LAND OFF BLUEBELL WAY, PRESTON EAST, Lancashire

Archaeological Evaluation Report

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SUMMARY

Following a proposal for a development of land at Preston East, Bluebell Way, Preston, Lancashire (centred on NGR SD 570 327), an Environmental Impact Assessment was carried out to accompany the planning application for the site. Lancashire County Archaeology Service (LCAS) stipulated a programme of archaeological evaluation be carried out as a condition of the planning consent, specifically a geophysical survey and subsequent targeted trial trenching, to understand the potential impact of the proposed development on the cultural heritage resource. The Preston East development is divided into four areas, Areas A-D. Area A was previously subjected to a programme of archaeological investigation by Oxford Archaeology (OA North) in 2011. The current programme of works is concerned with Areas 1 and 2 of Area B, which has been further sub-divided into four areas.

OA North was commissioned by Brookhouse Developments Ltd to undertake the archaeological investigation of Areas 1 and 2. In January 2012, the site was initially subjected to a geophysical survey, sampling 40% of the area with magnetometry and 15% with resistivity. However, the presence of a water main through the eastern side of the site, together with other modern debris and obstructions, meant that the survey was limited to the available area.

The combined geophysical survey results recorded anomalies mainly associated with the presence of the water main, although, in the ‘triangular’ western portion of Area 1 there were a number of anomalies that appeared to be possibly archaeological in origin, including areas of possible burning or burnt/fired objects, parallel linear anomalies that may have related to the medieval agricultural use of the area, and an area of high resistance that could have been the remains of a structure, for instance.

Consequently, eight trial trenches were excavated in February 2012 by OA North. Features of archaeological potential were targeted by Trenches 6, 7 and 8. Elsewhere, the ‘blank’ survey results were tested with Trenches 3 and 5, and Trenches 1, 2 and 4 were positioned to sample those areas outwith the survey, with Trench 2 also targeting a drain observed on site.

Only one archaeological feature was identified during the trenching, drainage ditch 205 within Trench 2. This ditch is clearly depicted as a boundary on early twentieth century Ordnance Survey mapping, and was probably in existence during the nineteenth century, although it appears in the first edition mapping to be merged with the southern boundary of an east/west-aligned trackway. It probably dates, therefore, to the enclosure of the moorland by the Parliamentary Enclosure Act in the eighteenth or nineteenth century. However, some boundaries of the area may have medieval origins, being formerly of the open field system farmed from the shrunken medieval settlement of Fulwood Row located to the east of the site.

The ditch, 205, was of low archaeological significance and no further archaeological features were observed. Therefore, no further archaeological work is recommended.
ACKNOWLEDGEMENTS

Oxford Archaeology North would like to thank Peter Waring of Brookhouse Developments Ltd for commissioning the project, and to Alban Cassidy, Cassidy and Ashton, for his help and provision of information. Thanks are also due to Brookhouse Developments Ltd and their staff for the provision of the mechanical excavator and their assistance during the project.

The fieldwork was undertaken by Andy Bates, assisted by John Onraet and Paul Dunn. The report was written by Andy Bates, with the drawings produced by Anna Hodgkinson. All finds were reported on by Chris Howard-Davis. The project was managed by Emily Mercer, who also edited the report.
1. INTRODUCTION

1.1 CIRCUMSTANCES OF PROJECT

1.1.1 Planning permission was granted for the Preston East development, positioned between Fulwood and Grimsargh, following the submission of an Environmental Impact Assessment (EIA) to accompany the planning application (GVA Grimley 2006). The proposed development is for industrial/warehousing and distribution units, together with business units, and a Girl Guides’ hall, on land that has been parcelled into Areas A-D. Area A, to the north of Bluebell Way, was previously evaluated by Oxford Archaeology North (OA North) in 2011 (OA North 2011). This second phase of works is concerned with Areas 1 and 2 of Area B, to the south of Bluebell Way, Preston, Lancashire, which has itself been further sub-divided into four areas. Areas 1 and 2 are the proposed locations for the Girl Guides’ hall and an access road.

1.1.2 The EIA found the area to have potential for medieval and post-medieval remains, of likely agricultural or small-scale industrial origin, to survive below ground (GVA Grimley 2006). A former highway marked as ‘Chews Road’ on the 1847 Tithe Map of the area runs adjacent to the south-eastern boundary of Area 2 (GVA Grimley 2006, Appendix A). Consequently, a programme of evaluation was required as a condition to the planning permission by the Lancashire County Archaeology Service (LCAS). Specifically, this entailed a sample geophysical survey and subsequent targeted trial trenching. This would enable the potential impact of the proposed development on the cultural heritage resource to be understood, and, therefore the implications for any required mitigation. OA North was commissioned by Brookhouse Developments Ltd to undertake the evaluation, which was completed in January and February 2012. Phase Site Investigations Ltd carried out the first stage of the work, the geophysical survey (see Appendix 1), the results of which were used to target a programme of trial trenching. This report provides a summary of the results of the evaluation in the form of a short document, outlining the findings and assessing the impact of the proposed development.

1.2 LOCATION, TOPOGRAPHY AND GEOLOGY

1.2.1 Location: the present development site lies within the M6 corridor in central Lancashire, and on the northern margins of the Ribble valley. The site, to the north-east of the Preston urban area, and just off the B4242 (NGR SD 570 327; Fig 1), falls within a generally rural region that is being encroached upon by light industrial development, such as Red Scar to the south. The area to the north of the site was delineated partly by a series of strip and irregular fields typical of the wider landscape (CAP 2006, 4), and comprises green- and brownfield areas. The landscape surrounding the site is typical of the Lancashire Plain and Bowland fringe area (Countryside Commission 1998, 92-93), characterised by isolated hamlets and farms, set within enclosed fields with irregular boundaries.
1.2.2 Topography and geology: the proposed development area lies approximately 60m AOD between the Savick Beck and the Blundel Brook, which flow toward the west. The solid geology of the area consists of red and green mudstones overlain by boulder clay glacial drift (ibid). The soil is generally of the Salop series, which is a typical stagnogley (Lawes Agricultural Trust 1983).

1.3 Historical and Archaeological Background

1.3.1 Introduction: the historical and archaeological background presented below is not intended to be an exhaustive account, but rather to place the site within its historical context.

1.3.2 Prehistoric period: the Ribble valley has been the focus of human activity since prehistoric times. The earliest evidence dates to the Mesolithic period (when people practised an economy based generally on nomadic hunting, fishing and gathering), and includes a mattock fashioned from red deer antler and dated to c 5400 BC, which was found on the banks of the Ribble in Preston (Hunt 2003, 15). Although traditionally the Neolithic period is defined by the introduction of agriculture and more permanent settlement, in Lancashire, the earlier Neolithic economy appears little different from that of the Mesolithic (Middleton 1996, 36–9). The closest Neolithic activity to the development site comprises finds of single polished axes from the Ribble Valley at Penwortham and Samlesbury Bottoms, each within 4km of the site (op cit, 44). Depositions of Bronze Age material are represented within the broader environs of the site, particularly in areas fringing the Ribble and its estuary. A large assemblage of artefacts was recovered during the construction of Preston Dock, a little over 7km to the south-west, which included human skulls, animal remains, two dugout canoes and a possible structure (Crosby 2000, 10–11; Middleton 1996, 46).

1.3.3 The Iron Age is notoriously underrepresented in Lancashire (Hodgson and Brennand 2006, 51; Haselgrove 1996, 61). This is probably influenced as much by the poor survival and identification of material of this date and the inherent difficulty of recognising potentially subtle regional site-types (Hodgson and Brennand 2006, 53; Cowell 2005, 75; Haselgrove 1996, 64) as it is by the often quoted suggestion of a low population density (Haselgrove 1996, 64). The closest known Iron Age site to the excavation area lies approximately 16km to the east, at Portfield Camp in Whalley (Cowell 2005, 68–72). It has been suggested that a promontory overlooking Clock House Farm, just over 1km to the north-east, was demarcated by a curving ditch (TC Welsh pers com), while an evaluation at Roman Way, Red Scar, located 1.5km to the south-east revealed ditches, possibly pre-Roman in origin (Earthworks Archaeological Services 2001).

1.3.4 Romano-British period: Lancashire lies within the Roman military hinterland to the rear of the Hadrianic frontier. The site is located in an area that was linked by the Roman roads that pass between the late first-century fort at Ribchester and the site at Kirkham (Buxton and Howard-Davis 2000; Howard-Davis and Buxton 2000), and between Wigan and Preston. The first of these
roads passes within 1km of the site (Margary 1973, 106, road 703), and was evaluated archaeologically in the area of Red Scar Industrial Estate (LUAU 1995). The road comprised a 9m-wide cambered surface consisting of sub-rounded stones and cobbles overlain by fine gravels (ibid). The postulated route of the Roman road that ran between Wigan and Walton-le-Dale, and then onto Lancaster (Margary 1973, 359, road 70a) lies approximately 4km to the west of the proposed development area, close to the position of the current A6 (Philpott 2006, 60). Walton-le-Dale was a significant industrial centre during the Romano-British period. Considering its position within the riverine and road network; it may have functioned as a part of a system of supply bases (op cit, 70; 75).

1.3.5 Early medieval period: following the withdrawal of the Roman military presence in the fifth and sixth centuries, several small kingdoms were established (GVA Grimley 2006). During the late sixth and early seventh centuries these were taken over by the Kingdom of Northumbria, which reached its peak around the ninth century and was followed by a period of political instability. Archaeological evidence for early medieval activity in the wider locale is not particularly widespread, but is extremely significant: the largest Scandinavian hoard in north-west Europe was found at Cuerdale, 4km to the south of the proposed development area (Newman RM 1996, 103). The 40kg hoard, dated to c AD 905, comprised 75% hack silver together with over 7250 coins, many minted in York (ibid; Newman RM 2006, 111). It has been suggested that the hoard, located so close to the Ribble, may have represented funds being gathered to fund a reinvasion of Ireland, following the expulsion of the Norsemen in AD 902 from the settlements they had founded (op cit, 112). Preston, which lies immediately to the south-west of the proposed development area, seems to have been the focus of activity prior to the Norman Conquest and its name derives from the Old English Preosta and Tun, meaning ‘the priest’s homestead’ (Lancashire County Council 2006a, 18). It is suggested (ibid) that the archbishop of York may have established a church at Preston as early as the tenth century, following King Aethelstan’s gift of land to St Peter’s church, York, dated c 930 (Fishwick 1900, 10).

1.3.6 Medieval Period: Preston is mentioned in Domesday Book and, in 1086, is listed first among the former holdings in Amounderness of Tostig (Faull and Stinson 1986), the treacherous pre-Conquest Earl of Northumbria. At the time of the Domesday survey, the Hundred was registered as part of Yorkshire, a legacy of its Northumbrian heritage. Subsequently, William the Conqueror bestowed the territory upon Roger de Poitou. Domesday records that the manor of Preston had 52 vills, but none of these appear to have generated any revenue worth mentioning and, indeed, only 16 are recorded as being inhabited; this impoverishment is traditionally ascribed to William I’s ‘Harrying of the North’ in 1069/70. Preston remained the dominant urban centre during the medieval period, becoming a chartered town by the thirteenth century (White 1996, 129).

1.3.7 The development site was located within the township of Fulwood, in the parish of Lancaster (Farrer and Brownbill 1912). The compound place-name ful(e)-wude, which first appears in a twelfth-century document, preserves the
Anglo-Saxon elements *fül*, meaning marshy or foul, and *wudu*, literally wood (Ekwall 1922, 148). For much of the later medieval period, Fulwood was a royal forest within the Honour Lancaster. Though originally extending further, Watling Street formed its southern extent by the thirteenth century (Hunt 2003, 34-5). In the Norman period, Crown hunting rights in royal forests were formalised, but from the early thirteenth-century reign of King John (1199-1216) successive medieval rulers granted common rights of pasturage and the right to collect wood for fuel and timber within the forest (Fishwick 1900, 18-9; Hunt 2003, 34-5). This led to the gradual clearance of the woodland and, by 1346, there were nine farmsteads within the boundaries of the forest (Hunt 1992). In 1253 King Henry III also granted 324ha of moorland to the burgesses of Preston (*ibid*).

1.3.8 Although the township of Haighton, just to the north, is recorded in Domesday as being a single ploughland in 1066 (Farrer and Brownbill 1912), “there is little evidence for the nature and morphology of Lancashire’s rural settlement before the thirteenth century” (Newman R 1996a, 114-116). From this date, it would appear that settlement to the north-west, within the lowlands of Amounderness, tended to be more nucleated, whilst upland settlement remained dispersed. Geographically, the area immediately surrounding the site is typical of the interface between the upland and lowland zones in Lancashire, and it seems likely that the scattering of small hamlets, such as Fulwood, and individual farmsteads shown on the earliest maps is reflective of a much more ancient settlement pattern (Hunt 1992). The landscape around the site is characterised as an area of ancient enclosure, which denotes field systems datable to before AD 1600 (Ede and Darlington 2002, 97), with access tracks across the moor linking the farms and enclosed fields to the roads (Hunt 1992). Some indication of the date of the ancient enclosure is suggested by an indenture of 1329, which granted to Sir Richard de Hoghton the right to enclose all the moors, woods, marshes and mosses in the neighbouring township of Grimsargh (Hindle 2002).

1.3.9 These irregular ancient enclosure fields can be seen to the north and east of the development site, which would appear to be on the edge of the remains of an open field system farmed from the shrunken medieval settlement of Fulwood Row, to the north of the site (Welsh 1992). This single-row settlement seems to have grown up without any marked degree of regularity on a local by-way (Welsh 1992; Higham 2004, 129), with its open fields to the east and ancient enclosures, to the west, perhaps denoting former common land or moss (mario.lancashire.gov.uk; Ordnance Survey (OS) 1849). The characteristic sigmoid shape of the former cultivation strips of the open fields can be seen fossilised in the ancient enclosures and are usually thought to represent ploughing with a team of oxen, the traditional method, as seen in the fourteenth-century Luttrell Psalter for instance, rather than typically post-medieval horse traction (Backhouse 2000, 16-18). These aratral earthworks are particularly prevalent to the north and south of the east/west-aligned lanes emanating from Fulwood Row.

1.3.10 *Post-medieval period*: the volume of accessible historical data for the wider region increases steadily throughout the post-medieval period. For the early
part of the period, it is likely that the character of rural settlement in the area changed little from that of the Middle Ages. From the later eighteenth century, however, development of the land would have been influenced by the tide of industrialisation that led to the expansion of Preston and its satellites. Textiles formed an important part of the local economy in the Preston area. The town had become a principal corn-milling centre by the late eighteenth century (Hunt 2003, 36–7) but, by the mid-nineteenth century, was a centre for cotton production, with 75 textile mills having been constructed in the vicinity. Powered spinning mills had been built first in Preston from 1777 (ibid) although, as they pre-dated the widespread introduction of mechanical looms (Jones 1996, 233), hand-weaving remained a valued and skilled occupation within the town and its hinterland. The textile industry was not restricted to cotton, and it is likely that many of the eighteenth-century farmsteads in the landscape surrounding the proposed development area were involved with traditional home-based weaving of indigenous wool and linen (Hunt 2003, 36–7; CAP 2006, 4). By 1856, however, powered looms were in use at 60 out of the 75 textile mills within Preston (LCC 2006b, 29) and this will inevitably have had an impact on the demand for home-based weaving in the rural areas surrounding the town.

1.3.11 The landscape surrounding the development site in this period remained predominantly rural, incorporating elements of the older medieval field systems fossilised as strip-fields, which can be seen emanating from the east of Fulwood Row, either side of two east/west-aligned tracks. Aerial photographs taken in the 1960s (mario.lancashire.gov.uk) suggest that the medieval field systems provided the framework for post-medieval agriculture and enclosure. Around the site, ridge and furrow is clearly apparent within the narrow, straighter strip fields, likely to date from the eighteenth or nineteenth century (Higham 2004, 58, 65), when the moor was finally subjected to the Enclosure Act. Those who benefited from the enclosure of the common land were responsible for demarcating it with hedges and fences (Hunt 1992).

1.3.12 The 1849 OS map shows many pits or ponds in the surrounding fields, likely to be marl pits dug to extract clay which, when mixed with lime, was spread on fields as a way of controlling acidity, improving the moisture content and texture of the soil. Such practices were common in various parts of England in the eighteenth and early nineteenth century and are indicators of arable crops (Newman and McNeil 2007, 119; Harvey 1984, 67-68). However, given that the drift geology of the area was clay, this would have proved a costly way of improving the land (ibid), and the practice declined in the later nineteenth century.
2. METHODOLOGY

2.1 INTRODUCTION

2.1.1 LCAS was consulted regarding the requirements of the evaluation, and it was verbally agreed that the same methodology would be employed that had been used for the previous evaluation on land to the north of Bluebell Way (OA North 2011). Consequently, a 40% sample magnetometer survey and 15% targeted resistivity survey was carried out in the first instance. From the results, eight trial trenches, equating to a 5% sample of the site, were positioned to target geophysical anomalies, as well as to test blank areas. The work was consistent with the relevant Institute for Archaeologists (IfA) and English Heritage guidelines (IfA 2008a, 2008b, 2011; English Heritage 2006).

2.2 EVALUATION TRENCHING

2.2.1 The topsoil was removed utilising an 18 ton 360° mechanical excavator (fitted with a 1.8m toothless ditching bucket) under archaeological supervision to the surface of the first significant archaeological deposit or the glacial till. This deposit was cleaned by hand, using hoes, shovel scraping, and/or trowels depending on the subsoil conditions, and inspected for archaeological features. All features of archaeological interest were investigated and recorded.

2.2.2 All trenches were excavated in a stratigraphical manner. Trenches were located by use of a differential Global Positioning System (dGPS), and altitude information has been established with respect to Ordnance Survey Datum.

2.2.3 All information identified in the course of the site works was recorded stratigraphically, using a system adapted from that used by the former Centre for Archaeology of English Heritage, with an accompanying pictorial record (plans, sections, and monochrome contacts/digital photographs). Primary records were available for inspection at all times.

2.2.4 Results of all field investigations were recorded on pro forma context sheets. The site archive includes both a photographic record and accurate large-scale plans and sections at an appropriate scale (1:50, 1:20 and 1:10). All artefacts were recorded using the same system, and will be handled and stored according to standard practice (following current IfA guidelines).

2.3 FINDS

2.3.1 The recovery of finds and sampling programmes were carried out in accordance with best practice (IfA 2008b), and subject to expert advice in order to minimise deterioration. All artefacts recovered from the evaluation trenches were retained for assessment.
2.4 ARCHIVE

2.4.1 A full professional archive has been compiled in accordance with current IfA and English Heritage guidelines (English Heritage 2006). The paper and digital archive will be deposited in the County Records Office, Preston, on completion of the project. The material archive is not worthy of retention.
3. FIELDWORK RESULTS

3.1 INTRODUCTION

3.1.1 In total, eight trenches were excavated during the course of the investigations (Fig 2), with three trenches targeting potential archaeological features identified by the geophysical survey (Appendix 1; Trenches 6, 7 and 8). The remaining five trenches sampled those areas that were either not included in the survey or showed no significant geophysical results. The length of the trenches varied, with two at 40m (Trenches 3 and 5), one at 30m (Trench 7), four at 20m (Trenches 1, 2, 6 and 8), and one at 15m (Trench 4). The evaluation area was curtailed along the very eastern edge of Areas 1 and 2 as a water mains pipe was known to run through this part of the site, the magnetic response of which was recorded in the magnetometer survey results (Appendix 1). A summary of the results is presented below, with a context list provided in Appendix 2 and the finds catalogued in Appendix 3.

3.2 RESULTS

3.2.1 Trench 1: was excavated in the northern part of part of Area 1, on a north-east/south-west alignment (Fig 2; Plate 1). It measured 20m in length and was excavated to a maximum depth of 0.42m. The trench was positioned to sample an area outwith the geophysical survey.

3.2.2 Excavation removed 0.42m of turf and topsoil, 101, to reveal the underlying glacial till, 102. Areas of root action were visible in the base of the trench, and one feature of archaeological potential was investigated in the centre of the trench. To further clarify its origin a small extension to the trench, measuring 1.85m by 1.85m, was excavated on the south-eastern side of the trench, whereupon the feature was clearly identified as the result of root action (Plate 2). No archaeologically significant deposits were present.

Plate 1: Trench 1, looking south-west
3.2.3 **Trench 2:** was excavated in the southern part of Area 1. It measured 20m in length and was excavated to a maximum depth of 0.7m (Fig 2; Plate 3). The trench was again positioned to sample an area not included within the geophysical survey, as well as being located over one of the drainage ditches in the area.

3.2.4 The underlying glacial till, 202, was revealed at a depth of 0.45m. A 0.2m deep sondage was excavated at the north-western end of the trench in order to test the natural. Cutting across the trench on a north-east/south-west alignment was drainage ditch 205, which rapidly flooded upon excavation (Fig 3). It contained one fill, 204, which comprised very dark brown silt, sealed by
topsoil 200. No finds were recovered from this feature. It existed as a linear hollow in this part of the site, but formed a more substantial drainage ditch to the south of Trench 2.

3.2.5 A north-west/south-east aligned pipe trench, 203, for a water pipe was located in the south-eastern half of the trench, running almost parallel to the south-western limit of excavations (Fig 2; Plate 4). It aligned with a fire hydrant to the south-east, and a concrete marker post to the north-west.

Plate 4: Pipe trench 203 of a water main, looking north-west

Plate 5: General view of Trench 3, looking north-east

3.2.6 Trench 3: was excavated in the northern part of Area 2, on a north-east/south west alignment. No particular features of archaeological potential were recorded during the geophysical survey, only an area of enhanced response
associated with the mains water pipe known to run along the eastern side of Areas 1 and 2 (Fig 2; Plate 6). Therefore, this trench was positioned to sample a ‘blank area’ in the survey results. The trench measured 40m in length, and was excavated to a maximum depth of 0.4m. The underlying glacial till 301 was overlain by 0.32m of turf and topsoil, 300. A ceramic field drain was located at the south-western end of the trench, but no archaeologically significant features were present.

3.2.7 **Trench 4:** was excavated in the central part of Area 2, on a north-north-east/south-south-west alignment (Fig 2; Plate 7). It measured 15m in length and was excavated to a maximum depth of 0.4m. The trench was positioned to generally sample the area that lay outwith the geophysical survey. The underlying glacial till, 401, contained areas of root action, but no archaeological features. This was overlain by 0.4m of topsoil, 400.

3.2.8 **Trench 5:** was excavated in the southern part of Area 2, on a north-east/south-west alignment. Similar to Trench 3, the geophysical survey showed no features of archaeological potential, only an area of enhanced response associated with the mains water pipe known to run along the eastern side of Areas 1 and 2 (Fig 2). The trench measured 40m in length, and was excavated to a maximum depth of 0.5m. The underlying glacial till, 501, was overlain by 0.32m of turf and topsoil, 500. Two land drains were noted cutting across the trench on a north-east/south-west alignment, and no archaeologically significant deposits were present within the trench.

3.2.9 **Trench 6:** was excavated in the western part of Area 1 on a north-west/south-east alignment. This area appeared to contain an arrangement of geophysical anomalies of possible archaeological potential, and so was targeted with Trenches 6, 7 and 9 (Fig 2). Trench 6, specifically, targeted anomalies interpreted as the result near surface ferrous objects or fired material. The trench measured 20m in length, and was excavated to maximum depth of 0.64m (Plate 6).
3.2.10 Two plough scars were recorded scored into the underlying glacial till, 602, on an east/west alignment. A 0.2m sondage was excavated at the north-western end of the trench but no archaeologically significant deposits were located within the trench. Overlying till 602 was 0.2m of subsoil, 601, and topsoil and turf, 600.

3.2.11 **Trench 7**: was excavated in the western part of Area 2 on a north-east/south-west alignment (Fig 2; Plate 7), targeting high resistance anomalies that may have represented the remains of an archaeological structure or feature. The trench measured 30m in length and was excavated to a maximum depth of 0.55m.

![Plate 7: Trench 7, looking south-west](image)

3.2.12 The underlying glacial till, 702, was overlain by 0.2m of subsoil, 701, which was beneath 0.2m of turf and topsoil, 700. No archaeological significant deposits were present within the trench.

3.2.13 **Trench 8**: was excavated in the western part of Area 2, on an east/west alignment (Fig 2; Plate 8). The trench was positioned to target parallel linear geophysical anomalies to investigate whether these were of agricultural origin or otherwise. (Fig 2). The trench measured 20m in length and was excavated to a maximum depth of 0.4m.

3.2.14 Across the underlying glacial till, 802, three field drains were observed on a north-east/south-west alignment, which are likely to be the cause of the linear geophysical anomalies, but no archaeologically significant deposits were observed within the trench. Overlying the till, 802, was 0.1m of subsoil, 801, that lay beneath 0.24m of turf and topsoil, 800.
3.3 FINDS

3.3.1 In all, four fragments of artefacts were recovered during the investigation. Their distribution is shown below (Table 1). Although of medium size, and largely unabraded, they can add little to an interpretation of the site, except to indicate probably twentieth century activity in Trenches 1 and 7.

<table>
<thead>
<tr>
<th>Trench</th>
<th>Context</th>
<th>Pottery</th>
<th>CBM</th>
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<td>1</td>
<td><strong>4</strong></td>
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*Table 1: Distribution of artefacts by context*
4. CONCLUSION

4.1 DISCUSSION

4.1.1 The combined geophysical survey, using resistivity and magnetometry, recorded anomalies mainly associated with the presence of the water main along the eastern side of both Areas 1 and 2. However, in the ‘triangular’ western portion of Area 1 there were a number of anomalies that may be archaeological in origin, including areas of possible burning or burnt/fired objects, parallel linear anomalies that may have related to the medieval agricultural use of the area, and an area of high resistance that could have been the remains of a structure, for instance. The features of archaeological potential were targeted by Trenches 6, 7 and 8. Elsewhere, the ‘blank’ survey results were tested with Trenches 3 and 5. Trenches 1, 2 and 4 were outwith the survey areas and were positioned to sample these areas, with Trench 2 also targeting a drain observed on site.

4.1.2 Only one feature of possible archaeological origin was identified by the trial trenching, that of drainage ditch 205 within Trench 2, which was evidently still in use. Excavation of this ditch did not produce any dating evidence. The position of this ditch is depicted as a boundary on the 1913 OS map of the area (OS 1913), and it probably originated from at least the nineteenth century. However, the boundaries at this location on earlier mapping are not as clearly defined, with it having likely been merged with the southern side of an east/west-aligned trackway (OS 1849; OS 1893). The boundary possibly dates to the enclosure of the moorland by the Parliamentary Enclosure Act, in the eighteenth or nineteenth century (Higham 2004, 58, 65), although some boundaries may have medieval origins in the open field system farmed from the shrunken medieval settlement of Fulwood Row, positioned to the east of the site (Welsh 1992). The feature is considered to be of low archaeological significance, and no further work is recommended.

4.1.3 None of the geophysical anomalies within Trenches 3, 5, 6, 7 and 8 were identified as being of an archaeological origin. These geophysical anomalies must, therefore, be of geological or pedological origin, or caused by metal objects within the topsoil.
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Plate 7: Trench 7, looking south-west

Plate 8: Trench 8, looking east

6.3 TABLES

Table 1: Distribution of artefacts by context
Figure 1: Site location

Based upon the Ordnance Survey mapping with the permission of the Controller of Her Majesty's Stationery Office ©Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Oxford Archaeology Licence No. AL 10005569 (2012).
Figure 2: Plan showing the location of geophysical survey anomalies and trial trenches.
APPENDIX 1: GEOPHYSICAL SURVEY
Preston East
Preston

Archaeological Geophysical Survey
Project No. ARC/700/286

February 2012
Preston East
Preston

Archaeological Geophysical Survey
Project No. ARC/700/286

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DIGITAL COPY OF REPORT CAN BE FOUND ON CD ATTACHED TO BACK COVER
1. SUMMARY

Phase Site Investigations Ltd was commissioned by Emily Mercer of Oxford Archaeology North to carry out a geophysical survey at land within the Preston East Development Area, Preston, Lancashire (centred at NGR SD 570 327). The survey area consisted of two areas, Area 1 (0.685 ha) and Area 2 (0.274 ha) which encompassed three fields. A 40% sample magnetic gradiometer and 15% earth resistance survey were carried out over areas of 0.38 ha and 0.178 ha respectively.

The aim of the survey was to help establish the presence / absence, extent, character, relationships and date (as far as circumstances and the inherent limitations of the technique permit) of archaeological features within the survey areas. Much of the survey area was unable to be surveyed due to tarmac areas, ditches, fences and areas of severe waterlogging. This reduced the choice of locations for the sample areas.

The magnetic survey has identified a number of strong dipolar responses which are probably associated with modern features such as the water main along the eastern edge of Area 2 and numerous discrete dipolar responses which are probably due to individual metallic objects. There are a number of magnetic linear trends in Area 1 which may indicate the presence of former agricultural features. A small positive magnetic linear anomaly is present in Area 2 which is of unknown origin. Numerous, discrete positive magnetic responses also in this area may be due to pedological / geological variations.

No anomalies of a definite archaeological original were identified and so the resistance survey was carried out over Area 1 to target the magnetic anomalies discussed above. Several areas and linear responses of relatively high resistance were identified. The cause of these is not known, although such response can often be caused by natural sub-surface variations / features. Some of the high resistance anomalies appear regular in shape but without other supporting evidence a non-archaeological origin is considered most likely.
2. INTRODUCTION

2.1 Overview

Phase Site Investigations Ltd was commissioned by Emily Mercer of Oxford Archaeology North to carry out an archaeological geophysical survey utilising a magnetic gradiometer and earth resistance at land within the Preston East Development Area.

The aim of the survey was to help establish the presence / absence, extent, character, relationships and date (as far as circumstances and the inherent limitations of the technique permit) of archaeological features within the survey area.

2.2 Site description

The site is situated on vacant land adjacent to the B6242 just to the east of Junction 31a of the M6 Motorway, Preston, Lancashire and is approximately 4.5 km to the east of the town centre (centred at NGR SD 570 327). The location of the site is shown in drawing ARC_700_286_01.

The survey area comprised two areas, Area 1 (0.685 ha) and Area 2 (0.274 ha) and encompassed three fields as shown in drawing ARC_700_286_02. The site is bounded to the north and east by roads and to the south and west by open fields. At the time of the survey, all the fields were laid down to rough grass. The northern part encompassed a short section of new road together with various ditches and heavily waterlogged areas which reduced the scope of the survey in this area. Newt fences were also present in Area 1 and the northern end of Area 2. Most of the field boundaries consisted of post and wire fences within hedges. A deep ditch ran diagonally across Area 2. A 32 inch water main ran along the eastern edge of Area 2, this area was avoided as far as was practicable.

The site was generally quite level and was approximately 58 m above Ordnance Datum (AOD).

The bedrock geology of the site consists of sandstones of the Sherwood Sandstone group. The superficial deposits comprise Devensian Till (Diamicton) (www.bgs.ac.uk). The soils consist mainly of slowly permeable, seasonally wet, slightly acidic but base-rich loamy and clayey soils (www.landis.org.uk/soilscapes).

Plates showing the general site conditions at the time of the survey are presented in Appendix 2.

2.3 Archaeological background

No archaeological background information was provided at the time of writing this report.

2.4 Scope of work

The client specified that a 40% (0.38 ha) sample of the site should be surveyed using a magnetic gradiometer (drawing ARC_700_286_02) and a 15% sample of the site (0.178) be surveyed using an earth resistance meter (drawing ARC_700_286_03). Areas of water logging and ditches were avoided. The site was surveyed with the gradiometer in the first instance and then areas of potential interest were targeted with earth resistance survey.
No problems were encountered during the survey which was carried out on 26\textsuperscript{th} and 27\textsuperscript{th} January 2012. The weather was cold with heavy showers of rain sleet and hail.
3. SURVEY METHODOLOGY

3.1 Geophysical survey

A Bartington Grad601-02 magnetic gradiometer was used for the magnetic survey. The instrument was balanced on site in a magnetically uniform area and regularly checked for instrument drift during the course of the survey.

The data were collected in zig-zag mode over a series of 30 m by 30 m survey grids. All data were collected at 0.25 m intervals over profiles spaced 1 m apart and stored in the instrument for download at the end of the day.

A Geoscan Research RM15 earth resistance meter with a 0.5m twin probe mobile array was used for the earth resistance survey. Two remote probes were placed into the ground outside of the survey grids.

The data were collected in zig-zag mode over a series of 30 m by 30 m survey grids. All data were collected at 1 m intervals over profiles spaced 1 m apart and stored in the instrument for download at the end of the day.

The survey grids were established using a Sokkia GRX-1 RTK GPS system and were set-out, using bamboo canes, directly to Ordnance Survey National Grid co-ordinates to an accuracy better than 0.03 m. Temporary survey stations (wooden stakes) were also set out and tied in to Ordnance Survey National Grid co-ordinates to allow the relocation of the survey grids using a total station.

The survey was carried out in accordance with the guidelines published by English Heritage (David et al 2008).

3.2 Data processing and presentation

The geophysical survey data were downloaded and gridded in Archaeosurveyor 2.5.16 (DW Consulting). Where required, the data were minimally processed or improved to remove errors caused by instrument drift and / or collection errors (See Appendix 1.5).

The magnetic data were exported from Archaeosurveyor as raster images (PNG files) and presented in greyscale format at 1:1000 in drawing ARC_700_286_04 and as X-Y trace plots in drawing ARC_700_286_05, with an accompanying interpretation in drawing ARC_700_286_07.

The earth resistance data were exported from Archaeosurveyor as raster images (PGN files) and presented in greyscale format at 1:1000 in drawing ARC_700_286_06, with an accompanying interpretation in drawing ARC_700_286_07.

All of the magnetic data greyscale plots were processed and clipped at -3 / 3 nT to allow fine detail to show through and exclude extreme values. The X-Y trace plots were clipped at -20 nT to 20 nT. The data shown in the greyscale plots has been ‘smoothed’ using the Grad. Shade option for presentation purposes. All the grids were destriped using zero mean traverse.

The earth resistance data were processed and clipped at 2 standard deviations to remove variations associated with geological variations to enhance potential archaeological targets.
The data has been displayed relative to a digital Ordnance Survey base plan provided by the client as drawing ‘ATKINS STATS.dwg’. The base plan was in the National Grid co-ordinate system and as the survey grids were set-out directly to national grid co-ordinates the data could be simply superimposed onto the base plan in the correct position.

The anomalies have been categorised based on the type of response that they have and an interpretation as to the cause(s) or possible cause(s) of each anomaly type is also provided.

A general discussion of the anomalies present within the data is provided for the entire site.

_The geophysical interpretation drawing must be used in conjunction with the relevant results section and appendices of this report._
4. RESULTS AND DISCUSSION

4.1 General

For the most part, the magnetic survey has identified a number of strong dipolar responses which are probably associated with modern features such as the water main along the eastern edge of Area 2 and numerous discrete dipolar responses which are probably due to individual metallic objects. There are magnetic linear trends in Area 1 which may indicate the presence of former agricultural features such as ditches or drains. One small positive linear anomaly has different characteristics to the linear trends and is of unknown origin. Numerous discrete positive magnetic responses are probably due to pedological / geological variations.

No anomalies of a definite archaeological original were identified and so the resistance survey was carried out over Area 1 to target the magnetic anomalies discussed above. Several areas and linear responses of relatively high resistance were identified. The cause of these is not known, although such response can often be caused by natural sub-surface variations / features. Some of the high resistance anomalies appear regular in shape but without other supporting evidence a non-archaeological origin is considered most likely.

4.2 Magnetic survey: dipolar responses

Dipolar responses are those that have a sharp variation between strongly positive and negative components. They are usually caused by modern ferrous features / objects although fired material (such as brick) and some ferrous archaeological features can also produce a dipolar response.

There are numerous isolated dipolar responses (‘spikes’) across the survey area that are indicative of ferrous or fired material on or near to the surface. The isolated responses are often caused by small objects, such as iron nails and horseshoes or pieces of modern brick or pot. Archaeological artefacts can also produce this type of response and some of the dipolar responses may be associated with archaeological features.

There are numerous areas of strong dipolar responses (magnetic disturbance). This type of anomaly is usually caused by concentrations of surface or near-surface ferrous or fired material but it is possible that they could be caused by industrial archaeological features or geological variations. The majority of the areas of magnetic disturbance within this survey are located adjacent to metallic surface features such as field boundaries or adjacent buildings and are non-archaeological in origin.

There is an area of strong magnetic disturbance at the containing dipolar responses running along the edge of Area 2. This is caused by a modern large diameter water pipe located adjacent to the survey area.

4.3 Magnetic survey: linear / curvi-linear trends

There are a number of responses that are weak, irregular or discontinuous but which appear to form linear patterns. These anomalies have been categorised as trends as it is not certain what their cause is or even if they are associated with definite features.

Although the trends in Area 1 appear to form a regular pattern it is considered most likely that they are associated with former agricultural features such as boundary ditches or drains, although an archaeological origin cannot be completely ruled out.
4.4 Magnetic survey: positive linear / curvi-linear anomalies

Positive magnetic anomalies indicate an increase in magnetism. Positive linear responses may be associated with agricultural activity but they can also be caused by ditches that are infilled with magnetically enhanced material and as such can indicate the presence of archaeological features particularly if these form a recognisable pattern.

There is one small, weak, positive linear response in Area 1 but the cause of this response cannot be determined.

4.5 Magnetic survey: enhanced responses

Enhanced responses have been classified as areas or discrete anomalies that have a broad, positive magnetic response. This type of anomaly can have a variety of causes including geological variations, infilled archaeological features, areas of burning (including hearths) or industrial archaeological features such as kilns or deeper buried ferrous material and modern fired material.

There are a number of discrete positive features mainly present in Area 1 that may be due to pedological / geological variations.

4.6 Earth resistance survey: high resistance responses

High resistance responses are classified as areas or discrete anomalies that have a generally higher resistance response to the surrounding area. This type of anomaly may have a number of causes such as geological or pedological variations, areas of compacted ground or structural features.

Within the earth resistance survey area, there are several areas of relatively high resistance. The cause of these responses is not known but natural sub-surface variations are considered to be the most likely cause for the anomalies.

4.7 Earth resistance survey: high resistance linear responses

These responses are classified as linear anomalies of a higher resistance to the surrounding area. They are generally caused by features such as banks, buried walls or natural features such as gravel lenses.

The cause of the linear high resistance anomalies is not known. Some of the responses appear regular in shape but there is insufficient evidence to suggest that they are caused by archaeological features. They may be natural variations that coincidently appear to be regular in shape.
5. CONCLUSIONS

No anomalies of a definite archaeological origin have been identified by the geophysical survey.

The majority of the geophysical anomalies appear to be associated with modern activity such as pipes or individual metallic objects.

Area 1 contains some anomalies that may be associated with former agricultural features, such as boundary ditches or drains. A small positive linear anomaly is present in Area 2 which is of unknown origin. Numerous, discrete positive magnetic responses also in this area may be due to pedological / geological variations.

Several areas and linear responses of relatively high resistance were identified. The cause of these is not known, although such responses can often be caused by natural sub-surface variations / features. Some of the high resistance anomalies appear regular in shape but without other supporting evidence a non-archaeological origin is considered most likely.

*It should be noted that a geophysical survey does not directly locate sub-surface features - it identifies variations or anomalies in the background response caused by features. The interpretation of geophysical anomalies is often subjective and it is rarely possible to identify the cause of all such anomalies. Not all features will produce a measurable anomaly and the effectiveness of a geophysical survey is also dependant on the site-specific conditions. The main factors that may limit whether a feature can be detected are the composition of a feature, its depth and size and the surrounding material. It is not possible to guarantee that a geophysical survey will identify all sub-surface features. Confirmation on the identification of anomalies and the presence or absence of sub-surface features can only be achieved by intrusive investigation.*
BIBLIOGRAPHY

APPENDIX 1

Geophysical survey: technical information

1.1 Magnetic Survey Theoretical background

1.1.1 Magnetic instruments measure the value of the Earth’s magnetic field; the units of which are nanoTeslas (nT). The presence of surface and sub-surface features can cause variations or anomalies in this magnetic field. The strength of the anomaly is dependent on the magnetic properties of a feature and the material that surrounds it. The two magnetic properties that are of most interest are magnetic susceptibility and thermoremanent magnetism.

1.1.2 Magnetic susceptibility indicates the amount of ferrous (iron) minerals that are present. These can be redistributed or changed (enhanced) by human activity. If enhanced material subsequently fills in features such as pits or ditches then these can produce localised increases in magnetic responses (anomalies) which can be detected by a magnetic gradiometer even when the features are buried under additional soil cover.

1.1.3 In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete features, such as pits, can also be detected. Less magnetic material such as masonry or plastic service pipes which intrude into the topsoil may give a negative magnetic response relative to the background level. The strength of magnetic responses that a feature will produce will depend on the background magnetic susceptibility, how rapidly the feature has been infilled, the level and type of human activity in the area and the size and depth of a feature. Not all infilled features can be detected and natural variations can also produce localised positive and negative anomalies.

1.1.4 Thermoremanent magnetism indicates the amount of magnetism inherent in an object as a result of heating. Material that has been heated to a high temperature (fired), such as brick, can acquire strong magnetic properties and although they may not appear to have a high iron content they can produce strong magnetic anomalies.

1.1.5 The magnetic survey method is highly sensitive to interference from surface and near-surface magnetic ‘contaminants’. Surface features such as metallic fencing, reinforced concrete, buildings or walls all have very strong magnetic signatures that can dominate readings collected adjacent to them. Identification of anomalies caused by sub-surface features is therefore more difficult, or even impossible, in the vicinity of surface magnetic features. The presence of made ground also has a detrimental effect on the magnetic data quality as this usually contains magnetic material in the form of metallic scrap and brick. Identification of features beneath made ground is still possible if the target feature is reasonably large and has a strong magnetic response but smaller features or magnetically weak features are unlikely to be identified.

1.1.6 The interpretation of magnetic anomalies is often subjective and it is rarely possible to identify the cause of all magnetic anomalies. Not all features will produce a measurable magnetic response and the effectiveness of a magnetic survey is also dependant on the site-specific conditions. The main factors that may limit whether a feature can be detected are the
composition of a feature, its depth and size and the surrounding material. It is not possible to guarantee that a magnetic survey will identify all sub-surface features.

1.1.7 Most high resolution, near surface magnetic surveys utilise a magnetic gradiometer. A gradiometer is a hand-held instrument that consists of two magnetic sensors, one positioned directly above the other, which allows measurement of the magnetic gradient component of the magnetic field. A gradiometer configuration eliminates the need for applying corrections due to natural variations in the overall field strength that occur during the course of a day but it only measures relative variations in the local magnetic field and so comparison of absolute values between sites is not possible.

1.1.8 Features that are commonly located using magnetic surveys include archaeological ditches and pits, buried structures or foundations, mineshafts, unexploded ordnance, metallic pipes and cables, buried piles and pile caps. The technique can also be used for geological mapping; particularly the location of igneous intrusions.

1.2 Earth Resistance Survey Theoretical Background

1.2.1 Earth resistance meters measure the value of the electrical resistance between two points on the ground surface; the units of which are ohms (Ω).

1.2.2 The electrical resistance of near-surface horizons is predominantly dependant on the amount and distribution of moisture within the sub-surface material. Where moisture is present there is a lower electrical resistance as the moisture allows the electrical current to flow with greater ease. Buried features, such as walls or infilled ditches, will have differing capacities to retain moisture which will impact on the distribution of sub-surface moisture and hence affect electrical resistance. This can result in a measurable contrast between the resistances of buried features to that of the surrounding deposits. This contrast is needed for sub-surface features to be detected by an earth resistance survey.

1.2.3 The strongest resistance contrasts or anomalies usually occur between a solid structure that inhibits the flow of the electric current, such as a buried wall, and moisture rich sub-soil. This shows as a resistive high. A weaker contrast is often present between an infilled feature and the surrounding material. If the infill material is soil it is likely to be less compact and hence more water retentive than the subsoil and so the feature will show as a resistive low. If the infill material is stone or rubble the feature may retain less water than the subsoil and so will show as a resistive high. The variations in ground resistance can be measured by passing a small electric current (~1mA) into the ground via a pair of electrodes (current electrodes) and then measuring changes in current flow (the potential gradient) using a second pair of electrodes (potential electrodes). If a structural feature, such as a wall, lies buried in a soil of uniform resistance much of the current will flow around the feature following the path of least resistance. This reduces the current density in the vicinity of the feature, which in turn increases the potential gradient. It is this potential gradient that is measured to determine the resistance. In this case, the gradient would be increased around the wall giving a positive or high resistance anomaly. In contrast a feature such as an infilled ditch may have a moisture retentive fill that is comparatively less resistive to current flow. This will increase the current density and decrease the potential gradient over the feature giving a negative or low resistance anomaly.

1.2.4 Earth resistance surveys require four electrodes to be inserted into the ground and so are only effective over soft ground. Data quality is reduced over hardstanding and gravel areas and asphalt and concrete cannot be surveyed. The technique needs the electrical current to pass into the ground and so if there is standing water present or the ground is highly saturated hen
this can result in some or all of the current passing along the ground surface which can reduce data quality or mean that no worthwhile results can be obtained.

1.2.5 The interpretation of earth resistance anomalies is often subjective and it is rarely possible to identify the cause of all such variations. Not all sub-surface features will produce a measurable resistance contrast and the effectiveness of an earth resistance survey is also dependant on the site-specific conditions. The main factors that may limit whether a feature can be detected are the composition of a feature, its depth and size and the surrounding material. It is not possible to guarantee that an earth resistance survey will identify all sub-surface features.

1.2.6 Features that are commonly located using earth resistance surveys include buried structures, foundations or other in situ remains. Near-surface geological variations and certain types of infilled features can also be located in the right conditions.

1.3 Instrumentation

1.3.1 A Bartington Grad601-2 magnetic gradiometer was used for the magnetic survey. The Bartington Grad601-2 is a dual sensor instrument, incorporating two Grad-01-1000 gradiometers set at a distance of 1 m apart.

1.3.2 A Geoscan Research RM15 earth resistance meter was used for the resistance survey. The RM15 was used with a PA20 probe array in twin 0.5 m probe separation configuration.

1.4 Survey methodology

1.4.1 The survey was carried out on a series of regular 30 m grids. The survey grids were established using a Sokkia GRX-1 RTK GPS system and were set-out relative to the Ordnance Survey national grid system. Grid points were set-out to an accuracy better than 0.03 m.

1.4.2 Magnetic data were collected on zig-zag profiles (walking along a profile and then returning up the adjacent profile in the opposite direction) that were 2 m apart within a grid (the dual sensor array means that this equates to 1 m profile intervals. All data was collected at 0.25 m and stored in the instrument for download at the end of the survey.

1.4.3 Readings were taken on 100 nT range (0.1 nT sensitivity). The instrument was balanced and ‘zeroed’ at a base station that was established on site in a magnetically quiet and uniform location. The instrument was checked for electronic and mechanical drift at this base station at regular intervals during the course of the survey.

1.4.4 Resistance data were collected on zig-zag profiles that were 1 m apart. Readings were taken every 1 m and stored in the instrument for download at the end of the survey.

1.5 Data processing, presentation and interpretation

1.5.1 The data were downloaded from the instrument at the end of the survey using bespoke software specific to the instrument. Both data sets were downloaded and gridded in Archaeosurveyor 2.5.16 (DW Consulting).

1.5.2 Where required the magnetic data was destriped and destaggered to remove errors caused by instrument drift and heading errors. The resistance data was filtered. This data has been classed as minimally processed data as no other processing steps were used.

1.5.3 The following processing schedule was applied to magnetic data presented within the report.
1.5.4 The magnetic data presented as X-Y trace plots is clipped at -20 nT to 20 nT. The data presented in the greyscale plots has been ‘smoothed’ using the Grad. Shade option clipped at -3 nT to 3 nT.

1.5.5 The following processing schedule was applied to the resistance data presented within the report

- Despike Threshold = 1 std dev window size 3 x 3
- Zero median traverse Threshold = 1.5 std dev

1.5.6 The resistance data presented as greyscale plots is clipped at 2 standard deviations and ‘smoothed’ using the Grad. Shade option.

1.5.7 The data was exported from Archaeosurveyor as raster images (PNG files).

1.5.8 The data has been displayed relative to a digital Ordnance Survey base plan provided by the client as drawing ‘ATKINS STATS.dwg’. The base plan was in the National Grid co-ordinate system and as the survey grids were set-out directly to national grid co-ordinates the data could be simply superimposed onto the base plan in the correct position.

1.5.9 The anomalies have been categorised based on the type of response that they have and an interpretation as to the cause(s) or possible cause(s) of each anomaly type is also provided.

1.5.10 The greyscale and X-Y trace plots and the accompanying interpretations of the anomalies identified in the geophysical data are presented as a 2D AutoCAD drawing. The interpretation is made based on the type, size, strength and morphology of the anomalies, coupled with the available information on the site conditions. Each type of anomaly is displayed in separate, easily identifiable layers annotated as appropriate.

1.6 Limitations of magnetic surveys

1.6.1 The magnetic survey method requires the operator to walk over the site at a constant walking pace whilst holding the instrument. The presence of an uneven ground surface, dense, high or mature vegetation or surface obstructions may mean that some areas cannot be surveyed.

1.6.2 The depth at which features can be detected will vary depending on their composition, size, the surrounding material and the type of magnetometer used for the survey. In good conditions large, magnetic targets, such as buried drums or tanks can be located at depths of more than 4 m. Smaller targets, such as buried foundations or archaeological features can be located at depths of between 1 m and 2 m.

1.6.3 A magnetic survey is highly sensitive to interference from surface and near-surface magnetic ‘contaminants’. Surface features such as metallic fencing, reinforced concrete, buildings or walls all have very strong magnetic signatures that can dominate readings collected adjacent to them. Identification of anomalies caused by sub-surface features is therefore more difficult or even not possible in the vicinity of surface and near-surface magnetic features.
1.6.4 The presence of made ground also has a detrimental effect on the magnetic data quality as this usually contains magnetic material in the form of metallic scrap and brick. Identification of features beneath made ground is still possible if the target feature is reasonably large and has a strong magnetic response but smaller features or magnetically weak features are unlikely to be identified.

1.6.5 It should be noted that anomalies that are interpreted as modern in origin may be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

1.6.6 A magnetic survey does not directly locate sub-surface features - it identifies variations or anomalies in the local magnetic field caused by features. It can be possible to interpret the cause of anomalies based on the size, shape and strength of response but it should be recognised that a magnetic survey produces a plan of magnetic variations and not a plan of all sub-surface features. Interpretation of the anomalies is often subjective and it is rarely possible to identify the cause of all magnetic anomalies. Geological or pedological (soil) variations or features can produce responses similar to those caused by man-made (anthropogenic) features.

1.6.7 Anomalies identified by a magnetic survey are located in plan. It is not usually possible to obtain reliable depth information on the features that cause the anomalies.

1.6.8 Not all features will produce a measurable magnetic response and the effectiveness of a magnetic survey is also dependant on the site-specific conditions. It is not possible to guarantee that a magnetic survey will identify all sub-surface features. A magnetic survey is often most-effective at identifying sub-surface features when used in conjunction with other complementary geophysical techniques.

1.7 Limitations of earth resistance surveys

1.7.1 The earth resistance survey requires that the mobile probes be simultaneously inserted into the ground. The presence of an uneven ground surface, dense, high or mature vegetation or surface obstructions may mean that some areas cannot be surveyed.

1.7.2 The depth at which features can be detected will vary depending on their composition, size, the surrounding material and the set up of the resistance meter used for the survey. Depth penetration of more than 1.0 m can sometimes be obtained but this increased penetration is often accompanied by a loss in resolution. If greater depth penetration is required then this must be decided prior to the commencement of the survey so that the mobile probe spacing can be increased.

1.7.3 Earth resistance surveys require four electrodes to be inserted into the ground and so are only effective over soft ground. Data quality is reduced over hardstanding and gravel areas and asphalt and concrete cannot be surveyed. The technique needs the electrical current to pass into the ground and so if there is standing water present or the ground is highly saturated then this can result in some or all of the current passing along the ground surface which can reduce data quality or mean that no worthwhile results can be obtained.

1.7.4 The presence of made ground also has a detrimental effect on the data quality as this usually contains a mix of materials which can produce localised resistance variations. Identification of features beneath made ground is still possible if the target feature is reasonably large and has a strong resistive response but smaller features or those that have low resistive contrasts are unlikely to be identified.
1.7.5 An earth resistance survey does not directly locate sub-surface features - it identifies variations or anomalies in the caused by features. It can be possible to interpret the cause of anomalies based on the size, shape and strength of response but it should be recognised that an earth resistance survey produces a plan of variations in electrical resistivity and not a plan of all sub-surface features. Interpretation of the anomalies is often subjective and it is rarely possible to identify the cause of all resistive anomalies. Geological or pedological (soil) variations or features can produce responses similar to those caused by man-made (anthropogenic) features.

1.7.6 Anomalies identified by an earth resistance survey are located in plan. It is not usually possible to obtain reliable depth information on the features that cause the anomalies.

1.7.7 Not all features will produce a measurable response and the effectiveness of an earth resistance survey is also dependant on the site-specific conditions. It is not possible to guarantee that an earth resistance survey will identify all sub-surface features. An earth resistance survey is often most-effective at identifying sub-surface features when used in conjunction with other complementary geophysical techniques.
APPENDIX 2

Plates

Area 1: North end facing north-east

Area 1: North end facing west
Area 1: North end facing east

Area 1: West side facing west
Area 2: Facing south
NOTE

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Scale  AS SHOWN   Drawing  Status
[44 Sheet]  ARC_700_286_01  FINAL

Client  OXFORD ARCHAEOLOGY NORTH LANCASTER
Site  PRESTON EAST
Title  SITE LOCATION MAP

Phase Site Investigations, Unit F9, Morton Park Way, Morton Park, Darlington, County Durham, DL1 4PQ
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Job No  ARC_700_286

KIT  Drawn  KIT
Chk.  MW  Date  01/02/12
### APPENDIX 2: CONTEXT LIST

<table>
<thead>
<tr>
<th>Trench</th>
<th>Context Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>Topsoil. A dark brown clayey-silt.</td>
</tr>
<tr>
<td>1</td>
<td>101</td>
<td>Glacial till. A reddish-orange clay, with c 10% small sub-rounded stone inclusions.</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
<td>Topsoil. A dark brown silty-clay.</td>
</tr>
<tr>
<td>2</td>
<td>201</td>
<td>Void</td>
</tr>
<tr>
<td>2</td>
<td>203</td>
<td>Cut for modern service.</td>
</tr>
<tr>
<td>2</td>
<td>204</td>
<td>Backfill of 203. A firm reddish-clay.</td>
</tr>
<tr>
<td>2</td>
<td>204</td>
<td>Fill of ditch 205. A very dark brown silt.</td>
</tr>
<tr>
<td>2</td>
<td>205</td>
<td>Cut of drainage ditch. Ditch measured 4.25m wide and 0.25m deep, with concave sides and base.</td>
</tr>
<tr>
<td>3</td>
<td>300</td>
<td>Topsoil. A dark grey-brown silty-clay.</td>
</tr>
<tr>
<td>3</td>
<td>301</td>
<td>Glacial till. An orangey-brown clay.</td>
</tr>
<tr>
<td>4</td>
<td>400</td>
<td>Topsoil. A dark grey-brown silty-clay.</td>
</tr>
<tr>
<td>4</td>
<td>401</td>
<td>Glacial till. A mid-orangey-grey clay.</td>
</tr>
<tr>
<td>5</td>
<td>500</td>
<td>Topsoil. A dark grey-brown silty-clay.</td>
</tr>
<tr>
<td>6</td>
<td>600</td>
<td>Topsoil. A dark brown silty-clay.</td>
</tr>
<tr>
<td>6</td>
<td>601</td>
<td>Subsoil. A mid brown silty-clay.</td>
</tr>
<tr>
<td>6</td>
<td>602</td>
<td>Glacial till. A mid-orangey-yellow clay.</td>
</tr>
<tr>
<td>7</td>
<td>700</td>
<td>Topsoil. A dark brown-grey silty-clay.</td>
</tr>
<tr>
<td>7</td>
<td>701</td>
<td>Subsoil. A mid-brown silty-clay.</td>
</tr>
<tr>
<td>7</td>
<td>702</td>
<td>Glacial till. A mid-orangey-yellow clay, with c 10% small sub-rounded stone inclusions</td>
</tr>
<tr>
<td>8</td>
<td>800</td>
<td>Topsoil. A dark brown-grey silty-clay.</td>
</tr>
<tr>
<td>8</td>
<td>801</td>
<td>Subsoil. A mid-brown silty-clay.</td>
</tr>
<tr>
<td>8</td>
<td>802</td>
<td>Glacial till. A mid-orangey brown-clay.</td>
</tr>
</tbody>
</table>
## APPENDIX 3: FINDS CATALOGUE

<table>
<thead>
<tr>
<th>Trench</th>
<th>Context</th>
<th>Material</th>
<th>Type</th>
<th>Qty</th>
<th>Description</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>Ceramic</td>
<td>Tile</td>
<td>1</td>
<td>Approximately 25% of a modern glazed wall or fireplace tile.</td>
<td>Twentieth century</td>
</tr>
<tr>
<td>7</td>
<td>700</td>
<td>Ceramic</td>
<td>Vessel</td>
<td>3</td>
<td>Three small fragments, two joining, of a cup or bowl in refined white earthenware.</td>
<td>Twentieth century</td>
</tr>
</tbody>
</table>