purposes of this note a summary of the material and the initial findings is given.

The raw material used is overwhelmingly cattle long bones, specifically metatarsals, although fragments of cattle metacarpal <39>, [4]; elephant ivory <18>, [1] and <132>, [492]; elephant tooth <51>, [3]; tortoiseshell <50>, [3]; antler <26>, [20] and sheep or goat metatarsals <29>, [20] and <63>, [3] are also known as well. It is unlikely that this reflects the true proportion of raw material worked at the site as different technological processes with characteristic waste products and attempts to work economically in expensive materials like ivory and tortoise shell will skew relative proportions. A fragment of elephant tooth <135>, [492] has a scratched graffito, possibly an importers mark.

Despite the fact that the most common material is cattle metapodials and other long bones only one epiphysis is present <207>, [390] and saw marks on only one face of many of the lathe turned offcuts (group 2) suggests these were sawn off, presumably at

an earlier stage of processing and possibly in a different location. A plentiful source of bones in this condition would be the tanneries in London and Southwark where metatarsals and metacarpals with sawn off ends are a characteristic waste product (Yeomans 2007, 110-12).

The bone waste has been preliminarily sorted into five broad categories. The bone ivory and tortoiseshell waste total 99 accessions but the actual fragment count is much higher. These have been preliminarily sorted into groups (Table 11). Group 1 predominantly came from Trench 1 (west of the site) while group 2 predominantly came from Trenches 6, 7 and 9 (centre and east). This suggests some spatial or chronological division across the site.

Group	Description	Contexts	Number frags	% of total
1	Knife cut bone pegs	[20][323][327][492][507][518]	100	59.88
2	Lathe turned ring offcuts	[1][3][4][20]	36	21.55
3	Part worked blanks and slabs	n/a	23	13.77
4	Other	n/a	8	4.79
Total			167	

Table 11: Preliminary breakdown of the bone waste by fragment count and morphological group

Group 1 waste is the most common form. These are pegs like blanks made from the wall of large animal long bones. They vary in form and length but most have saw cut ends and knife worked faceted faces. They appear to have been constructed by sawing the bones into sections of appropriate length, then splitting them longitudinally to smaller blanks with roughly square sections eg <172>, [492] before being further worked into roughly cylindrical pegs with knives. Some swell in the centre, some taper towards the end and some remain a more or less even width. Possible products include bone dowels and tuning pegs but the variation in length is so marked it is unlikely that they were all intended for the same purpose. Further analysis of these features by context may reveal spatial patterns in what was being worked and where.

The group 2 waste appears to come from the working of metapodials, mostly of cattle, on a lathe (Table 13). These are ring-like transverse off cuts from the ends of the bone objects between and after stages of working. The surviving tool marks allows the chaîne opératoire to be reconstructed. The bones were first roughly scraped with a coarse file before being further scraped and shaped with a flat bladed instrument like a knife. The bones were then turned on the lathe. The relative order of these processes are visible on offcuts and semi-complete objects such as <28>, [20], <36>, [4] and <62>, [3] where the earlier stages survive only on the ends as they are obliterated by succeeding finishes. These unfinished terminals are the probable source of most of the off-cuts which generally show file marks, knife cuts or both and were trimmed off on the lathe.

The final major group of waste is blocks, described in detail in the archive catalogue. These are predominantly piece of cattle long bone wall sawn then split longitudinally

before being worked to varying degrees. predominantly of cattle long bone wall, created by sawing off a section transversely The range of intended products can not be determined but threaded discs such as <20>, [20] are a possibility and a coarse bone disc <27>, [20] could be an unfinished example.

Accession	Context	Max length (mm)	Max Diam/ Width (mm)	Section	ends	shaft	comment
121	323	53.5	8	circular	both cut	even	
122	323	45	13	circular	both cut	tapered	
123	323	43	7.5	circular	both cut	swelling	
124	323	53	9.5	circular	both cut	tapered	
111	327	57.5	9.5	circular	both cut	even	
112	327	58	8.5	circular	both cut	swelling	
112	327	57.5	9	circular	both cut	swelling	
112	327	54	8	circular	both cut	tapered	
112	327	50.5	8.5	circular	both cut	tapered	
112	327	41	9	circular	cut/broke	?	
113	327	52.5	7	squared?	cut/broke	?	
114	327	47	12	circular	cut/broke	tapered	
115	327	53.5	7	circular	cut/point	tapered	
117	327	93	11	circular	both cut	tapered	
119	327	36.5	7.9	?circular	cut/broke	?	
120	327	47	7	circular	cut/broke	?	
148	492	67	7	circular	both cut	even	damaged
153	492	50	8.5	circular	both cut	even	
153	492	52.5	7.5	circular	both cut	even	
153	492	48.5	8	circular	both cut	even	
154	492	46	6	circular	both cut	even	
154	492	41	7.5	circular	both cut	even	
155	492	53.5	11	circular	both cut	even	
155	492	52	10	circular	both cut	even	
157	492	60	7.5	circular	both cut	even	
158	492	52.5	8.5	circular	both cut	even	
158	492	52	7.5	circular	both cut	even	
158	492	51.5	9	circular	both cut	even	



162	492	61.5	11	circular	both cut	even	damaged
164	492	53	8.5	circular	both cut	even	
166	492	51	7.5	circular	both cut	even	damaged
166	492	50.5	6.5	circular	cut/broke	even	damaged
166	492	45	7	circular	cut/broke	even	damaged
167	492	60.5	7.5	circular	both cut	even	
167	492	63.5	9.5	circular	both cut	even	
167	492	61	9	circular	both cut	even	
167	492	60	7	circular	both cut	even	
168	492	46	8	circular	cut/broke	even	Damaged
169	492	57	8	circular	both cut	even	
169	492	54.5	7	circular	both cut	even	
142	492	53.5	7	circular	cut/point	swelling	
148	492	65.5	6	circular	both cut	swelling	
151	492	101.5	9	circular	both cut	swelling	
153	492	47	9	circular	both cut	swelling	
154	492	47.5	7	circular	both cut	swelling	
157	492	62.5	8	circular	both cut	swelling	
157	492	58	7	circular	both cut	swelling	
157	492	53	8	circular	both cut	swelling	
157	492	58	9	circular	both cut	swelling	
157	492	56.5	8	circular	both cut	swelling	
157	492	62.5	8	circular	both cut	swelling	
159	492	60	9	circular	both cut	swelling	
160	492	72.5	8	circular	both cut	swelling	
161	492	44	11	circular	both cut	swelling	
163	492	49.5	5	circular	both cut	swelling	
169	492	52	9	circular	both cut	swelling	
169	492	53.5	7	circular	both cut	swelling	
148	492	69	6	circular	both cut	tapered	
148	492	67	6	circular	both cut	tapered	
149	492	27	7.2	circular	cut/domed	tapered	
150	492	29.5	10.5	Circular	cut/domed	tapered	
152	492	89	8	circular	both cut	tapered	
153	492	52.5	9.5	circular	both cut	tapered	



154	492	45.5	9	circular	both cut	tapered	
156	492	87	10.5	circular	both cut	tapered	
158	492	53	9	circular	both cut	tapered	
158	492	52.5	9.5	circular	both cut	tapered	
158	492	54.5	9.5	circular	both cut	tapered	
158	492	53	9	circular	both cut	tapered	
159	492	59	7.5	circular	both cut	tapered	
159	492	56.5	9	circular	both cut	tapered	
159	492	55.5	7.5	circular	both cut	tapered	
159	492	55	9	circular	both cut	tapered	
160	492	74	8	circular	both cut	tapered	
162	492	54	12	circular	both cut	tapered	
163	492	53	6	circular	both cut	tapered	
163	492	49	5	circular	both cut	tapered	
164	492	49.5	9.5	circular	both cut	tapered	
164	492	52.5	9.5	circular	both cut	tapered	
165	492	53	8.5	circular	both cut	tapered	
165	492	57	7.5	circular	both cut	tapered	
165	492	54	9	circular	both cut	tapered	
165	492	51	8.5	circular	both cut	tapered	
166	492	48	8.5	circular	both cut	tapered	
168	492	63.5	6.5	circular	cut/broke	?	Damaged
168	492	59	8.5	circular	both cut	tapered	
168	492	56.5	7.5	circular	cut/point	tapered	fine finish
170	492	54.5	5.5	circular	both cut	tapered	
170	492	56	6	circular	both cut	tapered	
192	507	53	6	circular	both cut	even	
217	518	30.5	9	circular	both cut	tapered	
25	20	113	13.5	circular	both cut	?	
172	492	51.5	7	square	both cut	blank	
172	492	51	10	square	both cut	blank	
147	492	56	8.5	square	both cut	blank	
147	492	56.5	8	square	both cut	blank	split?
147	492	55	8	square	both cut	blank	
143	492	42	8	square	both cut	blank	

137	492	48.5	5	square	both cut	blank	
140	492	49.5	14.5	square	both cut	blank	

Table 12: Bone working waste group 1: bone pegs by context

Accession	Context	Max L in mm	Species	Element	Turned interior	Turned exterior	File	Knife
17	1	10.5	Cattle	Metatarsal		Y	Y	
53	3	10	Cattle	Metatarsal	Y			Y
54	3	9.5	? Cattle	?Metatarsal	Y		Y	
55	3	11.6	Cattle	Metatarsal	H	H		
56	3	14.5	Cattle	Metatarsal				Y
57	3	6	Cattle	Metatarsal				
58	3	19	Cattle	Metatarsal	H		Y	Y
59	3	4.5	Cattle	Metatarsal				
60	3	20.5	Cattle	Metatarsal	H	H		
30	4	9.5	Cattle	Metatarsal	H	Y		
31	4	13.5	Bone	Longbone		Y		
32	4	16.5	Cattle	Metatarsal	H	?		Y
33	4	15	?Cattle	Metatarsal	H			Y
34	4	17.5	Cattle	Metatarsal	H		Y	
35	4	12.5	Cattle	Metatarsal	?H		Y	
37	4	12.5	Cattle	Metatarsal			Y	
37	4	12	Cattle	Metatarsal			Y	
38	4	8	?Cattle	?Metatarsal	Y			Y
39	4	11	Cattle	Metacarpal		H		
40	4	6	Cattle	Metatarsal		Y		
40	4	7	Cattle	Metatarsal			Y	
40	4	5.5	Cattle	Metatarsal			Y	
41	4	5.5	Cattle	Metatarsal			Y	
41	4	10	Cattle	Metatarsal			Y	
41	4	6.5	Cattle	Metatarsal				
42	4	17.5	Cattle	Metatarsal	H	H		Y
43	4	9.5	Cattle	Metatarsal	H		Y	
44	4	8.5	Cattle	Metatarsal			Y	

44	4	6.5	Cattle	Metatarsal			Y	
45	4	13	Bone	Longbone	Y	Y		
22	20	13	Bone	Metatarsal		Y		
26	20	6	?Deer	?Antler		Y		
74	216	12	Cattle	Metatarsal	H	?		

Table 13: Bone-working waste group 2: 'ring offcuts' from lathe working by context. Not including ivory. Tool mark summaries are based on a preliminary examination Y denotes presence and H denotes extension of turning over only part of the length of the object. Accession numbers are repeated when multiple fragments are included.

The best guide to the range of products being manufactured are the more complete pieces. <28>, [20], and <36>, [4] are two partially complete objects, both lathe worked decorative bone cylinders. It is impossible to be certain of their function, and they could be bone handles. However, the presence of a threaded disc <20>, [20] of approximately the right diameter to fit their interior and an appropriately counter sunk end on <28>, [20] suggests closed cylindrical containers.

Needlecases <52>, [3] (cf Biddle 1990, 817, np 2532) and seem to be among the range of products and <63>, [3] from the same context is a knife faceted blank of the same skeletal element, probably a sheep/goat metatarsal, and is exactly the same length. There is little doubt that it was intended to be further worked into a similar object. <108>, [327] is a similar object made of ivory, perhaps broken during manufacture (cf Biddle 1990, 817, 2535).

A tortoiseshell roundel <50>, [3] is also probably an unfinished component, perhaps a lid inlay from a small decorative box. <73>, [216] a polished strip of bone with a bevelled end could be a broken artefact of some sort or waste inlay.

The remainder of the bone and ivory objects could relate to the manufacturing evidence or more general domestic waste. The remainder of the post-medieval finds are less informative but do provide helpful dating evidence. Two ivory or bone pistol grip handles <1>, [2] <49>, [3] are a form of 18th-century or later date which is most commonly found on cutlery handles of c AD 1725 to 1750 (Singleton 1973, 2f) and two further less chronologically diagnostic ivory handle fragments, <2>, [20] and <205>, [390] were also found. A number of cylindrical lathe turned container or handle fragments were recovered including :<130>, [492], <131>, [492] and <133>, [492]. Given their association with the bone working waste it is possible that these too were products of the local workshop.

While the bone working waste forms the major component, a ceramic wig curler is of later 18th-century date <9>, [20] (Le Cheminant 1978) and fragments of a tortoiseshell fan <3>, [2] could also belong to this period although this fragment cannot be dated more closely than post 16th-century. A copper-alloy double oval buckle <127>, [492] is also post-medieval although these come into fashion as early as the mid 16th-century and could be residual from an earlier period. Two furniture fittings, a handle <103>, [327] and an oval mount <101>, [327] are certainly post-medieval as well and the mount finds its closest parallels to 18th-century material.

Context [533] contained a concentration of short copper-alloy wound wire pins <179–182> of the type used in textile working as well as several lengths of bent or twisted wire <183–9>. The most interesting of these are two lengths bent back on themselves and twisted to form a doubly ply length of wire with a loop at one end <184> and <187>.

Several undatable items came from probable post-medieval contexts: a group of seven short copper-alloy tacks <203>, [533]; a fragment of a decorated copper-alloy object <5>, [20], a copper-alloy pin with a spherical head <72>, [216], a copper-alloy handle <128>, [492], possible from a small late medieval or post-medieval spoon part of a bone pin shaft <69>, [230] and an oval piece of lead <6>, [20] probably waste.

A highly corroded iron object <68>, [3] cannot be identified without x-ray and an iron washer <7>, [20] is of a non-diagnostic type. Both are probably post-medieval date from their contexts but they contribute little to our understanding of the site.

A post-medieval context [533] contained 7 bulk iron nails: 5 medium nails (55–60mm) and two larger examples measuring 72mm and 85mm.

18.6.2.4 Undated bulk finds

There are four bulk iron nails from currently undated contexts. Three came from [227]. Two are joined by a piece of mineral preserved wood and both measure 68mm, the third measures 61mm but is incomplete and was probably the same size. One came from [239] and measures 51.5mm.

Context	Material	Weight
708	Vitrified ceramic hearth fragment	21.5g
715	2 fragments of iron slag (magnetic)	28g
715	Probable smithing hearth bottom fragment	359.5g

A piece of bulk leather comes from [309]. It is a small scrap with one cut edge but no signs of stitching.

18.6.3 Potential and significance

The finds from XSM10 have the potential to assist the dating of the site with well dated finds of Roman and post-medieval date. The Roman and medieval finds are few and with the exception of the possible copper-alloy sheet working waste <87>, [300] are common types which in themselves have limited potential for characterising activity in these periods. However, the post-medieval bone-working waste is of great interest and offers excellent potential for exploring the economy of the area in the 18th-century and providing insights into post-medieval bone-working technology. This appears to be the largest group of this type from post-medieval London and is likely to be of national interest.

18.6.4 Recommendations

Little further work can be done on the Roman and medieval finds. The bone-working waste deserves to be studied in detail once the assemblage from the whole site has been drawn together. Examination of its stratigraphic relationship with the glass-working waste and with any structures, the use of documentary sources and maps and consideration in terms of changing land use, may also contribute to our understanding of the social and economic position of this industry. Comparison with other 18th-century bone and ivory working waste assemblages such as BGX05 would also be worthwhile. It should certainly form part of any future publication programme either as part of an article or monograph or depending on the significance of the other post-medieval evidence as a short article in its own right in a journal such as *Post-medieval Archaeology*.

All remaining metal objects should be x-rayed. A decorated post-medieval copper-alloy object <5>, [20] may warrant investigative conservation and a copper-alloy coin <4>, [3] from a post-medieval context should be identified.

18.6.5 Bibliography

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18.7 Human bone

Michael Henderson

Trench	No. contexts	No. boxes (Skeleton)
1	64	58
2	66	
7	63	38
13	22	12

Table 14: Human bone general summary

18.7.1 Introduction

This report contains an osteological evaluation of the surviving in situ articulated human remains excavated from Trench 1 (64 contexts), Trench 2 (66 contexts), Trench 7 (63 contexts) and Trench 13 (22 contexts). It also details the data gathered from the examination of disarticulated human bones from Trenches 1, 2, 6, 7, 9 and 13.

18.7.2 Methods

All articulated and disarticulated remains were examined following Museum of London Archaeology standards (Powers unpublished). The results were entered directly into an Excel spreadsheet with each context scanned to collate data for completeness and preservation. A summary catalogue recorded each body area present. Overall completeness was then estimated in 5% increments from 5-95% based upon the proportions of bone present (skull 20%, legs and feet 20%, arms and hands 20%, torso and pelvis 40%). Bone preservation was coded on a three point scale from good to poor (1-3) following Connell and Rauxloh (2003). Age and sex estimates were carried out when appropriate elements were present. Subadult age was estimated following observations of the stage of eruption of the permanent molars (Gustafson and Kock 1974) and epiphyseal fusion (Scheuer and Black 2000). An absence of dentition resulted in individuals scored as 'subadult' (age code 12). Element size was only considered for obvious foetal/neonatal individuals. An adult age category was assigned if epiphyseal fusion was complete and/or the third molars erupted. No attempt was made to more precisely age adult individuals. Adult sex was estimated through observations of cranial and pelvic morphology following (Buikstra and Ubelaker 1994), and recorded on a five point scale (Table 15).

Age code	0	Neonate/foetus
	1	1 month to 6 years (to M1 erupted)

	2	7 to 12 years (M2 unerupted)
	3	13 to 16 years (M3 unerupted)
	7	Adult
	12	Sub-adult (age unknown)
Sex code	1	Male
	2	? Male
	3	Intermediate
	4	? Female
	5	Female
	9	Undetermined
	0	Sub-adult

Table 15: Evaluation codes

Gross pathological changes and dental pathology were recorded by disease category following Connell and Rauxloh (2003). This was supplemented by brief descriptions of location and type where appropriate.

A note was made of bone condition and any staining present. Intrusive animal bone was separated from the human bone, when identified, and its presence recorded. Intrusive elements were noted and the minimum number of individuals (MNI) for each context estimated based on the presence of repeated elements, age, morphology and preservation.

Details of disarticulated bone were entered onto an excel spreadsheet catalogue. Long bones were recorded by shaft segment (proximal, medial and distal). Elements or segments were counted where at least 50% was present. This created a catalogue of bones present. Loose teeth, hand and foot bones were not catalogued. This allowed for the calculation of a MNI based on the presence of repeated elements. A note was made of any intrusive animal bone, staining or observations of any pathological conditions. Age was recorded where possible.

18.7.3 Results

A full summary of the disarticulated bone examined can be found in the appendix (Table 20).

18.7.3.1 Trench 1

Archaeological evaluation recovered 64 contexts of in situ articulated burials from Trench 1. The majority of the remains showed good levels of bone preservation with minimal erosion and fine surface details clearly visible (41/64: 64.1%). Moderate levels of preservation were identified in 22 burials (22/64: 34.4%), one context was poorly preserved (1/64: 1.6%). Green staining from contact with copper objects was present in 11 contexts (11/64: 17.2%) and iron fragments, most likely remnants of coffin fittings,

were found adhered to the bones of one individual (1/64: 1.6%). Subadult [345] had black staining to the cranial bones and adult [370] had an almost full head of blonde hair still attached to the skull. Intrusive animal bone was found in one context (1/64: 1.6%). The completeness of burials ranged from 5-95%. The majority of the assemblage (37/64: 57.8%) had $\geq 50\%$ of skeletal elements present with 31.3% (20/64) $\geq 75\%$ complete, and 16 $\leq 25\%$ complete (16/64: 25.0%). Intrusive skeletal elements were present in 26.6% contexts (17/64). The demographic analysis of the Trench 1 assemblage identified 38 adults (38/64: 59.4%) and 26 subadults (26/64: 40.6%) (Table 16). The pooled adult demographic data revealed a higher proportion of males (20/38: 52.6%) compared to females (9/38: 23.7%). It was not possible to estimate the biological sex of nine adults (9/38: 23.7%). The majority of subadults were aged between one month and six years at death (14/26: 53.8%), four individuals (4/26: 15.4%) were aged 13–17 years.

	n	%
Neonatal/foetal	2	3.1
1 month to 6 years	14	21.9
7-12 years	1	1.6
13-17 years	4	6.3
Subadult	5	7.8
Adult	38	59.4
Total	64	100.0

Table 16: Age distribution of articulated burials from Trench 1

The most commonly observed pathological bone change was dental disease. This affected 21 individuals (21/64: 32.8%), 17 adults (17/38: 44.7%) and four subadults (4/26: 15.4%). This comprised evidence of dental caries (cavities), calculus (calcified plaque), ante-mortem tooth loss, enamel hypoplasia (developmental crown defects) and dental abscesses. Adult male [436] had an edentulous maxilla, having lost all teeth during life, and subadult [380] displayed severe developmental defects to the molar tooth crowns. A rounded wear facet with associated black staining to the teeth of adult male [372] suggested habitual clay pipe smoking.

Degenerative joint disease was recorded in 14 adults (14/38: 36.8%). In all cases this affected the joints of the vertebral column and included evidence of Schmorl's nodes (herniations) osteoarthritis, osteophytes (new bone formation) and inter-vertebral disc disease (pitting).

Non-specific infectious bone changes affected two adults (2/38: 5.3%) comprising plaques of new bone formation (periosteal lesions). Female [457] had inflammation on the visceral (inside) surfaces of the ribs.

Evidence of traumatic injury was present in five individuals (5/64: 7.8%), four adults (4/38: 10.5%) and one subadult (1/26: 3.8%). Two adults had well healed fractures, including adult [388] with a fractured left distal tibia and fibula (ankle) with fusion of the broken shafts. Subadult [380] had a greenstick fracture of the right femur, possibly a complication of rickets.

Two adults (2/38: 5.5%) had evidence of circulatory bone disorders including osteochondritis dissecans in the articular surfaces of the joints. Adult male [438] had necrosis of the left and right femoral heads and possible congenital dislocation of the right hip. Bowing in the lower limbs of subadult [380] suggested they had suffered rickets at an earlier age.

Twenty-nine bags of disarticulated bone were recovered from the general cemetery soil. This produced a total MNI of 127 individuals, including 38 subadults and 89 adults. When combined with the articulated burials this produced an overall MNI of **191** individuals from Trench 1.

Brief observations of pathology were recorded in the disarticulated bone. As with the articulated burials, this included the presence of dental pathology and degenerative joint disease. Evidence of trauma comprised numerous healed fractures including a fractured left lower leg with fusion of the of the tibia, fibula, talus and calcaneum (ankle). There was also evidence of surgical intervention, an adult frontal bone had been cleanly sawn on a horizontal plane indicating a craniotomy. Fused vertebrae diagnostic of diffuse idiopathic skeletal hyperostosis (DISH) and evidence of metabolic disease (active and resolved rickets) and circulatory disorders (slipped femoral epiphyses) were also present in the disarticulated bone.

18.7.3.2 Trench 2

Sixty-six contexts of in situ articulated burials were lifted from Trench 2. Good levels of bone preservation were recorded in 48 contexts (48/66: 72.7%) and just over a quarter had moderate levels of preservation (17/66: 25.8%). One context was poorly preserved (1/66: 1.5%). Green copper staining was present in 8 contexts (8/66: 12.1%). Skeletal completeness ranged from 5-95% with 59.1% (39/66) of the assemblage \geq 50% complete and 34.8% (23/66) \geq 75% complete. Twenty contexts (20/66: 30.3%) were \leq 25% complete. Intrusive skeletal elements were identified in 22 (22/66: 33.3%) of the burials. Demographic analysis revealed a higher proportion of adults (50/66: 75.8%) than subadults (16/66: 24.2%). In contrast to the other trenches, the highest subadult mortality was recorded in the 13-17 year age category (8/16: 50.0%) (Table 17). The adult sex data demonstrated an almost even distribution of males (17/50: 34.0%) and females (15/50: 30.0%). Biological sex estimates were not possible for 18 adults (18/50: 36.0%).

	n	%
Neonatal/foetal	0	0.0
1 month to 6 years	4	6.1
7-12 years	1	1.5
13-17 years	8	12.1
Subadult	3	4.5
Adult	50	75.8
Total	66	100.0

Table 17: Age distribution of articulated burials from Trench 2

Twenty three individuals had evidence of dental pathology (23/66: 34.8%): 19 adults (19/50: 38.0%) and four subadults (4/16: 25.0%). One adult female had lost all the teeth of the mandible during life (1/66: 1.5%).

Degenerative joint disease was present in 14 adults (14/50: 28.0%). This affected the vertebrae of twelve adults (12/50: 24.0%). Osteoarthritis affected the extra spinal joints of three adults (3/50: 6.0%). Subcircular erosions in the margins of the heads of both great toes in adult [600] may have resulted from gout.

Adult male [512] had an erosive lesion in the anterior sacrum, possibly the result of neoplastic disease (1/50: 2.0%). Male [602] had healed osteochondritis dissecans to the joint surface of the medial femoral condyle. Two adults had congenital bone disorders (2/50: 4.0%), including male [656] with bilateral spondylolysis of the fifth lumbar vertebrae.

Non-specific infectious bone changes affected five adults (5/50: 10.0%). Male [516] had a large bulbous ossified mass in the right maxillary sinus, diagnostic of chronic sinusitis. Adult [470] had diffuse plaques of woven new bone formation on the left tibia together with a large erosive lesion on the anteromedial surface, possibly the result of an overlying soft tissue lesion such as a longstanding skin ulcer (Ortner 2003, 207).

Two adults had suffered traumatic injuries (2/50: 4.0%). Female [620] had a possible compression fracture of the 12th thoracic vertebra. Male [608] had a possible healed sharp force or penetrating injury on the left frontal bone. Bowed limb deformities indicating resolved rickets affected three individuals (3/66: 4.5%).

Seventy eight bags of disarticulated bone were recovered from Trench 2. This produced a total MNI of 261 individuals: 45 subadults and 216 adults. When combined with the articulated burials, the overall MNI for Trench 2 was **327**. The large volume of disarticulated bone when compared to the other trenches most likely reflects the high levels of disturbance through modern service installation in the area.

Pathological bone changes included dental disease, degenerative joint disease, including fusion of a left hip joint, cribra orbitalia, DISH, trauma (healed fractures, subluxation, ankylosis), non-specific infection and metabolic disease (active and resolved rickets).

18.7.3.3 Trench 7

Trench seven contained 63 contexts of in situ articulated burials. The majority of these (33/63: 52.4%) had good levels of bone preservation. Twenty nine contexts were moderately well preserved (29/63: 46.0%) and only one (1/63: 1.6%) was poorly preserved. Green staining was present in 11 (11/63: 17.5%) contexts. The completeness of the burials ranged from 15-95%, with 71.4% (54/63) of the assemblage $\geq 50\%$ complete and 49.2% (31/63) $\geq 75\%$ complete. Only nine contexts (9/63: 14.3%) were $\leq 25\%$ complete.

Just under half of the burials contained intrusive skeletal elements (31/63: 49.2%). The remainder comprised of single individuals only.

The demographic analysis of Trench 7 revealed a higher number of adults (51/63: 81.0%) than subadults (12/63: 19.0%) (Table 18). The adult sample contained a higher proportion of males (27/51:52.9%) compared to females (17/51:33.3%). It was not possible to establish the biological sex of seven adults (7/51: 13.7%).

	n	%
Neonatal/foetal	2	3.2
1 month to 6 years	3	4.8
7-12 years	2	3.2
13-17 years	3	4.8
Subadult	2	3.2
Adult	51	81.0
Total	63	100.0

Table 18: Age distribution of articulated burials from Trench 7

Dental disease represented the most prevalent pathological bone change recorded: this affected 35 individuals (35/63: 55.6%), 29 adults (29/51: 56.9%) and six subadults (6/12: 50.0%). There was evidence of carious lesions, ante-mortem tooth loss, calculus, enamel hypoplasia, periodontal disease and dental abscesses.

Degenerative joint disease affected 24 adults (24/51: 47.1%), this chiefly involved the joints of the vertebral column. Non-specific infectious bone changes were recorded in six adults (6/51: 11.8%), mainly comprising periosteal lesions. Male [164] exhibited bone lesions in the distal limbs and clavicles consistent with a diagnosis of venereal syphilis. Four males had healed fractures (4/51: 7.8%) and two individuals had lesions to the roofs of the orbits diagnostic of cribra orbitalia (2/63: 3.2%). Three adults (3/51: 5.9%) displayed evidence of possible tobacco smoking including black dental staining and a worn pipe facet observed in the teeth of male [150]. Subadult [64] aged 13-16 years had a wedge shaped lumbar vertebrae and congenital lateral curvature of the lower spine. Male [98] had regions of porosity and localised lytic erosions on the outer surface of the cranium, possibly representing a metastatic carcinoma.

Forty three bags of disarticulated bone were collected from the general cemetery soil. This produced a total MNI of 158 individuals: 36 subadults and 122 adults. When combined with the articulated burials, the overall MNI for Trench seven was **221**.

Brief observations of pathology were recorded in the disarticulated bone. As with the articulated burials, this included the presence of joint disease, dental disease, trauma and non-specific infection. The disarticulated bone also revealed bowed deformities to some limb bones suggesting metabolic disease (active and resolved rickets).

18.7.3.4 Trench 13

Twenty two contexts of in situ articulated burials were recovered from Trench 13. The majority of the assemblage was well preserved (20/22: 90.9%) with only two contexts showing moderate levels of preservation (2/22: 9.1%). Copper staining was present in six burials (6/22: 27.3%). Completeness ranged from 10-90% with 54.5% (12/22) ≥50% complete and 36.4% (8/22) ≥75% complete. Six contexts (6/22: 2.7%) were ≤25% complete. Intrusive elements were present in 40.9% (9/22) of the burials. The remainder

contained single individuals only. There were more adults (20/22: 90.9%) than subadults (2/22: 9.1%) and the pooled data revealed a slightly higher number of males (9/20: 45.0%) than females (6/20: 30.0%). Biological sex could not be determined for five adults (5/20: 25.0%) (Table 19).

	n	%
Neonatal/foetal	0	0.0
1 month to 6 years	1	4.5
7-12 years	0	0.0
13-17 years	1	4.5
Subadult	0	0.0
Adult	20	90.9
Total	22	100.0

Table 19: Age distribution of articulated burials from Trench 13

Pathological bone changes included dental disease: affecting 13 adults (13/20: 59.1%) and one subadult (1/2: 50.0%). Degenerative joint disease affected seven adults (7/20: 35.0%), three adults had non-specific infectious bone changes (3/20: 15.0%), three adults displayed evidence of trauma (3/20: 15.0%) and two adults had cribra orbitalia (2/20: 10.0%). Female [251] had a rounded mass of sclerotic bone to the right parietal (button osteoma) and probable female [220] had congenital fusion of two ribs (bifid rib).

Sixteen bags of disarticulated bone were collected from the general cemetery soil. This produced a total MNI of 48: 10 subadults and 38 adults. When combined with the articulated burials this produced an overall MNI of **70** from Trench 13.

Evidence of degenerative joint disease, dental disease and metabolic disease (active and resolved rickets) were observed in the disarticulated bone.

An additional context of human bone [318] consisting of a moderately well preserved adult left femur was recovered from a Roman layer underlying the later burials in Trench 13. This was not included in the above statistics and most likely reflects redeposited remains from disturbance of *Roman* burials within the area.

18.7.4 Conclusions

A minimum number of **215** in situ articulated burials were identified during archaeological evaluation: 64 burials from Trench 1, 66 from Trench 2, 63 from Trench 7 and 22 from Trench 13.

In addition, the analysis of the disarticulated bone produced estimates for minimum numbers of individuals of 127 from Trench 1, 261 from Trench 2, 26 from Trench 6, 158 from Trench 7, 26 from Trench 9 and 48 from Trench 13. This provided a total MNI of **646** individuals from the disarticulated bone.



The possible early 16th to 17th-century date of the burials, and their association with the Hospital of St Mary Bethlehem (Bedlam) will help to further our knowledge and understanding of a hitherto archaeologically underrepresented time period (Museum of London 2002, 72).

The investigation and osteological analysis of the buried population under modern archaeological conditions will contribute to our knowledge of a population who lived at a time of great change. An expanding city and population would have impacted on all areas of human life including health and disease. Comparisons can be drawn with contemporary assemblages in London and nationwide.

18.7.5 Bibliography

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Appendix: table of assessment data

Sitecode	Trench	Bone elements	MNI adult	MNI subadult	Total MNI	Pathology
XMS10	1	4731	89	38	127	Dental pathology, craniotomy, ankylosis: sternum-ribs, spinal joint disease, DISH, sacralisation: L5, ulna fracture, Colles' fracture, rickets, avulsion fracture, ankylosis: L. ankle, slipped femoral epiphyses
XMS10	2	8215	216	45	261	Dental pathology, cribra orbitalia, maxillary sinusitis, spinal joint pathology, DISH, subluxation: L. scapula, Colles' fracture, ulna fracture, resolved rickets, active rickets, greenstick fracture, ankle trauma

						osteitis, OA, ankylosis of L. hip joint,
XMS10	6	946	22	4	26	Resolved rickets, periostitis
XMS10	7	6654	122	36	158	Rickets, Colles' fracture, periostitis, osteitis, Fracture with secondary osteomyelitis, healed fracture, spinal joint disease, dental pathology
XMS10	9	1131	20	6	26	Rickets, osteitis, periostitis, healed fracture
XMS10	13	1772	38	10	48	Rickets, dental pathology, spinal joint disease
	Total	23449	507	139	646	

Table 20: Summary of disarticulated bone

18.8 Zoology

Alan Pipe

Animal Bone

HAND-COLLECTED AND WET-SIEVED ANIMAL BONE FROM BATCH 1 (Trenches 5, 6, 7, 9 and 13) C257 CROSSRAIL CENTRAL – BROADGATE TICKET HALL EVALUATION, LONDON EC2, CITY OF LONDON (XSM10)

18.8.1 Introduction and methodology

This report quantifies, identifies and interprets the animal bone recovered from hand-collected context groups [62], [74], [104], [108], [138], [142], [146], [150], [156], [160], [167], [208], [211], [212], [213], [214], [227], [230], [268], [298], [299], [301], [306] and [318]; and wet-sieved bulk samples [244] {9}, [283] {10}, [299] {11}, [306] <12> and [314] {14} at XSM10. All recovered animal bones were washed, air-dried and then bagged and labelled as context and sample groups.

Animal bone from each context was then described and recorded directly onto the MOLA animal bone post-assessment Oracle database in terms of species, skeletal element, body side, age, epiphysial fusion, dental eruption and wear, sex, fragmentation, modification and measurement of complete bones. Species and skeletal element were determined using the MOLA animal bone reference collection together with Schmid 1972. Evidence for age at death was derived from epiphysial fusion (Schmid 1972) and dental eruption and wear (Amorosi 1989). As far as possible, each bone fragment was assigned to species and skeletal element and recorded as an individual database entry. Unidentifiable long bone fragments were assigned to the approximate category 'cattle-sized' or 'sheep-sized' as appropriate. The complete sitecode assemblage is held on the Oracle post-assessment database for future reference and analysis with respect to available stratigraphic data.

Table 21 shows the overall assemblage catalogue in terms of species, skeletal representation, age at death and modification. All data are available for consultation on request on the Museum of London Archaeology Oracle animal bone post-assessment database.

18.8.2 Preservation and quantification (Table 21)

A total of 148 fragments, nine standard archive boxes, approximately 15 kg, of well-preserved animal bone were recorded from hand-collected and wet-sieved contexts. Maximum fragment size generally exceeded 75mm, with most bone in very good surface condition and all tool marks, gnawing evidence and fusion lines easily visible.

18.8.3 The fauna (Table 21)

The identifiable faunal assemblage included mainly ox (cattle) *Bos Taurus*, sheep/goat including sheep *Ovis aries* and horse *Equus caballus* with occasional chicken *Gallus gallus* [142], [156] and [283]; pig *Sus scrofa* and dog *Canis lupus familiaris* with single examples of adult mallard/domestic duck *Anas platyrhynchos* [213], red deer *Cervus elaphus* [299] and rabbit *Oryctolagus cuniculus* [283]. The remainder of the assemblage comprised fragments of unidentifiable 'cattle-sized' and 'sheep-sized' long bone and rib from [104], [142], [150], [208], [211], [213], [214], [306] and [314]. There was no recovery of fish, amphibians, scavengers or commensal species.

The majority of the assemblage derived from sub-adult and adult animals with occasional recovery of juvenile cattle, sheep/goat, pig and horse. Recovery of infant animals was confined to single bones of calf [212] and pig [208].

Contexts [211], [213] and [299] produced the largest context assemblages, respectively 19, 44 and 10 fragments. There was abundant, clear evidence of butchery on chicken, cattle, sheep/goat (including sheep) and pig. Tool mark evidence of preliminary horn working was seen on sheep horn cores from [212] and [213]; evidence of skinning was seen on a red deer metatarsal from [299].

Estimated statures can be calculated from complete, fully-fused limb long bones of horse [214] and [318]; and dog [213], [299] and [306].

18.8.4 The context groups

Context [211] produced 19 fragments derived mainly from adult cattle mandibles, vertebrae, ribs, scapula, radius and innominate with sheep/goat mandibles and single fragments of sheep/goat scapula and sheep metacarpal (fore foot), male pig canine tooth and adult horse radius/ulna (lower fore-leg). The cattle bone showed clear evidence of butchery.

Context [213] produced 44 fragments, the largest context group in the whole assemblage. The group included cattle, horse and sheep/goat with single fragments of adult mallard or domestic duck radius (wing) and adult dog tibia (shin). The cattle group mainly included adult mandibles (lower jaws), sub-adult shorthorn horn core, vertebra and rib. The horse bones included mainly adult elements of the head and fore-foot. The sheep/goat group was particularly distinctive in that it included mainly adult head elements with to 13 adult mandibles, a small group of adult sheep horn cores and single fragments of hyoid and scapula.

Context [299] produced ten fragments including single fragments of sheep/goat femur and caudal (tail) vertebra; pig tibia and juvenile metatarsal (hind-foot); horse mandible and juvenile radius; dog adult humerus and innominate. A single knife-cut red deer metatarsal provided the only recovery of this species from the whole assemblage.

18.8.5 Potential for further work

This small but very well-preserved assemblage indicates waste from three sources; each of these components of the assemblage has potential for further interpretation.

1. Primary processing, butchery and post-consumption waste mainly derived from consumption of chicken, beef, mutton and pork. The relatively large numbers of

predominantly adult cattle and sheep/goat mandibles offers some potential for study of age at slaughter. Although poultry and wild game were represented, they are relatively minor components of the assemblage.

2. Chopped adult sheep horn cores from [212] and particularly [213] indicate waste from preliminary preparation for removal of horn for further use as an industrial raw material.

3. Recovery of horse and dog bones indicates disposal of non-consumed domesticates. Contexts [213], [214], [299], [306] and [318] included complete limb long bones suitable for calculation of estimated statures as withers ('shoulder') heights.

Analysis of the assemblage, now completely recorded on the Oracle post-assessment database, with reference to stratigraphic evidence for dating and feature description, will allow full interpretation with respect to meat diet (selection of species, carcass-part, age and butchery), industrial activity (tools and techniques associated with horn preparation) and non-consumed domesticates (stature). The absence of small wild vertebrates prevents any comment on surrounding habitat and conditions.

18.8.6 Bibliography

Amorosi, T A, 1989 A post-cranial guide to domestic neo-natal and juvenile mammals: the identification and ageing of Old World species *BAR International series 533*

Schmid, E, 1972 *Atlas of animal bones for prehistorians, archaeologists and Quaternary geologists* London. Elsevier

18.8.7 Table

Table 21: Hand-collected and wet-sieved animal bone (Tr5, 6, 7, 9 and 13)

CONTEXT	SAMPLE	COMMON NAME	BONE	AGE	MODIFICATION	COMMENT	NOS.
62	0	sheep-sized	long bone				1
74	0	sheep/goat	femur				1
104	0	cattle-sized	rib				1
108	0	cattle-sized	vertebra, lumbar				1
138	0	cattle	phalange 2	adult			1
142	0	cattle-sized	long bone				1
142	0	cattle-sized	vertebra, lumbar				1
142	0	chicken	metatarsal				1
146	0	sheep/goat	femur	adult			1
146	0	sheep/goat	innominate	adult			2
146	0	sheep/goat	femur	adult			1
150	0	cattle-sized	long bone				1
150	0	sheep/goat	innominate				1
150	0	sheep-sized	vertebra, cervical	juvenile	butchery		1
156	0	chicken	femur	adult	butchery		1
156	0	sheep/goat	mandible				1
156	0	sheep-sized	vertebra, cervical	juvenile	butchery		1
160	0	sheep/goat	tibia				1
167	0	sheep/goat	radius				1
208	0	cattle	vertebra, cervical	juvenile			1
208	0	cattle-sized	rib				1



208	0	pig	tibia	infant			1
208	0	sheep-sized	long bone				1
211	0	cattle	vertebra, atlas	adult	butchery		1
211	0	cattle	mandible	adult			2
211	0	cattle	vertebra, axis	adult	butchery		1
211	0	cattle	scapula	adult	butchery		1
211	0	cattle	vertebra, cervical	adult	butchery		1
211	0	cattle	innominate	adult			1
211	0	cattle	radius		butchery		2
211	0	cattle	vertebra, lumbar				1
211	0	cattle-sized	rib				3
211	0	horse	radius+ulna	adult			1
211	0	pig	tooth	adult, male			1
211	0	sheep	metacarpal				1
211	0	sheep/goat	mandible	adult			2
211	0	sheep/goat	scapula				1
212	0	cattle	femur	adult	butchery		2
212	0	cattle	mandible	adult			6
212	0	cattle	metatarsal	infant			1
212	0	sheep	horn core	adult	butchery/working		4
212	0	sheep/goat	mandible	adult			1
213	0	cattle	mandible				1
213	0	cattle	mandible	young adult	butchery		1
213	0	cattle	mandible	adult	butchery		1
213	0	cattle	horn core	subadult		shorthorn	1
213	0	cattle	skull	adult	butchery		1
213	0	cattle	atlas vertebra				1
213	0	cattle	horn core	sub-adult		shorthorn	2
213	0	cattle	ulna				1
213	0	cattle-sized	vertebra, thoracic	juvenile			1
213	0	cattle-sized	rib				1
213	0	dog	tibia	adult			1
213	0	horse	skull	adult			1
213	0	horse	vertebra, cervical	adult			1
213	0	horse	skull				1
213	0	horse	mandible				1
213	0	horse	tooth	adult			6
213	0	horse	metacarpal				1
213	0	horse	skull				1
213	0	mallard/domestic duck	radius	adult			1
213	0	sheep	horn core	adult	worked		4
213	0	sheep/goat	hyoid				1
213	0	sheep/goat	mandible	adult			13
213	0	sheep/goat	scapula				1
214	0	horse	tooth				2
214	0	horse	femur				3
214	0	horse	innominate				1
214	0	ox-sized	rib				1
227	0	sheep/goat	humerus	adult			1
230	0	cattle	mandible		butchery		1
230	0	pig	radius		butchery		1



230	0	sheep/goat	radius	juvenile			1
244	9	pig	phalange 2	adult			1
268	0	pig	tibia		butchery		1
268	0	sheep/goat	scapula				1
283	10	chicken	sternum				1
283	10	chicken	humerus	adult			1
283	10	rabbit	femur				1
283	10	sheep/goat	innominate		butchery		1
283	10	sheep-sized	vertebra, lumbar				1
298	0	cattle	metacarpal		butchery		1
298	0	sheep	mandible	juvenile			1
298	0	sheep/goat	scapula		butchery		1
299	0	deer, red	metatarsal		working		1
299	0	dog	innominate				2
299	0	dog	humerus	adult			1
299	0	horse	radius	juvenile			1
299	0	horse	mandible	adult			1
299	0	pig	tibia				1
299	0	pig	metatarsal 3	juvenile			1
299	11	sheep/goat	femur	adult			1
299	11	sheep-sized	vertebra, caudal	sub-adult			1
301	0	cattle	vertebra, thoracic	sub-adult			1
301	0	horse	vertebra, cervical	adult			1
306	0	cattle-sized	rib				1
306	0	dog	humerus	adult			1
306	0	dog	radius	adult			1
306	0	dog	ulna	adult			1
306	12	sheep-sized	long bone				1
314	14	sheep-sized	long bone				1
318	0	horse	vertebra, atlas	adult			1
318	0	horse	femur	adult	butchery		1
318	0	horse	tibia	adult	butchery		1

18.9 Hand-collected and wet-sieved animal bone From Batch 2 (Trenches 1 and 2)

18.9.1 Introduction and methodology

This report quantifies, identifies and interprets the animal bone recovered from hand-collected context groups [339], [347], [372], [390], [399], [458], [507], [527], [533], [598], [651], [693], [697], [699], [700], [702], [703], [707], [714] and [715]; and wet-sieved bulk samples [708] {25}, [714] {27} and [715] {28} at XSM10. All recovered animal bones were washed, air-dried and then bagged and labelled as context and sample groups.

Animal bone from each context was then described and recorded directly onto the MOLA animal bone post-assessment Oracle database in terms of species, skeletal element, body side, age, epiphysial fusion, dental eruption and wear, sex, fragmentation, modification and measurement of complete bones. Species and skeletal element were determined using the MOLA animal bone reference collection together with Cannon 1987; and Schmid 1972. Evidence for age at death was derived from epiphysial fusion (Schmid 1972) and dental eruption and wear (Amorosi 1989; and Payne 1973). As far as possible, each bone fragment was assigned to species and skeletal element and recorded as an individual database entry. Unidentifiable vertebra, rib and long bone fragments were assigned to the approximate categories 'ox (cattle)-sized' or 'sheep-sized' as appropriate. The complete assemblage is held on Excel Table 22 and Table 23 for future reference and analysis with respect to available stratigraphic data.

18.9.2 Tables

Table 22 shows the assemblage summary in terms of weight, fragment count, fragmentation, preservation, faunal representation and recovery of ageing and metrical evidence

Table 23 shows the assemblage catalogue in terms of species, skeletal element, age, fragment count and modification.

All data are available for consultation on request on the Museum of London Archaeology Oracle animal bone post-assessment database.

Table 22: Hand-collected and wet-sieved animal bone (Tr1 and 2)/summary

DATE	CONTEXT	SAMPLE	WT (kg)	FRAG (mm)	PRES	NOS	LMAM	SMAM	FISH	BIRD	AMPH
	339	0	0.01	25-75	good	1	1	0	0	0	0
	347	0	0.02	25-75	good	2	1	0	0	1	0
	372	0	0.05	25-75	good	1	1	0	0	0	0
AD 1730-1760	390	0	0.2	>75	good	5	5	0	0	0	0
	399	0	0.05	>75	good	5	5	0	0	0	0
	458	0	0.05	>75	good	1	1	0	0	0	0
AD 1580-1600	507	0	2.35	>75	good	225	73	0	150	2	0
	527	0	0.1	25-75	good	4	4	0	0	0	0
	533	0	0.4	>75	good	7	7	0	0	0	0

	598	0	0.04	>75	good	1	1	0	0	0	0
AD 1580-1600	651	0	2.2	>75	good	25	25	0	0	0	0
AD 1480-1610	693	0	3.35	>75	good	8	8	0	0	0	0
AD 120-160	697	0	0.35	>75	good	3	3	0	0	0	0
AD 50-160	699	0	0.3	>75	good	3	3	0	0	0	0
AD 120-250	700	0	0.04	>75	good	1	1	0	0	0	0
AD 150-200	702	0	1.05	>75	good	2	2	0	0	0	0
AD 120-160	703	0	0.075	>75	good	1	1	0	0	0	0
AD 120-160	707	0	0.25	>75	good	4	4	0	0	0	0
AD 120-160	708	25	0.025	25-75	good	8	8	0	0	0	0
AD 140-160	714	0	2.3	>75	good	25	25	0	0	0	0
AD 140-160	714	27	0.1	>75	good	9	9	0	0	0	0
AD 140-160	715	0	0.25	>75	good	3	3	0	0	0	0
AD 140-160	715	28	0.05	25-75	good	8	8	0	0	0	0
TOTAL			13.61			352	199	0	150	3	0

Table 23: Hand-collected and wet-sieved animal bone (Tr1 and 2)/summary

CONTEXT	SAMPLE	TAXON	PART	AGE	NOS.	COMMENT
339	0	sheep-sized	vertebra, thoracic	adult	1	split
347	0	chicken	rib		1	
347	0	sheep/goat	vertebra, atlas	adult	1	split
372	0	ox (cattle)	tibia	adult	1	
390	0	sheep/goat	scapula	adult	2	
390	0	sheep/goat	humerus		1	
390	0	sheep/goat	innominate	adult	1	chopped/male
390	0	sheep/goat	vertebra, lumbar	adult	1	split
399	0	cat	humerus		1	
399	0	pig	innominate		1	
399	0	sheep/goat	tibia		1	
399	0	sheep/goat	calcaneum	adult	1	
399	0	sheep-sized	vertebra	juvenile	1	split
458	0	sheep/goat	scapula		1	
507	0	cod (family)	vertebra		20	
507	0	cod (family)	rib		50	
507	0	cod (family)	fin ray		80	
507	0	deer, fallow	radius	adult	1	
507	0	goose	metatarsal	adult	1	chopped
507	0	mallard/domestic duck	ulna	adult	1	
507	0	ox (cattle)	skull	adult	1	>4.0 years
507	0	ox (cattle)	skull+horn cores	adult	1	chopped (worked)/medium horn
507	0	ox (cattle)	scapula	adult	2	chopped
507	0	ox (cattle)	mandible	adult	1	chopped
507	0	ox (cattle)	innominate	adult	1	chopped/male
507	0	ox (cattle)	innominate	adult	1	chopped
507	0	ox (cattle)	radius	adult	1	chopped
507	0	ox (cattle)	metatarsal		1	worked (pinner's bone?)
507	0	ox-sized	vertebra, lumbar	subadult	3	chopped
507	0	ox-sized	rib		2	chopped
507	0	ox-sized	vertebra, thoracic		2	chopped

507	0	pig	tibia	juvenile	1	chopped
507	0	pig	scapula	infant	1	
507	0	pig	tibia	infant	1	
507	0	rabbit	femur	adult	1	
507	0	rabbit	tibia	adult	1	
507	0	sheep	skull		1	hornless
507	0	sheep	skull		2	decapitated/split
507	0	sheep	horn core	adult	1	chopped/worked
507	0	sheep/goat	mandible	adult	1	3.0-4.0 years
507	0	sheep/goat	femur	juvenile	1	
507	0	sheep/goat	tibia	juvenile	1	chopped
507	0	sheep/goat	radius	adult	1	chopped
507	0	sheep-sized	rib		2	
527	0	ox (cattle)	tibia	juvenile	1	
527	0	ox (cattle)	mandible		1	
527	0	sheep/goat	vertebra, atlas		1	split
527	0	sheep/goat	vertebra, cervical		1	split
533	0	cat	humerus	adult	2	
533	0	ox (cattle)	radius	adult	1	split
533	0	ox (cattle)	vertebra, lumbar	subadult	1	split
533	0	pig	vertebra, cervical	juvenile	1	
533	0	pig	vertebra, thoracic	juvenile	1	
533	0	sheep/goat	humerus	juvenile	1	
598	0	sheep/goat	mandible	adult	1	
651	0	ox (cattle)	mandible	adult	1	>4.0 years
651	0	ox (cattle)	mandible	adult	1	>4.0 years/chopped
651	0	ox (cattle)	mandible	adult	1	>4.0 years/chopped
651	0	ox (cattle)	vertebra, atlas	adult	1	decapitated
651	0	ox (cattle)	vertebra, atlas	adult	2	split
651	0	ox (cattle)	skull	adult	1	split
651	0	ox (cattle)	vertebra, axis	subadult	1	split
651	0	ox (cattle)	sacrum	adult	1	split
651	0	ox (cattle)	mandible	juvenile	1	
651	0	ox-sized	rib		2	chopped
651	0	pig	mandible	juvenile	1	
651	0	pig	scapula	juvenile	1	
651	0	rabbit	femur	adult	1	
651	0	sheep	skull+horn core	adult	1	split
651	0	sheep	skull+horn core	adult	1	split/horn core chopped lateral
651	0	sheep/goat	hyoid	adult	1	
651	0	sheep/goat	mandible	adult	2	4.0-6.0 years
651	0	sheep/goat	mandible	adult	2	
651	0	sheep/goat	radius		1	chopped
651	0	sheep-sized	rib		1	
693	0	ox (cattle)	skull+horn cores	adult	1	chopped (worked)/medium horn
693	0	ox (cattle)	mandible	adult	1	>4.0 years
693	0	ox (cattle)	skull	adult	1	>4.0 years
693	0	ox (cattle)	radius	adult	1	subadult
693	0	ox (cattle)	horn core	subadult	1	chopped (worked)/medium horn
693	0	ox (cattle)	horn core	adult	1	chopped (worked)/medium horn
693	0	sheep	skull+horn cores	adult	1	chopped (worked)



693	0	sheep/goat	innominate	adult	1	male
697	0	ox (cattle)	tibia	adult	1	split
697	0	ox (cattle)	vertebra, cervical	adult	1	
697	0	ox-sized	rib			chopped
699	0	ox (cattle)	vertebra, cervical	adult	1	chopped
699	0	ox (cattle)	tooth, maxillary	adult	1	
699	9	dog	femur	adult	1	0.647 m shoulder height
700	0	dog	mandible	adult	1	
702	0	horse	metacarpal	adult	1	
702	0	horse	mandible	adult	1	
703	0	ox-sized	rib		1	chopped
707	0	ox (cattle)	radius	adult	1	chopped
707	0	ox (cattle)	ulna	adult	1	
707	0	sheep/goat	tibia		2	
708	25	dog	tooth, mandibular	adult	1	
708	25	ox (cattle)	tooth	adult	1	
708	25	sheep/goat	maxilla	adult	1	
708	25	sheep-sized	rib		2	
714	0	dog	mandible	adult	1	
714	0	dog	mandible	juvenile	1	
714	0	horse	rib	adult	1	
714	0	horse	metapodial		1	
714	0	human	ulna	adult	1	
714	0	human	rib		1	
714	0	ox (cattle)	innominate	adult	1	
714	0	ox (cattle)	mandible		1	chopped
714	0	ox (cattle)	radius	adult	1	split
714	0	ox (cattle)	metatarsal	adult	1	
714	0	ox (cattle)	metacarpal	adult	1	
714	0	ox (cattle)	radius	adult	1	chopped
714	0	ox (cattle)	femur		1	chopped
714	0	ox (cattle)	vertebra, thoracic	juvenile	1	chopped
714	0	ox (cattle)	vertebra, cervical	juvenile	1	chopped
714	0	ox (cattle)	phalange 1	adult	1	
714	0	ox (cattle)	sacrum		1	
714	0	ox (cattle)	skull		1	
714	0	ox (cattle)	mandible	adult	1	
714	0	ox (cattle)	scapula	adult	2	chopped
714	0	ox (cattle)	scapula	adult	1	chopped/hole through blade
714	0	ox-sized	rib		6	chopped
714	0	pig	skull	subadult	1	
714	0	sheep	metatarsal	adult	1	
714	0	sheep/goat	metatarsal		1	
714	0	sheep/goat	metacarpal		1	
714	0	sheep/goat	mandible	adult	1	2.0-3.0 years
714	27	ox-sized	rib		5	chopped
714	27	pig	metapodial		1	
714	27	pig	femur		1	chopped
714	27	sheep-sized	rib		2	
715	0	ox (cattle)	radius	adult	1	chopped
715	0	ox-sized	rib		1	

715	0	pig	humerus		1	
715	28	duck, unidentified	tibia		1	
715	28	ox (cattle)	tibia	juvenile	1	split
715	28	ox-sized	rib		1	chopped

18.9.3 Preservation and quantification (Table 22)

A total of 13.610 kg/352 fragments, seven standard archive boxes, of well-preserved animal bone were recorded from hand-collected and wet-sieved contexts. Maximum hand-collected fragment size generally exceeded 75mm, with most bone in very good surface condition, and all tool marks, gnawing evidence, tooth wear and fusion lines easily visible. Preliminary dating evidence available at time of writing indicates Roman dates for [697], [699], [700], [702], [703], [707], [708], [714] and [715]; 217, [258], [262] and [276]; 16th-century dates for [250] and [251]; and probable post-medieval dates for the remainder.

18.9.4 The fauna (Table 23)

The identifiable faunal assemblage included mainly ox (cattle) *Bos taurus* and sheep/goat including sheep *Ovis aries* with occasional recovery of pig *Sus scrofa* [399], [507], [533], [651], [714] and [715] and single examples of chicken *Gallus gallus* [347], goose *Anser anser* [507] and mallard or domestic duck *Anas platyrhynchos* [507]. Measurable cattle horn cores ranged between 220-360 mm on the outer curve and therefore indicated 'medium-horn' cattle (Armitage 1982, 43). Non-consumed domesticates included horse *Equus caballus* [702] and [714]; dog *Canis lupus familiaris* [699], [700], [708] and [714]; and cat *Felis catus* [399] and [533]. Wild 'game' species were extremely sparsely-represented; wild duck Anatidae [715], fallow deer *Dama dama* [507]; and rabbit *Oryctolagus cuniculus* [507] and [651]. The remainder of the assemblage comprised fragments of unidentifiable 'cattle-sized' and 'sheep-sized' long bone and rib from [104], [142], [150], [208], [211], [213], [214], [306] and [314]. There was no recovery of amphibians, scavengers or small mammals. A very small fish assemblage included fragmented bones of cod (family) Gadidae only [507].

Single examples of human adult rib and ulna (fore-arm) were recovered from [714].

The major domesticates were represented by all skeletal areas although cattle and sheep/goat showed a definite bias towards elements of the head and foot, although toe bones were very sparsely-recovered. In general, carcass-part representation suggests that the groups represent a combination of waste derived from primary carcass processing, butchery and consumption.

The major domesticate assemblage; cattle, sheep/goat and pig, derived from adults and juveniles with infant pig from [507] only and no recovery of foetal or neonate animals.

There was abundant, clear evidence of butchery on cattle with only occasional examples on sheep/goat and pig; all butchery involved use of cleavers only with no obvious use of knives or saws. Chop marks at the bases of cattle and sheep horn cores provided definite tool-mark evidence for preliminary horn removal in preparation for further horn-working. This was seen on 'medium-horn' cattle horn cores from [507] and [693]; and sheep horn cores from [507], [651] and [693]. A cattle metatarsal (hind foot) from [507] had been shaped into a pinner's bone, which had probably then been discarded at the

end of its functional life. A cattle scapula (shoulder blade) from [714] showed a hole driven through the 'blade' from the medial ('inner') side, probably indicating suspension from a butcher's hook for display.

The remainder of the assemblage largely comprised fragments of unidentifiable 'cattle-sized' and 'sheep-sized' long bone and rib from the majority of hand-collected and wet-sieved context and sample groups.

There was no recovery of scavengers, commensal species or small wild vertebrates.

There was no evidence for canine or rodent gnawing, burning or pathological change.

Hand-collected context groups ranged between 0.010 kg-3.350 kg/fragment counts 1-225; wet-sieved sample groups ranged between 0.025-0.100 kg/fragment counts 8-9. Contexts [507], [651] and [714] produced the largest fragment counts, respectively 255, 25 and 25 fragments, with all other context/sample groups producing nine fragments or fewer.

18.9.5 The groups (Table 22 and Table 23)

- Context [339] produced a fragment of sheep-sized thoracic vertebra.
- Context [347] produced 0.020 kg, single fragments of chicken rib and adult sheep/goat atlas vertebra.
- Context [372] produced 0.050 kg, an adult cattle tibia (shin).
- Context [390] produced 0.200 kg/five fragments of adult sheep/goat vertebra and upper fore- and hind-leg.
- Context [399] produced 0.050 kg/five fragments derived from sheep/goat vertebra, upper fore-leg and lower hind-leg with a single humerus (upper fore-leg) of cat.
- Context [458] produced 0.050 kg, a sheep/goat scapula (shoulder blade).
- Context [507] produced 2.350 kg/225 fragments, by far the largest and most species-diverse bone group. The fragment count derived mainly from fish of the cod family; vertebrae, ribs, fin spines and fin rays; with adult 'medium-horn' cattle and sheep/goat skull, vertebra, upper and lower leg and hind-foot; pig infant scapula (shoulder blade) and infant and juvenile tibia (shin) with single fragments of goose metatarsal (foot), mallard/domestic duck ulna (wing), adult fallow deer radius, and adult rabbit femur and tibia (hind-leg). Dental evidence from cattle skull and sheep/goat mandible (lower jaw) indicates animals of at least five and the four years of age.
- Context [527] produced 0.100 kg/four fragments comprised of single examples of cattle mandible and calf tibia (shin); and sheep/goat atlas and cervical (neck) vertebrae.
- Context [533] produced 0.400 kg/seven fragments comprised of two adult cat humeri (upper fore-legs) with single fragments of cattle radius (lower fore-leg) and lumbar (lower back) vertebra; juvenile sheep/goat humerus (upper fore-leg); and juvenile pig thoracic and lumbar (upper and lower back) vertebrae.

- Context [598] produced 0.040 kg/a fragment of adult sheep/goat mandible (lower jaw).
- Context [651] produced 2.200 kg/25 fragments derived mainly from adult cattle and sheep/goat. They included four cattle mandibles, a calf and three adults in at least the fifth year, cattle atlas, axis and sacral vertebrae; sheep/goat horn core, skull, mandibles including two from adults between four and six years old, and radius. There were also single fragments of juvenile pig mandible and scapula (shoulder blade). Wild 'game' species were represented by an adult rabbit femur (thigh bone).
- Context [693] produced 3.350 kg/eight fragments derived mainly from cattle horn core, skull and mandible with single fragments of adult sheep skull and male sheep/goat innominate (pelvis). Dental evidence from cattle skull and mandible indicates animals in at least the fifth year. All cattle horn cores derived from 'medium-horn' animals; three horn cores have had been chopped at the base as preparation for removal of the horn sheath.
- Context [697] produced 0.350 kg/single fragments of adult cattle cervical (neck) vertebra, rib and tibia (shin).
- Context [699] produced 0.300 kg/single examples of cattle tooth and cervical (neck) vertebra; and adult dog femur (thigh bone). Measurement of the dog femur allowed calculation of an estimated shoulder height of 0.647 metres.
- Context [700] produced 0.040 kg/a mandible of an adult dog.
- Context [702] produced 1.050 kg/two fragments of adult horse; a mandible (lower jaw) and a metacarpal (fore-foot).
- Context [703] produced 0.075 kg/a fragment of cattle rib.
- Context [707] produced 0.250 kg/four fragments; single examples of adult cattle radius and ulna (lower fore-leg) and two fragments of sheep/goat tibia (shin).
- Context [708] {25} produced 0.025 kg/eight fragments derived from single examples of cattle tooth; adult sheep/goat maxilla (upper jaw) and dog mandibular tooth with fragments of sheep-sized rib.
- Context [714] and sample {27} produced 2.4 kg/34 fragments derived from mainly from adult cattle with smaller groups of sheep/goat, pig, horse and dog. The cattle group included fragments of mandible (lower jaw), rib, scapula (shoulder blade) and radius (lower fore-leg) with single examples of skull, cervical and thoracic vertebra, innominate (pelvis), femur (thigh), metacarpal (fore-foot), metatarsal (hind-foot) and phalange (toe). Sheep/goat produced fragments of rib with an adult mandible with an adult metacarpal and two adult metatarsals (fore- and hind-foot); pig produced single fragments of skull, femur (thigh bone) and metapodial (foot). Dental evidence from the sheep/goat mandible indicated a third-year animal. Horse and dog produced single fragments of rib and metapodial (foot); dog produced single adult and juvenile mandibles.
- The hand-collected group included single fragments of human rib and adult ulna (lower fore-arm).

- Context [715] and sample {28} produced 0.300 kg/11 fragments including single examples of cattle rib, adult radius (lower fore-leg) and calf tibia (shin); and pig humerus (upper fore-leg). Wild 'game' species comprised a wild duck tibia (drumstick) only.

18.9.6 Interpretation

This small but very well-preserved assemblage includes waste from three sources; each of these components of the assemblage has some potential for further analysis and interpretation.

1. There is a substantial group of horn cores and foot elements derived from primary processing of cattle and sheep/goat carcasses. Clear basal chop marks on 'medium-horn' cattle and sheep horn cores suggest that these elements were removed for primary horn-working elsewhere.

2. Butchery and post-consumption waste provide the bulk of the remainder of the hand-collected and wet-sieved assemblage. Cattle and sheep/goat head, vertebrae and limb long-bones provide the bulk of the assemblage indicating a meat-diet biased heavily towards beef and mutton from carcass areas of moderate and prime meat-bearing quality; head, vertebrae, rib, upper and lower fore- and hind-leg probably suggesting some degree of affluence. Evidence from dental eruption and wear and epiphyseal fusion indicates definite selection of adult cattle, in many cases in at least the fifth year, and adult sheep, with no evidence for consumption of veal or lamb in addition to beef and mutton. By comparison, the very sparse recovery of juvenile and adult pig bones suggest only relatively occasional consumption of pork. Similarly, poultry (including chicken, goose and mallard or domestic duck) and wild 'game' (fallow deer and rabbit) provided only minor components of the meat diet. There were no groups of very young animals and no evidence for local stock-keeping.

3. Sparse recovery of horse, dog and cat bones indicates very limited disposal of non-consumed domesticates. Again, none of these species showed knife-cuts linked to hide removal and there is no evidence that they represent anything other than occasional carcass disposal.

Analysis of the assemblage with reference to full stratigraphic data and feature descriptions, would allow more detailed interpretation with particular respect to meat diet including selection of species, carcass-part, age-group and butchery tools and techniques.

18.9.7 Bibliography

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INVERTEBRATE FAUNA FROM C257 CROSSRAIL CENTRAL – BROADGATE TICKET HALL EVALUATION, LONDON EC2, CITY OF LONDON (XSM10)

Introduction and methodology

Wet-sieving and flotation of bulk samples yielded seven samples; [231] {7}, [237] {2}, [239] {3}, [244] {9}, [283] {10}, [299] {11} and [314] {14} showing diverse terrestrial and freshwater invertebrate faunas. Visual inspection, using a binocular microscope, indicated that sample [299] {11} provided the largest assemblage, several thousand mollusc shells, mainly of freshwater species, with the other samples including smaller numbers of some or all of the same species. For sample [299] {11}, preliminary identifications were made in an attempt to establish faunal composition and to determine the potential for further identification to species level to provide useful ecological information. Preliminary identification followed Cameron & Redfern 1976; and Macan 1977. This short report summarises the molluscan fauna for this sample in terms of the number of identifiable species present, identification to species or genus level was only done when the remains were particularly visually distinctive. Table 1 shows all identifiable species for each sample.

The fauna

Sample [299] {11} produced a diverse invertebrate fauna composed of terrestrial and freshwater molluscs.

Terrestrial molluscs provided less than 1% of the shell count. Glass snail *Oxychilus sp* is a terrestrial mollusc abundant and widespread in moist, sheltered habitats throughout southern Britain (Kerney 1990, 143-6). Whorl snail *Vertigo sp*, probably marsh whorl snail *Vertigo vertigo*, is a lowland wetland species mainly avoiding places with marked fluctuations in water level (Kerney 1990, 92). Amber snails in the family Succineidae are widespread wetland species found in damp, sheltered conditions throughout lowland Britain; they are virtually amphibious and able to tolerate long periods of submersion (Kerney 1990, 75-9).

Freshwater species provided the bulk, at least 99%, of the shell count, of the mollusc fauna. They derived mainly from at least eight species of ram's-horn snails Planorbidae and three species of pond snails Lymnaeidae. The pond snails mainly included dwarf pond snail *Lymnaea truncatula* with smaller numbers of two other species, probably common/wandering pond snail *Lymnaea peregra* and marsh pond snail *Lymnaea palustris*. Dwarf pond snail inhabits marshy grassland and shallow ephemeral ponds (Kerney 1990, 51); common/wandering pond snail is ubiquitous in freshwater habitats of all kinds (Kerney 1990, 56); marsh pond snail is a mainly lowland species living in stagnant or slowly moving water including those liable to summer drying (Kerney 1990, 53).

In addition, moss bladder snail *Aplexa hypnorum* was also identified; this is a small species typical of swampy pools and ditches and able to survive periodic desiccation (Kerney 1999, 48).

Both the Planorbidae and Lymnaeidae show considerable *inter*-specific differences in terms of their ecological requirements.

Preliminary examination produced no ostracod valves.

Potential for further work

Identification of all mollusc species in samples [231] {7}, [237] {2}, [239] {3}, [244] {9}, [283] {10}, [299] {11} and [314] {14} will allow interpretation of ecological conditions indicated by each sample, particularly in terms of vegetation, water flow, water quality and liability to seasonal desiccation, and will clearly highlight any ecological differences between the sample groups. Identification will follow Cameron & Redfern 1976; and Macan 1977. Ecological interpretation will follow Davies 2008; and Kerney 1990.

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Table

Table 24: Wet-sieved/floated Invertebrates from XSM10 [299] {11}/preliminary identifications

CONTEXT	SAMPLE	MOLLUSCS (TERRESTRIAL)	MOLLUSCS (FRESHWATER)	OSTRACODS	HABITAT
299	11	<i>Vertigo sp</i>			moist/sheltered
299	11	<i>Oxychilus sp</i>			moist/sheltered
299	11	Succineidae species 1			wetland
299	11		<i>Aplexa hypnorum</i>		freshwater
299	11		Planorbidae species 1		freshwater
299	11		Planorbidae species 2		freshwater
299	11		Planorbidae species 3		freshwater
299	11		Planorbidae species 4		freshwater
299	11		Planorbidae species 5		freshwater
299	11		Planorbidae species 6		freshwater
299	11		Planorbidae species 7		freshwater
299	11		Planorbidae species 8		freshwater
299	11		<i>Lymnaea truncatula</i>		freshwater
299	11		<i>Lymnaea peregra</i>		freshwater
299	11		<i>Lymnaea palustris</i>		freshwater

18.10 Environmental

Anne Davis

N.B. The information contained within this report is preliminary assessment data, and may be modified in the light of detailed analytical work. It should not be quoted without the permission of the author, or Head of Service.

Methodology

Nineteen environmental bulk samples have been taken from trenches 1, 2, 7 and 13. They came from a range of deposits, including dumps and fills of pits and ditches, all except one thought to date from the Roman period. The samples were processed by flotation, and the wet flots evaluated to determine the presence and nature of any plant remains and other biological material present.

Results

Five samples produced no flots, but all the remainder produced large assemblages of organic plant and invertebrate remains.

Trench 1: Remains of a variety of aquatic plants and invertebrates were seen in samples from fills [707]{24} and [708]{25} of ditch [710], indicating the water-filled nature of this feature.

Plant remains from two further samples, from fill [714]{27} of pit [713] and dump deposit [715]{28}, came mostly from plants of dry-ground habitats, with the former including several food plants.

Trench 2: a small assemblage of aquatic and wetland plants, and many molluscs, was seen in a sample from fill [697]{20} of linear feature [698].

Trench 7: Samples [237]{2} and [239]{3}, from fills of parallel ditches [229] and [240] respectively, contained large assemblages of waterlogged seeds, mainly from aquatic and wetland habitats, indicating that the ditches were water-filled for much of the year. Each also contained seeds of several dry-ground plants, and a very small number of seeds from food plants. Mollusc shells were common in both samples. A mixture of remains from wet and dry ground plants was seen in sample [244]{9}, also from ditch [240]. Preservation was less good in sample [231]{7}, from silty clay flood deposits, but again seeds of both wet and dry habitats were seen, as well as many mollusc shells.

Trench 13: Samples [306]{12} and [309]{13}, from fills of ditch [310] and its re-cut [308], each contained substantial numbers of waterlogged wetland plant remains, but also

many stem fragments, several wheat (*Triticum* sp.) glume bases, and seeds of plants from disturbed and also grassy habitats. Complete cereal caryopses were also seen in sample {13}. The nature of these assemblages suggests that they may contain stabling waste. A smaller range of taxa was seen in fill [314]{14}, but again containing wheat glume bases as well as seeds of wet and disturbed ground.

Another assemblage of mixed wet and dry ground plants was seen in organic deposit [299]{11}, with an exceptionally large assemblage of molluscs.

Very few remains of wetland plants were seen in sample [283]{10}, a post-medieval organic deposit, which contained many stem fragments and numerous seeds of hemp (*Cannabis sativa*), along with mainly weeds of arable and/or waste ground. Fly puparia, characteristic of rotting organic matter, were also abundant. Hemp was cultivated for the use of its stem fibres in textile manufacture, and its seeds were crushed to extract oil.

Faunal remains

Fragments of beetle exoskeleton were seen in eleven of the samples, and molluscs were abundant in seven and moderately so in two. Three of these also contained large ostracod assemblages.

Potential

All these samples contain plant assemblages worthy of further analysis, and would provide potentially useful information primarily on the natural environment of the site and of individual features. Analysis of the insect, mollusc and ostracod remains from some or all of the richer samples would maximise the potential of the samples for environmental reconstruction. Samples {10}, {12} and {13} (all from Trench 13) may also indicate agricultural and industrial activities taking place on or near the site.

Table 25: Summary of environmental assessment data (1 = occasional, 2 = moderate, 3 = abundant)

trench	context	sample	feature	period	Dating	Proc	Flot	Proc	CHD	CHD	CHD	CHD	WLG	WLG	Comments
									Grain	Chaf	Seeds	Wood	Seed	Misc	
						Vol.	Vol.		A D	A D	A D	A D	A D	A D	
1	707	24	fill ditch 710	Rom?	0-0	30	30	F				1 1	3 3	3 1	WET. AQUATIC PLANT REMS & INVERTS
1	708	25	fill ditch 710	Rom?		20	100	F		1 1		1 1	3 3	3 3	WET.AQUATIC/WETLAND PLANTS & INVERTS
1	709	26	fill pit 713			30									NO FLOT
1	715	28	dump deposit	Rom?		30	20	F		1 1	1 1	3 1	3 2	1 1	DRY. MOSTLY DRY GRND PLANTS & RANSC
1	712	29	clay			30									NO FLOT
1	714	27	fill pit 713	Rom?	0-0	30	500	F			1 1	3 1	3 3	3 3	WET.WOODY, FEW FOODS, MOSTLY DRY SPP.
2	695	19	Fill cut 696			40									NO FLOT
2	697	20	fill linear feature 698	Rom?	0-0	40	10	F	1 1	1 1		1 1	3 3		DRY. AQUATIC/WETLAND PLANTS, MOLLUSCS
2	698	18	cut			40									NO FLOT

			number?												
7	231	7	dump	Rom?	120 to 160	5	20	F				1 1	3 2		WET. MOD PRES. WET & DRY GRND PLANTS
7	237	2	fill ditch 229	Rom?		30	10	F					3 3	2 2	WET. WETLAND/AQU PLANTS, MOLLUSCS
7	239	3	fill ditch 240	Rom?	150 to 300	30	100	F				1 1	3 3	2 2	WET.MOSTLY WETLAND PLANTS, SOME DRY
7	244	9	fill ditch 240	Rom?	50 to 400	5	100	F				2 1	3 3	3 1	WET.ROOT? EPIDERMIS, WET & DRY GRNDSEEDS
13	283	10	org deposit	pmed?	1550 to1600	30	250	F					3 2	3 2	WET. MANY HEMP SEEDS. DISTBD, FEW WET PL
13	299	11	org deposit	Rom?	120 to 250	30	200	F				1 1	3 3	1 1	WET,&DRY WASTELAND PLANTS. V MANY SNAILS
13	306	12	fill ditch 310, recut 308	Rom?	0-0	20	300	F				1 1	3 3	3 3	WET.WET, & DRY DISTBD GND SEEDS
13	309	13	fill ditch 310	Rom?	140 to 160	20	800	F				1 1	3 3	3 3	WET.MOSTLY DRY GRND PL - STABLE WASTE?
13	314	14	fill ditch 310, recut 308	Rom?		15	100	F				1 1	3 3	3 3	WET. WET & DRY GROUND PLANTS
13	315	15	fill ditch 310	Rom?		20									NO FLOT

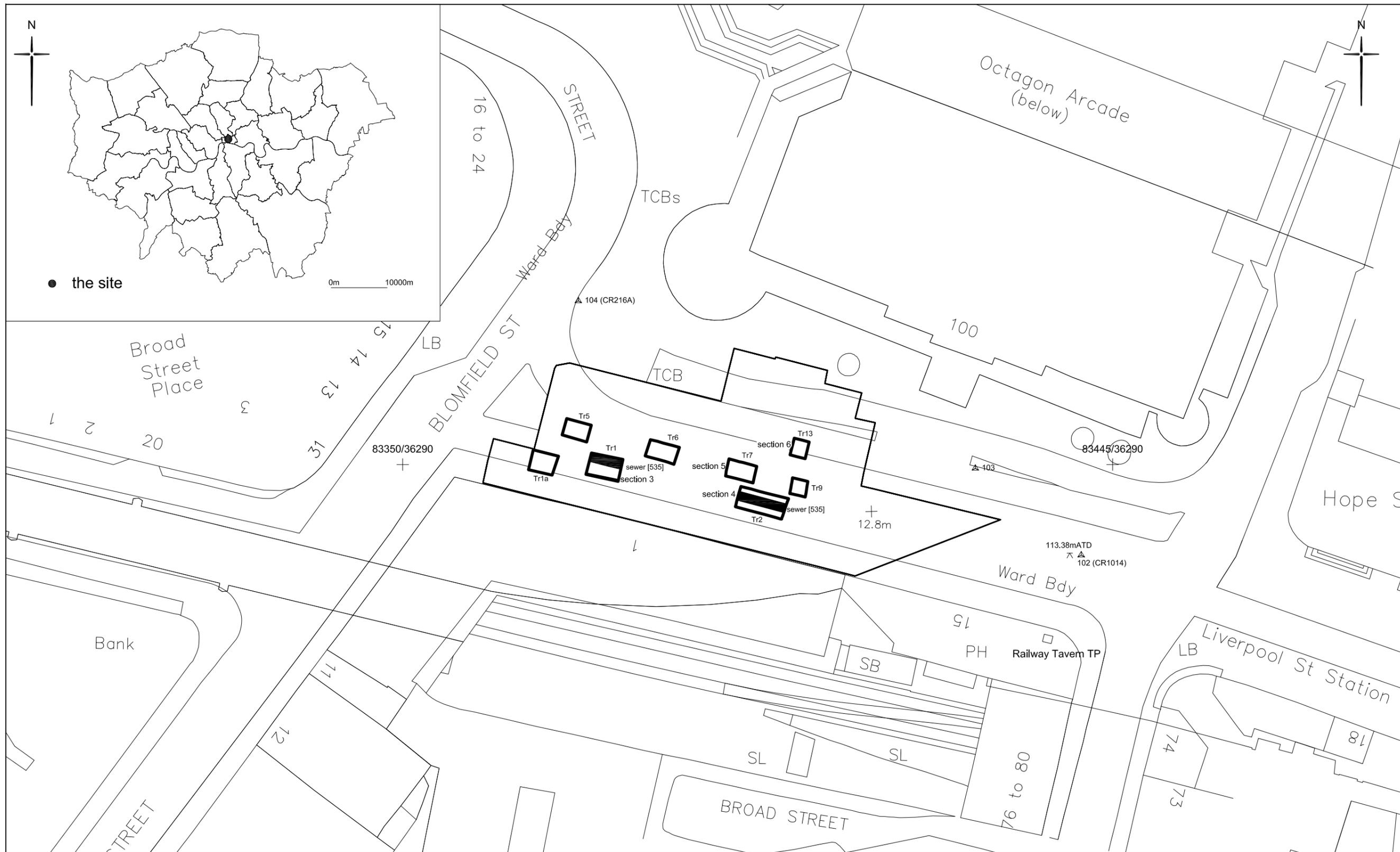


Figure 1 Location of archaeological investigations including the location of sewer [535]

- site outline
- areas of archaeological investigation
- sections
- TBMs
- Crossrail derived control

1:500 @ A3

0 50m

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83385/36300



83385/36280

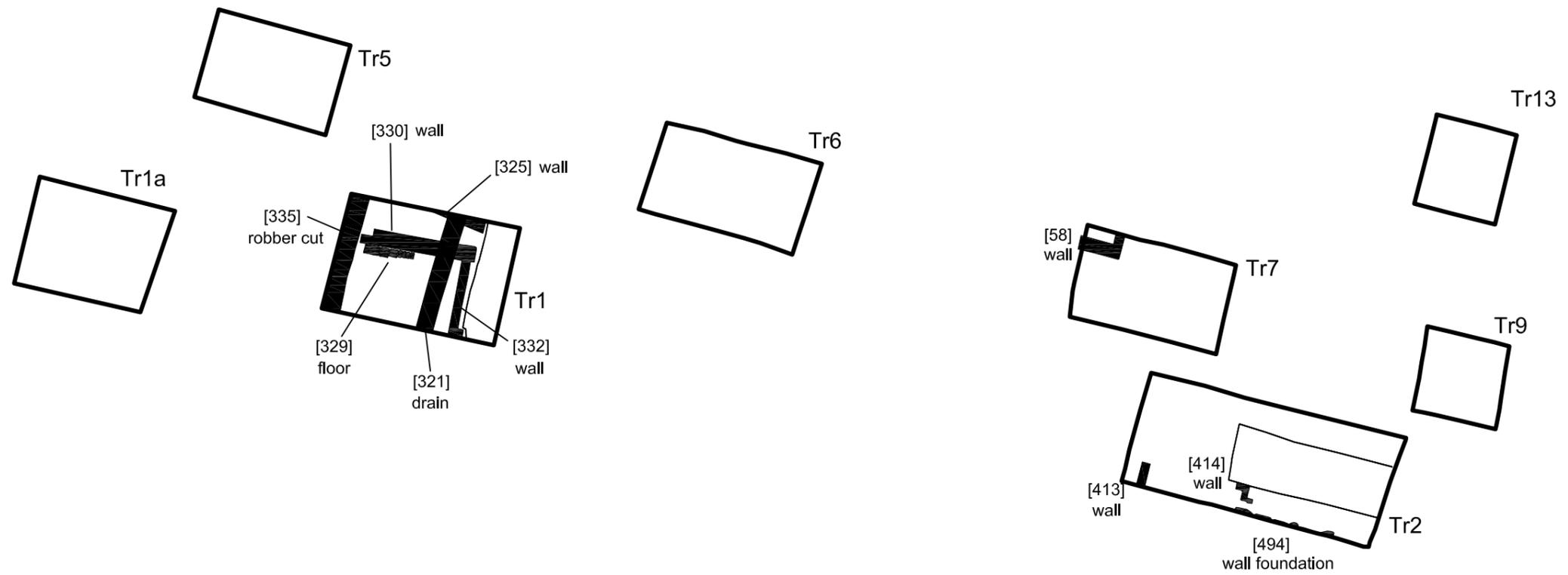


Figure 2 Multi-context plan of post-medieval structural features

-  trench edge
-  c17th to 18th-century structure
-  truncation

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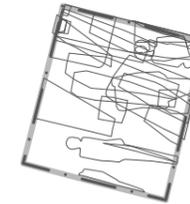
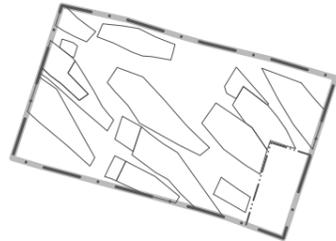


83390/36295

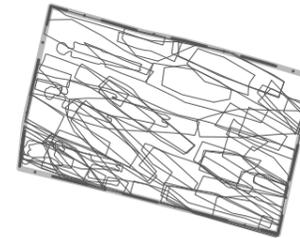


Tr6 (excavated to surface of cemetery)

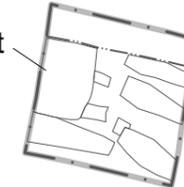
Tr13 (fully excavated)



Tr7 (fully excavated)

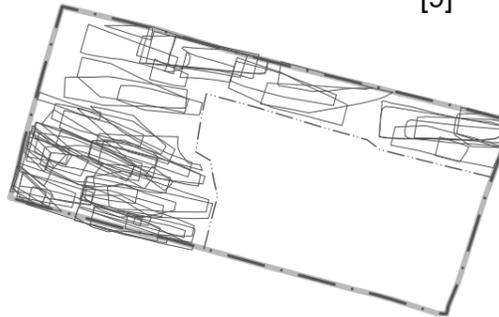
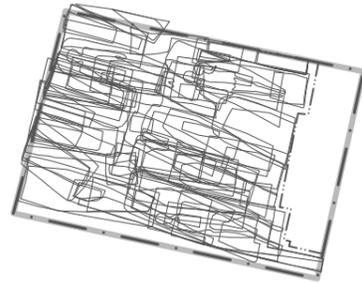


charnel pit
[9]



Tr9
(excavated to surface of cemetery)

Tr1 (fully excavated)



Tr2 (fully excavated)

83390/36280



Figure 3 Overview of burials

-  trench edge
-  archaeological feature
-  truncation

1:100 @ A3



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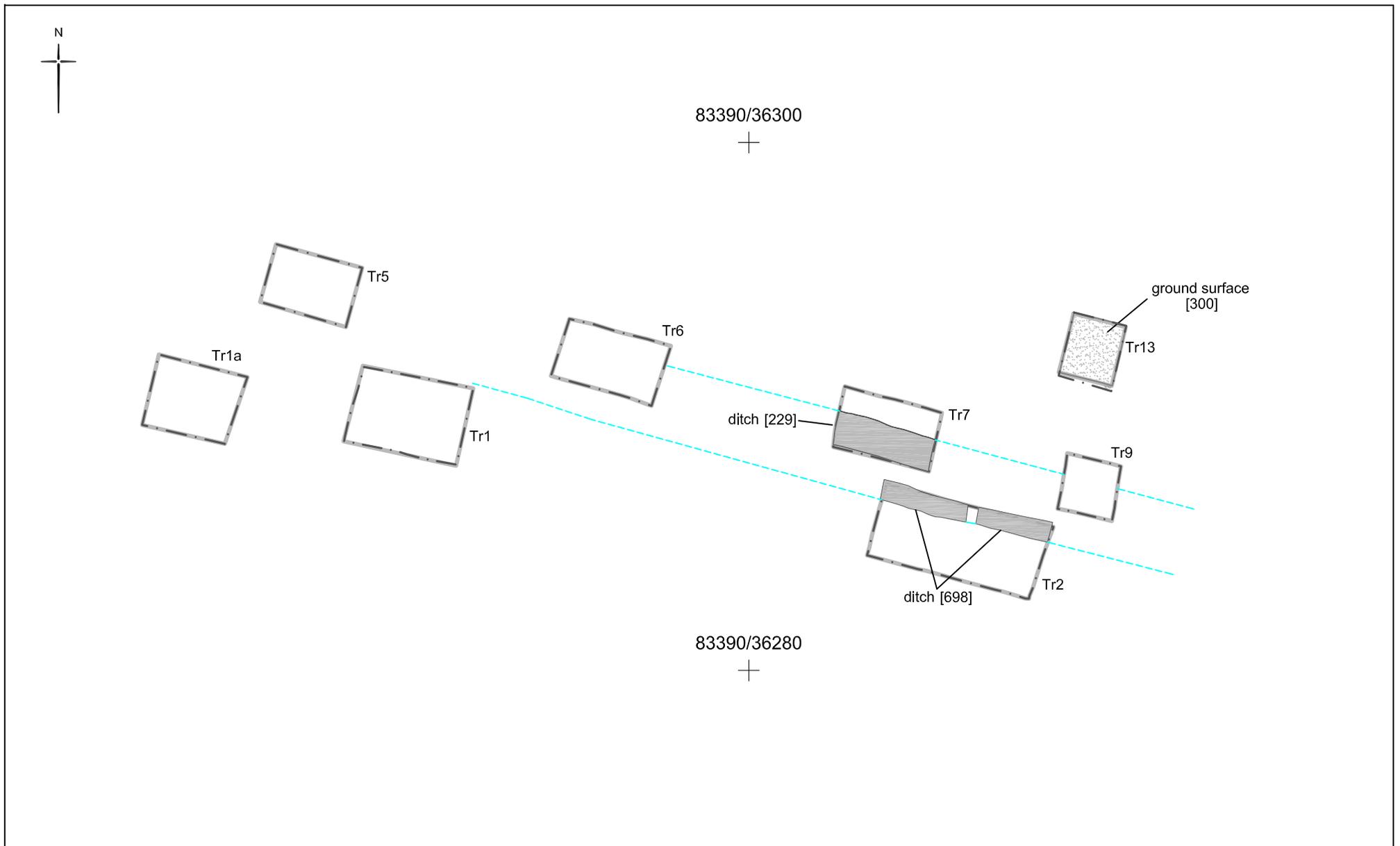


Figure 4 Roman: provisional 3rd-century features

- trench edge
- archaeological feature
- conjecture

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0 5m

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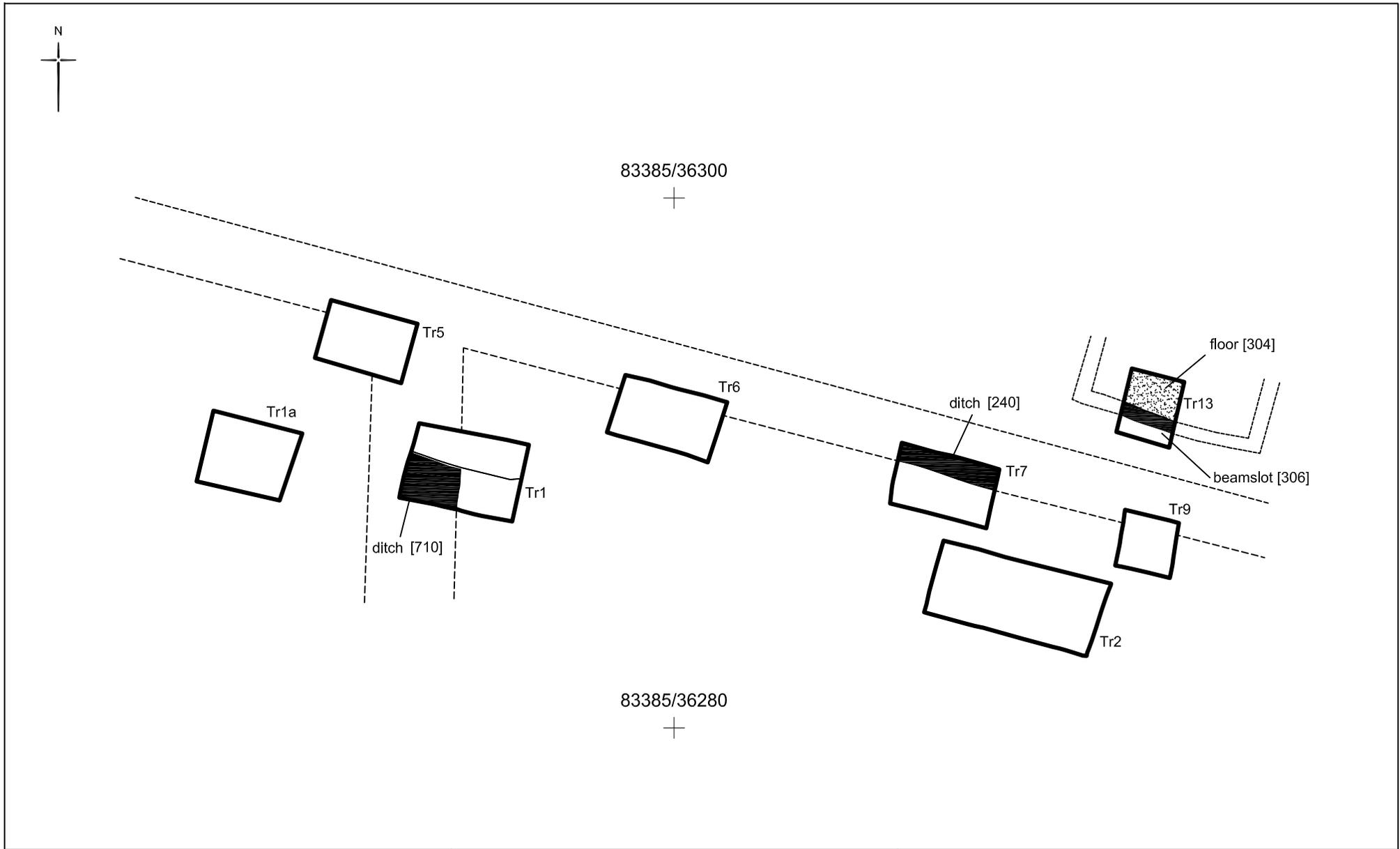
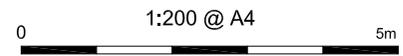


Figure 5 Roman: provisional 2nd-century features

- trench edge
- archaeological feature
- truncation
- ... conjecture



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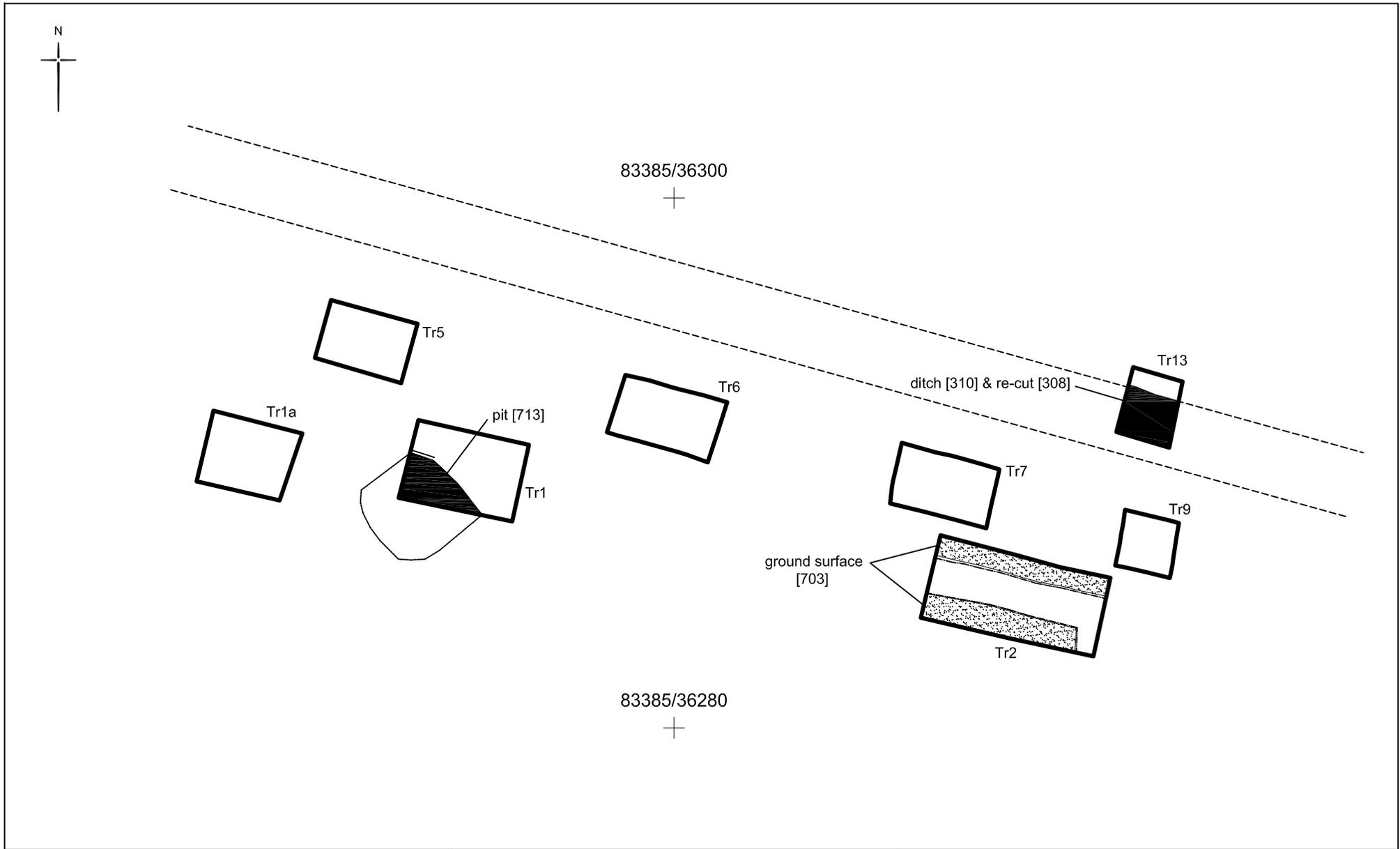
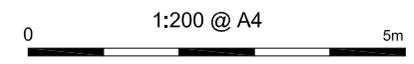


Figure 6 Roman: provisional 1st to early 2nd-century features

-  trench edge
-  archaeological feature
-  truncation
-  conjecture



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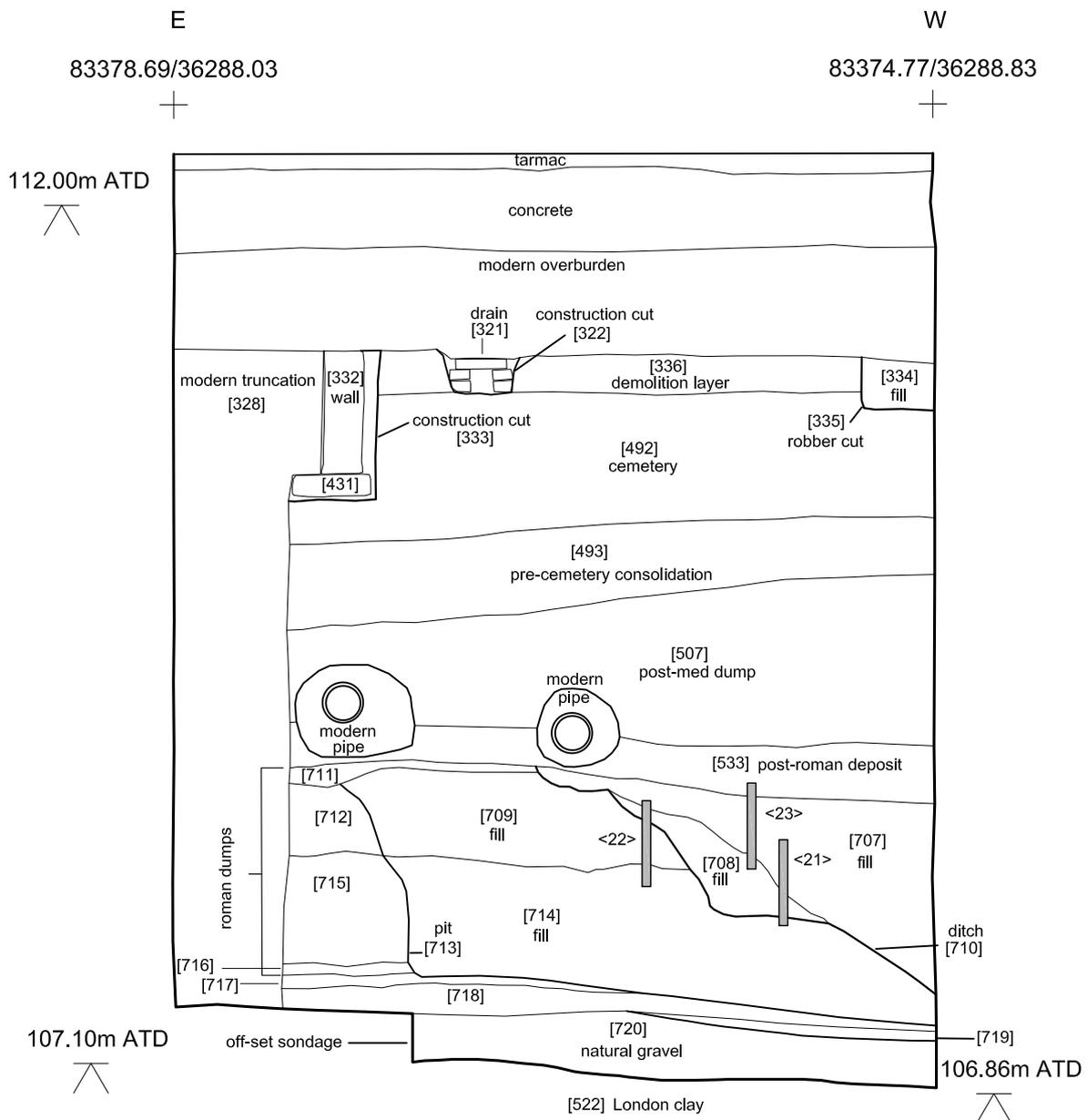


Figure 7 Section 3: north-facing section of trench 1 (see Fig 1 for section location)

- trench edge
- archaeological feature
- levels
- soil monolith samples



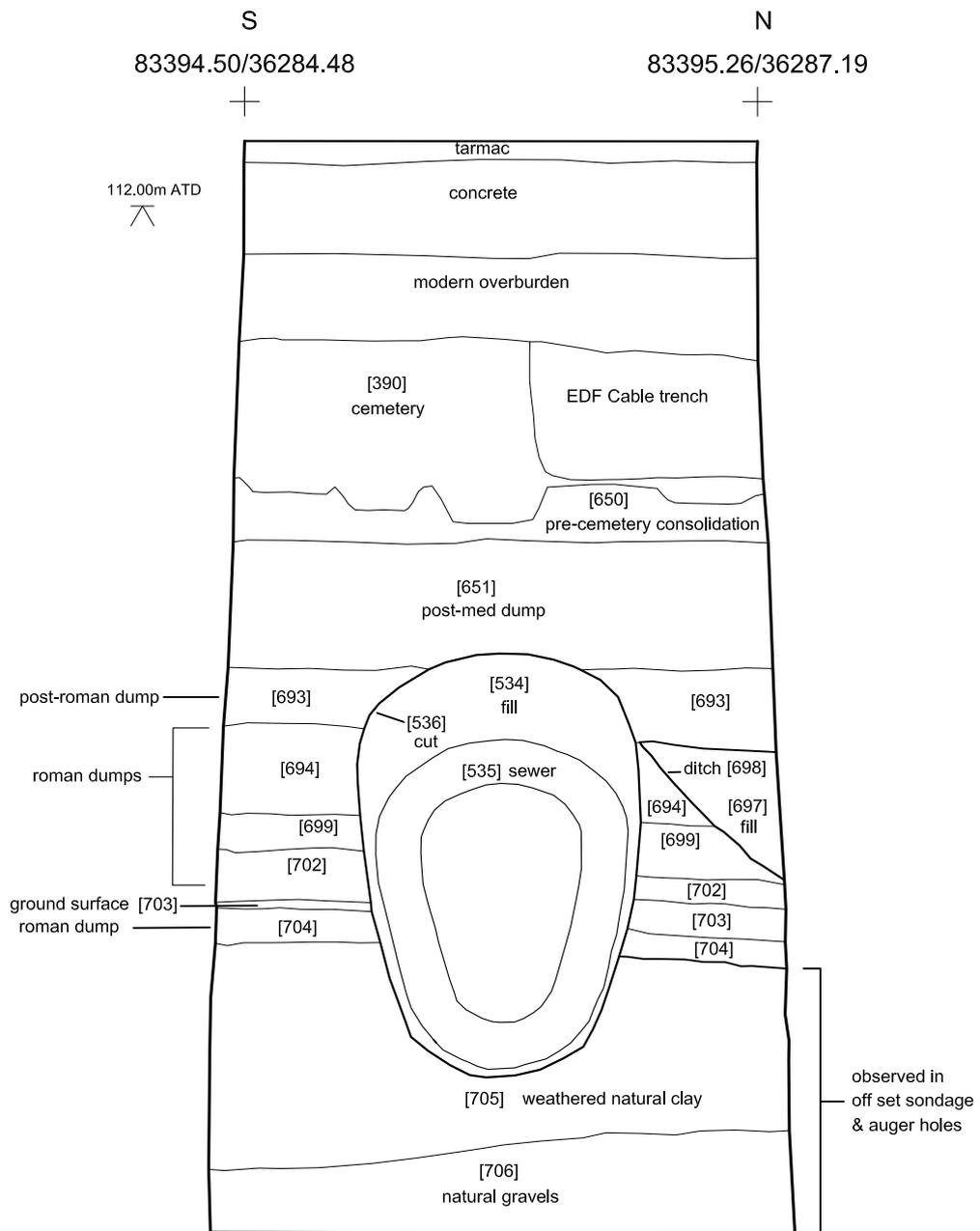


Figure 8 Section 4: east-facing section of trench 2 (see Fig 1 for section location)

trench edge
[45] archaeological feature levels
112.00m ATD
 \wedge

1:40 @ A4

0
0
1m

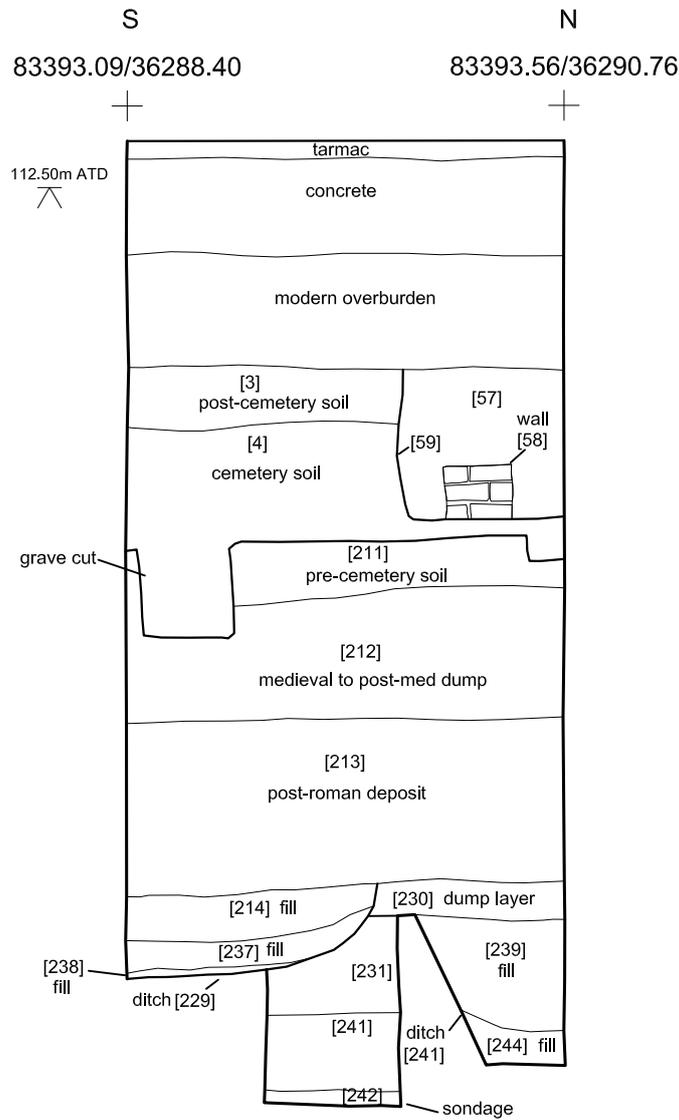


Figure 9 Section 5: east-facing section of trench 7 (see Fig 1 for section location)

- trench edge
- [45] archaeological feature levels

1:40 @ A4



112.50m ATD

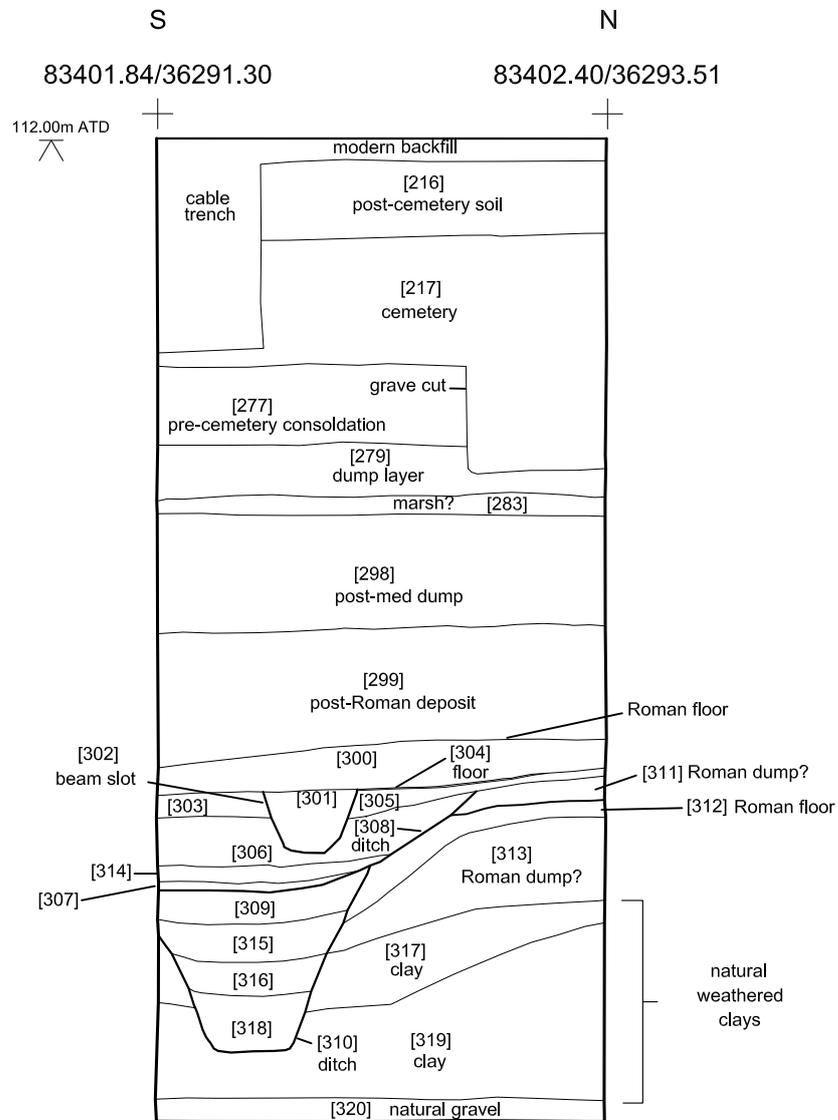


Figure 10 Section 6: east-facing section of trench 13 (see Fig 1 for section location)

trench edge
 [45] archaeological feature levels

1:40 @ A4

0 1m

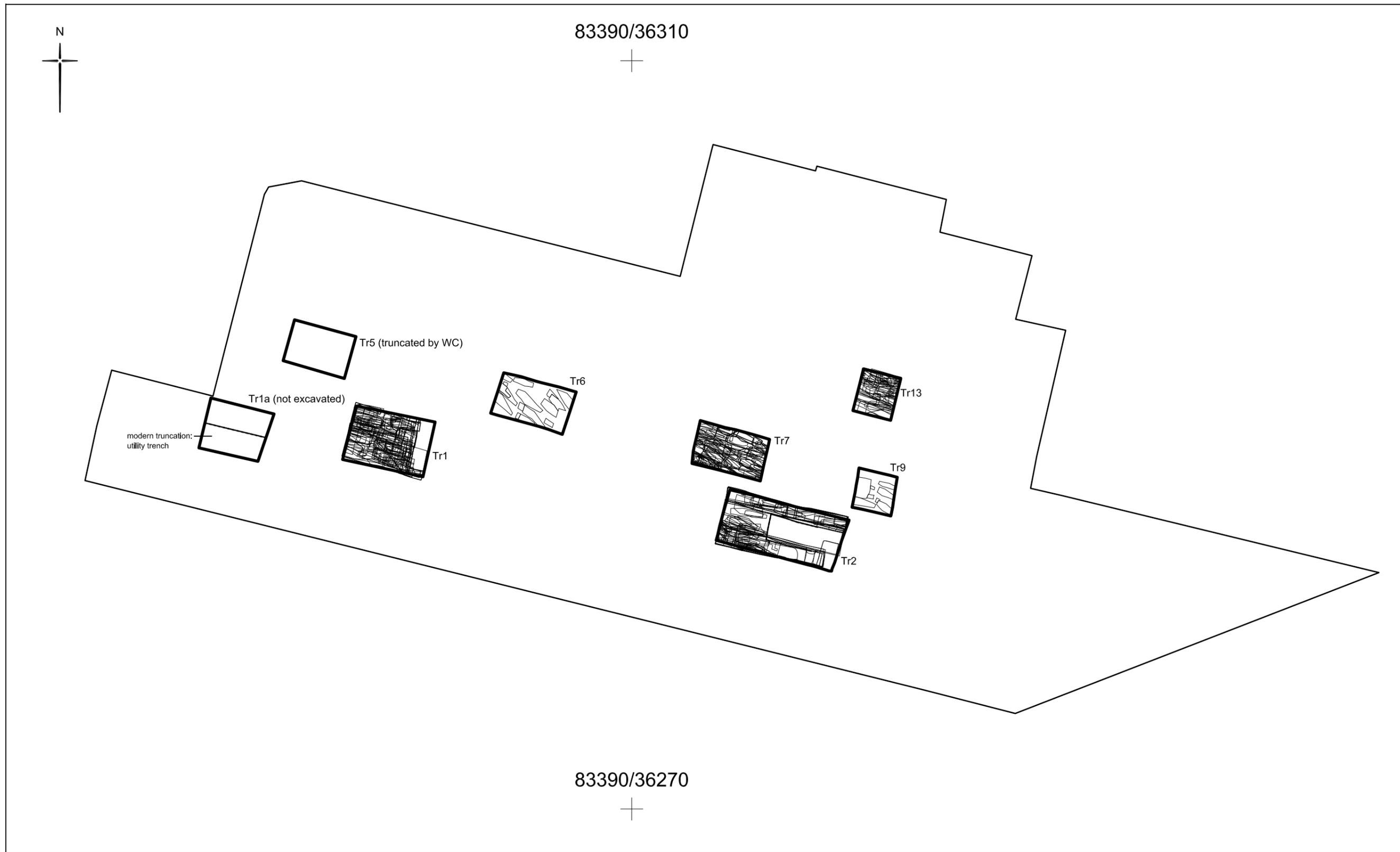


Figure 11 Plan of site showing all excavated features

-  site outline
-  areas of archaeological investigation

1:500 @ A3


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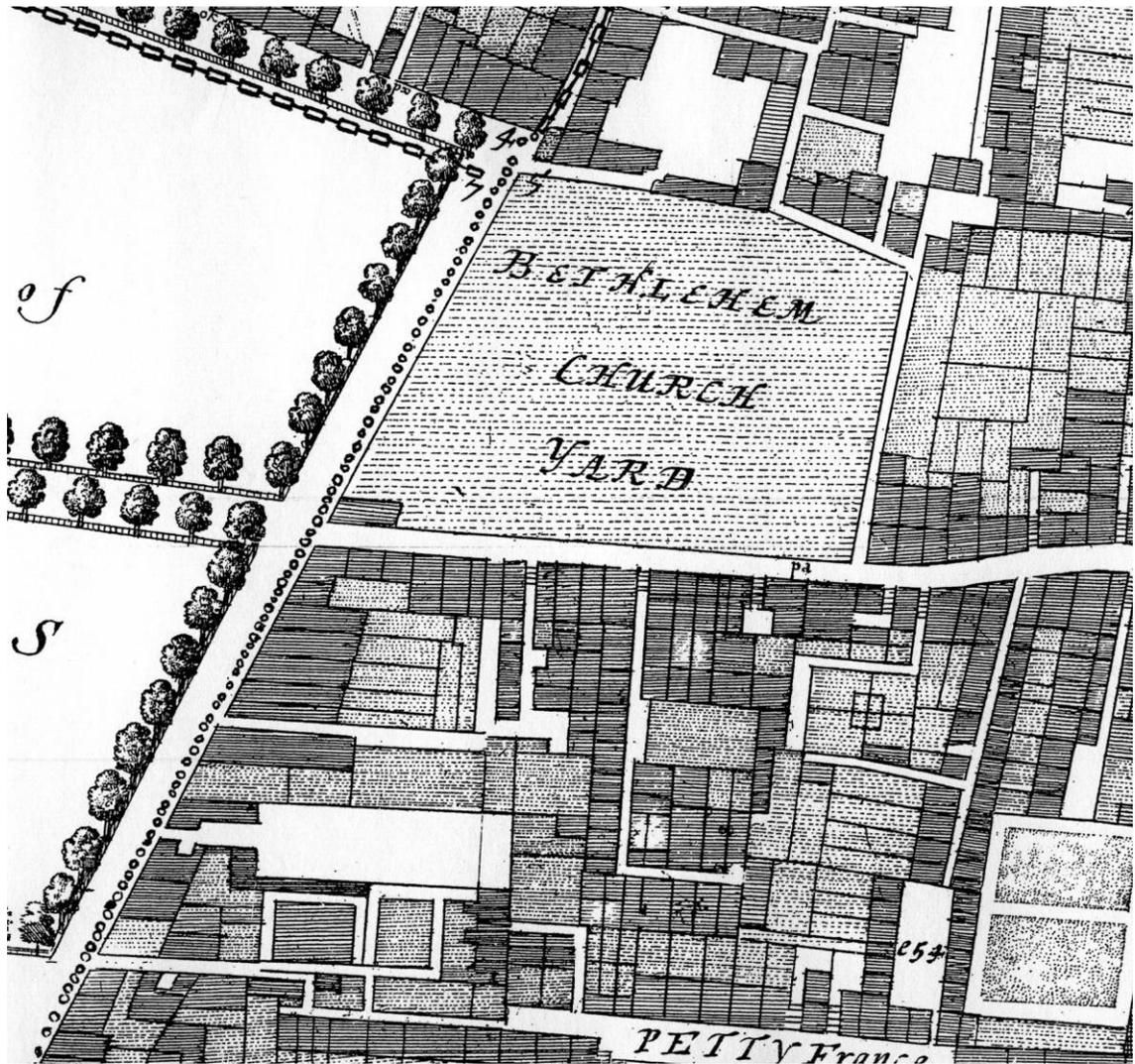


Figure 12 Ogilby and Morgan's map of 1676

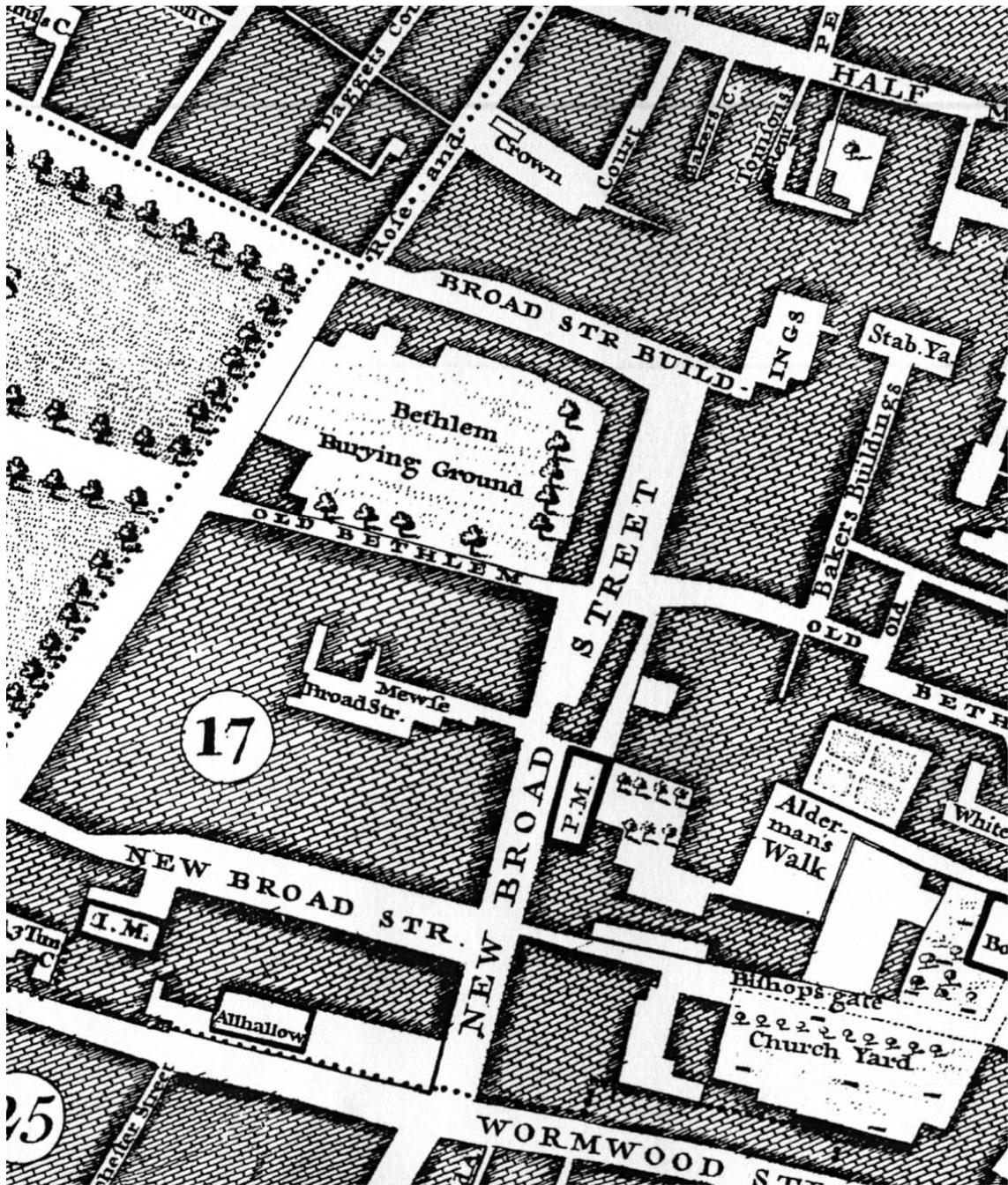


Figure 13 Rocque's map of 1746

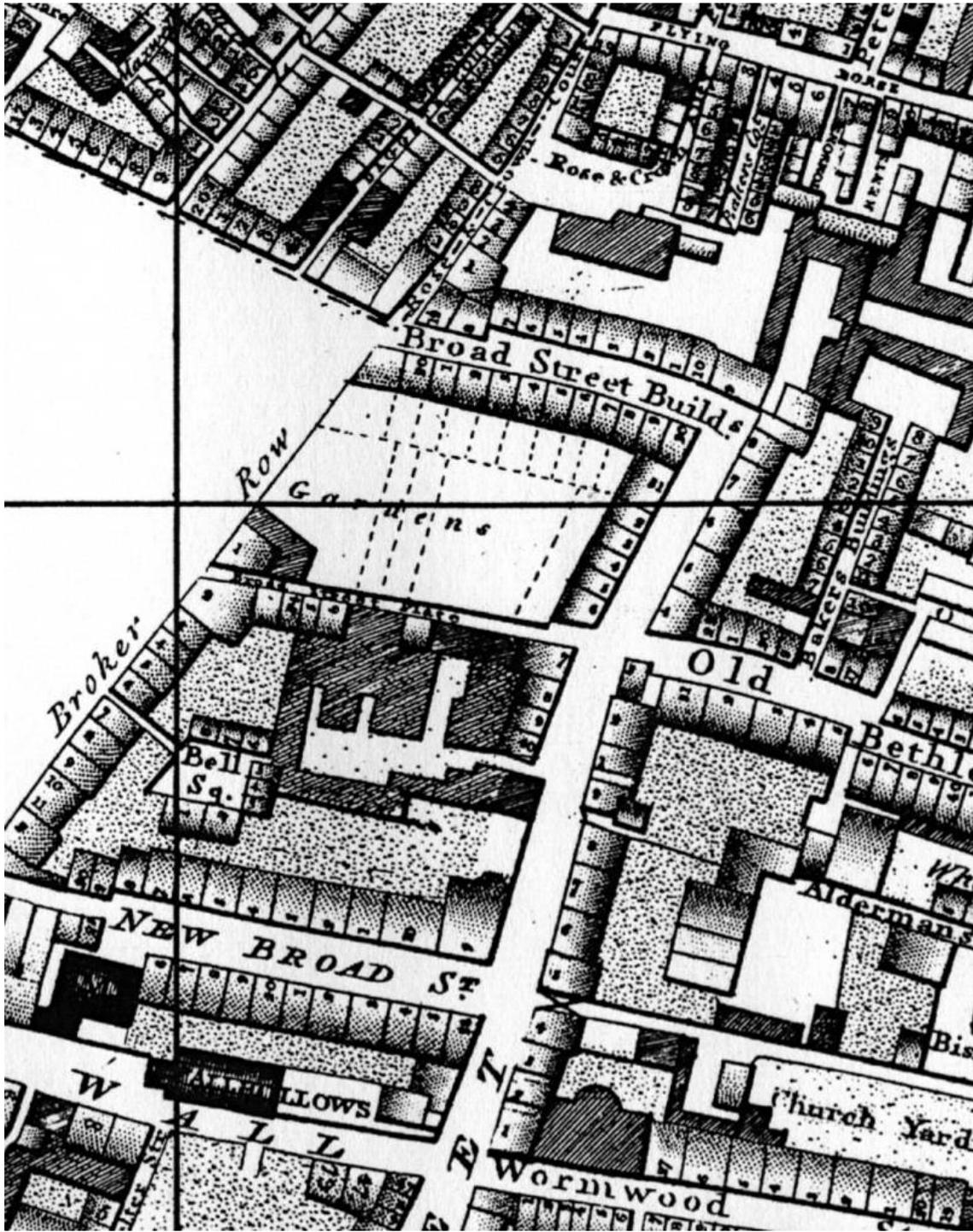


Figure 14 Horwood's map of 1799