2947

Ancient Monuments Laboratory
Report 76/2000

ELSYNG PALACE, ENFIELD, LONDON: REPORT ON GEOPHYSICAL SURVEY, SEPTEMBER 2000

N T Linford

Ancient Monuments Laboratory Report 76/2000

ELSYNG PALACE, ENFIELD, LONDON: REPORT ON GEOPHYSICAL SURVEY, SEPTEMBER 2000

N T Linford

Summary

A trial ground penetrating radar (GPR) survey was conducted over the site of the former Tudor Palace, Elsyng, London Borough of Enfield, following successful earth resistance and magnetic surveys. A number of significant anomalies were identified in the GPR profiles that were interpreted as reflections from buried walls and drainage conduits associated with the former palace. However, due to the limited area of the GPR survey amplitude time slices created from this data failed to provide convincing evidence for the location of the 1963-7 excavation trenches.

Author's address :-

Mr N T Linford
ENGLISH HERITAGE
Centre For Archaeology Fort Cumberland
Fort Cumberland Road Eastney
Portsmouth
HANTS
UK
PO4 9LD

ELSYNG PALACE, LONDON BOROUGH OF ENFIELD

Report on geophysical survey, September 2000

Introduction

The location of the lost Tudor palace at Elsyng (SAM No. GL 59) was first established during excavation by the Enfield Archaeological Society between 1963 and 1967 (Jones and Drayton 1984). Regrettably, the precise location of the features observed during this field campaign is unknown and it was hoped that geophysical survey might provide a means for identifying the excavation trenches. Initial earth resistance and magnetic surveys conducted by the Ancient Monuments Laboratory proved highly successful and identified a number of significant anomalies (Horsley1997). However, the ground conditions were not suitable for geophysical survey in the area of the suspected excavation. Similarly, a more extensive earth resistance and magnetic survey commissioned by the Inspector of Ancient Monuments, English Heritage, to assist with the management of the site was also unable to penetrate the area of scrub where the excavation had been conducted (Bartlett 1998).

Given the well preserved nature of the remains described by Jones and Drayton (1984) and the enthusiasm of Prof. Dennis Hill, a member of the Enfield Archaeological Society, to arrange for the site to be cleared a trial ground penetrating radar (GPR) survey was considered prudent. It was hoped that the GPR survey would be able to locate the substantial vaulted brick drains discovered during the earlier excavations (Jones and Drayton 1984; Fig. 23).

The site (TQ 335 987) lies on soils of the Windsor association (Soil Survey of England and Wales 1983) developed over Taplow Terrace deposits overlying London Clay (Institute of Geological Sciences 1973). Such soils are reported to have a variable clay content and may become seasonally waterlogged. Ground conditions for the survey were generally level and varied from a well compacted trackway to recently cleared scrub.

Method

A Pulse Ekko PE1000 console was used to collected trial profiles with both 450MHz and 225MHz antennas. From this data the 225MHz antenna was selected as the most suitable centre frequency for obtaining the depth of penetration and lateral resolution required for the survey. A common mid-point (CMP) velocity analysis was subsequently conducted with this antenna and confirmed that the velocity of the radar wavefront in immediate topsoil was ~0.0889m/nS. This latter velocity was then used to estimate the depth to reflection events in the recorded profiles. Individual profiles were subject to post-acquisition processing involving the adjustment of time-zero to coincide with the true ground surface, removal of any low frequency transient response (dewow) and the application of a spreading and exponential compensation (SEC) gain function to enhance late arrivals.

A total of 21 parallel EW profiles separated by 1m were collected over the site at a sample interval 0.05m (Figures 1 and 2). Selected profiles, showing significant anomalies, are presented in Figure 3. Amplitude time slices created from the entire data set following additional processing with a recursive spatial high pass filter to enhance diffraction tails and scattering features are illustrated in Plan A (David and Linford 2000, Pulse Ekko 1996).

Results

The results from Line 1 (Figure 3) collected along an 80m length of the unobstructed trackway demonstrate the general GPR response at the site. High amplitude reflections are recorded within the first 40nS (two-way travel time) before the signal becomes increasingly attenuated with depth. From the CMP velocity estimate the depth of this interface, possibly indicative of a change in subsoil or the local water table, occurs at ~2.25m below the ground surface.

More significant anomalies evident in Line 1 include a broad arcuate response [1] corresponding with the topography of the raised bank to the E of the survey line and two hyperbolic responses [2] and [3]. Of these, [2] occurs close to the ground surface (~0.5m) and is associated with considerable "ringing" that may well be indicative of a metallic or possibly fired brick target. Anomaly [3] represents a reflection from an approximate depth ~2.25m and is likely to represent a more deeply buried wall footing or drainage conduit. A curious area of near surface (~0.5m) multiple scattering events is found at [4] and this is replicated throughout the data set (eg anomalies [12], [13] and [15]). The nature of this latter response is difficult to establish but may well be due to accumulation of brick rubble or ferrous litter in the topsoil. At the W end of Line 1 two more tentative hyperbolic anomalies [5] and [6] are evident that may be associated with the course of the vaulted drain observed in the gas main trench to the N of this profile (Jones and Drayton 1984; Figs. 27 and 28).

Line 2 (Figure 1) contains evidence for possible continuation of anomaly [2] southwards at [7] and a more substantial wall-type anomaly [8] that may be associated with [3]. Anomaly [8] is flanked by areas of attenuation to either side (ditches?) and is in close proximity to a further, deeper-lying wall-type response at [9]. Additional, near-surface walls are evident at [10] and [11] before the signal is interrupted by the response possibly due to rubble noted above.

Lines 7 and 8 contain the most convincing evidence for the expected response from a vaulted brick-lined drain. Both anomalies [14] and [15] consist of multiple, superimposed reflection events that may be due to the response from the roof and floor of the drain. However, the data does not contain the expected brick→air / air→brick signal polarity reversal that would occur for an air-filled void. In addition, the earliest reflection, due to the roof of the vault, occurs at 20nS equating to a depth of ~0.9m followed by a later reflection at 45nS due to the floor. If the drain were still an air-filled void then the signal would travel at the velocity of radio waves in air (~0.3m/nS) between the roof and floor suggesting the height of the drain to be ~3.0m. Applying the velocity estimate determined for the subsoil at the site would reduce the height of the drain to ~0.9m in keeping with the observed height of 0.97m recorded by Jones and Drayton (1984).

Time slices

Plan A shows amplitude time slices created from the parallel profiles at 10nS (two-way travel time) intervals to a maximum of 90nS. From the estimated subsurface velocity determined through the CMP test the depth between each successive time slice is ~0.44m. It was hoped that the time slices would reveal linear anomalies through the continuity of reflection anomalies between adjacent individual profiles. However, the data contains a high degree of background noise (increasing over the rough terrain to the south) that has hampered the identification of linear anomalies within the amplitude time slices.

Two high amplitude wall-type reflections [16] and [17] (Plan A; 10-20nS) enter the survey from the N and correlate with anomalies [10]/[11] and [8] identified in the profile plots (Figure 3). These anomalies occur at a depth of ~0.5m from the ground surface but do not continue further than 2m to the S. The data between 10 – 40 nS contains many high amplitude reflections that hamper the identification of any pattern but may be indicative of building rubble, particularly at [18] (Plan A; 20 – 30nS). Highly tentative linear anomalies may be identified at [19] delimiting the area containing multiple scattering events (Figure 3, [4] and [12]); at [20], indicating the upper reflection from the drain-type anomaly (Figure 3; [14] and [15]; at [21] possibly associated with an EW wall; and at [22] following the lower reflection beneath [20].

Conclusion

Despite the unfavourable terrain and clay content of the soil at the site, GPR survey has successfully identified a number of significant anomalies that seem likely to be associated with the remains of the former Tudor palace. Unfortunately, due to the limitations of the present trial survey only a keyhole area has been covered hampering the precise correlation between the earlier excavation plan and significant anomalies in the GPR data. A possible location for one of the vaulted brick drains identified during the excavation has been suggested. However, if these latter anomalies do indeed represent such a structure then it would no longer appear to be an extant air-filled void.

The amplitude time slices created from this GPR data have not proved particularly useful. This may well be due to the modest area covered by the survey, an unsuitable spacing between survey lines (1m) or the quantity of reflections from near-surface ?rubble obscuring more significant anomalies. In addition, it is possible that the brick foundations of the Tudor palace have become water-logged reducing the physical contrast between this material and the subsoil (*cf* results from the resistivity survey at Hampstead Marshall, Linford 1997).

Further GPR survey over other areas of the site prior to excavation would prove fruitful provided a larger area containing less challenging terrain is available. In addition, an increased sample density and survey during the summer months may well improve both the GPR response to brick remains and the subsequent interpretation of amplitude time slices.

Surveyed by: N. Linford | Date of survey: 25 September 2000

Reported by: N. Linford | Date of report: 18 October 2000

Archaeometry Branch,
Ancient Monuments Laboratory,
English Heritage

Acknowledgements

The author wishes to thank Prof. Dennis Hill of the Enfield Archaeological society and Mr Robin Densem of Compass Archaeology for their kind assistance in the field.

Bibliography

Bartlett, A. D. H., 1998, *Site of Elsyng Palace, London Borough of Enfield, Report on Archaeogeophysical Survey 1998*, Bartlett-Clark Consultancy Report for English Heritage.

David, A. and Linford, N., 2000, Physics and Archaeology, *Physics World*, **13**, No. 5, pp27-31.

Institute of Geological Sciences (British Geological Survey) 1973 1:50 000 map. *Geological Survey of Great Britain, Sheet 256 North London - Drift.*

Jones, I.K. and Drayton, I.W. 1984 *The Royal Palaces of Enfield*. Enfield Archaeological Society Research Paper No. 4.

Linford, N, 1997, *Hamstead Marshall, Report on geophysical surveys 1996*, Ancient Monument Laboratory Report Series **2/97**.

Sensors and Software, 1996, *pulseEKKO IV RUN User's Guide*, Technical Manual 20.

Soil Survey of England and Wales, 1983, Soils of England and Wales, Sheet 4, Eastern England.

List of enclosed figures

Figure 1 Location plan of GPR survey transects superimposed over the topographic plan of the site. (1:1250).

Figure 2 Detailed relocation plan of the GPR transects including significant anomalies discussed in the text. (1:250)

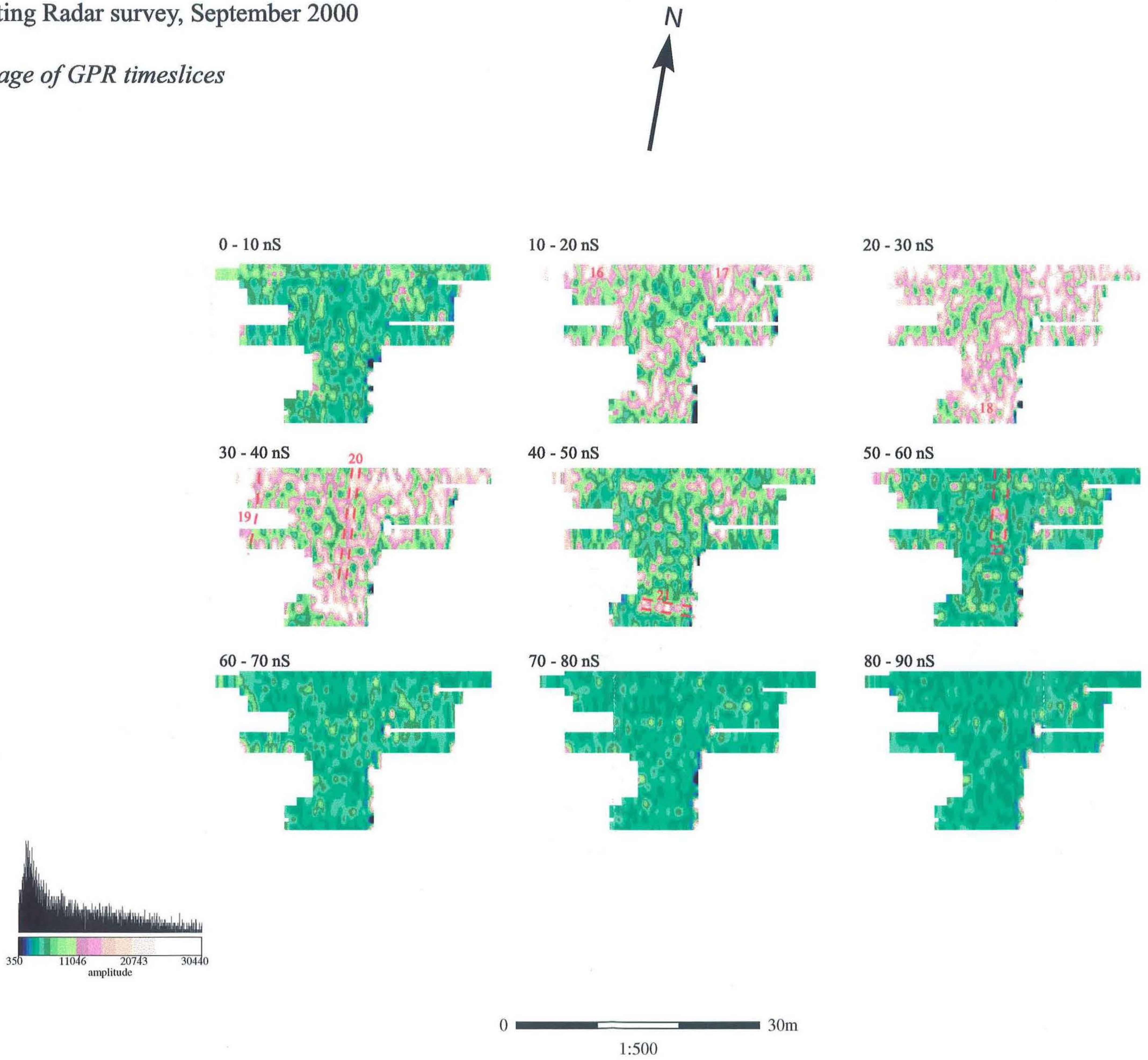
Figure 3 Selected GPR profiles.

Plan A Amplitude time slices created from the GPR profiles (1:500).

Elsyng Palace, London Borough of Enfield
Ground Penetrating Radar survey, September 2000

PLAN A

False colour image of GPR timeslices

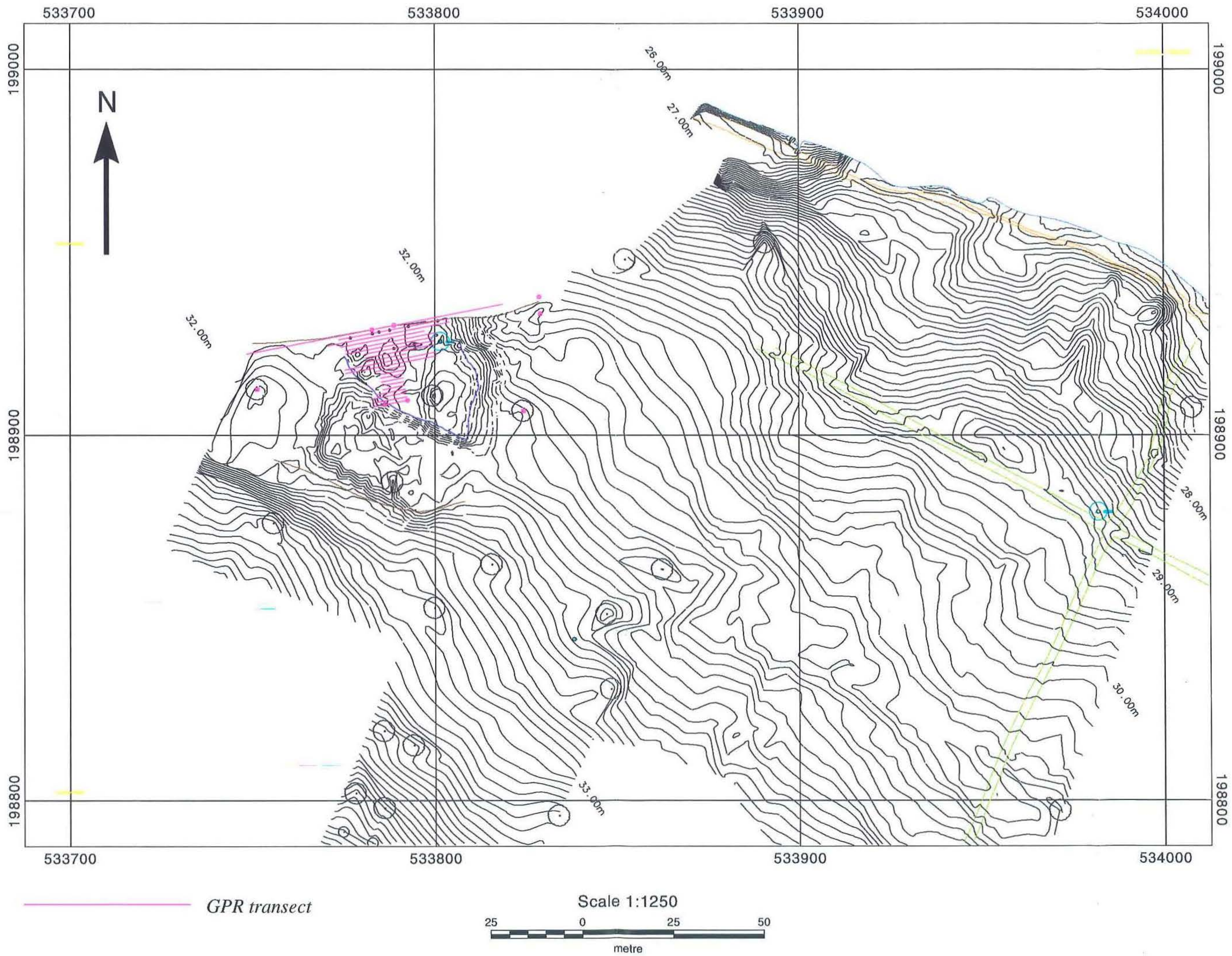


Ancient Monuments Laboratory 2000

ELSYNG PALACE, LONDON BOROUGH OF ENFIELD
Location of GPR Survey, September 2000

Figure 1

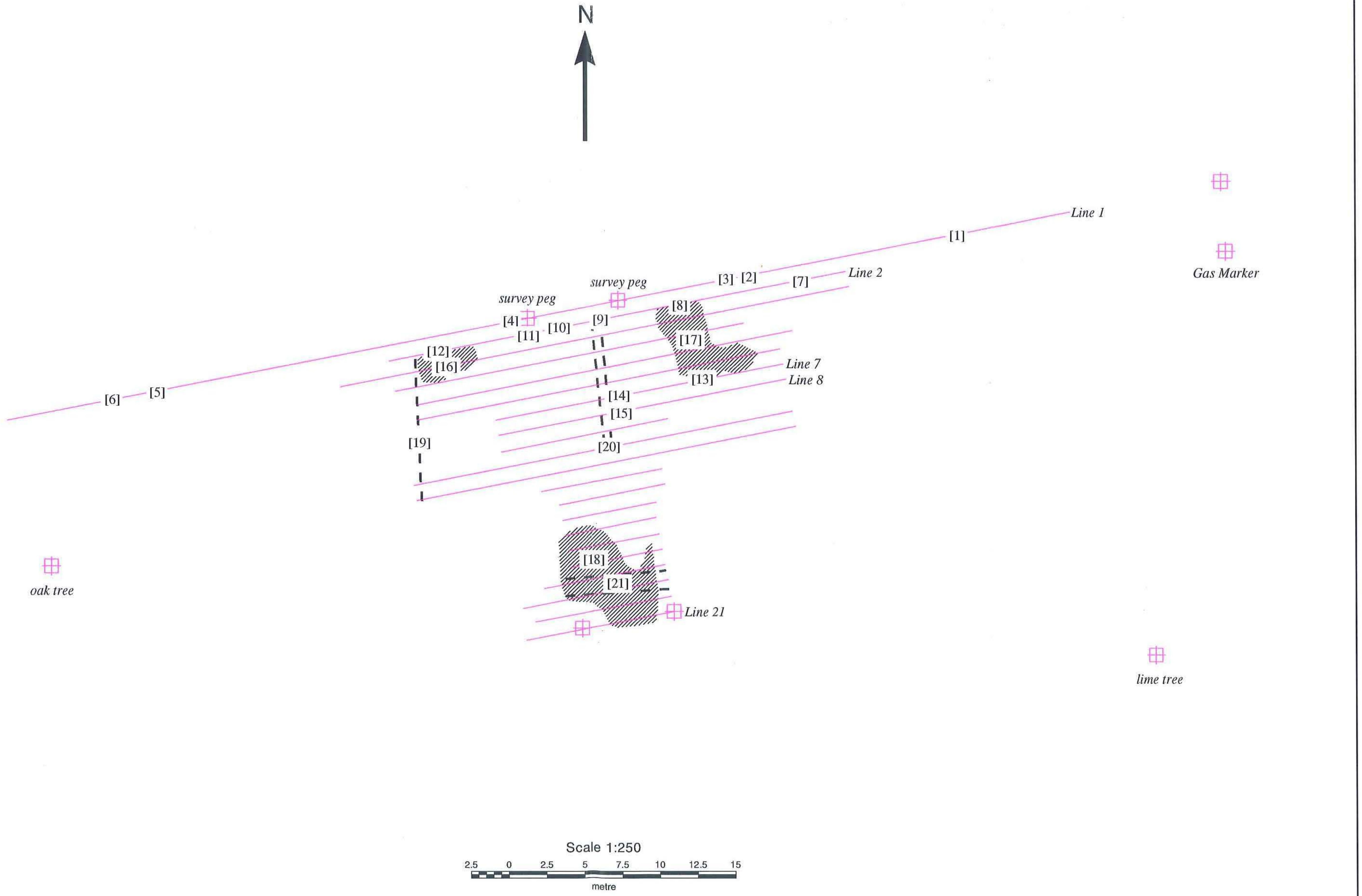
GPR transects superimposed over the topographic plan of the site



Ancient Monuments Laboratory 2000

ELSYNG PALACE, LONDON BOROUGH OF ENFIELD
Interpretation of GPR Survey, September 2000

Figure 2



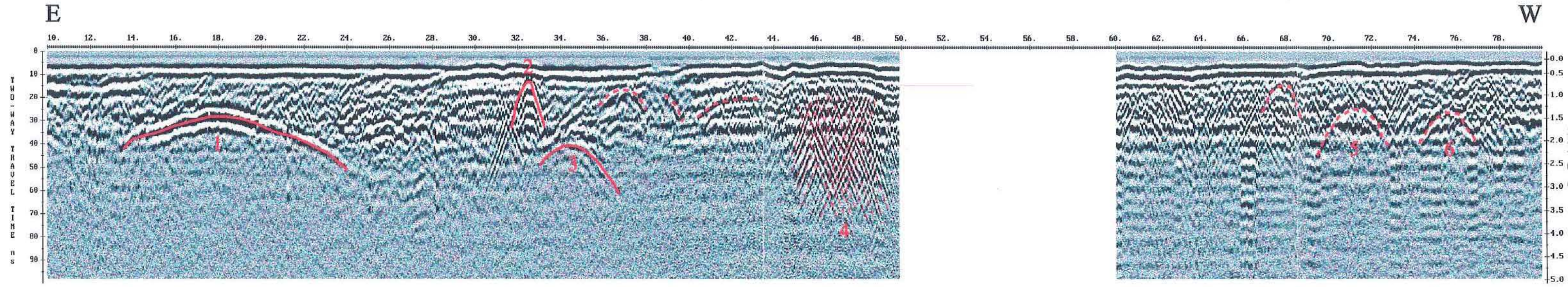
Ancient Monuments Laboratory 2000

Figure 3

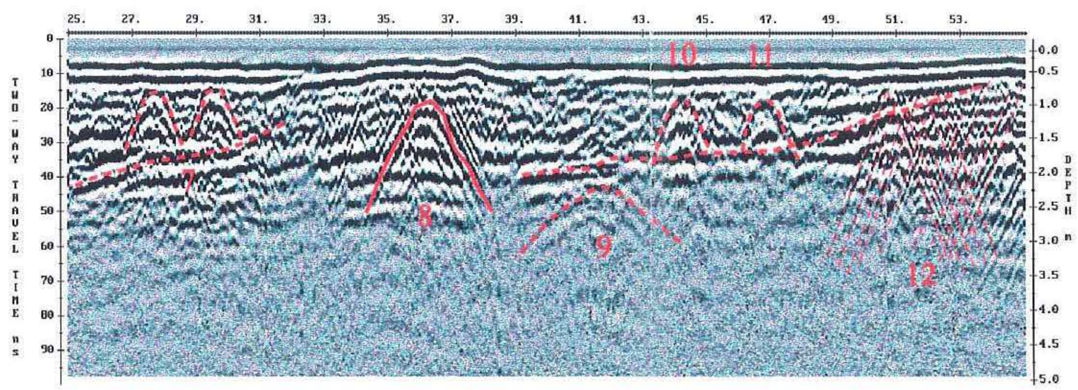
Elsyng Palace, London Borough of Enfield
Ground Penetrating Radar Survey, September 2000

Selected GPR profiles

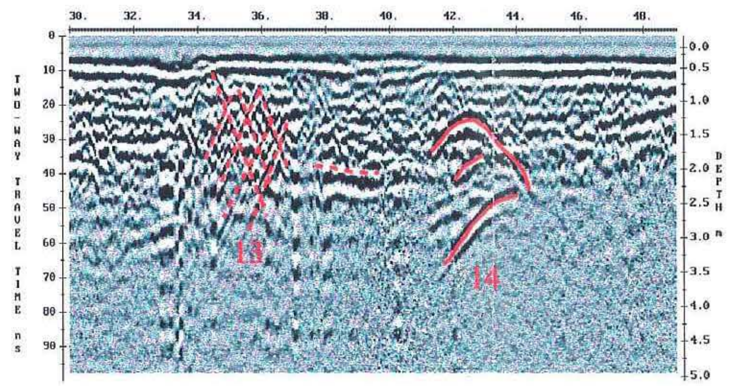
Line 1



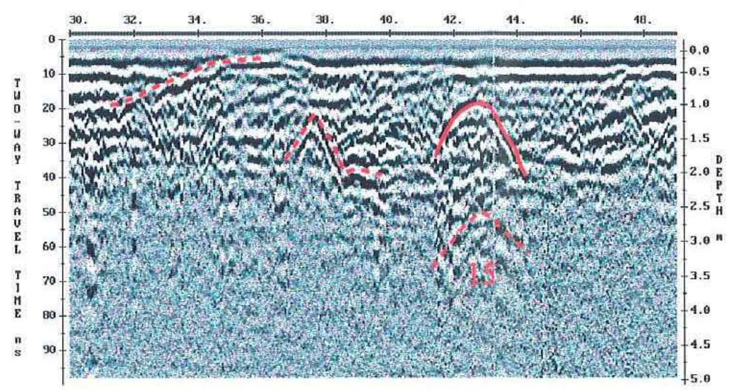
Line 2

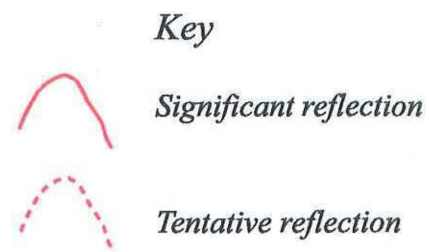


Line 7



Line 8





Ancient Monuments Laboratory 2000