

EAST HILL HOUSE, COLCHESTER, ESSEX

Magnetometer (gradiometer) & Topographic Survey

(Survey Ref : 2710303/ECE/CBC)

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SUMMARY

Non-intrusive archaeological fieldwork, comprising geophysical and topographic survey was carried out in the grounds of East Hill House, Colchester, Essex, within the south eastern angle of the walled Roman town (centred on NGR 600125 225140).

Topographic survey was undertaken across the whole of the walled area south of High Street and east of the bus station in order to provide context for previous archaeological finds and former landscaping activity. Geophysical survey comprising close-centred magnetometer (gradiometer) survey (taking readings along 0.5 m traverses at 0.25 m intervals) was undertaken across the gardens in front of East Hill House, and within the former playing field to the south.

The magnetometer (gradiometer) identified a number of weak linear anomalies which could include stone walling, or other structural remains, and possibly a track or street, although these are very tentative suggestions, as none can be identified with any confidence. Several possible pit forms, ranging between 2 and 5 m in diameter, were also located. The nature of the magnetic response suggests that locally increased depths of overburden are present. In addition, a clearly defined zone of rubble and other magnetic debris was identified extending between 20 and 40 m behind the Town Wall. Despite this area of disturbance, the magnetic evidence gives the overall impression that the grounds of East Hill House are generally free from post Medieval disturbance, and only relatively minor changes have been made in the course of landscaping and terracing for gardens and sports facilities.

1. INTRODUCTION

- 1.1 Non-intrusive archaeological fieldwork, comprising geophysical and topographic survey, was commissioned by Colchester Borough Council Museums Service in the grounds of East Hill House, Colchester, Essex, lying within the south eastern angle of the Roman walled town: both this area of the town and the Town Wall are Scheduled Ancient Monuments (Essex County SAM Nos. 7 and 173 respectively). The location, centred on NGR 600125 225140, is shown on Fig. 1. The fieldwork was carried out in late March-April 2003.
- 1.2 The geophysical survey covered the gardens in front (south) of East Hill House together with the former playing field to the south, the survey extending in places to within 5-15 m of the Roman town wall. A combination of chance finds of tessellated pavements, both decorated and plain, together with archaeological investigations in advance of the Day Nursery to the east and the bus station to the west, have revealed fragmentary traces suggesting an essentially residential area of the Roman town comprising stone houses of probable 2nd century AD date, some probably large and well-appointed with hypocausted underfloor heating, painted wall plaster and mosaic floors. The land, known from the later Medieval period as Berry Field, has probably remained open from the end of the Roman period onwards. The presence of at least one principal east-west street is known, observed beneath the department store fronting Queen Street to the west and crossing the northern wing of the Day Nursery to the east, whose projected line would cross the southern half of the lower garden terrace of East Hill House. No orthogonal north-south streets have yet been located within the survey area, although one is postulated to run on, or close to, the current boundary separating the playing field from the bus station (Hull 1958). The archaeological evidence has recently been summarised by Oxford Archaeological Associated Limited (Johnson *et al* 2003).
- 1.3 The geology comprises Pleistocene sands and sandy gravels above a London Clay basement.
- 1.4 Present ground levels were recorded by EDM Total Station across the whole of the land bounded by the Town Wall, east of the bus station (including the Day Nursery, with the permission of Essex County Council Social Services Department, and St. James's churchyard, with permission of Father Peter Walker). In addition, the present survey readings have been combined with a previous survey of the existing levels on the bus station to provide a topographic overview of the whole land block bounded by High Street, Queen Street and the Town Wall.
- 1.5 The geophysical survey comprised magnetometer (gradiometer) survey: an explanation of the techniques used, and the rationale behind their selection, is included in an Appendix to the present report. Although not normally undertaken in built-up urban contexts, taking into consideration the long-term agricultural/garden landuse (see 1.2 above) and evidence for terracing and levelling at several locations (garden landscaping, terracing for a bowling green and tennis courts), it was felt that where significant archaeological 'cut' or burnt features, or any constructed with

highly magnetic material (such as hypocausted chambers), might be anticipated reasonably close to the surface beneath relatively ‘uncluttered’ overburden, they may be visible to the magnetometer, particularly in close-centred mode.

2. **SURVEY DESIGN**

- 2.1 Topographic survey was undertaken using a Geodimeter 600S 5' Total Station. 1734 readings were taken, and XYZ data processed by Golden Software Surfer Version 6. The OS benchmark used was found on the front (north) wall of The Minories, No.74 High Street, at 26.19 m AOD (a temporary benchmark was established on the small traffic island within the bus station, NGR 600045.71 225149.80 at 22.929 m AOD). The current survey information has been combined with a previous survey of existing levels on the bus station and adjacent land by Colchester Borough Council Highways & Engineering Services (Ref. S7-2-12 n.d.), having been digitised and corrected to grid north and the National Grid (Figs. 10 & 11).
- 2.2 Following the AML 1995 guidelines, the geophysical survey grid is internally accurate to ± 10 cm, and locatable on the OS 1:2500 map to the nearest metre (AML 1995:Part I, 3.2).
- 2.3 An area totalling just under 1 ha was investigated by close-centred gridded magnetometer (gradiometer) survey with a Geoscan Research FM 36 Fluxgate Gradiometer (sampling 4 readings per metre at 0.5 metre traverse intervals in the 0.1 nT range). The nanotesla (nT) is the standard unit of magnetic flux (expressed as the current density), here used to indicate positive and negative deviations from the Earth's normal magnetic field.
- 2.4 The topographic survey, with contours at 0.10 m intervals, is shown on Fig. 12. Magnetometer data have been presented as grey scale, interpretative and stacked trace (raw data) plots (Figs. 4 -9), with an overview of results on Fig. 3.

3. SURVEY RESULTS

TOPOGRAPHIC SURVEY

- 3.1 The topographic survey clearly shows the relatively flat expanses of the principal lawn, and the terracing and banked enclosure encircling the sunken terrace in front of the house, and the general trend of the contours rising from the southwest to the northeast, and northwards towards St. James's Church. An area of generally 'hummocky' ground extends westwards and northwards from the large earthen mound immediately north of the Nursery (a garden feature associated with George Wegg's house, Morant 1748), extending into the churchyard and clearly predating the churchyard wall and a series of graves cut into obviously undulating levels at this point. The whole of the playing field slopes gently southwards, showing no obvious sign of any terraces cut for the for the former (mapped) bowling green and tennis courts.

MAGNETOMETER (GRADIOMETER) SURVEY

- 3.2 The proposed magnetometer survey area was confined by areas of thick scrub, stands of trees, tarmac paths or roadways, and modern fences: the proximity of large ferrous objects such as chain link fencing and metal gate fittings, creating strong local magnetic anomalies, further reduced the available area available for survey, leaving four relatively clear areas.

AREA 1 (Figs. 4 & 8)

- 3.3 An area measuring 60 x 30 m covering the lawn at the front of East Hill House, which was largely unobstructed apart from a central area of bushes, bounded on both the west and east by scrub, and extending eastwards as far as the tarmac access road.
- 3.4 The magnetometer (gradiometer) identified several weak linears running on a general northwest-southeast trend which appear as slightly negative anomalies which could conceivably represent buried walling or other structural features such as stone-built drains or culverts. The generally attenuated signal suggests that there may be some depth of overburden at this location.
- 3.5 A number of pits or infilled hollows are represented by positive magnetic anomalies, although it should be noted that more deeply buried ferrous material is often capable of generating similar signals. One extensive area of probable pitting within the northeast corner of the survey grid, measuring some 5 x 2 m, may indicate a single or possibly two conjoined intrusions.
- 3.6 This survey area also contains a considerable amount of ferrous material, some relatively close to the surface, together with what appears to be a mixture of rubble and ferrous or other magnetic material suggestive of the infilling of former hollows.

None can be clearly identified as having any obvious structural geometry, although such concentrations are not uncommon in the vicinity of demolished buildings.

- 3.7 There is no magnetic evidence for any elements of former formal gardens on the terrace in front of the house.

AREA 2 (Figs. 5 & 8)

- 3.8 This survey area, measuring 30 x 22 m, covered the lawn on the lower terrace (1.25 m lower than the upper lawn) bounded by a semi-circular planting of mature trees and scrub.
- 3.9 The magnetometer (gradiometer) revealed clear anomalies which appear to be relatively deeply buried pit forms which, judging by the attenuation of the signal, may lie at some depth beneath the present surface.
- 3.10 There are the slightest suggestions of extremely weak positive linear and curvilinear anomalies on a similar (northwest-southeast) trend to those seen in Area 1 (3.4 above).
- 3.11 Three substantial strong pockets of ferrous material are visible, two buried and the third (the most southerly) caused by a garden bench with iron fittings. There is otherwise a light litter of ferrous material present at varying depths up to and including the topsoil.

AREA 3 (Figs. 6 & 9)

- 3.12 This survey area, measuring a maximum of 45 x 15 m, was located on the site of the playing field (and former bowling green), 1 m north of the modern transverse concrete post and timber fence.
- 3.13 A strong area of magnetic disturbance within the northwest corner of the survey grid lies adjacent to a small mound of rubble which is visible on the surface. Two large ferrous anomalies visible on the northern edge of the survey, spaced c.6 m apart give a response typical of buried vertically placed metal; their spacing is consistent with that of goalposts.
- 3.14 The remainder of the magnetic anomalies appear to be infilled pits or hollows varying between 1 m and 5 m in diameter: the attenuation of the signal suggests that they are likely to be buried at some depth beneath the present ground surface. The stacked trace plot (Fig. 9) shows that the anomaly some 2 m in diameter visible in the centre of the magnetometer plot is represented by a 'double-peak' anomaly suggestive of *in situ* burning.
- 3.15 A weak negative anomaly running on a northeast-southwest trend and visible for a distance of c.15 m within the centre of the survey grid appears to be a continuation of a similar anomaly observed within Area 4 (see 3.18 below).

- 3.16 Apart from the northwest corner in proximity to modern debris, surprisingly few ferrous objects were detected in the modern topsoil in this survey area.

AREA 4 (Figs. 7 & 9)

- 3.17 A survey area measuring a maximum of 74 x 45 m covering all the available unobstructed land on the playing field south of the modern fence, extending south as far as the 5 - 15 m wide strip of scrub and trees bounding the Town Wall, and eastwards as far as the scrub bounding the Nursery fence. Despite standing the survey grid off 2 m from the bus station wall on the west, considerable magnetic interference was caused by the wire fence on top of the brick wall (elevated wire fences of this nature invariably produce a strong local 'pull' on the magnetometer), causing a magnetic 'wipeout' along this boundary for a distance of 5 m.
- 3.18 The survey area shows two distinct magnetic zones. A 20 m wide zone (narrowing to 15 m on the west) within the northern half is essentially 'quiet' magnetically, showing slight suggestions of former hollows or pits. Running north-south, almost parallel with the western boundary of the survey area, and spaced 20 m to the east, is a broad positive anomaly up to 3 m in width. Within 5 m of the northern boundary of the survey grid this feature turns northeastwards, apparently continuing northwards on this alignment into Area 3 (see 3.15 above). Its course is obscured to the south by a clutter of ferrous material and disturbance. This positive anomaly gives the impression of a deeply buried feature comprising stone, or possibly another material of low magnetic susceptibility such as clean clay or sand, although at depth similar magnetic anomalies may be produced by changes of level represented by interfacing zones of contrasting magnetic susceptibility.
- 3.19 There are the slightest traces of further lineations on a roughly east-west alignment within the northern zone of otherwise subtle and 'subdued' magnetic activity. The broken red line on Fig. 7 shows the division between this and a contrasting magnetic zone characterised by considerable amounts of rubble and ferrous material to the south. There is nothing within this area showing unambiguous structural geometry which could be related to former structures, although structural material (of unknown date) is undoubtedly present within this spread of material.

4. CONCLUSIONS

- 4.1 The magnetic evidence tends to support the supposition that the land has not been subject to a high level of post Roman disturbance. Surprisingly little ferrous or other magnetic debris was found over much of the site, much less than would normally be expected within an ancient walled town; in some respects the type of magnetic 'clutter' identified in the zone directly behind the Town Wall might be regarded as a more typical of the magnetic signature which would be normally anticipated in an urban context.
- 4.2 Potential archaeological features are undoubtedly present. A number of pit forms and infilled hollows can be identified with some confidence. However, it is not possible to be so assertive in the identification of weak negative anomalies which might suggest the presence of buried walling or other stonework.
- 4.3 The general response of the magnetometer (gradiometer), showing some attenuation of the magnetic signal, suggests that some of the anomalies are deeply buried, and it is possible that some of those identified as pits might represent pockets of more highly susceptible material within former structures at depth (the broad anomaly seen in the northeastern angle of Area 1 may come into this category), although the majority are be interpreted as rubbish pits or similar intrusions.
- 4.4 A negative linear anomaly running north-south and diverging to the northeast in Area 4 is enigmatic. It appears to represent stone (or some other weakly magnetic material), and is regular in form. Its dimensions (at least 3 m wide) are too broad for walling, and consequently a street, revetment, or terrace may be considered.

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Geophysical and Topographic survey by Oxford Archaeotechnics Limited under the direction of A.E. Johnson with J. Walford & A. Johnson. The project was co-ordinated by A.P. Johnson BA, PhD, MIFA.

APPENDIX 1 - MAGNETIC TECHNIQUES: GENERAL PRINCIPLES

- A1.1 It is possible to define areas of human activity (particularly soils spread from occupation sites and the fills of cut features such as pits or ditches) by means of *magnetic survey* (Clark 1990; Scollar et al. 1990). The results will vary, according to the local geology and soils (Thompson & Oldfield 1986; Gale & Hoare 1991), as modified by past and present agricultural practices. Under favourable conditions, areas of suspected archaeological activity can be accurately located and targeted for further investigative work (if required) without the necessity for extensive random exploratory trenching. Magnetic survey has the added advantages of enabling large areas to be assessed relatively quickly, and is non-destructive.
- A1.2 Topsoil is normally more magnetic than the subsoil or bedrock from which it is derived. Human activity further locally enhances the magnetic properties of soils, and amplifies the contrast with the geological background. The main enhancement effect is the increase of *magnetic susceptibility*, by fire and, to a lesser extent, by the bacterial activity associated with rubbish decomposition; the introduction of materials such as fired clay and ceramics - and, of course, iron and many industrial residues - may also be important in some cases. Other agencies include the addition and redistribution of naturally magnetic rock such as basalt or ironstone, either locally derived or imported.
- A1.3 The tendency of most human activity is to increase soil magnetic susceptibility locally. In some cases, however, features such as traces of former mounds or banks, or imported soil/subsoil or non-magnetic bedrock (such as most limestones), will show as zones of lower susceptibility in comparison with the surrounding topsoil.
- A1.4 Archaeologically magnetically enhanced soils are therefore a response of the parent geological material to a series of events which make up the total domestic, agricultural and industrial history of a site, usually over a prolonged period. Climatic factors may subsequently further modify the susceptibility of soils but, in the absence of strong chemical alteration (e.g. during the process of podzolisation or extreme reduction), magnetic characteristics may persist over millions of years.
- A1.5 Both the magnetic contrast between archaeological features and the subsoil into which they are dug, and the magnetic susceptibility of topsoil spreads associated with occupation horizons, can be measured in the field.
- A1.6 There are several highly sensitive instruments available which can be used to measure these magnetic variations. Some are capable, under favourable conditions, of producing extraordinarily detailed plots of subsurface features. The detection of these features is usually by means of a *magnetometer* (normally a fluxgate gradiometer). These are defined as passive instruments which respond to the magnetic anomalies produced by buried features in the presence of the Earth's magnetic field. The gradiometer uses two sensors mounted vertically, often 50 cm apart. The bottom sensor is carried some 30 cm above the ground, and registers local magnetic anomalies with respect to the top sensor. As both sensors are

affected equally by gross magnetic effects these are cancelled out. In order to produce good results, the magnetic susceptibility contrast between features and their surroundings must be reasonably high, thereby creating good local anomalies; a generally raised background, even if due to human occupation within a settlement context, will sometimes preclude meaningful magnetometer results. The sensitive nature of magnetometers makes them suitable for detailed work, logging measurements at a closely spaced (less than 1 metre) sample interval, particularly in areas where an archaeological site is already suspected. Magnetometers may also be used for rapid 'prospecting' ('scanning') of larger areas (where the operator directly monitors the changing magnetic field and pinpoints specific anomalies).

- A1.7 *Magnetic susceptibility measuring systems*, whilst responding to basically the same magnetic component in the soil, are 'active' instruments which subject the sample area being measured (according to the size of the sensor used) to a low intensity alternating magnetic field. Magnetically susceptible material within the influence of this field can be measured by means of changes which are induced in oscillator frequency. For general work, measuring topsoil susceptibility *in situ*, a sensor loop of around 20 cm diameter is convenient, and responds to the concentration of magnetic (especially ferrimagnetic) minerals mostly in the top 10 cm of the soil. Magnetically enhanced horizons which have been reached by the plough, and even those from which material has been transported by soil biological activity, can thus be recognised.
- A1.8 Whilst only rarely encountering anomalies as graphically defined as those detected by magnetometers, magnetic susceptibility systems are ideal for detecting magnetic spreads and thin archaeological horizons not seen by magnetometers. Using a 10 m interval grid, large areas of landscape can be covered relatively quickly. The resulting plot can frequently determine the general pattern of activity and define the nuclei of any occupation or industrial areas. As the intervals between susceptibility readings generally exceed the parameters of most individual archaeological features (but not of the general spread of enhancement around features), the resulting plots should be used as a guide to areas of archaeological potential and to suggest the general form of major activity areas; further refinement is possible using a finer mesh grid or, more usually, by detailing underlying features using a gradiometer.
- A1.9 Magnetic survey is not successful on all geological and pedological substrates. As a rule of thumb, in the lowland zone of Britain, the more sandy/stony a deposit, the less magnetic material is likely to be present, so that a greater magnetic contrast in soil materials will be needed to locate archaeological features; in practice, this means that only stronger magnetic anomalies (e.g. larger accumulations of burnt material) will be visible, with weaker signals (e.g. from the fillings of simple agricultural ditches) disappearing into the background. Similar problems can arise when the natural background itself is very high or very variable (e.g. in the presence of sediments partially derived from magnetic volcanic rocks).
- A1.10 The precise physical and chemical processes of changing soil magnetism are extremely complex and subject to innumerable variations. In general terms,

however, there is no doubt that magnetic enhancement of soils by human activity provides valuable archaeological information.

- A1.11 As well as locating specific sites, topsoil magnetic susceptibility survey frequently provides information relating to former landuse. Variations in the soils and subsoils, both natural and those enhanced by anthropogenic agencies, when modified by agriculture, give rise to distinctive patterns of topsoil susceptibility. The containment of these spreads by either natural or man-made features (streams, hedgerows, etc.) gives rise to a characteristic chequerboard or strip pattern of varying enhancement, often showing the location of former field systems, which persist even after the physical barriers have been removed. These patterns are often further amplified in fields containing underlying archaeological features within reach of the plough. More subtle landuse boundaries and indications of former cultivation regimes are often suggested by topsoil magnetic susceptibility plots.
- A1.12 Where a general spread of magnetically enhanced soils contained within a long-established boundary becomes admixed over a long period by constant ploughing, it can be diffused to such a point that the original source is masked altogether. Magnetically enhanced material may also be moved or masked by natural agencies such as colluviation or alluviation. Generally, it appears that the longer a parcel of land has been under arable cultivation, the greater is the tendency for topsoil susceptibility to increase; at the same time there is increasing homogeneity of the magnetic signal within the soils owing to continuous agricultural mixing of the material. Some patterns of soil enhancement derived from underlying archaeological features are, however, apparently capable of resisting agricultural dispersal for thousands of years (Clark 1990).

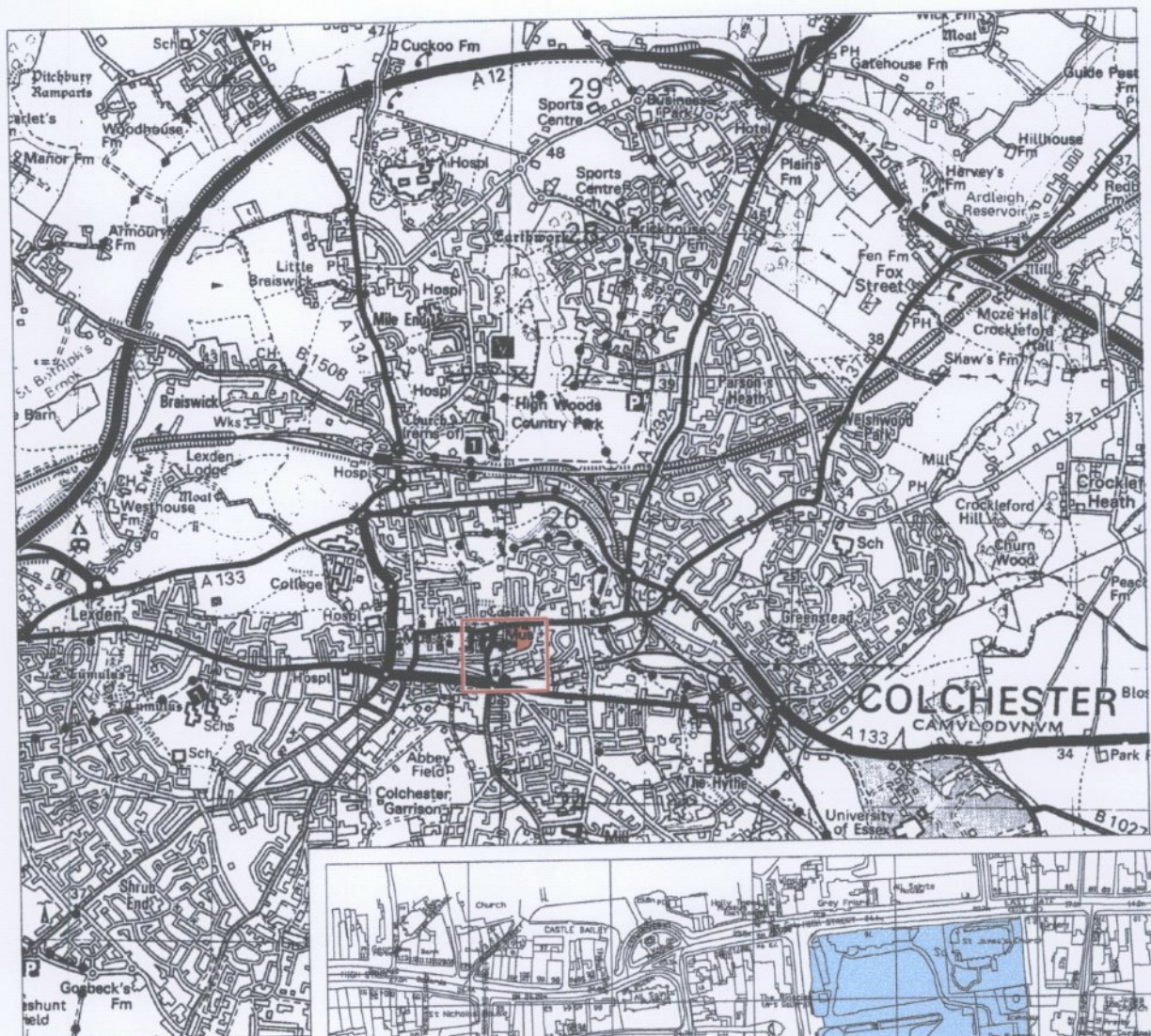
FIGURE CAPTIONS

- Figure 1. Location. Scale 1:50,000 and 1:5000. Based upon OS 1:50,000 Landranger Map 168 and OS digital data.
- Figure 2. Location of topographic and magnetometer (gradiometer) survey areas. Scale 1:2500.
- Figure 3. Magnetometer (gradiometer) survey: overview. Scale 1:2500.
- Figure 4. Magnetometer (gradiometer) survey. Area 1: grey scale plot and interpretation. Scale 1:500.
- Figure 5. Magnetometer (gradiometer) survey. Area 2: grey scale plot and interpretation. Scale 1:500.
- Figure 6. Magnetometer (gradiometer) survey. Area 3: grey scale plot and interpretation. Scale 1:500.
- Figure 7. Magnetometer (gradiometer) survey. Area 4: grey scale plot and interpretation. Scale 1:500.
- Figure 8. Magnetometer (gradiometer) survey. Areas 1 & 2: stacked trace (raw data) plots. Scale 1:500.
- Figure 9. Magnetometer (gradiometer) survey. Areas 3 & 4: stacked trace (raw data) plots. Scale 1:500.
- Figure 10. Topographic survey. Present topographic survey combined with Colchester Borough Council Highways & Engineering Services Plan (Ref S7/2-12 n.d.). Overview: @ 0.25 m contour intervals. Scale 1:2500.
- Figure 11. Topographic survey. Present topographic survey combined with Colchester Borough Council Highways & Engineering Services Plan (Ref S7/2-12 n.d.). Overview: filled contour plot @ 0.25 m contour intervals. Scale 1:1250.
- Figure 12. Topographic survey: contours at 0.10 m intervals. Scale 1:500.

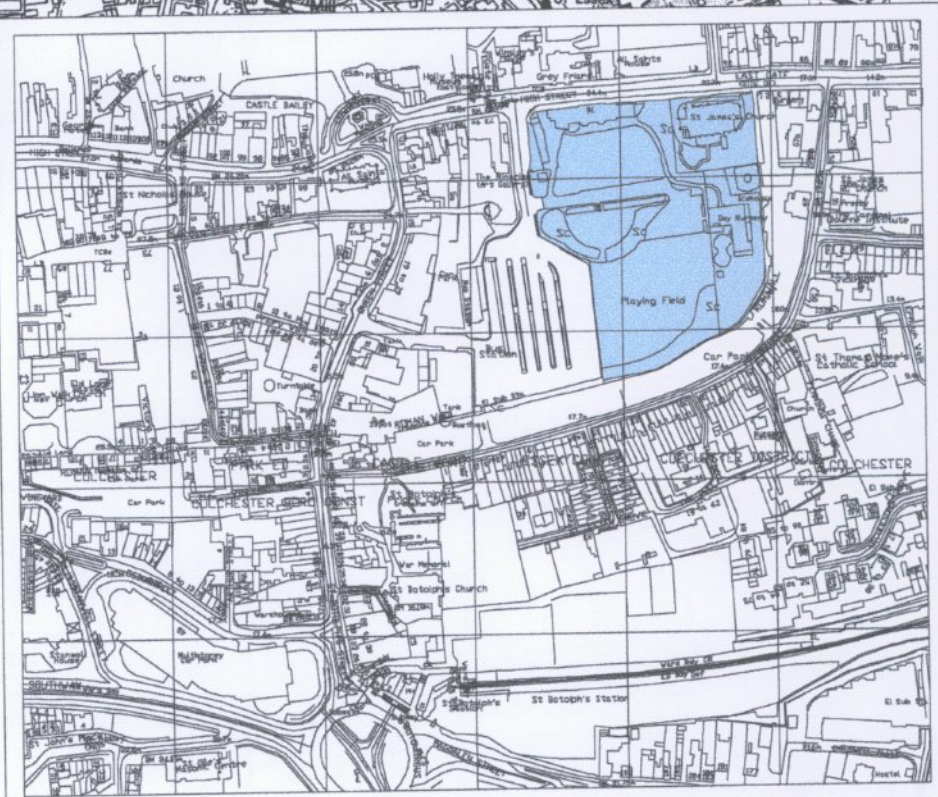
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East Hill House, Colchester, Essex

Magnetometer & topographic survey, location



1:50,000



1:5,000

East Hill House, Colchester, Essex

Magnetometer & topographic survey, location



SCALE 1:2500



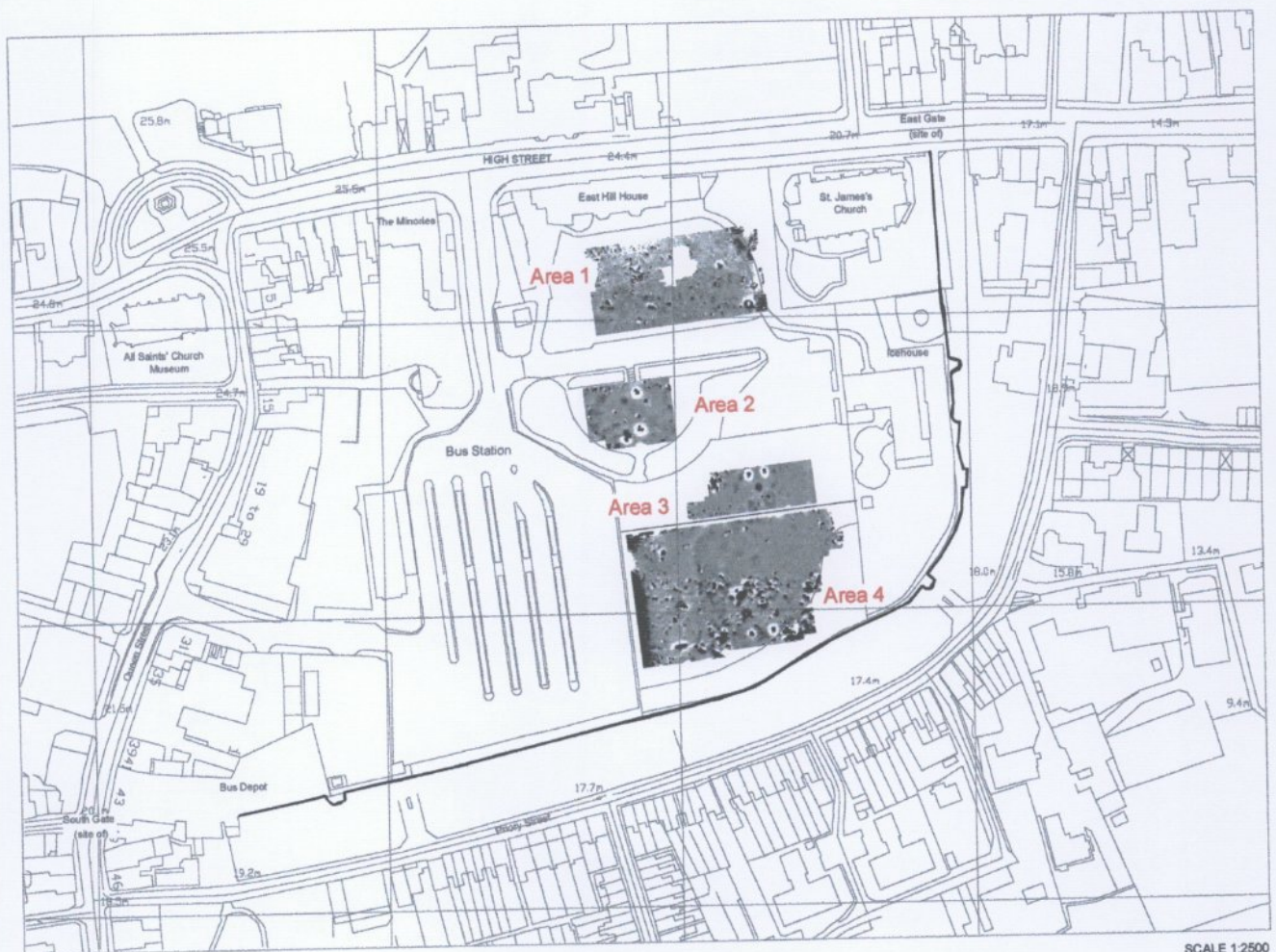
General area of topographic survey



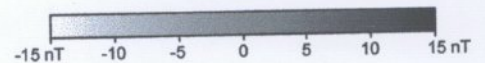
Magnetometer survey locations

East Hill House, Colchester, Essex

Magnetometer survey, overview



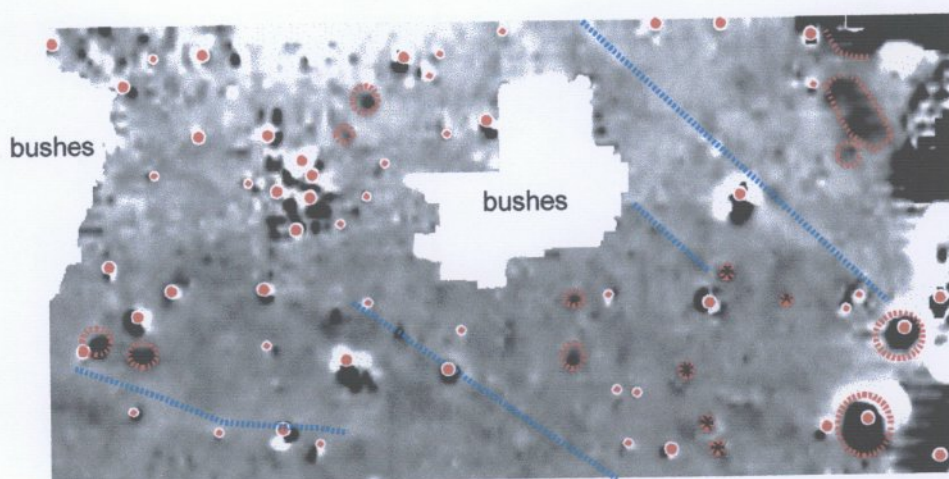
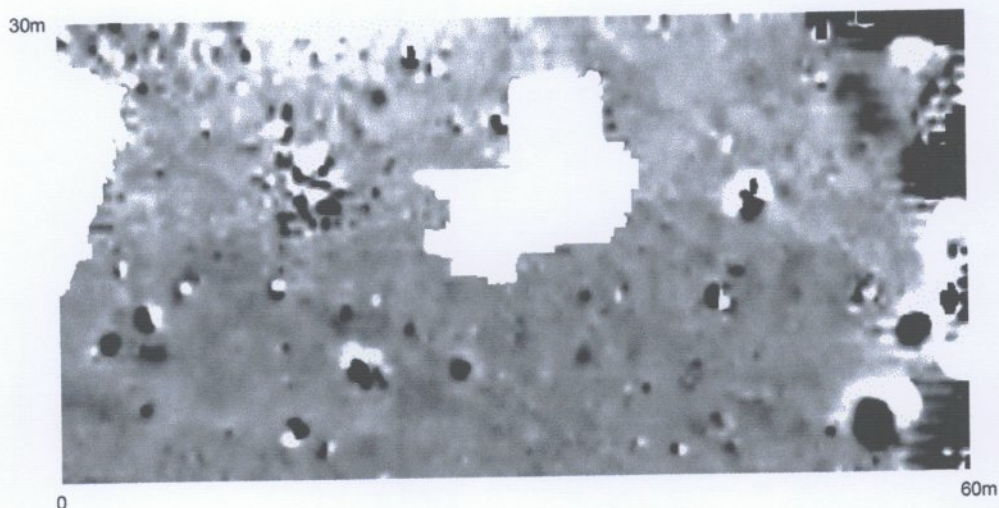
SCALE 1:2500



East Hill House, Colchester, Essex

Magnetometer survey, grey scale plot

Area 1



Interpretation



Linear and
curvilinear features



Weak linear and
curvilinear features,



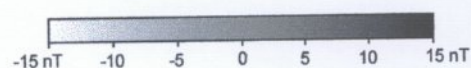
Ferrous material
(main concentrations)



Possible pits
and pockets of deeper soils



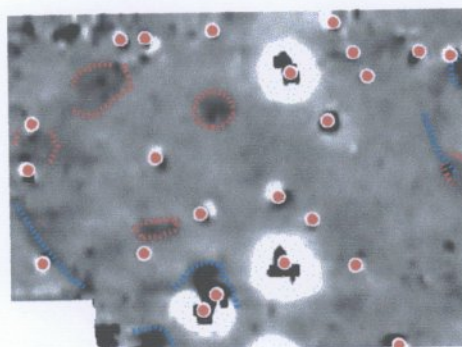
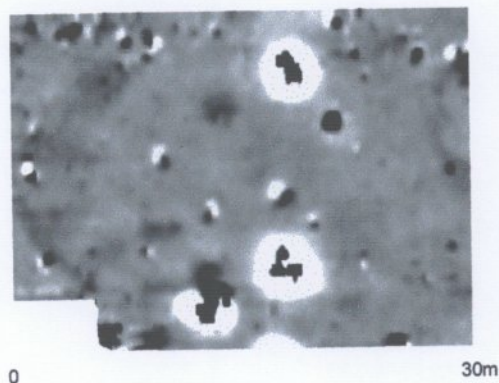
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East Hill House, Colchester, Essex

Magnetometer survey, grey scale plot

Area 2



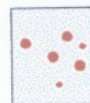
Interpretation



Linear and
curvilinear features



Weak linear and
curvilinear features,



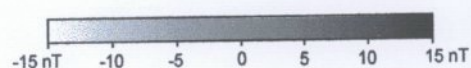
Ferrous material
(main concentrations)



Possible pits
and pockets of deeper soils



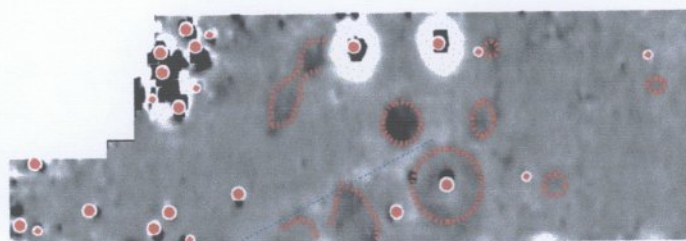
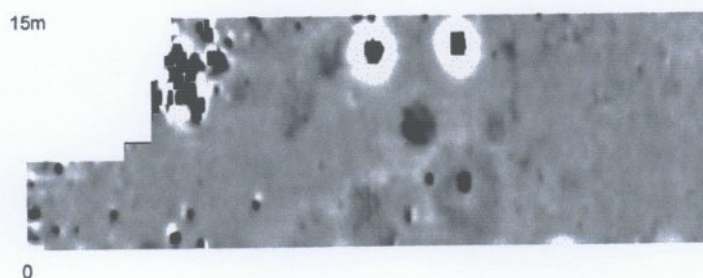
1:500



East Hill House, Colchester, Essex

Magnetometer survey, grey scale plot

Area 3



Interpretation



Linear and curvilinear features



Weak linear and curvilinear features,



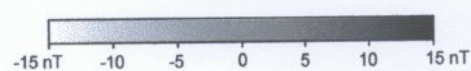
Ferrous material
(main concentrations)



Possible pits
and pockets of deeper soils



1:500

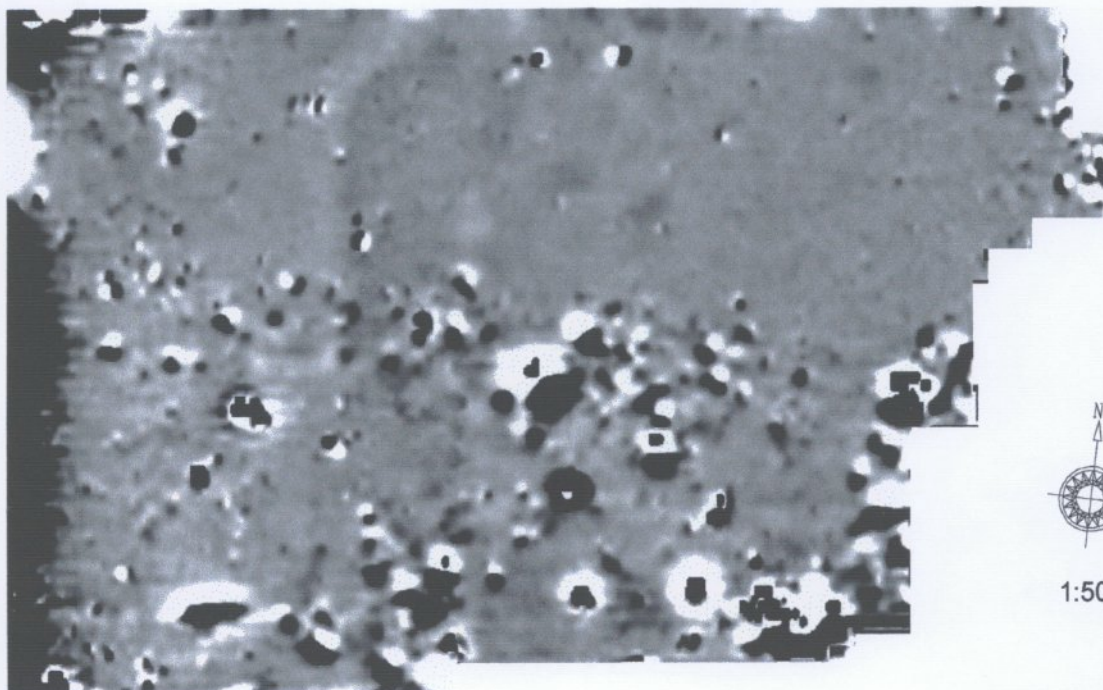


East Hill House, Colchester, Essex

Magnetometer survey, grey scale plot

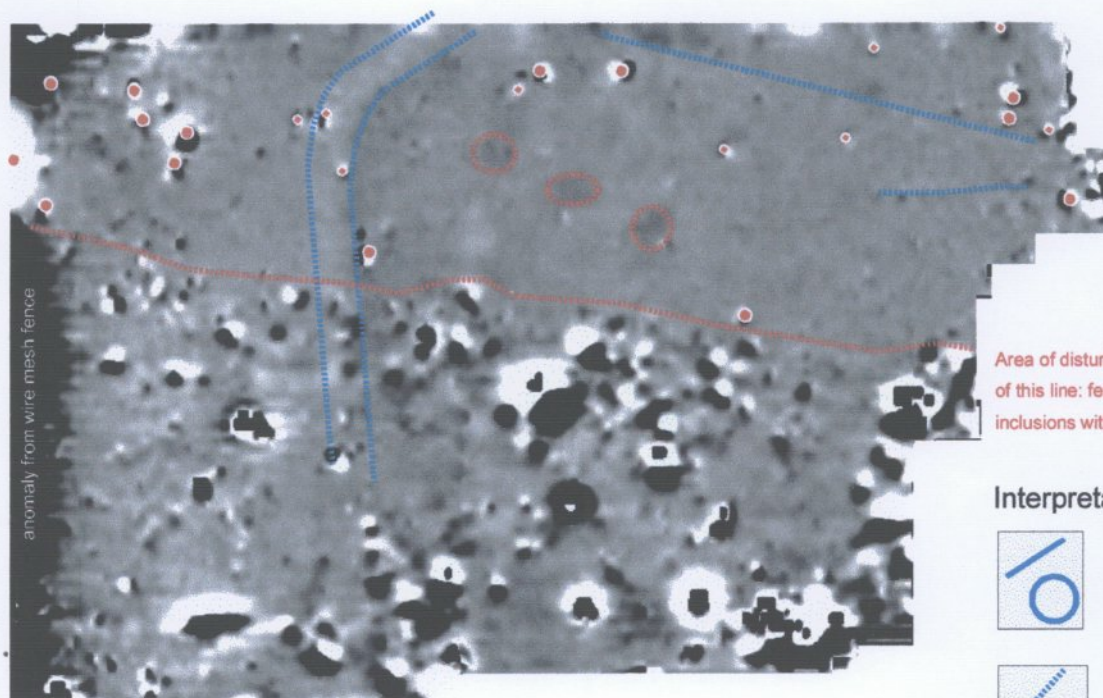
Area 4

45m



1:500

0



Interpretation



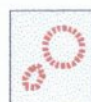
Linear and curvilinear features



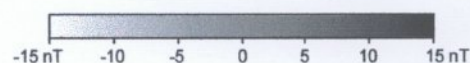
Weak linear and curvilinear features,



Ferrous material
(main concentrations)



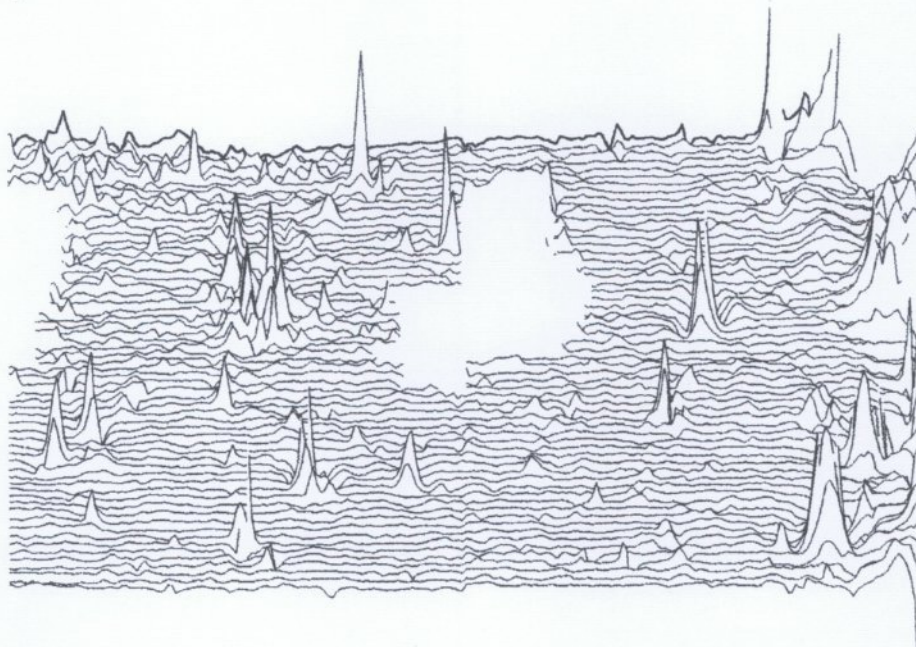
Possible pits
and pockets of deeper soils



East Hill House, Colchester, Essex

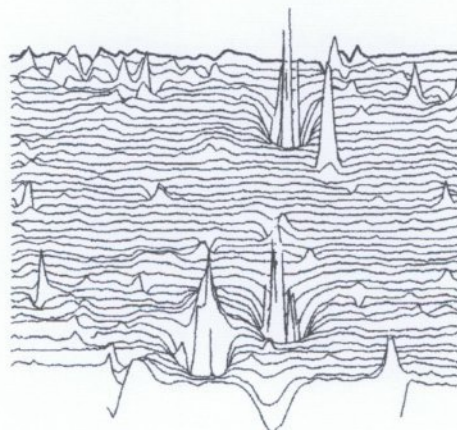
Magnetometer survey, stacked trace plots

Area 1



120 nT

Area 2



120 nT

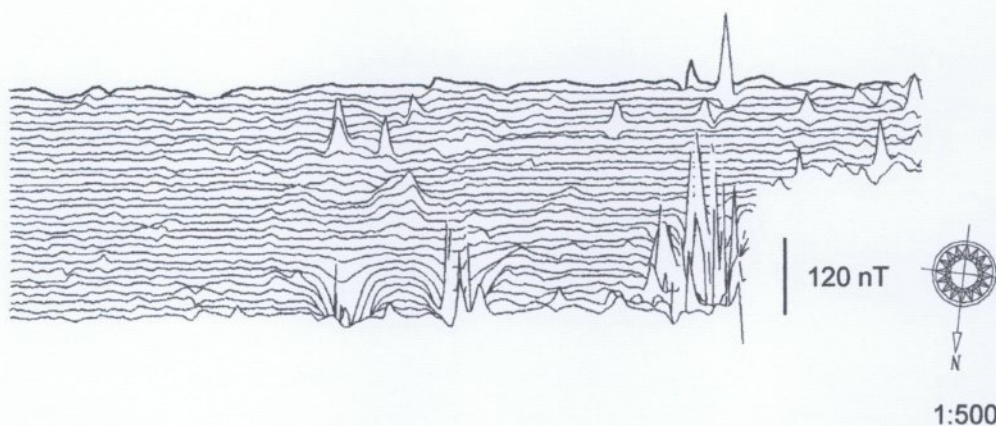


1:500

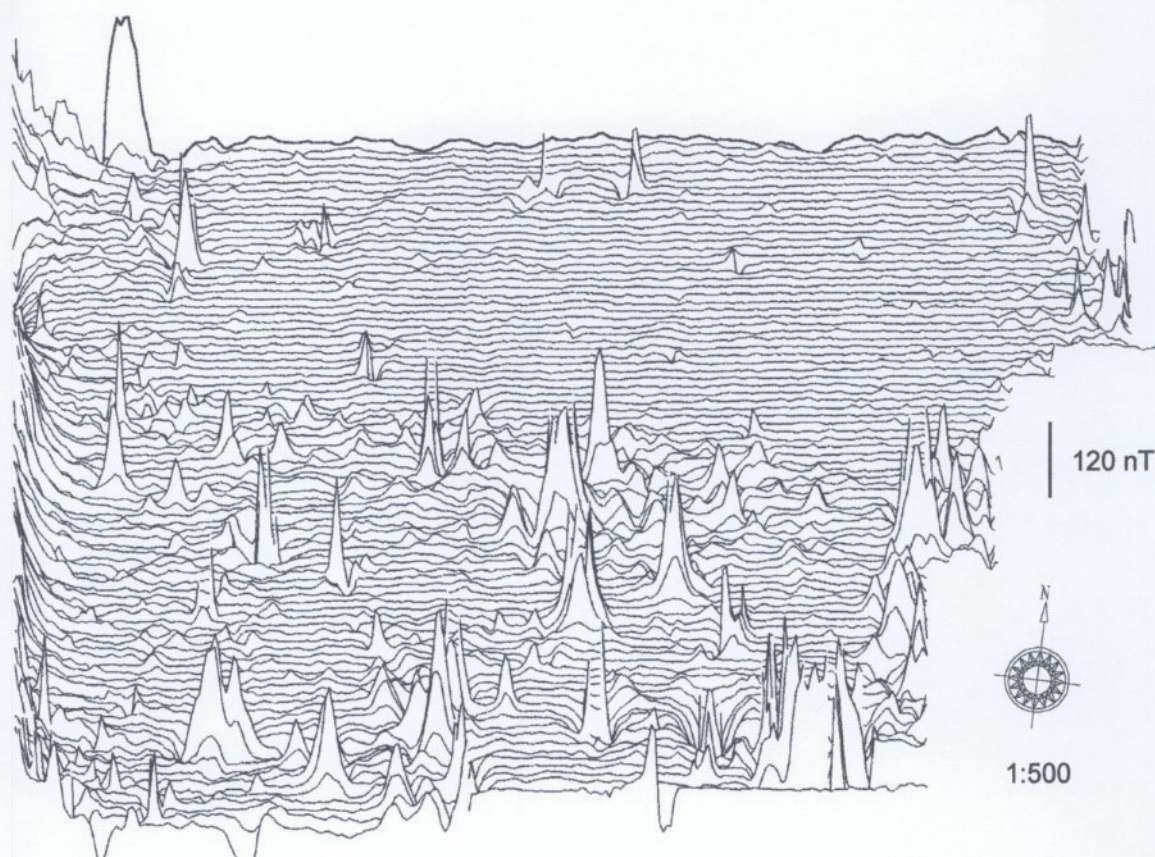
East Hill House, Colchester, Essex

Magnetometer survey, stacked trace plots

Area 3



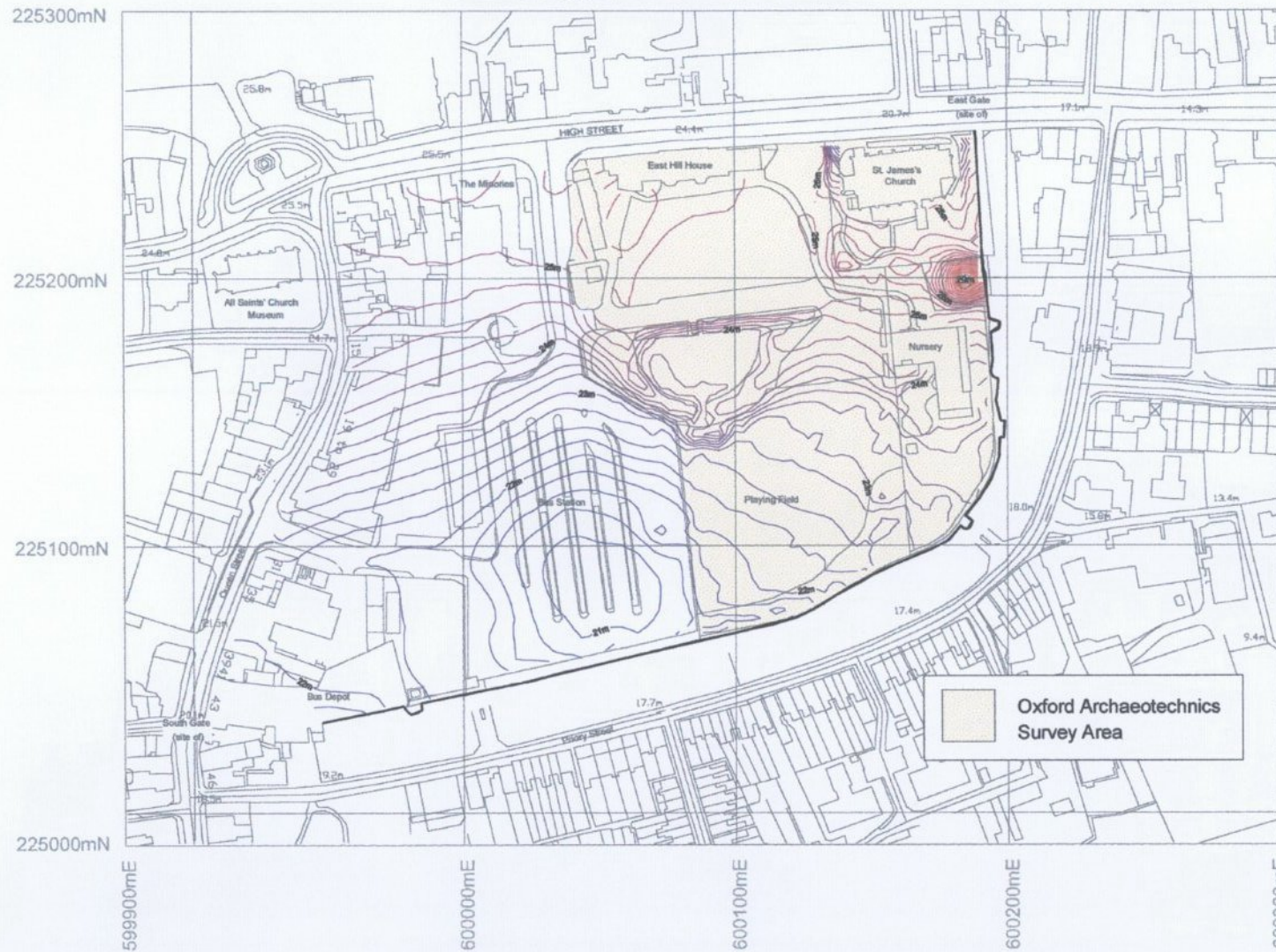
Area 4



East Hill House, Colchester, Essex

Present topographic survey combined with data from Colchester Borough Council Highways & Engineering Services Plan (Ref S7/2-12 nD)

Overview: @ 0.25m contour intervals

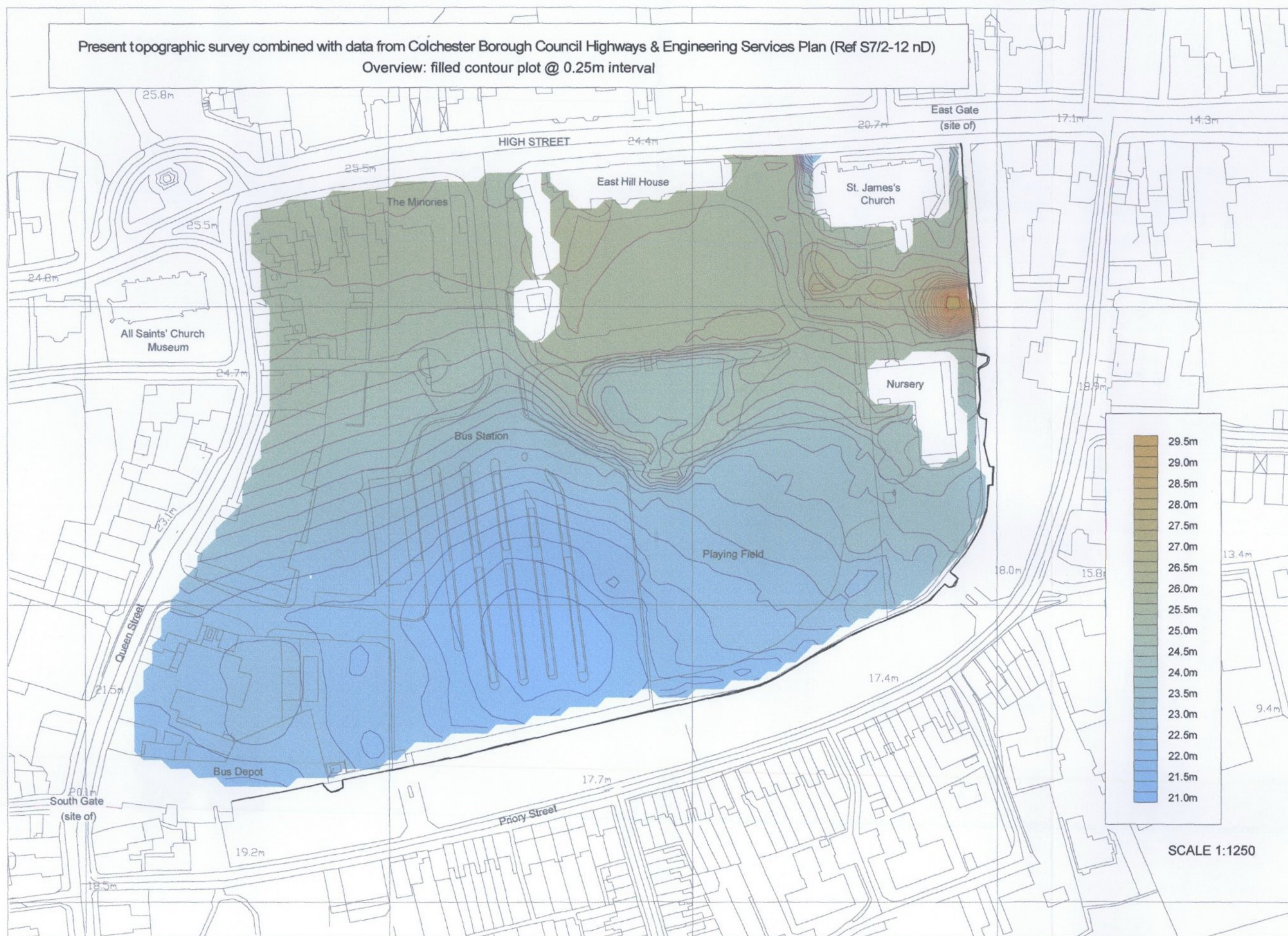


SCALE 1:2500

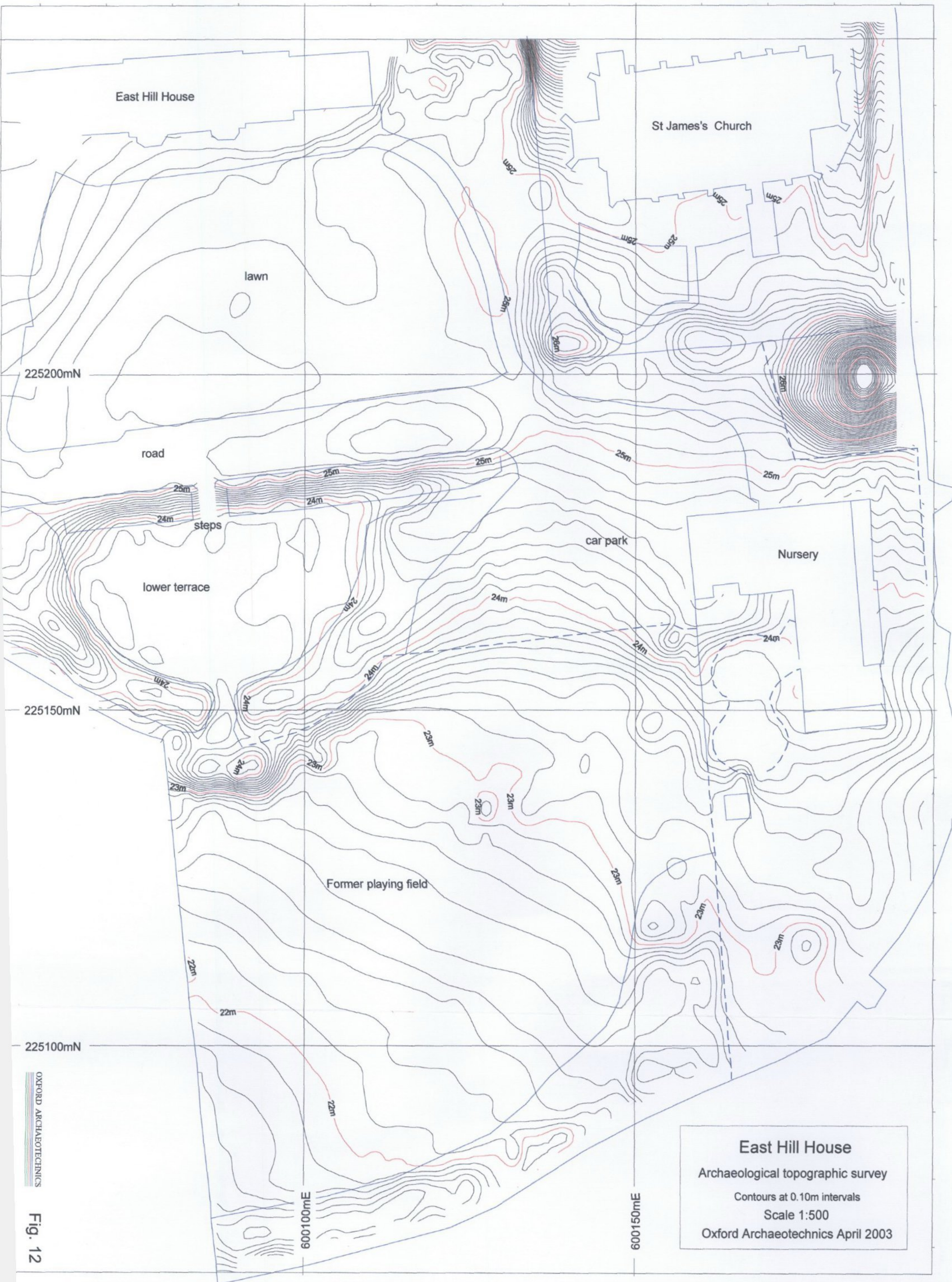
East Hill House, Colchester, Essex

Present topographic survey combined with data from Colchester Borough Council Highways & Engineering Services Plan (Ref S7/2-12 nD)

Overview: filled contour plot @ 0.25m interval



SCALE 1:1250



East Hill House
Archaeological topographic survey
Contours at 0.10m intervals
Scale 1:500
Oxford Archaeotechnics April 2003

INTERNAL QUALITY CHECK

Survey Reference	2710303 / ECE / CBC		
Primary Author	na	Date	04 / 04 / 03
Checked By	AET	Date	9-4-03
Checked By		Date	
Further Corrections		Date	

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