GROUND PENETRATING RADAR SURVEY AT GREYFRIARS, WINCHELSEA, EAST SUSSEX

Winchelsea Archaeological Society

National grid reference: TQ 906 171

Survey date: 21 September 2006

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1. Introduction

1.1. Terms of reference

1.1.1. On 21 September 2006, Arrow Geophysics carried out a ground penetrating radar survey on the upper east lawn of Greyfriars in Winchelsea, East Sussex.

1.1.2. The survey was commissioned by Winchelsea Archaeological Society with the aim of locating archaeological remains of the Franciscan monastery which occupied the survey area and its environs from about 1284 until 1538.

1.2. Location

1.2.1. Figure 1 shows the survey area in its regional and immediate context.

1.3. Geology

1.3.1. General geology consists of Wadhurst Clay over sandstone sub-strata. The survey area itself is likely to have been fairly extensively reworked.

1.4. Archaeological potential

1.4.1. The Grey Friars (Franciscans) moved to this site from Old Winchelsea, where they had been since 1252. Their monastery appears to have been badly damaged by the storms that hit Old Winchelsea and, in 1284, they were granted a 4-acre site by John Bone of Wickham to allow them to relocate.

1.4.2. The monastery was dissolved in 1538 and most of the buildings were demolished to provide stone for Camber Castle. The site was sold off by the Crown in 1545. The surviving buildings were converted into a private residence but this was demolished in 1819 to make way for the current house.

1.4.3. The above summary is extracted from the website "The Ancient Town of Winchelsea" (WWW1).

1.4.4. Resistivity survey carried out by Winchelsea Archaeological Society has revealed buried features within the survey area and its environs which are thought to be the archaeological remains of the Franciscan monastery. The present radar survey is an attempt to better understand these buried features.

2. Acquisition

2.1.1. Radar data were collected at a base frequency of 500 MHz using a Malå GeoScience AB RAMAC/GPR system consisting principally of a shielded monostatic antenna, CUII control unit and XV11 monitor.

2.1.2. Profiles were collected at a line spacing of 0.5 metres and a station spacing of two centimetres. The nominal location of each profile is shown in Figure 2.

2.1.3. The time window for reflection measurement was set to 49.3 nanoseconds, which corresponds to a potential penetration depth of approximately 2.1 metres at an estimated radar wave propagation velocity of 8.5 cm/ns.

3. Processing

3.1. Stacked profiles

3.1.1. DC offset correction and linear time gain were applied to the radar data to correct for low frequency noise and amplitude attenuation with distance respectively.

3.1.2. Profiles were then stacked to produce the series of images included in the digital data archive which accompanies this report.

3.2. Depth slices

3.2.1. Kirchhoff migration was applied to the profile data using a radar wave propagation velocity of 8.5 cm/ns (based on profile measurement). This migration process positions features more accurately in section, and in particular collapses hyperbolic reflections to their source locations.

3.2.2. Profile signal amplitudes were then squared to improve signal-to-noise ratio and reduce the effect of transmitter waveform shape.

3.2.3. The profile dataset was then sliced at a vertical interval of 200 mm to produce depth slices suitable for feature interpretation. Depth slices from surface to 1600 mm were gridded using a kriging algorithm to produce the images shown in Figures 3a-3h. Radar reflectance in these images grades from low (black) to high (white). Amplitude thresholding has been applied to enhance feature interpretability.

3.3. Software

3.3.1. Processing was mainly carried out using Shakespeare[1] and Geosoft Target.

4. Interpretation

4.1. General comments

4.1.1. The advantage of radar depth slices is that the *spatial relationship* of individual features can be appreciated in plan view. The advantage of radar profiles is that the *changing character* of individual features can be studied profile by profile. A combined approach - identifying features on depth slices, and ascertaining their characteristics from profiles when necessary - is usually the best method of radar interpretation in an archaeological context.

4.1.2. Effective signal penetration was achieved to a depth of approximately 1.6 metres at this site.

4.2. Specific features

4.2.1. Specific features interpreted from the survey dataset are shown in Figure 4.

[1] Proprietary software for processing radar data developed by Arrow Geophysics

4.2.2. Two broad categories of feature have been identified: masonry footings and pathway footings.

4.2.3. The masonry footings occur at a depth of 400 mm-plus, and probably indicate the outlines of buildings and passages associated with the former Franciscan monastery. Corner buttressing is observed in places, and the general level of feature preservation is high. It is interesting to note that the footings parallel the alignment of the existing private residence but are oblique to the exposed church remains north of the survey area.

4.2.4. Truncating and obscuring the masonry footings in a number of places are shallower, and therefore presumably more modern, pathway footings. It is possible that these are associated with successive generations of formal gardening, the youngest of which still exists. Note the northward and westward movement of pathway alignment over time along the northern and eastern edges of the survey area respectively.

5. Conclusion

5.1.1. Radar has successfully imaged a number of masonry footings thought to be associated with the former Franciscan monastery that occupied the survey area and its environs between the 13th and 16th centuries AD.

5.1.2. More recent pathway footings provide evidence for successive generations of formal gardening.

6. Acknowledgements

The assistance of Winchelsea Archaeological Society in laying out the field grid for this survey is gratefully acknowledged.

7. References

WWW1. www.winchelsea.net/visiting/winchelsea_history_pt11.htm

APPENDIX: GROUND PENETRATING RADAR FOR ARCHAEOLOGICAL PROSPECTION

Ground Penetrating Radar for Archaeological Prospection

Ground penetrating radar has a generally poor reputation in UK archaeology. The reasons for this include an over-optimistic exposé of the technique in a 1989 *Antiquity* paper, some poorly thought-out surveys in the early 1990s, and the technique's complete lack of suitability for many archaeological applications.

So why should we consider it now?

Radar has undergone a quiet revolution since the early 1990s - not in fundamental technology, but in packaging. In summary, hardware has become extremely portable and increasingly robust, and software is able to present survey results in a more easily understood format. When combined with a good understanding of the technique's strengths and limitations, these advances make radar a thoroughly viable alternative to more established geophysical techniques.

Advantages

Radar enjoys a number of significant advantages over other geophysical techniques:

Brownfield and urban sites
Magnetic techniques tend to fail when there is significant site contamination due to modern ironwork

Hard surfaces
Conventional resistivity cannot be carried out on concrete, tarmac or stone floors.

Vertical faces
Magnetic and resistivity techniques are seldom suitable for surveying walls and other standing structures – they lack the resolving power and are cumbersome in small spaces.

Three dimensions
Radar can provide direct information on feature depth, enabling successive archaeological contexts to be distinguished and complex structural changes to be resolved.

Deep penetration
Under suitable conditions, radar energy can penetrate to depths of more than ten metres, whereas conventional magnetic and resistivity techniques typically sample the top half metre of the subsurface.

Disadvantages

Radar suffers from three significant disadvantages:

Unconstrained sites
Radar detects background clutter as well as features of archaeological importance. Without some idea of what is being sought, survey results can be extremely difficult to interpret.

Conductive geology
Clay-rich and saline soils severely limit the effective penetration of radar energy.

Broken ground
Poor antenna coupling with the ground surface reduces horizontal continuity of genuine reflections and introduces data artefacts. For this reason, radar is seldom recommended on areas of broken ground such as ploughed land. Small survey areas can sometimes be manually or mechanically compacted in advance of survey commencement to reduce the effect of poor antenna coupling.

Cost

Until now, radar has suffered from a fourth significant disadvantage: cost. Expensive hardware, slow rates of data acquisition, and time-consuming processing and interpretation have conspired to make radar surveys a luxury affordable to very few archaeological projects.

Arrow Geophysics perceives high cost as a major stumbling block to the general acceptance of radar as a mainstream geophysical prospection technique. In order to make radar more accessible for broad-scale reconnaissance work, we are currently developing a methodology that will offer multi-hectare radar survey at prices comparable to those currently charged for conventional resistivity.

Suggested applications

Radar can in principle be used to investigate a range of archaeological targets, including the following:

Masonry
- Walls
- Foundations
- Burial vaults
- Kilns

Voids
- Cellars
- Caves
- Tunnels

Earthworks
- Earth-cut graves
- Garden features
- Moats and ditches

Standing structures
- Brick
- Concrete
- Wattle-and-daub
- Plaster and mosaic murals

Stratigraphy
- Geological layering
- Context evaluation
- Water table mapping

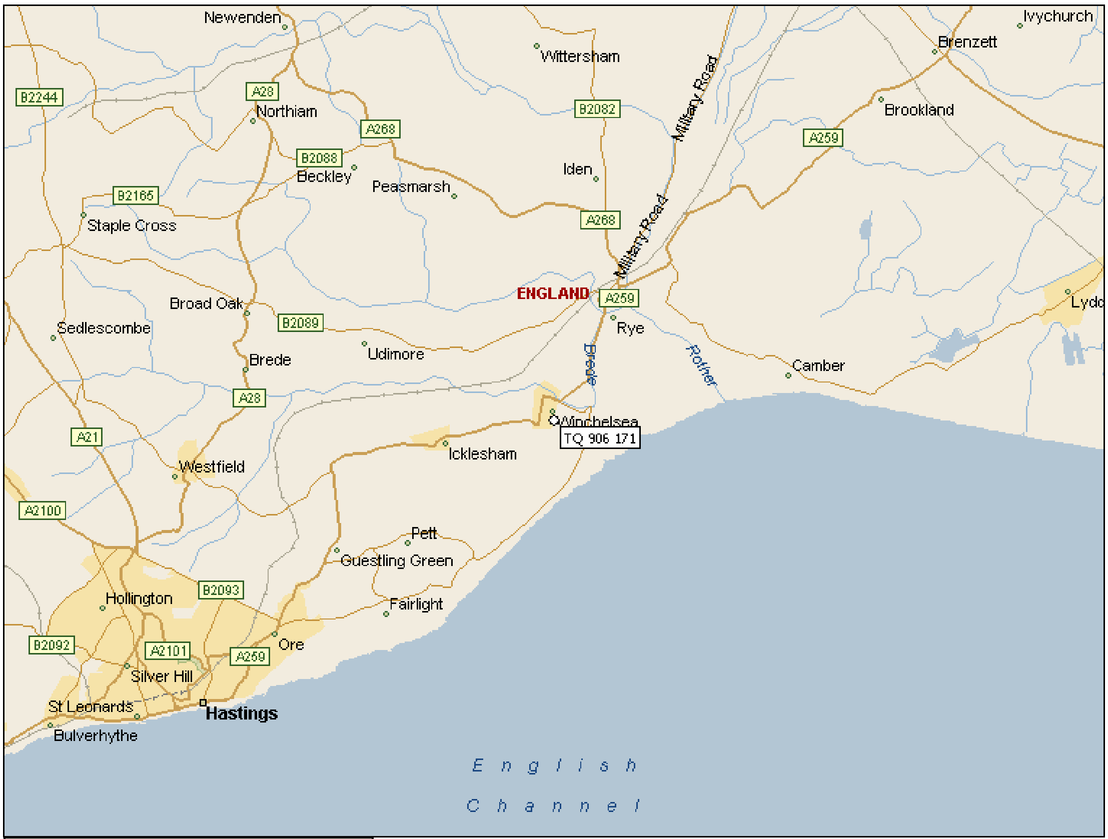
An important, if obvious, question to ask when considering a radar survey is whether the material to be investigated exhibits a contrast with its surroundings. Considering the above list, one can see that the answer to this question is not always straightforward!

Handle with care…

Radar was not the universal panacea for archaeological uncertainty in the 1990s; it is not the universal panacea for archaeological uncertainty now. What has changed is the practicality of available hardware and the power of available software. Notwithstanding, radar surveys need to be planned and executed with care in order to maximise the advantages and minimise the disadvantages of this extremely powerful geophysical technique.

FIGURES

Figure 1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Northiam
A268
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Military Road
Brookland
A259
B2088
Beckley
Peasmarsh
Iden
B2165
Staple Cross
A268
Military Road
ENGLAND
A259
Broad Oak
Sedlescombe
B2089
Rye
Lydd
Brede
Udimore
Brede
Rother
Camber
A28
Winchelsea
TQ 906 171
A21
Icklesham
Westfield
A2100
Pett
Guestling Green
B2093
Hollington
Fairlight
B2092
A2101
Ore
A259
Silver Hill
St Leonards
Hastings
Bulverhythe
English
Channel

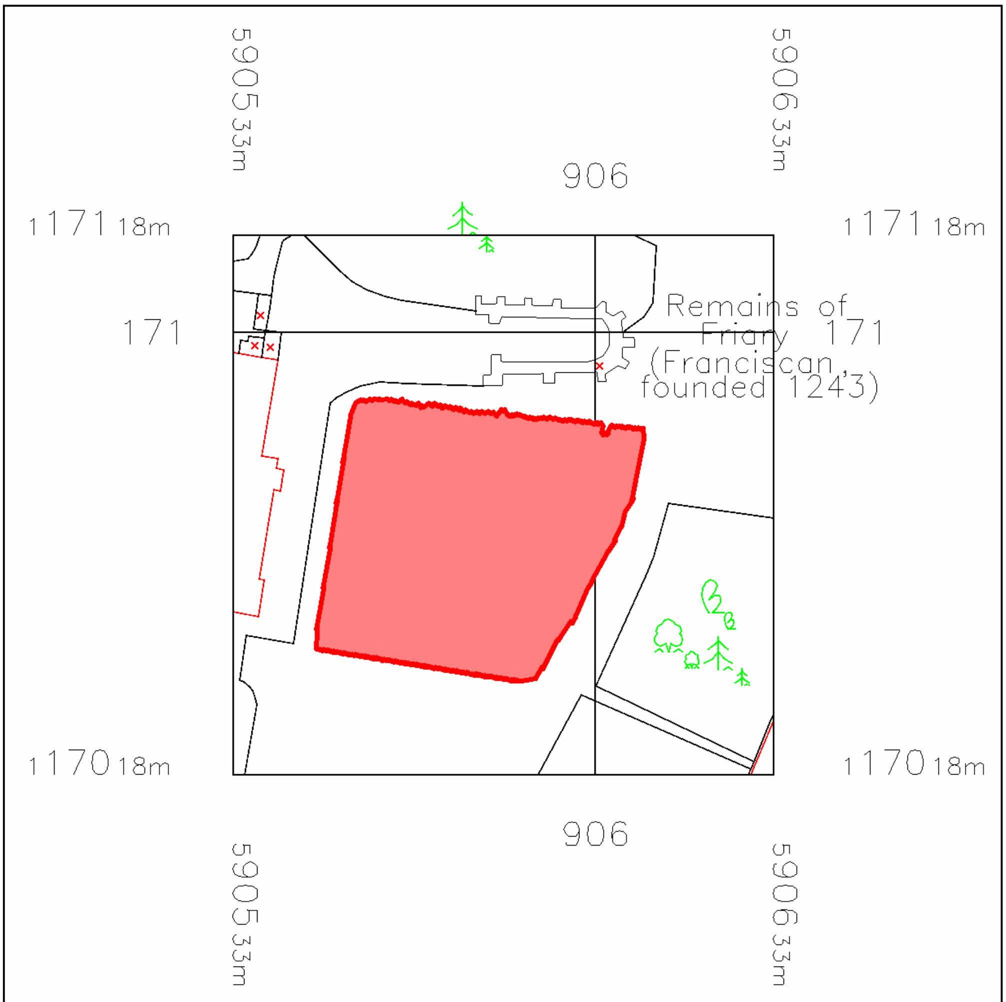
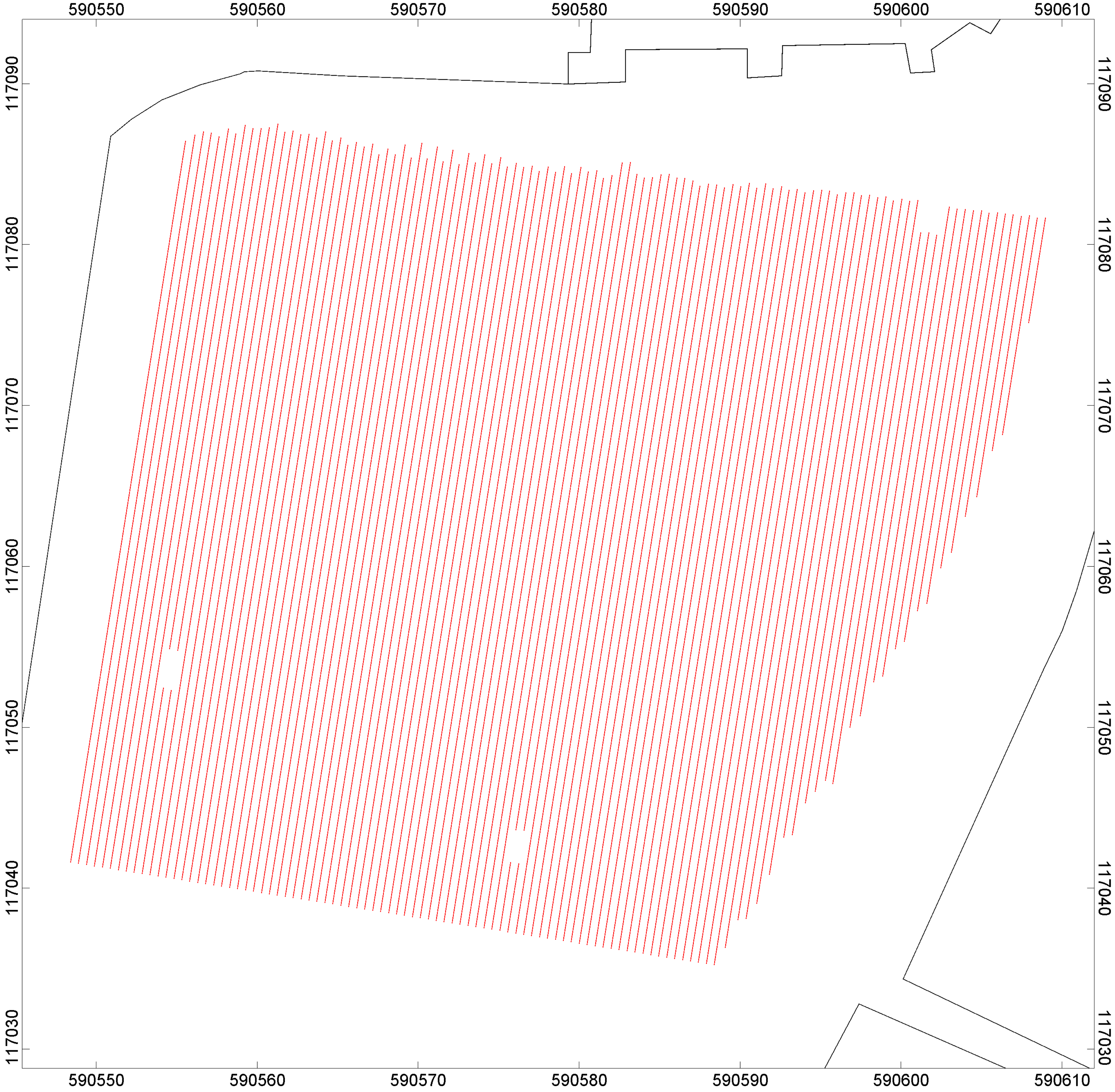
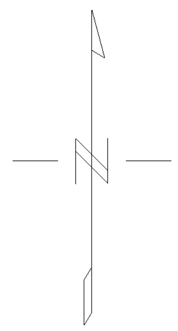

590533m
590633m
906
117118m
117118m
171
Remains of Friary (Franciscan, founded 1243)
171
117018m
117018m
906
590533m
590633m

Figure 2





Scale 1:300

metres

OSGB 1936 / British National Grid

Winchelsea Archaeological Society

Greyfriars
Winchelsea, East Sussex
High-resolution GPR survey

location of profiles

Arrow Geophysics