Developing a methodology for archaeological prospection on alluvial floodplains with a case study involving the Winckley Lowes barrow sequence, Lancashire.

Declaration

I confirm this paper does not exceed the 20,000word limit ±10% and that all the work is my own and has been submitted within two years of initial registration. None of the contents have been submitted for any other award.

Mike Birtles September 2013

Abstract

This paper seeks to develop a balanced methodology for non-intrusive archaeological prospection on dynamic alluvial floodplains. A combination of LiDAR, gradiometry, field-walking and topographic surveying are employed on floodplains on the confluence of the Rivers Ribble, Hodder and Calder near Clitheroe, Lancashire. This was chosen as a case study due to the presence of three putative burial mounds and one confirmed mound of anthromorphic origin. The results of this investigation provide evidence of the development of river terracing, human occupation from the Mesolithic period onwards and offers interpretation of how the surrounding landscape influenced the shape of the mounds.

A substantial lithic assemblage dating to the Mesolithic through to the Bronze Age period suggests that there were terraces of which the overlaying alluvial deposits were not at such a depth that would mask features identifiable during a gradiometer survey, indeed, the successive survey revealed evidence of human occupation. LiDAR data provided further evidence of sequential river terrace development and conclusions were therefore drawn suggesting that both mounds at Winckley Lowes were likely to be constructed at different time periods.

Contents

Acknowledgements

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1.1 Introduction

A group of three putative burial mounds can be found on the middle reaches of the River Ribble where the Rivers Calder and Hodder flow into the Ribble. Despite being regionally unique, none of these mounds have had any sort of documented archaeological exploration since the end of the 19th century. All three mounds have experienced contrasting degrees of excavation, Mound A at Winckley Lowes was excavated by Rev.Luck in 1894 and yielded human remains, prehistoric pottery and flints (Luck, 1894). Mound B was excavated the same year, also by Luck, but showed no signs of archaeological stratigraphy or artefacts (Luck, 1895, 29-30). A mound on the opposite river bank at Brockhall was reportedly flattened in 1836, with the farmer finding human bones and iron spears which crumbled to dust upon exposure to air (Luck, 1895, 32).

Primarily, the inspiration for this paper was to further investigate Mound B and Brockhall to establish whether these were manmade features or merely geological. Mound B is a scheduled monument based on its proximity to Mound A and is extremely overgrown with trees and gorse, these factors limited the ability to undertake any kind of non intrusive survey or excavation which could provide the answers required. The ploughed-out mound at Brockhall is not a scheduled monument but the landowners there did not want excavation carried out on their land. This was not considered a setback but rather an opportunity to investigate the wider landscape and hopefully place Mound B and Brockhall in context with the wider setting.

The dynamic nature of alluvial floodplains is problematic. The continual shifting of the river course and silting during flood events over several millennia lays down unknown depths of alluvial deposit. These can mask features or even make them unreachable through techniques used during conventional archaeological prospection. This paper seeks to address these problems and develop a balanced methodology for archaeological prospection using multiple and combined techniques on alluvial floodplains. The methods which will be discussed include LiDAR, topographic survey, field walking, magnetometry and earth resistance. Each method will be reviewed and the methodology for each technique used in the field will be discussed, as will a detailed assessment and interpretation of the results. Any interpretation offered will consider questions posed including the history of the local study area, the prehistory of the Ribble Valley, deposition using rivers in prehistory, the geological composition of the River Ribble catchment area and mound construction and chronology.

The effectiveness of these methods will be compared and contrasted to ascertain whether one or more technique proved particularly successful or unsuccessful and whether the various techniques can be used to complement each other to provide an interpretation of the results. In addition to the development of a methodology, this paper will attempt to suggest a date of floodplain occupation and assess whether all three mounds were contemporary with each other.

2 Approaches to alluvial landscape archaeology

2.1 Introduction

Rivers by nature can be very dynamic bodies of water, this chapter will discuss some of the potential issues encountered during the geo-archaeological study of dynamic river systems and the methods that could potentially be utilised to overcome problems. This chapter will also discuss the various fluvial systems that tend to categorise river systems found in Holocene Northern Europe.

2.2 What is alluvium?

Alluvium is defined by Weston (2001) as soils in dynamic riverine and estuarine environments that have been transported and deposited by the fluvial processes along the watercourse. The texture and mineralogy of the alluvium is determined by the geology between the source and the place of deposition. The depth of the alluvium and the soil particle size is determined by the river currents and characteristics of flooding (2001, 265). An example of such characteristics could be an extensive floodplain on the inside of a large sweeping river bend: where it would be fair to expect the coarser material to be deposited near the main river flow but the finer grains to settle from the slower water on the edge of the flooded area. There is an example of this type of variation in the case study (below, section 5) at Winckley Lowes.

Howard and Macklin (1999, 529) recognise four different styles of fluvial channel in British Holocene river systems; braided; meandering; anastomising (*figure 2.1*) and straight: although braided and anastomising are generally found in high latitude glacial environments, such as Alaska and Canada, and are therefore relatively rare in Britain today. Braided and anastomising river systems are a result of the high concentrations of sediment found in glacial regions. This in turn causes the river to split into several dynamic channels around alluvial islands (Wooster, 2002, 1-2).

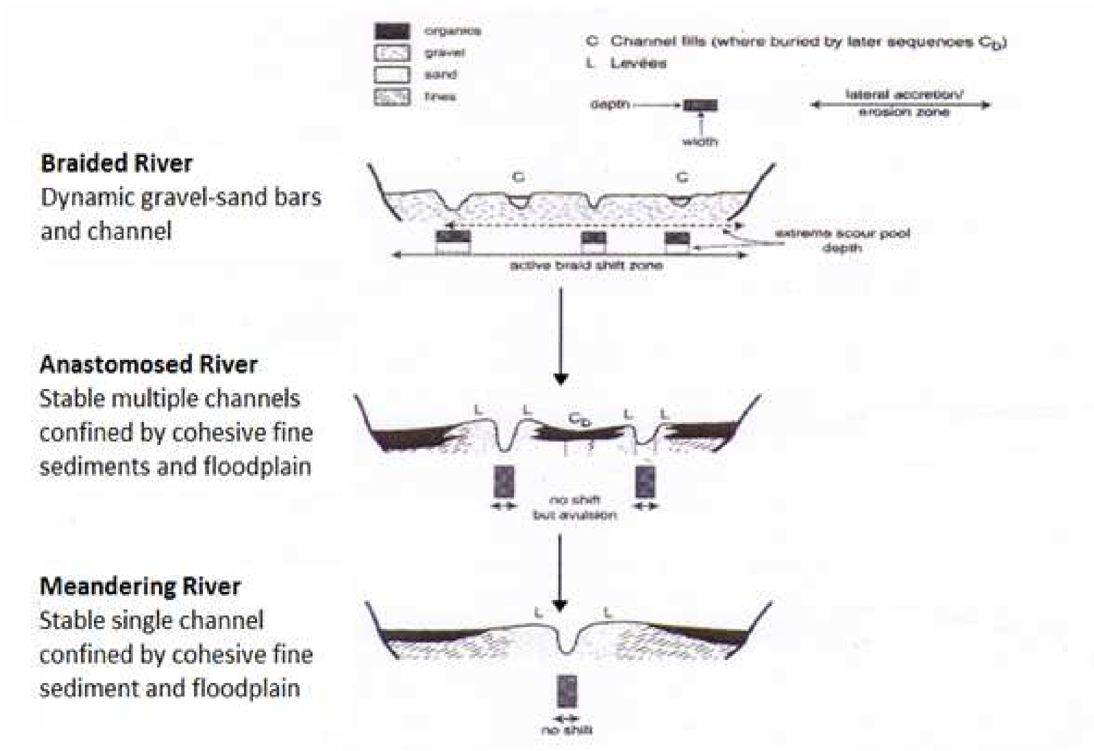

Figure 2.1 Diagram of Braided ,anastomised and meandering river systems (Dixon 2013)

A further subdivision based on the physiography and basin relief determines which category the river system falls into and how the alluvial deposits create the terraces. Based upon these categories, Howard and Macklin divide river systems as follows: high energy river systems with non-cohesive channel banks; medium energy river systems with non-cohesive channel banks and low energy river systems with cohesive channel banks. Each type of river system is tackled by Howard and Macklin (1999, 527-539), by assessing the Holocene geomorphic development and archaeological preservation and prospection potential. Examples of these river systems are given in the next chapter.

2.3 Alluvial archaeology: The advantage and problems

Preservation is the primary advantage conferred by alluvial landscapes, Howard and Macklin suggest that the growing number of alluvial studies demonstrates that sites containing archaeological features buried under a depth of alluvium have great potential for preservation, depending upon the river system classification discussed above (1999, 527).

However, as this alluvial overburden poses the archaeologist with challenges (see below), it is worth reviewing the advantages to not only archaeologists but other disciplines. Alluvial landscapes have provided attractive environments for human occupation since prehistory (Howard and Macklin, 1999, 527). Even though geophysical surveys in the past have tended to concentrate on river terraces that have attracted dry land settlement, with little attention given to recording floodplain landforms and other natural features, the development of alluvial geo-archaeology since a conference held in the UK in 1991, and more recently, in Cork, 2000 has resulted in the application of geophysical techniques in such landscapes (Challis and Howard, 2006, 232).

High energy river systems with non cohesive banks are characteristic of upland and northern Britain. These systems are defined as having high river channel gradients and steep valley sides which merge into the channel with no intervening floodplain. They also all flow through areas glaciated during the late Devensian which deposited sediment unconnected to geomorphic processes. The episodic deepening of these river channels is interspaced with periods of valley floor refilling which results in well-developed flights and terraces (Howard and Macklin, 1999, 531). A typical example of one of these systems is Thinhope Burn *(figure 2.2*) in the northern Pennines. Howard and Macklin (1999, 531) suggest that the relatively modern entrenchment of the valley floor, c.250-530 and 550 – 980AD would result in considerable preservation of earlier archaeology.

Figure 2.2 Thinhope Burn, an example of a high energy river system with non-cohesive banks (Brampton Weather, 2013)

Medium energy river systems with non cohesive banks are found in the upland margins of northern and western Britain. Examples of this type of river include the Severn and the Ribble (*figure 2.3*). These river systems are characterised by floodplains between the valley sides and river channels. These floodplains develop through the deposition of gravel bed-load and fine sediments during flood events. They are often comprised of sediments that had been deposited during the late Devensian glaciations which covered much of the areas where these systems are found (Howard and Macklin, 1999, 532). The higher terraces on these systems would have been formed early during the late Pleistocene / Early Holocene, providing an attractive settlement area. By contrast, the younger flights of terraces would have formed from sediments dislodged by human activity, for example deforestation. Careful analysis of sediment layers in these flights of terraces can provide considerable amounts of information about the environment and river morphology (Macklin and Howard, 1999, 534).

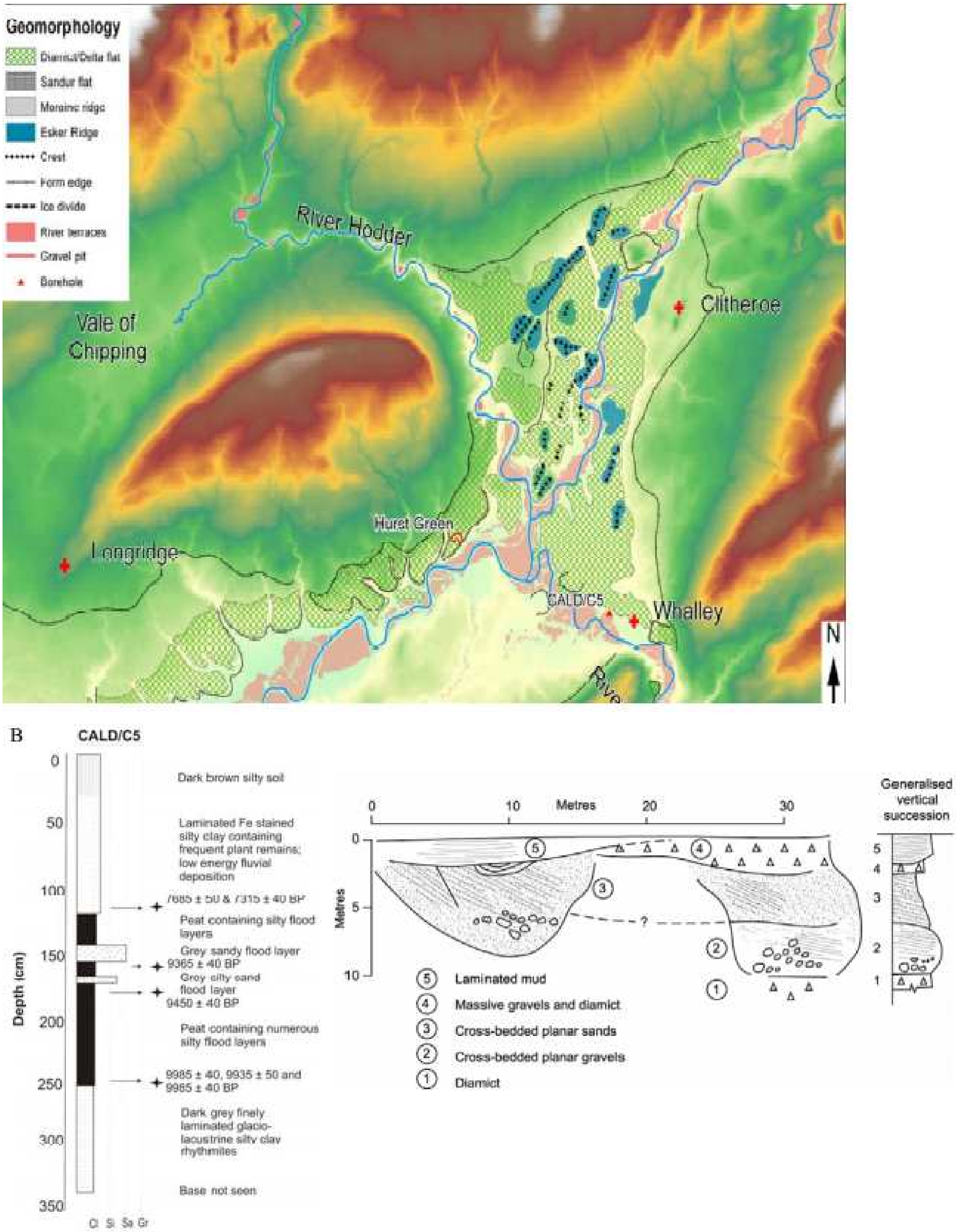

Figure 2.3 Geomorphology and sediment depth obtained from boreholes on the River Calder near the confluence with the River Ribble (Quartermaine, 2013).

Low energy river systems with cohesive river banks (*figure 2.4*), predominantly found in eastern and southern Britain as well as the English Midlands, are characterised by low angle valley sides and well developed floodplains; examples being the arterial rivers of the Thames and lower Trent. The abandonment and infilling of the channels of these secondary braided river systems dates to around 9500BP and then again around 3500-2000BP (Macklin and Howard, 1999, 537). The gradual increase of fine sediments in these systems leads to well preserved cultural remains (Macklin and Howard, 1999, 537). Peri-marine zones associated with these low energy systems would have been susceptible to flooding during periods of rising sea levels, these floodplains would have been abandoned in favour of higher grounds. However, Macklin and Howard suggest that these areas also saw an increase in the construction of jetties, piers and track ways, the remains of which are observed under 10 metres of alluvium in Roman London for example (1999, 537).

A study of the Trent and Tame basin, UK, revealed gravel bars and islands suggesting that this river system was braided until the climate became warmer at the start of the Holocene, the reduction of water borne sediments eventually created a single channel river (Butaux, 2012, 3).

Weston suggests that palaeochannels, which are often filled with alluvium, can provide invaluable palaeoenvironmental and palaeographical information, including palaeobotanical evidence of the previous landscape before the alluvial deposition (2001, 270). He argues that the evidence gained from the palaeochannels can then be used to determine the development of river systems and how people interacted between the landscape and settlement (Weston 2001, 270).

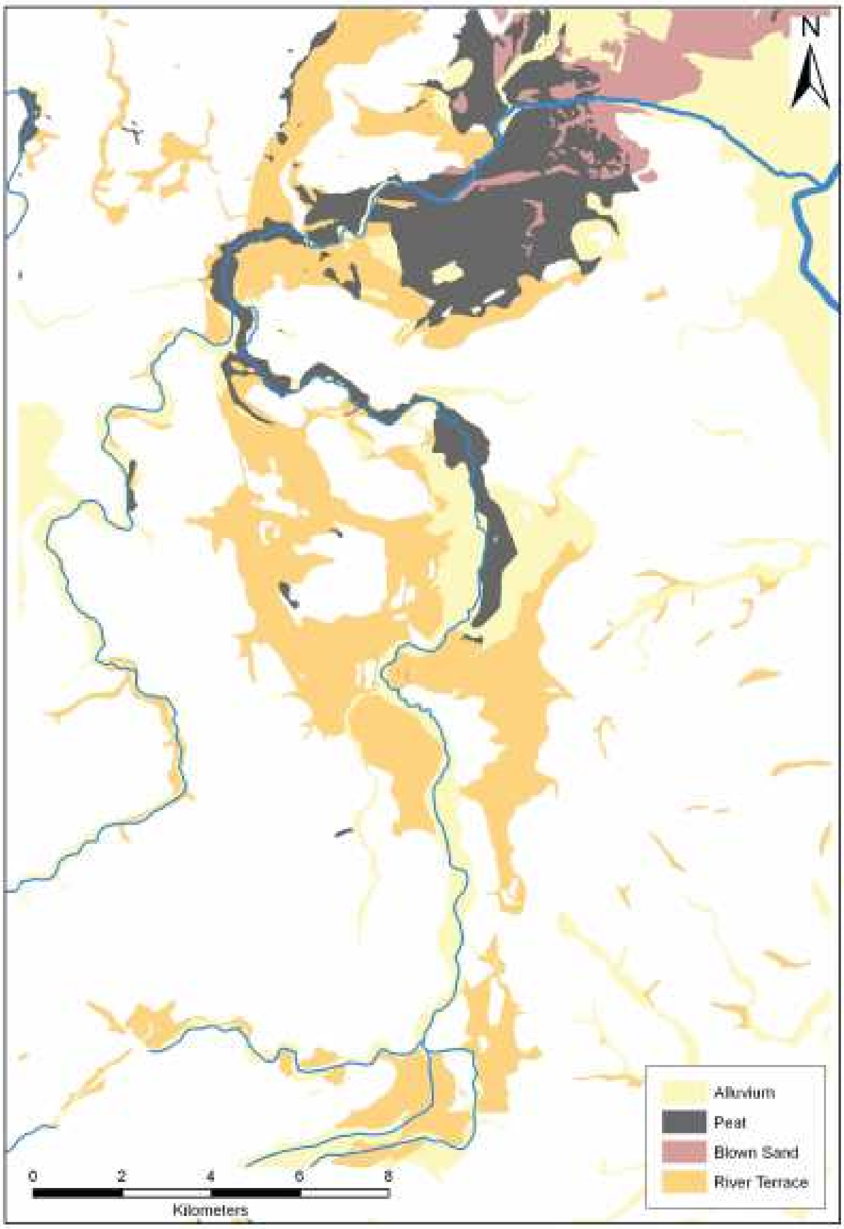

Figure 2.4 River Dove catchment, a tributary of the River Trent and an example of a low energy river system with cohesive river banks (Challis et al, 2006).

We have discussed how the depth of alluvium can be of benefit by providing an anaerobic environment suitable for preservation. However, this can also be extremely problematic, especially for the geophysicist using magnetometry. This technique will be detailed later on, but the problems encountered will be discussed here.

Weston (2001, 265) argues that natural variations in alluvial composition, including particle size, magnetism and inclusions, amongst other chemical and physical properties, can seriously hinder archaeological prospection. This is due to these variations being greater than that of the buried archaeology. For example, a small pit or ditch fill is likely to be less magnetic that the alluvial overburden. Moreover, certain geological alluviums, for example those deposited from areas where the natural geology is comprised of igneous rock, will have a naturally high magnetic enhancement, therefore masking or impeding archaeological features or even giving the false impression of actually being features (Weston 2001, 265-267). He excludes discussing sites comprising of Pleistocene fluvioglacial sands and gravels but does suggest that such sites with deep coarse homogonous soils and a high water table can prove problematic for fluxgate gradiometry (Weston 2001, 266). A half metre fluxgate gradiometer is only effective up to one metre penetration therefore, without knowing the depth of alluvium in the first instance, this will be prone to failure (Weston, 2001, 266).

High and medium energy river systems with non-cohesive banks have been described by Howard and Macklin as providing good preservation, especially on the oldest terraces where multi-period archaeological remains may be present (Howard and Macklin, 1999, 529),However, the high entrenchment rates following large scale deforestation during the Late Iron Age and Roman periods will result in earlier structural remains potentially being destroyed through channel reworking, artefactural evidence is also likely to be moved by water currents and deposited out of context (Howard and Macklin, 1999, 531-534).

2.4 Geophysics

Geophysical prospection techniques can be applied at site scale where the spatial resolution provided by airborne remote sensing is generally in excess of one metre. Challis and Howard argue that the move away from individual surveys towards integrated survey of monument complexes and/or alluvial landscapes has provided the greatest advancement in this technique in recent years (2006, 237). Here, we discuss various techniques used in geophysical prospection and how they have been applied in the field.

2.4.1 Earth resistance

Sites that are saturated due to a high water table can suffer from a depleted or impeded magnetic enhancement. This problem can be overcome by adopting an earth resistance survey. A case study at Newbold, Staffordshire was carried out in 1994 comparing gradiometer and earth resistance survey techniques.. This site which contains clearly visible cropmarks lies on a floodplain on the banks of the River Trent. Despite these highly visible cropmarks, a gradiometer survey failed to identify any features whereas, earth resistance was more successful. Weston argues that earth resistance proved successful because the features were filled by material texturally distinct from those in the surrounding soils (2001, 270).

Generally, earth resistance will give the following results:

High resistance anomalies	**Low resistance anomalies**
Walls	Ditches/pits
Rubble/hardcore	Drains
Made-up surfaces	Graves
Roads/track ways	Metal pipes
Stone coffins/cists	Slots and Gullies

(Gaffney and Gator, 2011, 26).

The use of earth resistance can be advantageous in situations where other survey methods are ruled out for various reasons, metal contamination for example, however, this is a method rarely used on a large scale due to the manpower required and the amount of time it takes to cover a large area. A standard RM15 earth resistance meter has a two probe array that are required to make contact with the ground at each individual sample point, although the time consumed by this method can be reduced by increasing the number of probes to four or six, it is still labour intensive and therefore often unsuitable for large survey areas. Resistance data can also vary with the season, for example during a wet spell, a ditch will not give a different response from the surrounding saturated soil (Gaffney and Gator, 2011, 26).

2.4.2 Magnetometry

Gaffney and Gator suggest that magnetometry can be an effective tool in identifying archaeological remains from the Mesolithic onwards, arguing that Palaeolithic archaeology is too dispersed and ephemeral to have left an identifiable magnetic imprint (2011, 120). Field systems often show up on magnetometry surveys as a positive or negative anomaly where ditches have filled in with magnetically enhanced material or walls have been made up of igneous rock and subsequently been covered with earth. Settlement sites often provide the best responses because of the many burnt areas and rubbish deposits (Gaffney and Gater, 2011, 124) Magnetic methods can also identify burnt mounds, associated with the Late Bronze Age and often found in or next to palaeochannels (Gaffney and Gater, 2011, 126).

In 2001, Weston argued that geophysical prospection on alluvial landscapes is problematic without continuing to manufacture ever more sensitive equipment or machine stripping the site prior to survey (2001, 265). Using a trio of case studies, Weston considers the effectiveness and contributing factors prohibiting the use of magnetometry on alluvial sites. Whitemoor Haye is an alluvial environment on a gravel terrace on the western bank of the River Tame in Staffordshire. This is a site known to contain visible cropmarks; the survey here was purposely targeted to sample these features to determine the correlation of magnetometry results. The results showed that areas devoid of cropmarks proved disappointing with only a few anomalies detected, excavation showed these to be variations in the top/subsoil interface. The sample over the cropmarks were also disappointing showing no detectable anomalies, Weston concluded that the reason for this was that the features were too shallow or damaged to be detectable by magnetometry (2001, 270).

The remaining two sites surveyed by Weston, Besthorpe, a floodplain on the eastern bank of the River Trent in Nottinghamshire in 1992, and Riverside Meadows, a site to the south east of the Great Ouse, both yielded similar results. The geology at Riverside Meadows was sand and alluvial clay whilst the underlying geology at Besthorpe comprised of pelo-alluvial gleys. The magnetometer results at both these sites gave a good strong response which clearly faded as the survey progressed towards the water course. A very strong response indicating a palaeochannel could be seen at both sites, whilst at Besthorpe the slightly higher ground yielded a dense concentration of archaeological activity. Weston suggests that the reason for the weakening response near the river was due to an increase in alluvial overburden impeding the effectiveness of the magnetometer survey (2001, 267). Gaffney and Gater argue that small scale surveys on alluvial floodplains may not be able to identify a channel due to the lack of magnetic contrast at a particular point. This would be due to the varying flow speeds and deposition rates of magnetic gravels, suggesting that large scale surveys are required to provide an adequate sample area (2011, 122).

2.4.3 Electrical Resistance Ground Imaging

This advanced earth resistance technique hinges on differences between soil conductivity/ resistance and soil moisture/ texture which results in different responses at varying depths depending on alluvial variation. The advantage of this method is that it provides a cross section of the deposit / fill, highlighting cuts and re-cuts, and provides evidence of areas prone to flooding and braiding of channels but moreover this method provides a greater penetration than fluxgate gradiometry (Weston, 2001, 270).

Electrical resistance ground imaging (ERGI) can be used in conjunction with other methods, for example coring, to determine the depth of alluvial deposits. A case study of a prehistoric site at Vetren-Pistos in Bulgaria using this method was successful in determining the depth and extent of alluvium in a palaeochannel and was also able to distinguish between sedimentary components of the alluvium (Weston, 2001, 270).

The development of a methodological approach to alluvial studies incorporating ERGI against other methods has been tested in the Trent valley. Challis and Howard suggest that adapting such a methodology will enable archaeologists to make informed decisions when dealing with low lying wet valley floors, unsuitable for conventional geophysical prospection techniques (2006, 237).

This chapter has discussed three different methods used for geophysical survey. When surveying a large area, magnetometry would be the most productive and least labour intensive method. Should archaeology become evident then follow up earth resistance or ERGI could be considered to target on a local basis.

2.5 Field-walking

Field-walking has been suggested as being a useful tool for investigating archaeology in low energy river systems with cohesive channel banks, where the river dynamics are least likely to have destroyed archaeology or moved artefacts. High and medium energy river systems with non-cohesive channel banks are regarded as responding poorly to field-walking (Howard and Macklin, 1998, 538). However, Waddington investigated an area intended for gravel extraction at Lanton on the Millfield plain, a medium energy river system with non cohesive channel banks, his findings show the effectiveness of field-walking on two different river terraces (2003, 1-18).

Two areas were field-walked. Area 1 was a flat glacial terrace deposited at the end of the Devensian glaciations, 15,000 yrs ago with an elevation of 50m. The elevation of Area 2 was 38-40m and comprised of much later Holocene deposits (Waddington, 2003, 4 and 15). Despite the well known archaeology from the surrounding Millfield basin, including ring ditches, settlement evidence and a stone avenue, aerial photography and a walk over ground survey yielded no archaeological evidence in the study areas. The river Glen runs along this southern end of the Millfield plain with a natural crossing point close to the terrace where Area 2 is located (2003,3).

Waddington suggests that this area would have been attractive for human settlement, not only because of the riverine proximity but also the views and landscape setting. The area is bounded by the steeply rising slopes of the Cheviot massif and the hummocky terrain of the Tweed drumlin fields (2003, 3).

Waddington suggests that by walking at 2 metre intervals, the visual inspection of the surface is covered 100% as each walker is observing 1 metre either side, not only does this allow the total recovery of all finds, but the differing plough soils can be noted for fluctuations which might identify features (2003, 7). Lithic densities for areas of gravel terraces where there is known Neolithic and Bronze Age archaeological remains average at 14.7 lithics per hectare. Area 1 averaged out at 6.1 lithics per hectare, below the average. However, Waddington identified clear clusters, particularly in the northern corners of the site. By delimiting these clusters, the average came out at 11.3 lithics per hectare which was closer to the average. These clusters contrast sharply with the blank areas elsewhere which are seemingly archaeologically sterile (Waddington, 2003, 7-8).

Most natural cobbles or nodules of source lithic material have a weathered outer rind called a cortex covering the un-weathered inner material. Flakes are often differentiated by the amount of cortex present on their dorsal surfaces as the amount of cortex indicates what part of the core the flake came from. Primary cortex flakes are those whose dorsal surfaces are entirely covered with cortex; secondary cortex flakes have at least a trace of cortex on the dorsal surface; and tertiary flakes lack cortex, having derived entirely from the interior of the core. Primary flakes and secondary flakes are usually associated with the initial stages of lithic reduction, while tertiary flakes are more likely to be associated with trimming and bi-facial reduction activities (Andrefsky, 2005, 255-258)

Waddington (2003, 15) sorted the finds for this area according to the reduction sequence and quantified them as follows; 36% are from the tertiary stage, such as tools, 52% belong to the secondary stage and 11% belong to the primary stage. Mesolithic material was represented by micro cores.

The lithic density from Area 2 was 2.4 per hectare, totalling 12 lithics. However this compared well with the average density associated with alluvial surfaces of 0.3 per hectare. Waddington suggests that the archaeological remains in this lower terrace are likely to be buried under at least 0.5 metres of Holocene deposit. The lithics found are likely to be a result of down slope movement from the higher terraces or from floodwater deposition (Waddington, 2003, 15).

A 1m x 1m test pit was placed on a cache of flints found in area 1 and placed through a 0.5mm sieve, a further 48 lithics were identified in a tight cone below the surface cache including an end scraper and a projectile.

These findings show how useful field walking can be on alluvial landscapes where there is no visible archaeology present.

Another example of field walking alluvial landscapes comes from Winchelsea, Sussex. Field walking was used to assess the archaeological remains along the proposed corridor for the new A259 in the Brede Valley at Winchelsea, Sussex (Barber, 1992, 3). Barber's methodology differed from Waddington's as he walked at 20m transects, although there is mention in the text to suggest that the lines walked were closer together. Recording the finds from each transect in a single finds bag. Barber mapped the transects, giving each an individual number to assist further field walking should extra fields become accessible in the near future. Barber recorded the National Grid Reference (NGR), ground conditions, lighting and date for each bag (Barber, 1992, 5-6). In total, 78 sherds of medieval pottery were recorded, the majority of these were recovered from higher ground along with seven pieces of prehistoric flint. The floodplain, despite providing good visibility, only yielded three sherds of medieval pottery, but did produce a regular dense spread of 19th and 20th century pottery. Barber suggests the reason for this was that the Medieval level would possibly be well below the plough line: consultation with the Hastings area Archaeological Research Group (HAARG) revealed that there were no previous recorded finds from the floodplain, however Medieval and later pottery had been recorded from the higher ground (Barber, 1992, 6).

Barber concludes that the higher ground above the floodplains would have been more suitable for settlement and occupation where there was less risk of flooding however Barber also comments on the restrictions of available arable land when field walking (Barber, 1992, 7).

Comotto of the Winchelsea Archaeological Society reports from a programme of field walking in Winchelsea in 2011. Comotto divided the area surveyed up into 20 m transects, walked at 2 m intervals with all finds regardless of significance recorded per transect. Each finds bag record form recorded the location of the grid, name of transect walker, conditions affecting the quality of data including weather, lighting and ground condition, soil type, topography and other observations in the field such as earthworks (Comotto, 2012, 4). The finds from this research were well presented in a series of tables and special plots of finds.

Further field walking prior to another road scheme was documented by Trimble of Lincoln Archaeology. This 50m wide corridor was divided up into three 25m wide transects, each walked along lines spaced 2m apart (Trimble, 2000, 7). This methodology is a bit confusing as a 50 m wide corridor would be expected to be divided into two 25 m transects as opposed to the mentioned three, however, Trimble recorded modern finds from each transect as a whole in the same way as Barber, paying more attention and accuracy to finds of increased archaeological significance. Trimble concludes that the finds have not at the time of publication been processed by a specialist, but the general typology of pottery sherds has enhanced the understanding of Saxon-Norman and Medieval settlement extent of Weston (2000, 8). Trimble also suggests that the Desk based assessment carried out in conjunction with the programme of field walking highlights the potential that archaeological remains from the Palaeolithic onwards are likely to be concealed under considerable depths of alluvium in the study area (2000, 8).

This section has compared field walking events by Waddington, Barber, Comotto and Trimble, all of these authors used a methodology of walking two metres apart, the reason for this suggested by Waddington as providing 100% visibility. Barber adopted a different approach walking at much wider intervals but has numbered each transect should a further visit be necessary. Comotto paid much attention to detail, documenting ground and weather conditions amongst others. It would be fair to suggest that a programme of field walking should be tailored to what the project hopes to achieve.

2.6 Remote Sensing

The contribution of archaeological remote sensing is fundamental to achieving an understanding of the complex sedimentation and erosion of dynamic alluvial landscapes. Remote sensing encompasses a broad range of techniques, the earliest and most extensively used being aerial photography, identifying features within the visible spectrum in alluvial environments such as soil marks, crop marks and field boundaries (Challis and Howard, 2006, 232). Until the 1990s, aerial photography was the primary method used, in conjunction with borehole and test-pitting, for the coarse modelling of land surfaces. However, an unpublished paper by Allsop and Greenbaum highlighted the potential of airborne multispectral imagery (Challis and Howard, 2006, 232). Archaeology on alluvial landscapes is at risk through the extraction of minerals and the development of transportation networks (Howard and Macklin, 1999, 527). This has led to the creation of the Aggregates Levy Sustainability Fund (ALSF) in 2001 and subsequent extensive, diverse and technologically innovative research reviewed at the European Association of Archaeologists annual conference a conference in Cork, Ireland in 2005. (Challis and Howard, 2006, 233).

Light detection and Ranging (LiDAR) data uses light sensors to measure the distance between an airborne sensor and the target object. This method was developed in the UK and used on a wide scale by the Environment Agency for river catchment management (Challis and Howard, 2006, 235). The spatial resolution offered by LiDAR of at least 2 metres renders it an effective tool for major landscape mapping. Generally, LiDAR is exploited to provide a three dimensional map of river valleys, however Challis and Howard suggest that the intensity of the reflection of each laser pulse can be influenced by several factors, notably the moisture content in the soil. This can be processed to provide information on sub surface features such as Palaeochannels, providing environmental preservation within floodplain sediments (2006, 236). LiDAR has been used alongside multispectral airborne thematic mapper (ATM) and synthetic aperture Radar (SAR) in a comparative study of part of the typically lowland River Trent valley. This study shows that these were particularly useful, especially the thermal infrared band at mapping floodplain geomorphology and identifying cultural archaeology (Challis and Howard, 2006, 236).

A method not widely used in the UK but worth noting is the use of satellite imagery, the spatial resolution offered by this technique limits its use for identifying cultural and geomorphological features, however the development of software such as Ikonos and Quickbird provide a higher resolution image. Unfortunately the cost often sends this type of information beyond the civilian user (Challis and Howard, 2006, 234).

A case study utilising LiDAR on a 27km stretch of the River Dove, Derbyshire, a tributary of the River Trent, increased the number of sites ranging from isolated monuments to relict landscapes to 900, a huge increase from some 143 known sites recorded on the Heritage

Environment Record (HER) identified from existing cultural records such as aerial photographs (Challis and Howard, 2006, 235).

A key contributing factor to the ever increasing dependency on and utilisation of remote sensing in large landscape surveys has been the development of computing ability. Powerful processors, increasing data storage and sophisticated software packages allow very large quantities of data to be stored, processed and manipulated. Much of this is now presented through on-line media for the end user to process, rather than in print (Challis and Howard, 2006, 232-233). The development of software such as Amira Visualisation coupled with Fakespace Powerwalk allow the user to interact with the computer generated landscape, the results of which, Challis and Howard suggest, come close to Tilley's phenomenological approach to the landscape (2006, 238).

Aerial photography is still a valuable tool when identifying archaeological remains on floodplains amongst other environments, however the development of LiDAR has generally replaced aerial photography as the principle tool of investigation. The primary reasons for this is the ever-increasing bank of data obtained and the ease in which this data can be downloaded from the internet at resolutions as accurate as 0.25m. Once obtained, this data can be manipulated utilising freeware such as QGIS showing various views emulating different levels of shading and contrast

This chapter has discussed the various types of river systems found in Britain and the advantages and potential problems caused as a result of the deposited alluvium. The River Ribble is arguably within the category of Medium energy with non-cohesive banks. Remote sensing and technological advances in recent years now provide the archaeologist with a greater range of possible techniques when dealing with unknown depths of alluvium such as LiDAR and geophysics which can be used in conjunction with traditional techniques such as field walking and coring where localised results can be adapted to the wider landscape setting to assist interpretation.

3 The Archaeology of Barrows and Rivers in Lancashire

3.1 Introduction

This chapter will review the archaeology of barrows and rivers in Lancashire. The antiquarian activity within the study area incorporating the mounds at Winckley Lowes and Brockhall will be reviewed and consequently put into context with some of the known archaeological sites in the region and the practice of monumental re-use. The chronology and mound construction typology will be reviewed and subsequently will be considered during interpretation of the results of fieldwork discussed in chapter 5 and conclusions in chapter 6.

3.2 Regional Background

The geology of the area is documented by the British Geology Survey. The bedrock encompassing the majority of the Ribble catchment area is predominately limestone. Igneous rocks resulting from volcanic activity can hinder magnetometer survey due to the high amounts of iron contained within the rock. However there is no igneous bedrock in the study area, nor is there any igneous rock within the catchment area of the River Ribble and its tributaries (BGS 2013). Despite there being no river transported igneous rocks within the catchment area, there is evidence through drumlin fields that ice flowed in a southerly direction from the volcanic geological areas in Cumbria which could account for any isolated igneous deposits (Brennand et al, 6, 2008).

Mesolithic evidence in Lancashire is represented by a limited number of sites, notably flint assemblages from Halton Park and Marles Wood which contain well dated lithics from the Late Mesolithic period. Middleton et al (1997, 87) suggest that black chert which was present in both these assemblages was unique to this period. Marles Wood is only a short distance down-stream from the study area.

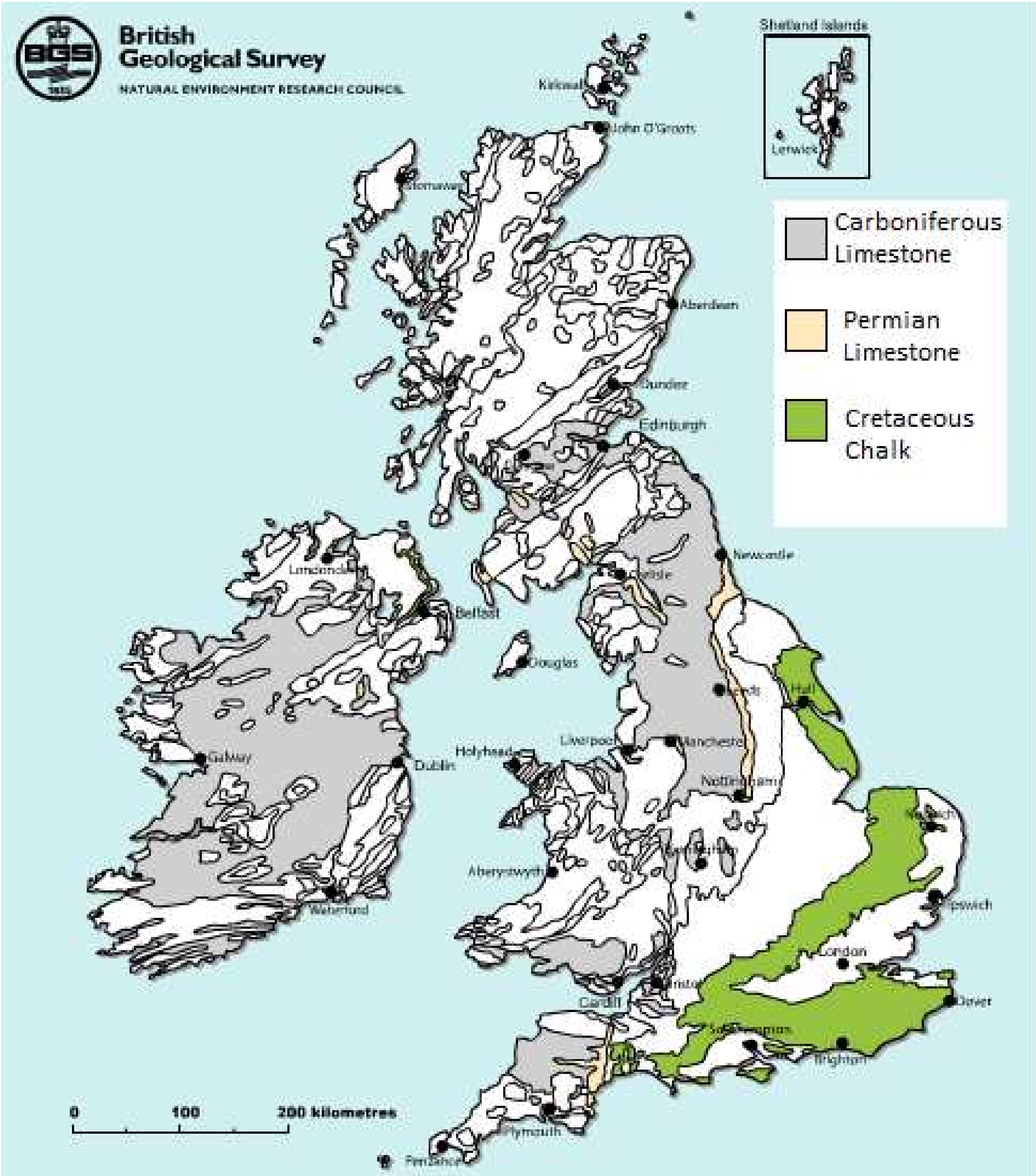

Figure 3.1 Geological map of Northern England showing sources of chert and flint in areas of Limestone and Chalk respectively (BGS.2012)

Figure 3.1 above illustrates the areas of northern England where chert can be sourced, Hind suggests that the predominance of source chert accounts for a large proportion of stone tools during the Mesolithic period (1998).

Neolithic evidence from the Ribble Valley tends to be restricted to flint working, these lithic remains generally come from the same areas as the Mesolithic flint scatters suggesting a degree of continuity, however there are a handful of new sites, including Portfield Camp near Ribchester. Here Neolithic Grimston Ware and flints were found in pits (Brennand et al, 2008, 15). The River Ribble originates in the area of Ribblehead in North Yorkshire, the Ingleborough area is rich in prehistoric archaeology, including a pair of Neolithic long cairns(*figures 3.2 and 3.3*) (SD 7465277396) with a north-south axis which Luke suggests were deliberately placed to straddle the north facing edge of a limestone terrace (2011).

Figure 3.2 Plan of Keld Bank long cairn (Luke, 2011).

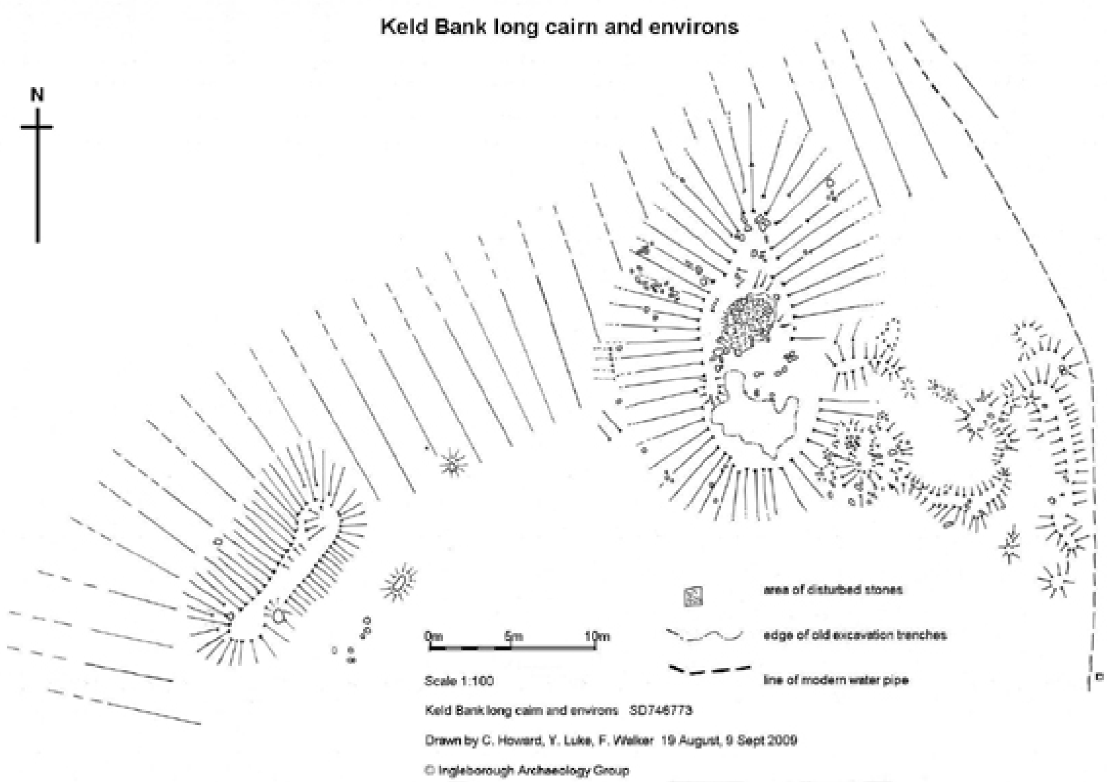

Figure 3.3 Plan of Keld Bank long cairn (Luke, 2011)

The Bronze Age in the Ribble Valley is marked by more obvious signs of monumentality and activity appearing on the landscape. A timber circle at Bleasdale is dated to the Early Bronze Age and a barrow dated to this period is located at Cat Knott Well on the eastern edge of the Forest of Bowland overlooking the Ribble Valley (Brennand et al, 2008, 17). A group of 50 small clearance cairns at Nicky Nook in the Forest of Bowland may be a result of Bronze Age agriculture as it was common practice to create small cairns of stones whilst creating land suitable to arable purpose (Brennand et al, 2008, 18).

Wider afield in Lancashire and the surrounding areas, the monumental Bronze Age is marked by a limited number of upland burial cairns, many of these are hengiform monuments or low ringed earthworks. Examples of this type of monument are found at Hell Clough, Burnley, Lancashire (Barrowclough, 2008, 119). Hell Clough comprised of three monuments between 7.5 and 17.5m in diameter, the largest of which contained seven stones encircling the perimeter ditch (Barrowclough, 2008, 120).

There are over 100 recorded Bronze Age round barrows recorded from Cheshire and Greater Manchester (Barrowclough, 2008, 113). however Lancashire and South Cumbria contain significantly fewer barrows. A number of cairns containing Early Bronze Age Beakers have been recorded from lowland areas in the region, particularly in the area around Blackpool and Kirkham, which due to changes in sea levels would have overlooked water in the Early Bronze Age (Barrowclough, 2008, 107). A small number of examples at Manor Farm near Carnforth, Lancashire and Levans Park near the River Kent near Milnthorpe, South Cumbria have been recorded (Barrowclough, 2008, 98), as have previously destroyed barrows/cairns alongside mosses at Whitprick, Arnside, Warton and Lytham in the north of Lancashire (Middleton et-al, 1995, 205). This contrasts to no recorded Bronze Age monuments in South Lancashire (Middleton et-al, 2013, 183). It would appear that during the Early Bronze Age it was commonplace to deposit cremated human remains within urns in natural places such as caves, for example, Dog Holes Cave at Warton, Lancashire and within limestone grykes as an alternative to monumental burial(Barrowclough, 2008, 98).

Evidence obtained during extensive surveying of Lancashires wetlands suggests that the sea level during the Early Bronze Age was approximately five metres higher than current levels (Middleton et-al, 1995). Slightly elevated hills amidst the low lying coastal areas have yielded much evidence for Bronze Age occupation, an example being a hoard of Bronze Age metalwork found at Cogie Hill Farm, Winmarleigh near Garstang (Middleton et-al, 1995, 67). Workmen cutting peat in the Over Wyre moss-lands discovered a wooden track-way during the nineteenth century, this planked track-way, dated by stratigraphic association was suggested as extending over a mile and a half across the Bronze Age bog (Barrowclough, 2008, 104).

The archaeology of the northwest as a whole has been well documented by the *Archaeological Research Framework for North West England* volumes (Gill *et-al*, 2006), complimented by The *Aggregate Extraction and Geoarchaeological Heritage of the Ribble Valley and Kirkham Moraine.* This was an Aggregates Levy Sustainability Fund project that studied the potential impact of aggregate extraction on the archaeological resource of two areas in Lancashire, England: the Ribble Valley (2005-2007) and the Kirkham Moraine (2007-2008) and covers much of the terraces along the Ribble Valley (Quartermaine, 2008). `

3.3 Winckley Lowes

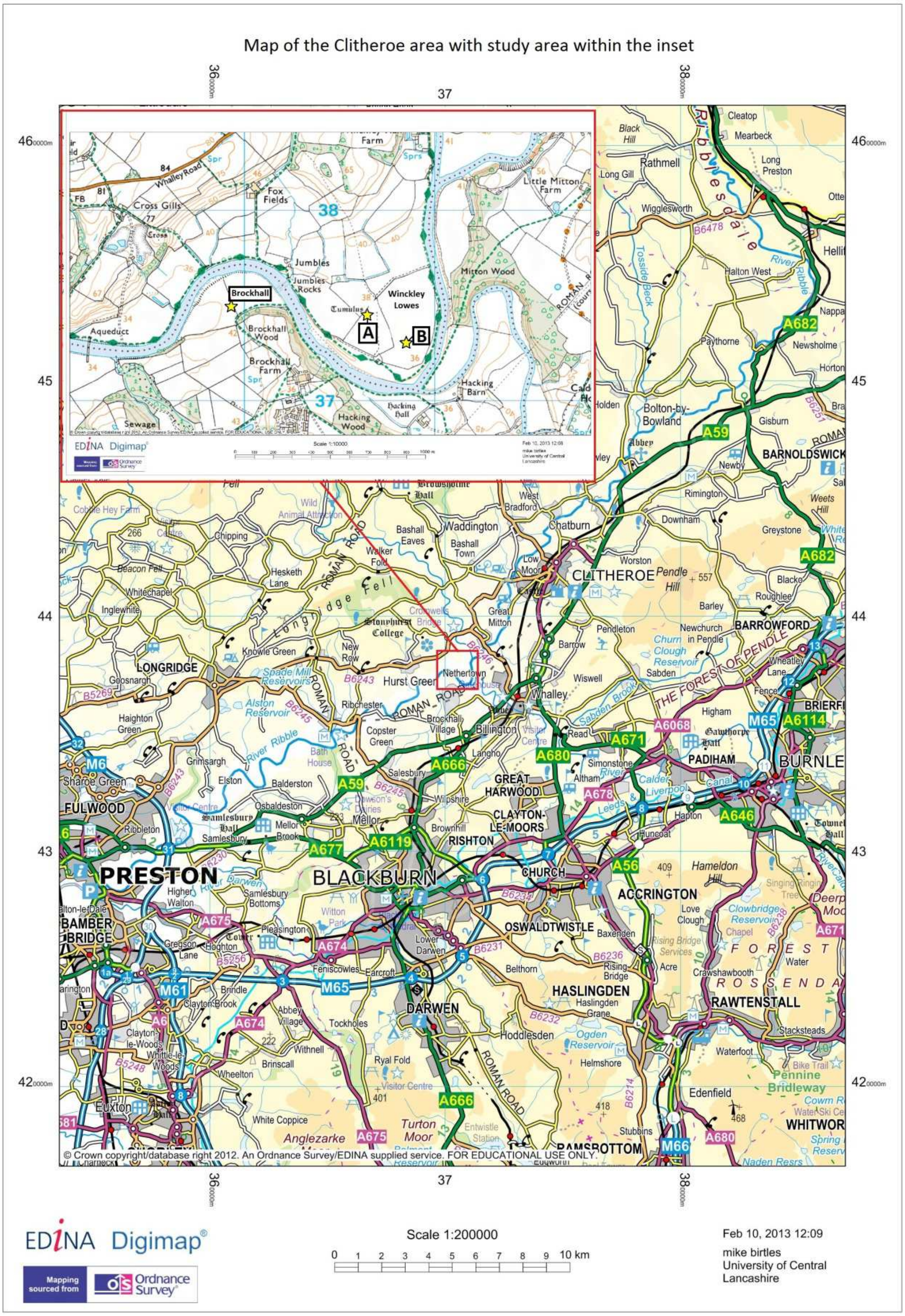

Figure 3.4 Location Map showing the study area and Mounds A and B (Edina Digimap, 2013).

There are two main tributaries of the River Ribble north of Preston, the Calder and the Hodder, both of these rivers confluence with the Ribble at Winckley Lowes, a large flood plain located 5 ½ Km southwest of Clitheroe, Lancashire. The Lancashire Historic Environment Register (HER) identifies three monuments- Winckley Lowes A, Winckley Lowes B and Brockhall Wood in this area (*figure 3.4*).

The Anglo Saxon Chronicle records a battle on this site in 798AD between Eardwulf (King of Northumbria) and rebel chief Wada, this battle was also recorded in an account by Simeon of Durham who refers to place names of Billangahoh nr Walalega where there were heavy losses on both sides. These names are preserved in the modern day as Billington and Whalley, the battle was recorded as being most fiercely fought at Bullasey Ford, known today as Jumbles rocks (Luck 1895, 31). Dr Whittaker is reported to have searched in vain for evidence of this battle in 1815 before suggesting that the large mounds opposite the confluence of the River Calder covers the remains of some chieftain (Luck, 1895, 32-33).

Winckley Lowes A (PRN180) (SD 70650 37450) is situated 250m north of Hacking Boat House and was excavated by Rev JR Luck in 1894. This mound was described by Luck as a bowl shaped mound with an almost perfectly round base, 115ft diameter, near the top is a basin too large to be accounted for as a result of caving in, suggesting the mound had been dug in to for use as a lime kiln (1894, 34).

Fortunately Luck paid a reasonable amount of attention to the excavation of this mound (*figure 3.5*). Initially Luck intended to excavate a section from the base of the mound at field level into the centre but decided to reverse this by excavating a section from the base of the depression outwards. A large piece of tree root below the turf led Luck to believe the mound had previously been untouched (1894, 34). Three feet below the surface of the turf, Luck came across a cairn of large stones with soil amongst them. The stones were water worn and comprised of limestone and sandstone. Luck reported removing hundreds of these often large boulders before coming across many pieces of human skull, teeth and other broken human bones. There was also a small flint knife or scraper which he described as elliptical in shape, 3 ¾ inches long by 1 ½inches wide with a serrated edge. These were found five feet below the surface. Lower down and five feet south of the centre, Luck reports another very thin skull, probably that of a child not more than six or seven years old based on the teeth, together with many other broken bones (1894, 36).

Upon piercing the cairn, which was a dome of stones four feet thick covering a heap of brown clay mixed with stones, Luck reports finding what he believed to be the chief internment, in the form of the remains of a cremated human body on a thin layer of charcoal. This charcoal was widely diffused through the underlying clay and clearly not associated with cremation *in situ* as the temperature would not have been great enough and there was no sign of baked clay. The bones appeared to have been broken up after burning (1894, 36).

Luck continued digging deeper until having passed through a layer of grey-blue clay he reached a bed of fine yellow sand which had evidently never been disturbed, this was located 13½ feet below the apex of the mound. Returning to his original plan of digging from the perimeter to the centre, Luck excavated a section into the south facing edge of the mound finding some well fitting squared stones, these appeared to be part of the cairn mentioned above. Luck suggests that some of these stones had been removed and burnt for lime as he found large calcareous matter mixed with pieces of coal, evidently strengthening his belief that the mound had been used as a lime kiln (1894, 38). Enlarging the cutting at the centre, Luck found another skull, four feet below the turf and six feet east of the centre, Luck believed this to be a child approximately 13 or 14 years old. A whetstone with striations borne from metal sharpening was found in this part of the mound, reported to be 4 inches long by 1 ¼inches wide and ¼inch thick, along with two pieces of pottery. One was described as a handle made of fine well burnt clay with indentation made by finger and thumb to attach it to a main vessel, the other piece was the side or base of a large flat pan, black in the middle with brick coloured surfaces (Luck, 1894, 39).

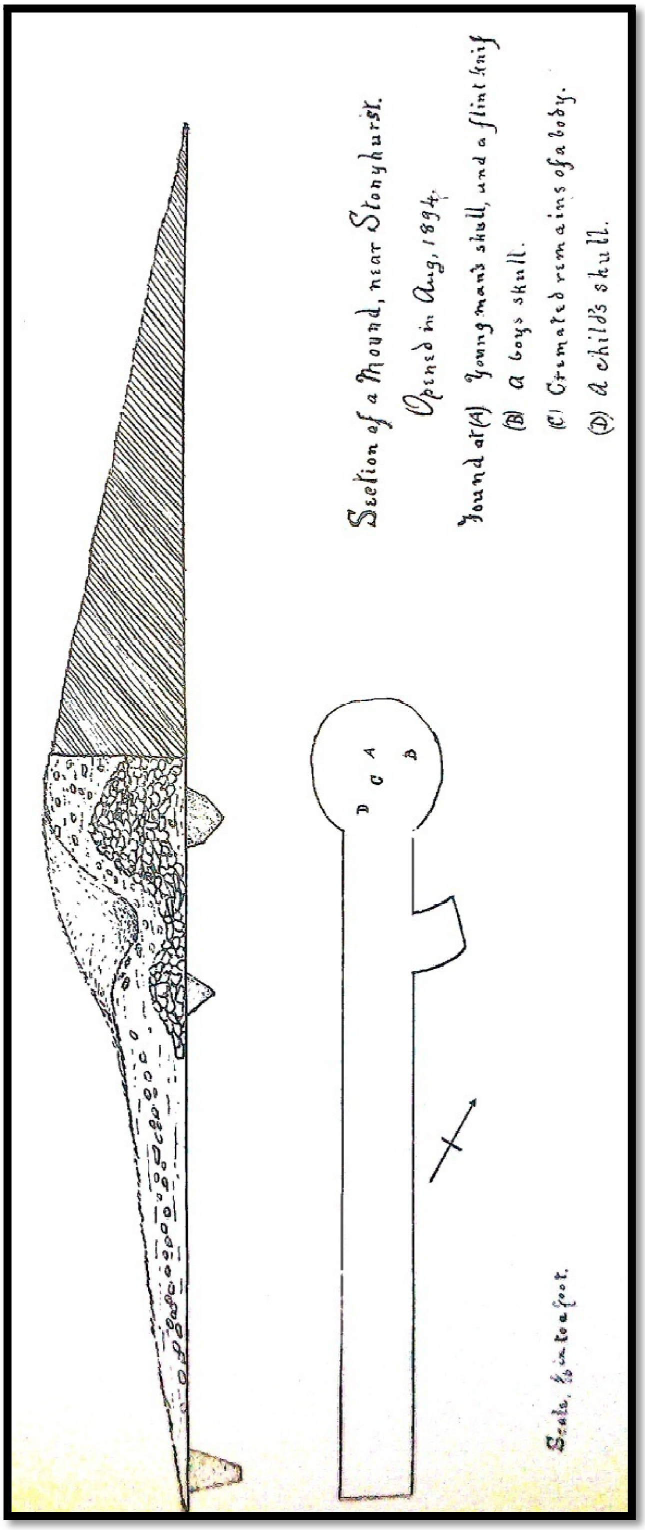

Figure 3.5 Plan and section of Mound A recorded by Rev Luck (1894)

Winckley Lowes B (PRN179) (SD 70850 37300) is situated 170m from Hacking Boat House (*see figure 3.4*), This mound was initially excavated by Whittaker in 1815 who found the work hard going and gave up, suggesting the mound was geological as no part was stratified before reaching the centre, and no more attention was paid to this mound until 1894 (Luck, 1895, 33).

The Rev JR Luck returned to excavate this mound in September 1894, believing the site to be a long barrow. Luck planned on cutting a section from the east to the centre but ‘not wishing to sacrifice the old Hawthorns’ he cut a 10 feet wide slot from the southeast corner to beyond the centre. Luck found a layer of light brown clay to a depth of three feet from the top containing mussel shells, clay tobacco pipes, coins and modern pot sherds, believed to have been left by Whittaker in 1815. Four feet below the top was a mass of hard slate coloured clay overlaying deeply ice scoured limestone boulders. Boulder clay was again encountered 13 feet below the top, the only sign of stratification was a long tongue of sand which Luck reported as running in a down valley direction (Luck, 1895, 29). Parkinson of Brockhall argues the mound is an outlier of the boulder deposits on each side of the valley, suggesting that it may be a product of floodwaters from all three rivers that meet on the plain (Luck, 1895, 30). The hawthorns are still present on the mound to the present day.

The third site is Brockhall Wood (PRN149) (SD 69930 37500, (see figure 3.4), this tumulus was removed in 1836 by Thomas Huckerby, the farmer. Upon removal, Huckerby discovered a cist and the remains of human bone and rusty spear heads which were reported as turning to dust upon exposure to air (Luck, 1895, 32). This site is on the opposite side of the River Ribble to Winckley Lowes A and B but it is of note that the only reported crossing point for miles around, Bullasey ford (Luck, 1895, 31-33), is directly between both sites. The HER reports personal communications that the mound was situated on an alluvial terrace, 150m south of the river and 80m north west of the old river bank above the terrace and, until being ploughed out completely during the last war, it could be identified by a very slight elevation in the ground. Dr Whittaker visited this site in 1815, over 100 years before the period when the feature was apparently destroyed but has made no reference to a mound (Luck, 1895, 32-33) suggesting that the mound at Brockhall never did exist and any burial and/or cist there was interred in a natural rise in the ground.

3.4 Bronze Age Mound Construction.

The study area of Winckley Lowes contains documented barrows which are scheduled. There is a degree of uncertainty about the age of these barrows (see section 3.3). For this reason, I will review the construction literature of several sites which may be used when concluding this paper.

Round barrows began to appear from the Late Neolithic but are much more prominent in the Bronze Age and were generally considered to reflect individual burial rites rather than the communal aspect as considered to be associated with the Neolithic long barrows (Woodward, 2000, 36). The traditions of Neolithic monuments are often reflected by continuity in the Early Bronze Age, round barrows were often constructed in landscapes marked by existing Neolithic earthworks such as cursus monuments and linear banks but are also often located close to rivers indicating a passage to death associated with Bronze Age deposition (Cockcroft,2012,5).

Round barrows were not always used for burial, some round barrows did not contain burials, for example, barrows at Raunds and Etton in Northamptonshire (Healy and Harding, 2007, 57) but as in the case of some long barrows, were used as cenotaphs and should therefore be looked at as artificial mounds rather than graves. Barrows constructed between 2500–1500BC which had flat or concave tops such as ring, platform and pond barrows are considered to have had a ceremonial role used as an open arena monument. These ceremonial monuments constructed before 2100 BC rarely contain human remains and deposited artefacts in contrast to those constructed between 2100 BC and 1500 BC, for example, Brenig 51 and Carneddau in Wales when deposition became common (Garwood, 2007, 34).

A chronological summary framework for Late Neolithic and Early Bronze Age funerary and ceremonial monuments is provided by Garwood (2007), outlined as follows:

From c.2500-2100 BC mounds tended to be small and constructed in a single phase, often close to existing ancient monuments. Cremations were rare at this time with burials tending to be centrally positioned adult male single inhumations. Grave goods are commonly found such as Beakers with Food Vessels often used towards the end of the period.

Between c.2150-1850 BC the size of mounds was progressively enlarged to accept further burials of both gender groups from a wide range of ages, grave goods continued to be provided in the form of Beakers and Food Vessels. Single inhumations in both central and peripheral positions are buried, however cremations are also introduced during this time period in Collared Urns.

From c.1850–1500 BC single phase mounds again predominate although often much larger that those constructed between c.2500–2100 BC, the progressive enlargement during this time was rare but carefully shaped barrows such as bell and disc barrows appeared in the landscape. By now, cremation burials predominate with multiple central burials now rare (Garwood, 2007, 41).

Round Barrows constructed in the Bronze Age are often multi-period monuments. An example of this includes the Sawdon Moor Round Barrows in North Yorkshire where the pre-barrow land surface contained sherds of Early Neolithic Grimston Ware pottery, Late Neolithic Peterborough ware and Bronze Age Collared (Brewster and Finney, 1995, 18).There were two barrows at Sawdon Moor, both constructed in three stages as described below.

1. A mound of turf and pre barrow land surface containing cremation pits.
2. A second stage mound enclosing the first with a cist and sandstone kerb.
3. Another mound covering the previous two obtained from a ring ditch.

(Brewster and Finney, 1995, 24).

The construction of Bronze Age round barrows on pre-existing sites used for Neolithic burials/ cremation pits are not known to be widespread nationwide, the Sawdon Moor examples are the only known examples in North Yorkshire (Manby, 1995, 41). However the remains show that the re-use of Neolithic sites in the Bronze Age did occur and further examples remain undiscovered. Healy and Harding (2007, 53) review twenty Early Bronze

Age round barrows located along 3.5km of the Nene valley bottom in Northamptonshire. Some of these were built on low river terraces previously occupied by up to eight Neolithic monuments. The whole of the Nene valley is lined by hundreds of round barrows and ring ditches, these are often in clusters and their valley bottom location prevents the panoramic landscape views observed from other barrow sites (2007, 53). Healy and Harding show how the clusters of barrows follow the course of the River Nene, the individual barrows that are included in the cluster tend to be smaller in contrast to the larger more widely spaced round barrows from the Neolithic period (Healy and Harding, 2007, 55).

Healy and Harding consider how barrows fit into the landscape on a wider scale, suggesting that the location of a barrow may have expressed that group's links with the local terrain. Using an example of the barrow 1 at Raunds where nearly 200 cattle skulls were deposited over the primary burial, Healy and Harding suggest that this represents hundreds of people in the community due to the meat consumption (2007, 66). Barrows on a river terrace to the north east of barrow 1 at Raunds were located in such a way to emphasise and extend the alignment of existing Neolithic monuments, including a long barrow. This effectively enclosed a space demarcated by older monuments and tributaries of the Nene (Healy and Harding, 2007, 67).

Ardmarks have been found under Neolithic and Bronze Age barrows, Bradley (1978, 268) suggests that these might have been connected with ritual practices around burial. However, evidence of a field boundary at South Street long barrow in Wiltshire is an early example of a barrow fitting in with a pre-existing field boundary. At Vassen, Bradley suggests that there are parts of the field layout which reflect the positions of earlier track ways leading to a barrow cemetery. The barrows themselves are considered in the layout of arable plots with some barrows remaining in islands of unploughed land whilst others are incorporated into the edges or corners of fields (1978, 268).

Round barrows tend to fall into five distinct categories: bowl, bell, disc, pond and saucer with other less commonly found cone and broad barrows. Generally barrows are encircled by a broken ditch, however some of the smaller examples such as bowl barrows are not (Woodward, 2000, 19). Nowakowski (2007, 91) explores the importance of the ditch on 19 examples of Early Bronze Age barrows in Cornwall. Nowakowski argues that the ditch often occupies a secondary position in terms of interpretation with the mound itself generally being the focus in terms of ritual closure and land demarcation (2007, 91). Less than 0.5% of the 3500 burial mounds in Cornwall have been examined by excavation, however Cornwall benefits from having significant excavation on groups of barrows. It is this documentation that Nowakowski has studied the life stories of these Early Bronze Age barrows (2007, 92). Nowakowski tabulates excavation data from the 19 sites, recording the barrow's name, character of ditch, percentage of the site investigated, overall site history, type of barrow and any other comments obtained through historical data (2007, 93-95) following this up with laboratory data and references from C-14 dating (2007, 96-97). Nowakowski argues that the excavation records provide evidence of a diverse variety of form and size of ditch, some are circular and continuous whilst others have huge gaps and causeways, all of the examples contained soils, some contained objects and some ditches were proven to have been built after the construction of the mound. Certain areas of ditches appeared to have been used more often than others suggesting that visitors at a particular time demonstrated a shared knowledge; also certain areas were used for deposition at given times (2007, 98-100).

Little Gaverigan Barrow was one of those examined by Nowakowski, here she discusses a very large ritual mound which contained no human remains, this monument sported evidence of two ditches, the primary ditch had been dug in a decisive fashion with clean steep sides and made as a continuous feature which was a prominent feature in the landscape delimiting land, the north of this were a series of smaller related pits containing bits of twigs, leaf impressions and remains of post timbers indicating that the primary ditch had replaced an earlier landscape feature, the primary ditch itself had been re-cut exactly along the line of the first but was much shallower, this secondary ditch contained spreads of what Nowakowski describes as exotic soils, brought in from far-away places (2007, 101).

Riverine locations were often places utilised for settlement and burial in the Bronze Age, several examples have been identified and case studies are presented here. The confluence of the rivers Trent, Soar and Derwent in the Middle Trent Valley, UK and associated floodplains are well known for having a rich archaeological record, the Holocene gravel deposits on these floodplains contain a multitude of prehistoric features identified from aerial photographs including ring ditches, cursuses, henges, pit circles and a possible mortuary enclosure (Howard et-al, 2008, 1041). The area encompassing these river confluences has been evaluated using LiDAR at a resolution of 1m, ground penetrating radar and earth resistance survey to create a three dimensional image of the river terracing and palaeochannels, this methodology ground-truthed by sediment coring created a model comprising of two river terraces (Howard et-al, 2008, 1043-1044). The study area was field-walked, Terrace 1 closest to the river contained very few finds in contrast to terrace 2 where the overlaying soils were considerably thinner, this contrast is also reflected in the number of known features identified from the HER, LiDAR and aerial photographs (Howard et-al, 2--8, 1045-1046).

Research on the alluvial floodplains along the Upper and Middle River Thames prior to gravel extraction has revealed a Bronze Age barrow cemetery at Yarnton, Oxon (Allen et-al, 1997, 125). This small barrow cemetery dating from the Middle to Late Bronze Age was surrounded by a scattering of pits, watercourses and gullies and flint debitage associated with flint knapping. Further evidence of domestic activity at Yarnton is substantiated by the presence of Burnt Mounds, nearly twenty oval buildings, wells and cooking areas, all of which were revealed during excavation (Allen et-al, 1997, 124-125).

A sequence of Prehistoric earthworks dating from the Neolithic onwards has been identified from aerial photography alongside the River Exe, Devon (Bayer, 2011, 155). By targeting these features using gradiometry, Bayer was able to discount one circular feature as being prehistoric but identified two additional circular earthworks as likely dating to the Neolithic or Bronze Age (Bayer, 2011, 164). Excavation of an enclosure ditch located within the survey area revealed the subsoil to be 0.85m thick overlaying the river terrace gravels (Bayer, 2011, 165).

3.5 River use in Late Prehistory

Many artefacts and human remains have been recovered from the River Ribble, the majority of these were recovered from the Preston Dock excavation in the 1880s. This Preston Dock assemblage included a wooden dug-out canoe, a bronze spear head, a flint spearhead and around 23 human skulls. Many of these skulls showed signs of violence including a female skull with a large hole in the back of the head, this skull has been dated to 3100-2900 cal BC (4370 ±45 BP, OxA-71416). Other dated skulls range from the Neolithic through to the Early Medieval period and showed signs of river transportation, indicating that they entered the river upstream and all ended up in roughly the same area (Barrowclough, 2008, 206).

Metalwork deposition appears to be located in the middle and upper reaches of river systems in the Northwest. This is in contrast to the general trend associated with the Early Bronze Age when metalwork was deposited in the lower reaches of rivers. For example, a small hoard of socketed axes has been found in the Ribble near Clitheroe (Barrowclough, 2008, 157).

There is a comprehensive gazetteer of archaeological artefacts found from within/on the banks of the River Ribble and its tributaries on the Lancashire HER. The close proximity of the study area to the confluence of two of these tributaries, the River Hodder and the River Calder, indicates the relevance of taking into account the importance of rivers to our ancestors for hunting and ceremonial deposition, particularly in late prehistory.

York's (2008) study of Bronze Age metalwork from the Thames is a useful comparison. York examines the 302 pieces of metalwork found in the River. Most of the artefacts were found during episodes of dredging for navigation and construction of locks, a high proportion were representative of the Bronze Age (2002, 77). York assessed the stage of the objects life cycle when deposition took place by assessing the degree of damage evident on the artefact, categorising the artefacts as either

- unused-no damage or river rolling.
- used-showing signs of wear, for example, chipped edged or nicks, notches and tears.
- deliberately destroyed-rendered unusable.

(2002,80).

York examines all known artefacts from her study area along the Thames, documenting the state, period, object type and area found. Taking into account the rarity of bronze in the Thames Valley during the Bronze Age and the quantity of discarded usable tools and weaponry found in the study area, York suggests that there might have been a ceremonial reason for removing the items from circulation (2002, 88).

3.6 Conclusion

This chapter has reviewed the limited antiquarian excavations at Winckley Lowes and the known documentary evidence referring to Brockhall. Clearly the evidence from Luck (1894 and 1895) suggests that Mound A is indeed man made but the origin of Mound B was unconfirmed. No dating evidence was provided as a result of Luck's excavation, without excavation, the archaeologist has to rely on the typology/ shape of the mound and put the earthwork into context with the regional evidence. This chapter has reviewed the archaeology of the rivers and barrows in Lancashire, specifically within the catchment area of the River Ribble and tributaries. The long Mound and Keld Bank shares traits with Mound A at Winckley Lowes. The shape and the suggestion that Keld Bank straddles two terraces are particularly significant, this will be compared with the mounds at Winckley Lowes and discussed in chapters 5 and 6.

As discussed in chapter 3.3, the mounds lie within a floodplain where the Ribble, Hodder and Calder all meet, it is arguable that the meeting of these rivers played an important part in situating the mounds here, deposition in rivers, particularly during the Bronze Age has also therefore been discussed to highlight the importance of rivers during the Bronze Age. Studies of alluvial landscapes have shown that rivers were clearly attractive to people in the Bronze age and that the river terraces can be mapped to reflect geomorphologic changes in water course and how they landscape was used in late Prehistory.

Construction techniques and phases of prehistoric mounds have been reviewed to contrast against the geophysical and LiDAR data results and will be considered whilst suggesting an interpretation in chapters 5 and 6.

4 Methodology

4.1 Introduction

Three primary non-intrusive methods of fieldwork will be used to evaluate and assess the archaeological potential of the Winckley Lowes and Brockhall floodplains in this paper: LiDAR, Gradiometer survey and field-walking. This chapter outlines the methodology for each process.

4.2 LiDAR

LiDAR is a useful tool for topographically mapping an area which can be as large as the available data coverage, see below.

Lidar data for the Brockhall and Winckley Lowes sites was obtained from The Geomatics Group and processed using Quantum GIS (QGIS) Lisboa open source software. The data files can be obtained in several formats:

- Digital Surface Model (DSM), this includes vegetation and buildings etc.
- Digital Terrain Model (DTM), this is the bare earth model with all buildings and vegetation removed
- Joint Photographic Experts Group (JPEG or JPG), a basic image that illustrates elevation changes but is not geo-referenced or available to process.
- American Standard Code for Information Interchange (ASCII), full geo-referenced dataset for a selected tile which can be processed using suitable GIS software.

The availability of datasets varies by region, the data is often used by the Environment Agency (EA) for assessing flood risk and therefore low lying valleys tend to be available. The resolution of the datasets may also be restricted by availability; resolutions vary from 0.25m to 2m, the latter being most widely available at the time of writing. A resolution of 0.25 provides the greatest amount of detail as readings are taken every 0.25m. A 1m resolution data set has readings taken at 1m intervals over a 1km^2 grid.

The ASCII datasets have been processed using QGIS Lisboa to illustrate topographic features, primarily, river terraces, visible from various lighting positions, the azimuth degree represents the position of the natural sunlight from north, this can be simulated along with the altitude angle of simulated sunlight casting varying shadows which highlight features differently. Images processed in QGIS are presented to emulate aerial photography.

4.3 Gradiometer Survey

4.3.1 Introduction

The most commonly used geophysical survey techniques for the location of many archaeological remains are magnetic and electrical resistance. These allow below-ground remains to be located in a non-intrusive manner, and may applied to the same site as they produce complementary results. However, the results are very much dependent upon a number of variables which vary from site to site. These are generally based on the objectives of the survey, but there are external factors including the local geographical positioning of the site and topographic features, current and past land use, the solid and drift geology, and available resources such as time.

Magnetic survey (magnetometry) using a gradiometer is the preferred technique for geophysical survey owing to its ability to survey large areas relatively quickly and is therefore one of the most cost effective. Consequently, magnetometry is a very efficient technique and is recommended in the first instance by the English Heritage Guidelines (2008) for such investigations.

Magnetometry will usually locate 'positively magnetic' material such as ferrous-based features and objects, or those subjected to firing such as kilns, hearths, and even the buried remains of brick walls. Therefore, this technique is suitable in the detection of features associated with industrial activity. This technique can also be widely used to locate the more subtle magnetic features associated with settlement and funerary remains, such as boundary or enclosure ditches and pits or postholes, which have been gradually infilled with more humic material. The breakdown of organic matter through microbiotic activity leads to the humic material becoming rich in magnetic iron oxides when compared with the subsoil, allowing the features to be identified. Conversely, earthwork or embankment remains can also be identified with magnetometry as a 'negative' feature due to the action in creating the earthwork of upturning the relatively low magnetic subsoil on to the more magnetic topsoil. This technique is classed as a passive technique as it relies on measuring the physical attributes, or the magnetic field, of features that exist in the absence of a measuring device, such as a kiln or ferrous object (Schmidt, 2001, 6).

The main drawback to magnetic surveys is that some non-thermoremnant features, such as stone foundations, or those features with magnetic susceptibility levels similar to those of the background (particularly in areas where the parent material of the topsoil has very low magnetic susceptibility levels) will fail to be seen in the magnetic survey results. Therefore, a complementary or more suitable technique, such as an earth resistance survey, should be considered in addition should the requisites of the project deem this necessary, however for the purpose of this study area, no further geophysical technique is considered suitable due to the alluvial drift and likely ephemeral nature of any likely features.

4.3.2 Survey Equipment

For the purpose of this survey, a Bartington Grad 601-2 dual gradiometer *(figure 4.1*) was used, this instrument comprises of two high stability fluxgate Grad-01-1000 sensors fixed with a 1m separation, data is collected and logged by the onboard DL601 data logger. The range was set to 100nT/m allowing a resolution of 0.03nT/m. The space between the connector junction block and the upper holding bracket was set to 150mm to ensure that each sensor maintained an equal distance from the ground, although this does vary when using more than one operator. Prior to commencement of survey, the gradiometer was balanced twice and again midway through the day over a suitably quiet area of ground that had been checked in scan mode and found to have difference of ≤0.5nT/m.

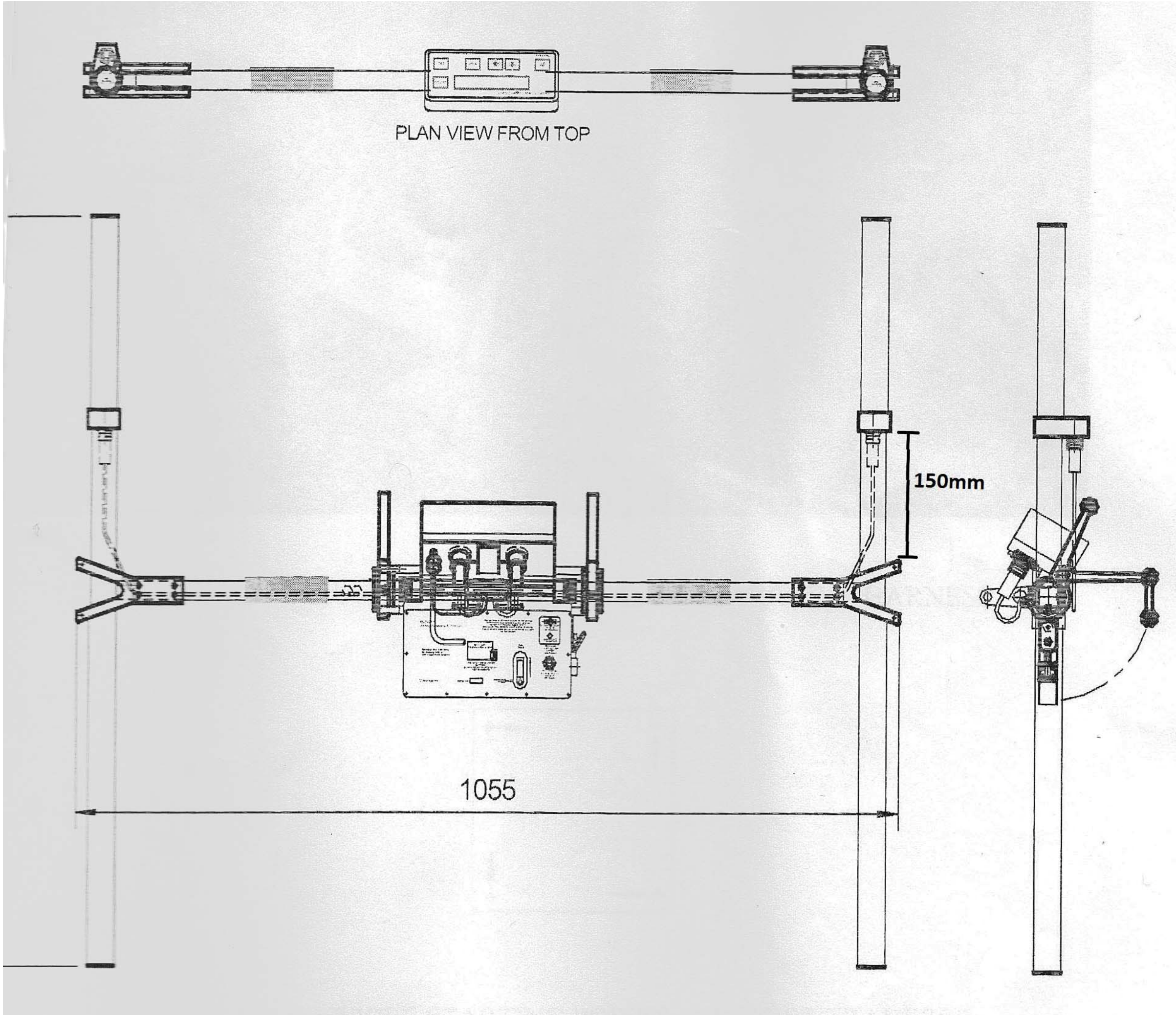

Figure 4.1 Bartington 601 Fluxgate gradiometer (Instrument instruction manual)

4.3.3 Data Processing

Minimal processing of data is desirable, however sometimes it is necessary to make some adjustments to rectify drift and stagger when the instrument operator has gone slightly off course, usually as a result of difficult ground conditions such as long vegetation, uneven ground including rocky outcrops, marshland and heavily ploughed soils. The purpose of processing data is not to hide flaws, processing will not restore inherently flawed data, it is used to enhance images of data to assist in providing a meaningful interpretation (Aspinall *et al*, 2008, 115). The data collected during this study will as standard be subject to the following processing methods:

- **Zero-Mean Traverse**- When collecting data using multi-sensor arrays and/or in a zig-zag traverse pattern as used during this survey, there may be slight base line shifts appearing as stripes in the data, particularly if an inferior set up point has been used as a zero point to balance the instrument. Using the Zero-mean traverse option whilst processing, resets the mean value of each line to zero, reducing the stripe effect. (Aspinall *et al*, 2008, 120).

- **De-stagger**- One of the major and most commonly encountered difficulties carrying out a gradiometer survey is trying to walk in a straight line at a constant speed, particularly over rough terrain, if the operator is unable to keep pace, the data image appears staggered this is extremely noticeable and untidy when a strong feature in visible on the graphics plot. De-stagger allows the processor to effectively move a data string several places to the left or right, bringing it back into line, however this is only effective for data with errors of up to a maximum of one metre, with greater stagger, it can often look messy and results in gaps in the data which has been moved. (Aspinall et al, 2008, 126).
- **Filtering**- There are various ways to filter data, High-pass filter, median filter and low-pass filter can be used, as well as manually selecting the scope of data required on a particular plot or trace, setting a high pass filter may make a graphics plot look impressive and full of archaeological features, however by setting the parameters too high, false features can be created, generally it is considered desirable to keep the data clipped tight which provides a truer interpretation. It is also worth clipping the data to treat negative and positively enhanced features separately, for example, to visualise negatively enhanced magnetic features, the data might be clipped at -3 to +1nT this enhances the visibility of each negative magnetically enhanced feature type , conversely, to bring out the positively magnetic enhanced features, the data might be clipped at -1 to +3nT. (Aspinall et al, 2008, 128-132).
- **Interpolation-** Interpolation can be applied to data once it has been processed to smooth the edges of coarse samples, Interpolation works by calculating additional data to increase the spatial density, for example, 1m to 0.5m traverse spacing. This is a useful tool for making a graphics plot look less pixelated, particularly when used in GIS such as QGIS. (Aspinall et al, 2008, 133-134).

Several software packages are available to process gradiometer survey data, DW Consulting offer Terrasurveyor which is available on license, Snuffler is a freeware package that offers the ability to download data from the unit and limited processing ability, however all data obtained during this survey was processed using Geoplot3 software provided by Geoscan and graphics produced in greyscale. Where archaeology appears to be present, an X-Y plot will be used to assist in interpretation.

4.4 Field walking

Field walking and its contribution to floodplain studies has already been discussed earlier in the review. The typology of finds recovered during an episode of field walking provide much detailed information into the type of activities and the periods of occupation within the study area. Often when the Late Prehistoric period is the focus of investigation, lithics provide evidence of the landscape use. A detailed methodology into macroscopic approaches to lithic analysis is provided by Andrefsky (2005) who discusses lithic analysis including debitage and the reduction processes involved. Andrefsky also discusses the types of raw materials available, how these were manipulated in terms of availability and usefulness and provides a glossary of terms commonly found in lithic based archaeological papers.

Generally in the Mesolithic and Early Neolithic, technological traits of flint working include a wide variety of good-quality raw material from the local area and further afield, evidence of well-prepared cores trimmed platforms and evidence of the production of blades in the form of blade removal scars of the blades themselves. During the Late Neolithic-Early Bronze Age, there was a wider use of mainly local materials of poor quality which is reflected by high quantities of irregular waste. There is occasional use of high quality materials which may came come from considerable distances. There is no evidence of prepared cores during this period (Middleton et-al, 2013, 15-16). This generalisation will be considered when attempting to date lithics recovered during fieldwalking.

The floodplains around the Winckley Lowes mounds are of uncertain antiquity therefore by field-walking the ploughed fields, it is hoped to provide evidence which would suggest if the prehistoric soil horizons are concealed below a substantial depth of alluvial deposit.

Field walking will be undertaken within a week of ploughing. This will allow the freshly turned soils to be observed before being subjected to heavy weathering. The field would be walked using volunteers walking parallel, spaced 2 metres apart to provide complete visual coverage. All finds pre-dating 1500AD including lithics , chert and pottery etc, will be collected and labelled with the co-ordinates mapped using a handheld GPS to Universal Tranverse Mercator (UTM) 30N co-ordinate system. Notes would be made of ground conditions and visibility and any changes of soil types observed and of any finds post-dating 1500AD. The location of finds will then be plotted in a distribution map using QGIS Lisboa.

5 Fieldwork and results

5.1 Brockhall

5.1.1 Introduction

The site at Brockhall was investigated using a gradiometer survey and LiDAR data. These methods have been combined to assess the effectiveness of each method on an alluvial floodplain where there is an oral history of a burial mound which has been included on the Lancashire HER, but there is no hard artefactual or scientific evidence to support the existence of the site. The following sections discuss the results of each method deployed.

5.1.2 Lidar

5.1.2.1 Introduction

LiDAR data was obtained in both DTM jpg and ASCII formats for the Brockhall site, this chapter will compare processed datasets at 1m resolution and discuss if remains of the mound suggested to once have stood on this site can still be identified. The ASCII data was processed following the methodology outlined in chapter4

5.1.2.2 Results

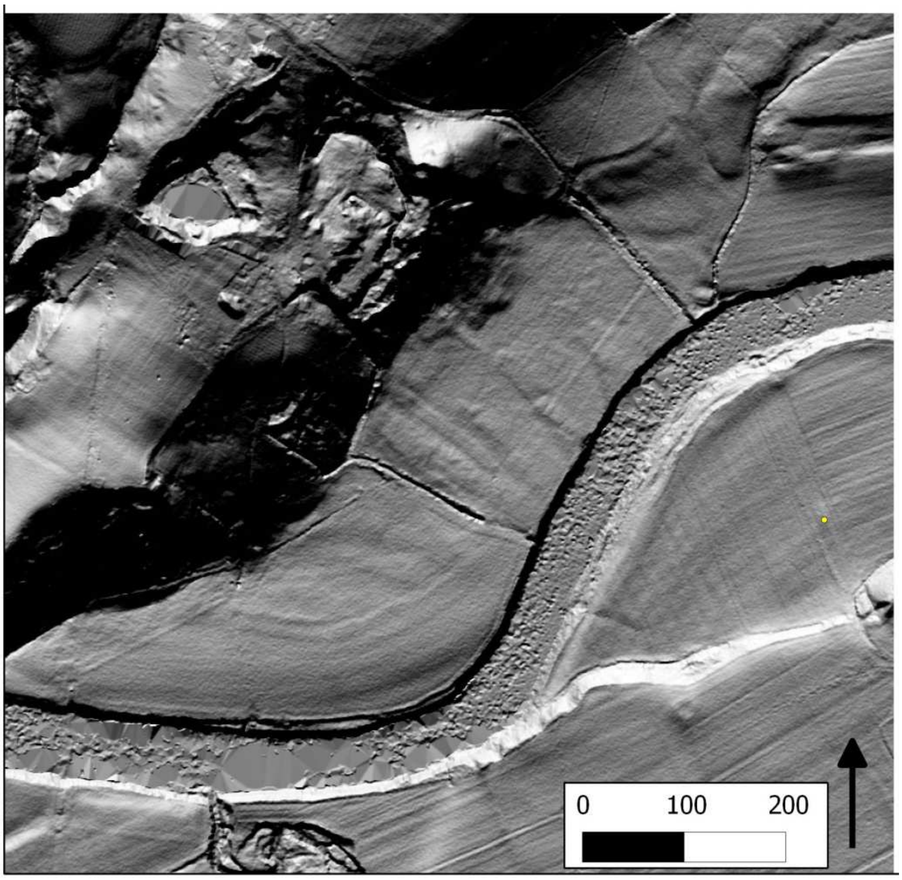

Figure 5.1 LiDAR model showing location of Brockhall mound, identified by yellow dot

Figure 5.1 above shows the Brockhall site, the actual suggested location of the mound according to the HER represented by the small yellow dot. The tile has a vertical exaggeration multiplied by a factor of 5 to enhance to contrast, the azimuth has been set to 350 degrees, and the altitude set to 30 degrees to enhance low relief changes of elevation.

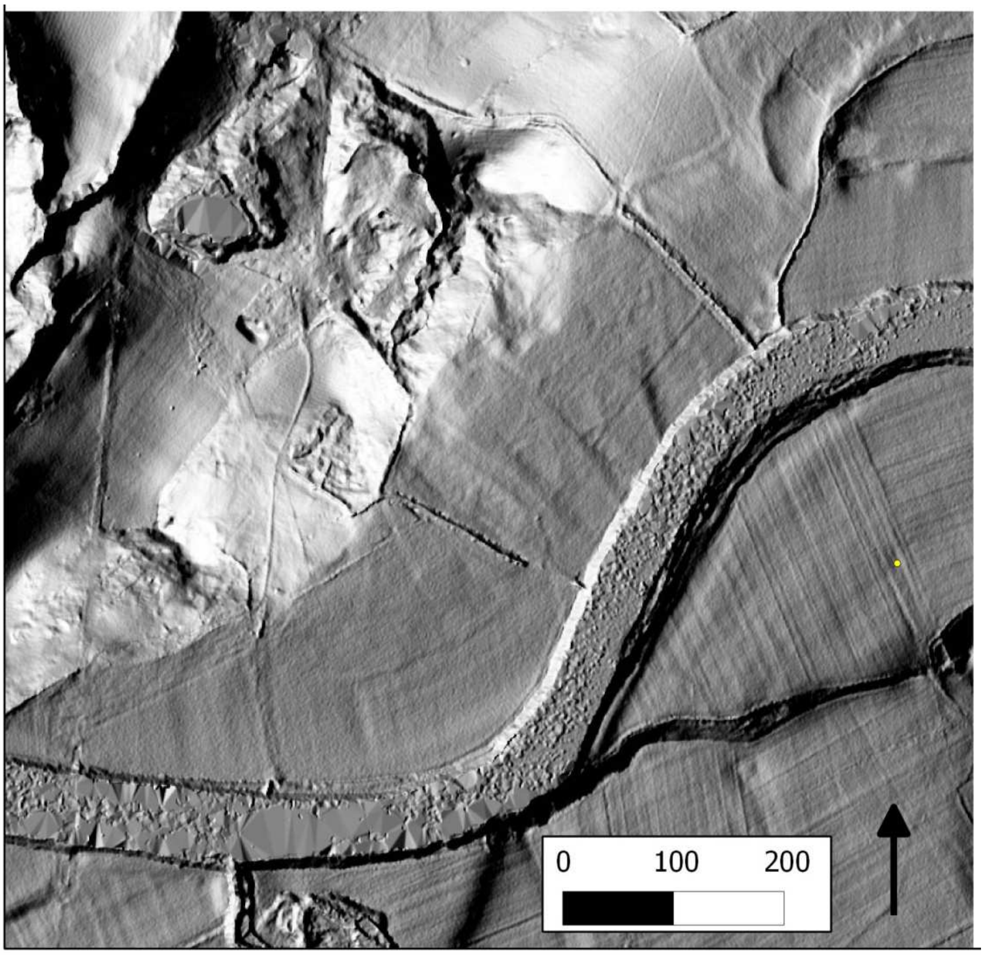

Figure 5.2 LiDAR model of Brockhall floodplain SD 6937

Figure 5.2 above shows the Brockhall site, the actual suggested location of the mound according to the HER represented by the small yellow dot. The tile has a vertical exaggeration multiplied by a factor of 5 to enhance to contrast, the azimuth has been set to 100 degrees, and the altitude set to 30 degrees to enhance low relief changes of elevation. By lowering the azimuth factor to 100 degrees, the DEM now takes on a negative elevation effect, this has enhanced the linear plough lines on the floodplain to the north and west of the mound location.

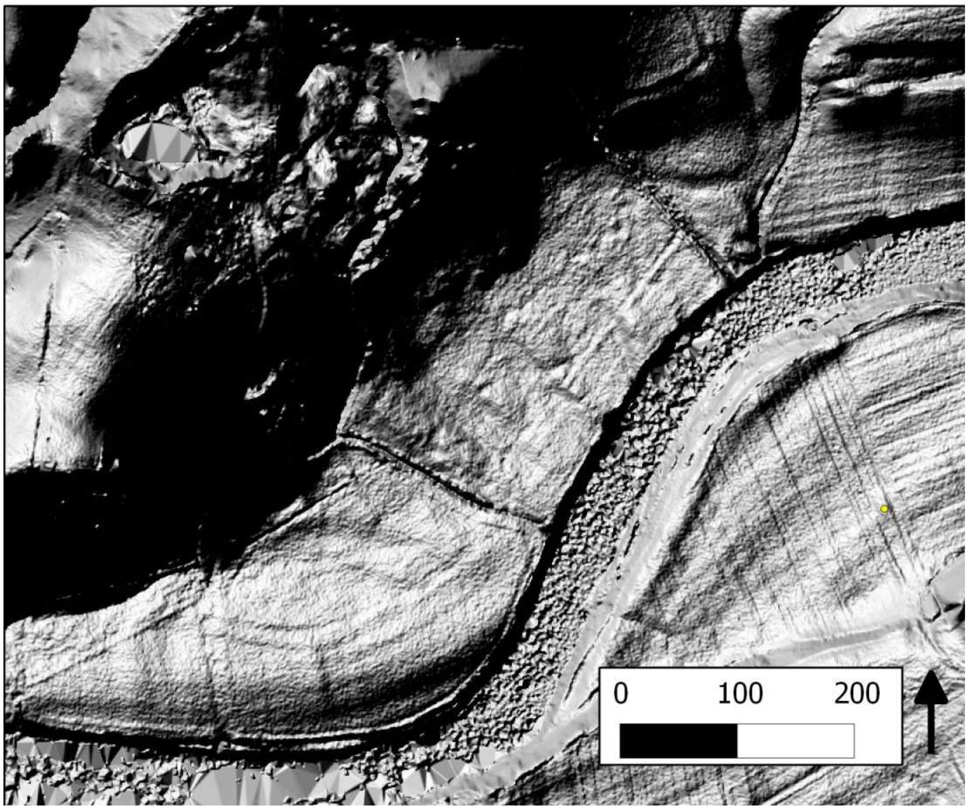

Figure 5.3 Processed LiDAR model SD 6937

This cropped image above (*figure 5.3*) has the vertical exaggeration increased to 26 degrees, the azimuth factor is retained at 315 degrees and the altitude angle set to 45 degrees. This model clearly shows the slight changes in elevation on the river terraces, the mound, again represented by the yellow dot can be seen to sit on the slightly elevated terrace set back from the river.

Figures 5.1-5.3 above have been extracted from a single LiDAR tile, SD6937, to concentrate on the area around the mound. The remainder of the flood plain is included on a separate LiDAR tile, SD7037. Figures 5.4 and 5.5 illustrate the entire floodplain at Brockhall. The annotated figure below (*figure 5.5*) illustrates the edge of the river terrace, farm track and bi-directional plough lines, also indicated is a circular feature which could potentially be the location of the barrow as opposed to the suggested location on the HER

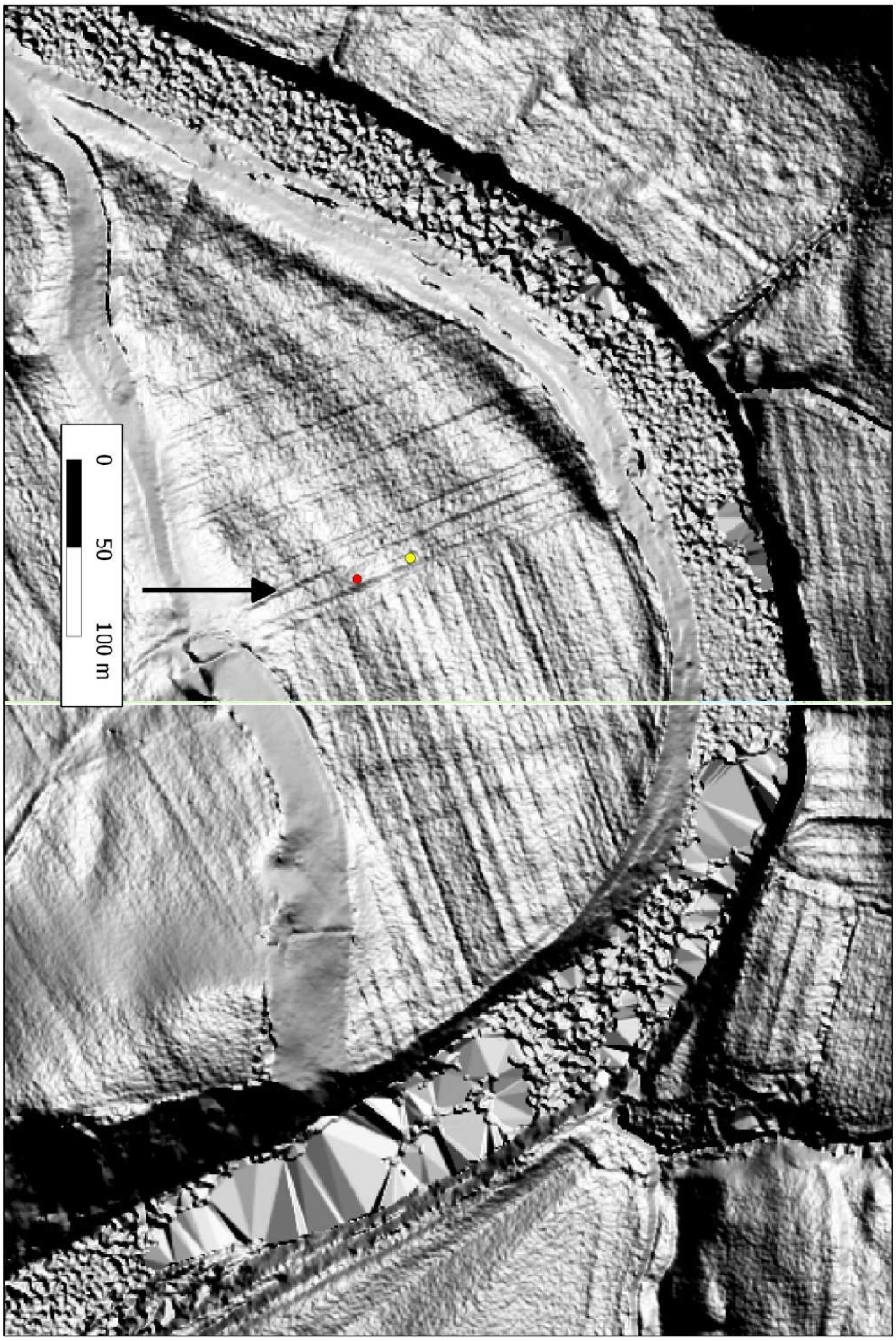

Figure 5.4 Full Lidar Model of the Brockhall floodplain.

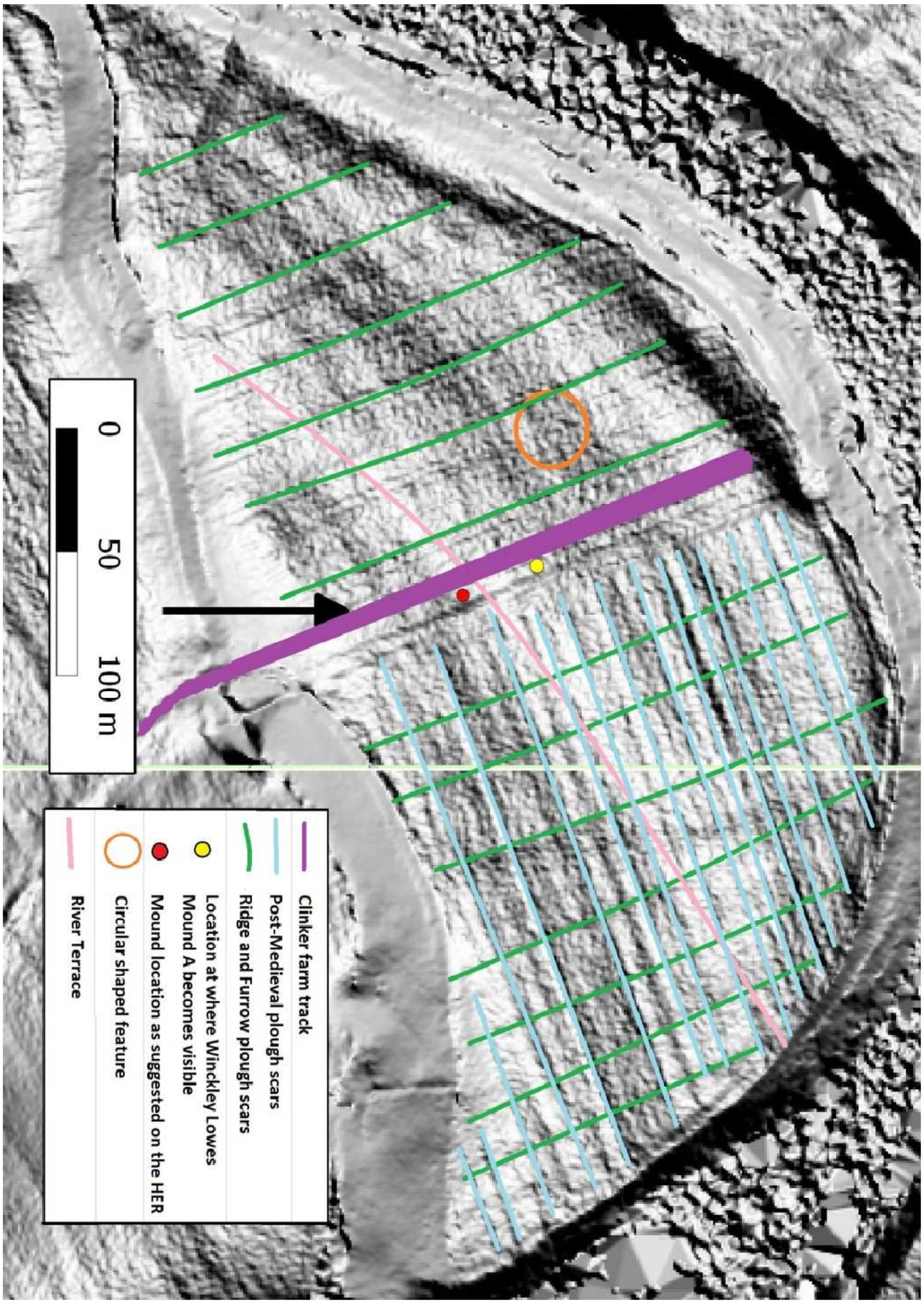

Figure 5.5 Annotated LiDAR model of SD 6937 and SD 7037

5.1.3 Geophysical survey

5.1.3.1 Introduction

A geophysical survey was carried out using a Bartington 601 fluxgate gradiometer. This survey was carried out in line with English Heritage guidelines which suggest that surveys are normally undertaken using gradiometers on a regular grid. English Heritage Guidelines recommend that a high resolution is advisable, the suggested minimum spatial resolution suggested is 0.25m along lines with a traverse spacing of 1m or less (0.25m × 1m) (Shmidt, 2007, 6).

A total of nine grids, each measuring 30m x 30m were centred on the Ordnance survey co-ordinate where the mound was suggested to have stood on the HER (SD 369930 437500).

The purpose of carrying out a gradiometer survey on this location was threefold:

- to identify any artificial negative or positive features associated with a mound,
- to locate any natural features such as a palaeochannel or river terrace that might have influenced human inhabitation or the construction of an artificial mound, should the latter be no longer evident in the survey result
- and finally to identify any areas of ferrous deposit which might remain as suggested in the HER which mentioned rusty swords which disappeared to dust upon exposure to air, the imprint of a ferrous object or objects would result in a spike in the data.

The site was surveyed during the last week of December 2012, conditions for any sort of survey work were unfortunately, far from ideal, the ground was saturated in places, grid number 4 was completely under approximately 0.1m of standing water which was also partially covering grids 1, 2 and 5 to a lesser depth. There was a very slight visible rise in the ground where the mound was suggested to have been, this area was slightly drier and can be seen on the Lidar tiles illustrated above, (*figures 5.3 to 5.5*).

The results of the gradiometer survey will be detailed below.

5.1.3.2 Results

Figure 5.6 Location map of the gradiometer surey at Brockhall

figure 5.6 above illustrates the location of the surveyed are on the floodplain. The red circle indicates the location of the mound as suggested on the HER

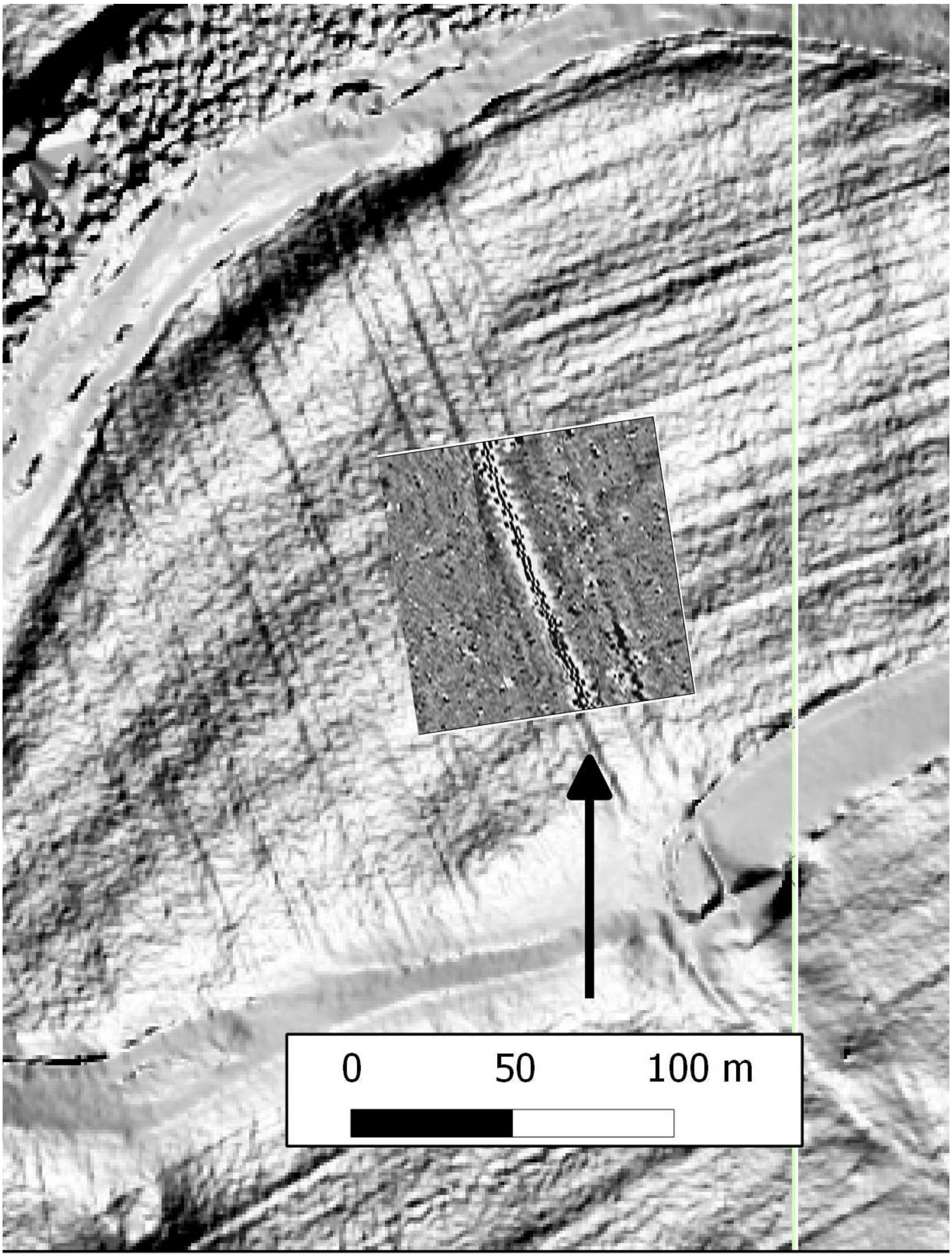

Figure 5.7 Gradiometer survey overlaid onto the LiDAR model of Brockhall

The illustration above (*figure 5.7*) shows the gradiometer data layered over the Lidar tile to compare both sets of results.

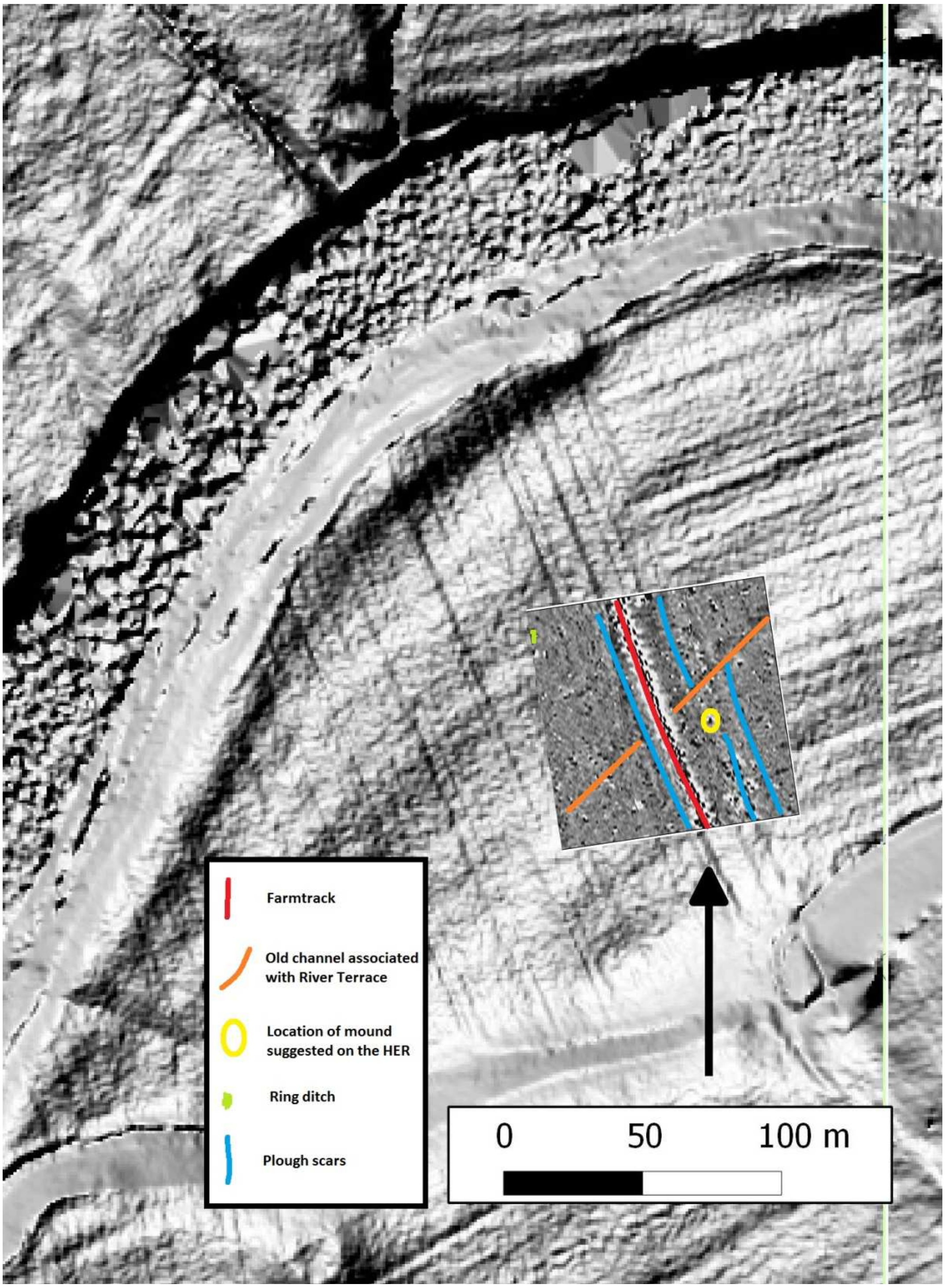

Figure 5.8 Interpretation of Brockhall Gradiometer survey

This annotated figure 5.8 illustrates the geophysical anomalies following processing of the data. The linear dipolar response with a north-south orientation is a modern farm track, clearly comprised of highly magnetic material, possibly clinker, the reason for this feature appearing staggered top centre is due to the depth of standing water making it difficult to survey. A slight raise in the ground as seen on the Lidar data is also evident on the gradiometer survey, illustrated by the blue/red line running from the south-west to the north-east corners, this is likely to be the edge of an old river terrace.

There are a number of linear banks and ditches which appear to be indicative of ridge and furrow ploughing, apart from these features, the only possible prehistoric archaeology here is represented by the curvilinear banks and ditches in the north-west corner of the survey and a possible bank or earthwork/mound where the ploughed out barrow was meant to be.

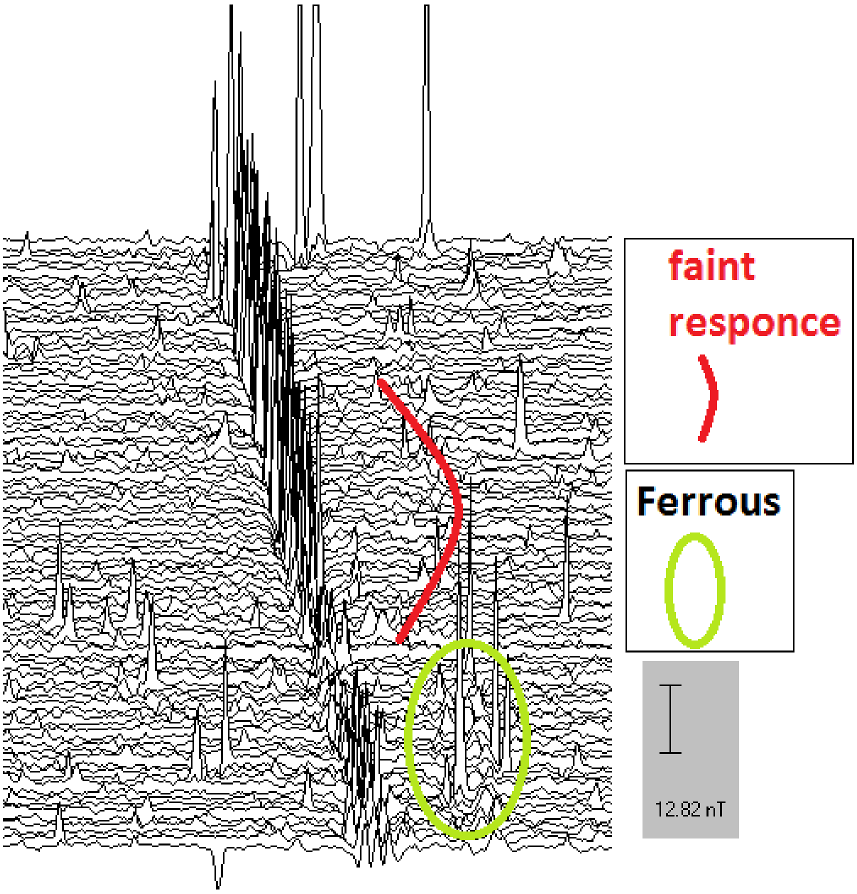

Figure 5.9 X-Y plot of Brockhall gradiometer survey with interpretation

The X-Y plot illustrated above (*figure 5.9*) has been processed to a resolution of 0.1, this brings out the slightest anomalies, the track way is clearly seen through the centre, however there appears to be two areas of interest showing to the right of the track way, an area of ferrous material and a rough curvi-linear response which also has traces of ferrous material.


North
West
South
East

Figure 5.10 Panoramic photograph of the entire landscape as seen from the suggested mound location on the Brockhall floodplain

The River Ribble approaches the floodplain from the east, travelling around the floodplain to the north in a westerly direction towards the Irish Sea. The panoramic photograph above (*figure 5.10*) is taken from the location of the mound, the metalled track as seen on the geophysics can be seen running from the western edge of the scarp to the south towards the river in the north. There is a natural crossing point in the river to the east of Brockhall which may well have been used throughout prehistory, connecting the Brockhall site with the Winckley Lowe site. The land between the sites is predominately alluvial floodplain which would likely have remained free of vegetation based on the observation that floodplains tend to be free from dense tree cover during modern times.

5.1.4 Discussion

There is no obvious mound remaining visible on this floodplain, however a small area measuring approximately 20m x 20m was clearly slightly higher than the surrounding area. This area was drier than the surroundings and would not have been noticeable had the conditions not been so wet. This raised area matched the suggested mound location on the HER when surveyed using a handheld GPS unit. This slight elevation is also noticeable, albeit slight on the LiDAR.

LiDAR identifies the raised area where the mound once stood and the edge of the older river terrace, if the suggested mound co-ordinates are correct, the mound would have been located on this river terrace. The gradiometer survey also enhances the edge of the river terrace but as with the LiDAR, fails to positively identify a mound, although the slight bank showing as a negative enhancement might be indicative of a small cairn .A small circular feature is visible on the LiDAR (*figure 5.5*)

Clearly the LiDAR data shows how the floodplain has been heavily ploughed in the past, although this is not dateable, it is likely to be a mixture of medieval ridge and furrow crossed by modern ploughing at right angles. Ridge and furrow ploughing is visible in many fields throughout the Ribble Valley. It is likely that any remains of a mound here will have been destroyed though this agricultural activity.

The ferrous response on the X-Y plot is possibly indicative of the remant iron objects recovered whilst destroying the mound in 1836, if so this would date the mound to the Iron Age (800BC-43AD) at the earliest, however the literature suggesting that one of the mounds in this area had been used to inter a local chief following a battle in 798AD,(section 3.3).

Although the fieldwork has failed to provide conclusive proof that the mound or barrow once stood on this flood plain, the river terrace, natural river crossing place and the nearby Winckley Lowes suggest that it is plausible that there was once a mound there, but not necessarily of the same antiquity of Winckley Lowes.

Further fieldwork would need to be carried out by digging some evaluation trenches to determine the period and conclusive evidence of a mound, in particular targeting the circular anomaly identified on the LiDAR. Unfortunately at the time of writing, the landowner was not keen on any excavation taking place.

5.2 Winckley Lowes

5.2.1 Introduction

The flood plain at Winckley Lowes contains two extant mounds, Mound A and Mound B (*figures 5.13 and 5.14*), the depth of alluvial deposits here is unknown, therefore the initial method employed here was field walking. The resulting assemblage amassed during field walking will be used to provide evidence which could consequently be utilised to suggest if the prehistoric land horizon was below the plough soil as a pre-cursor to the effectiveness of other methods. In order to compliment the field walking data, a series of gradiometer surveys were carried out both ploughed arable and pasture within the floodplain boundary, LiDAR data was also acquired to investigate any remnant earthworks in the area.

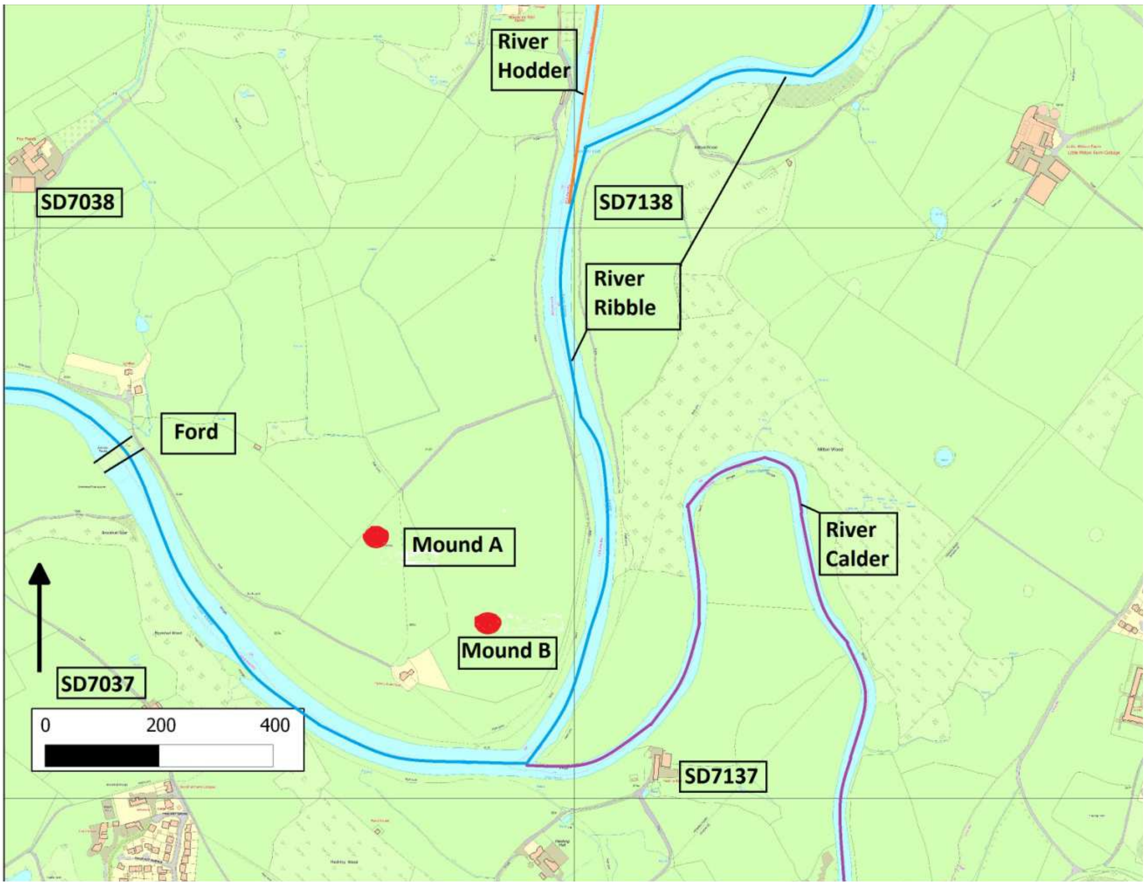

Figure 5.11 Location map showing Mounds A and B and the rivers Calder and Hodder with meet the Ribble on the floodplain

Figure 5.12 Photographs of Mounds A and B showing signs of damage at the summits

5.2.2 LiDAR

5.2.2.1 Introduction

LiDAR data was obtained in both DTM jpg and ASCII formats for the Winckley Lowes site, this chapter will compare processed datasets at 1m resolution and discuss if remains of any earthworks or palaeochannels on this site can still be identified. The ASCII data was processed following the methodology outlined in chapter 4.

5.2.2.2 Results

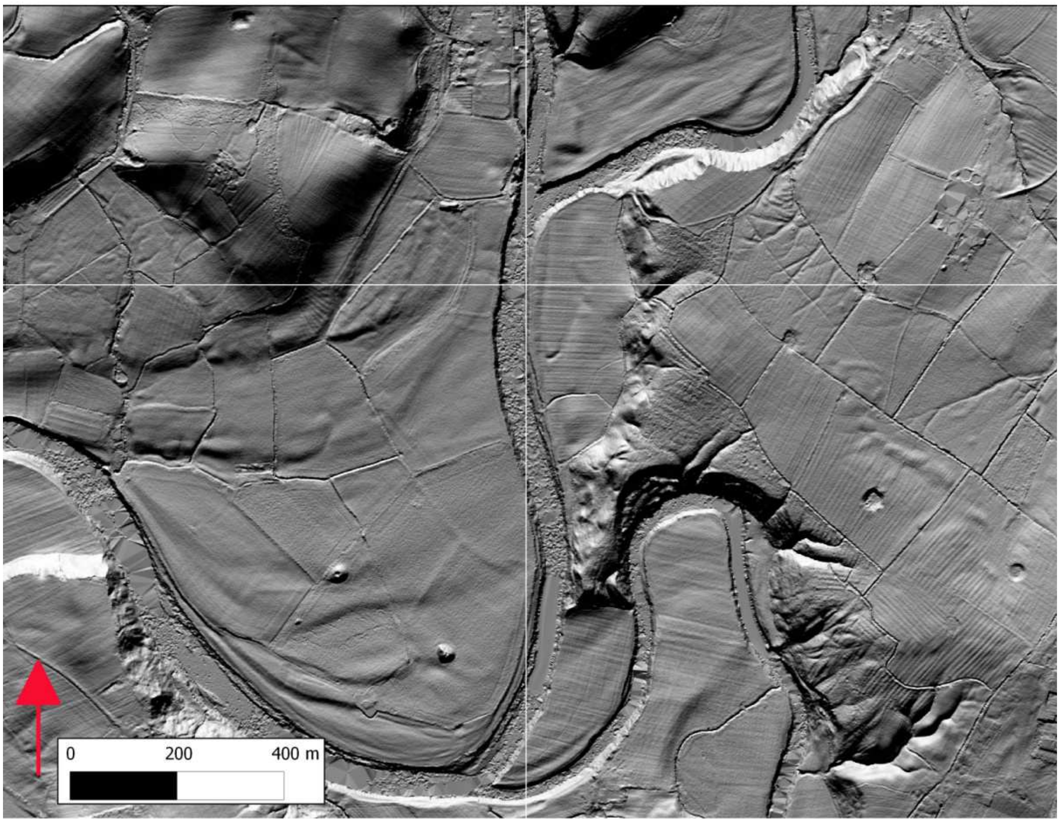

Figure 5.13 Lidar model covering the floodplains of the rivers Ribble, Hodder and Calder at Winckley Lowes

Figure 5.13 above illustrates the processed LiDAR data covering the entire floodplain at Winckley Lowes (SD7037 centred) and the surrounding area. The extant mounds are clearly visible in the bottom left, also visible are palaeochannels, river terraces and ridge and furrow ploughing (see figure 5.14 below). This data has been processed to show a vertical exaggeration multiplied by a factor of 5 to enhance to contrast, the azimuth has been set to 350 degrees, and the altitude set to 30 degrees to enhance low relief changes of elevation. The next illustration has been exaggerated to enhance slight features, the vertical exaggeration increased to 26 degrees, the azimuth factor is retained at 315 degrees and the altitude angle set to 45 degrees.

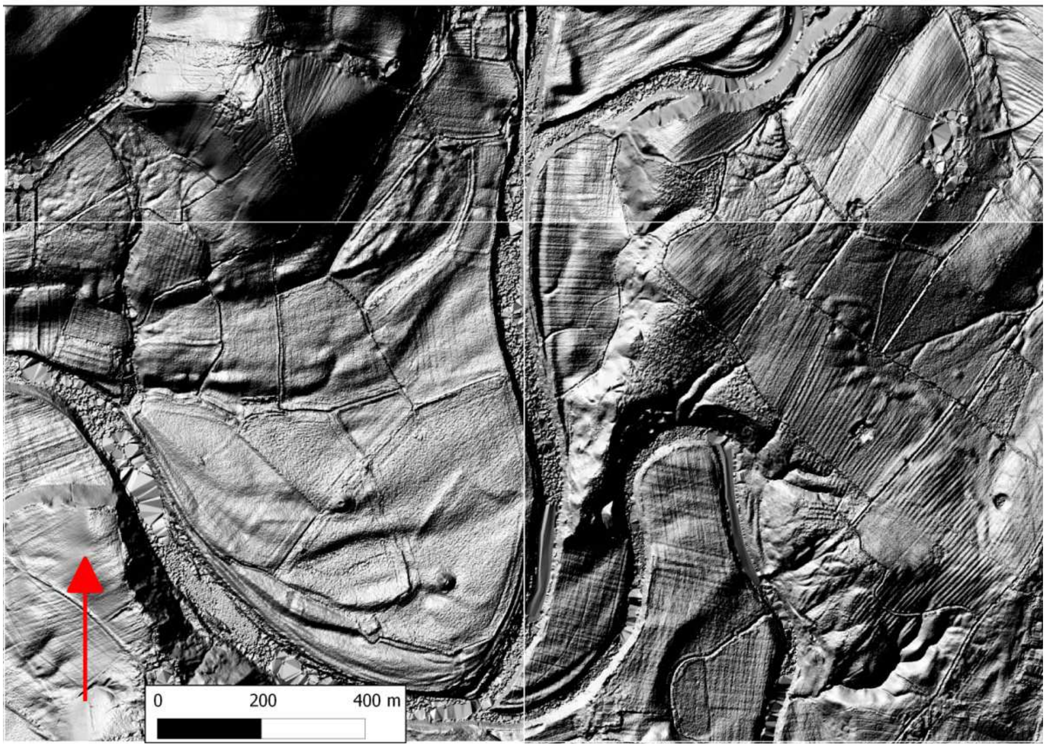

Figure 5.14 Exaggerated LiDAR model of the Winckley Lowes floodplains as interpreted in figure 5.16

This exaggerated model (*figure 5.14*) clearly shows all of the features depicted in figure 5.13 but fails to identify any extra features that could not be seen in the previous figure.

An interpretation of the LiDAR image is provided on figures 5.15 and 5.16 below.

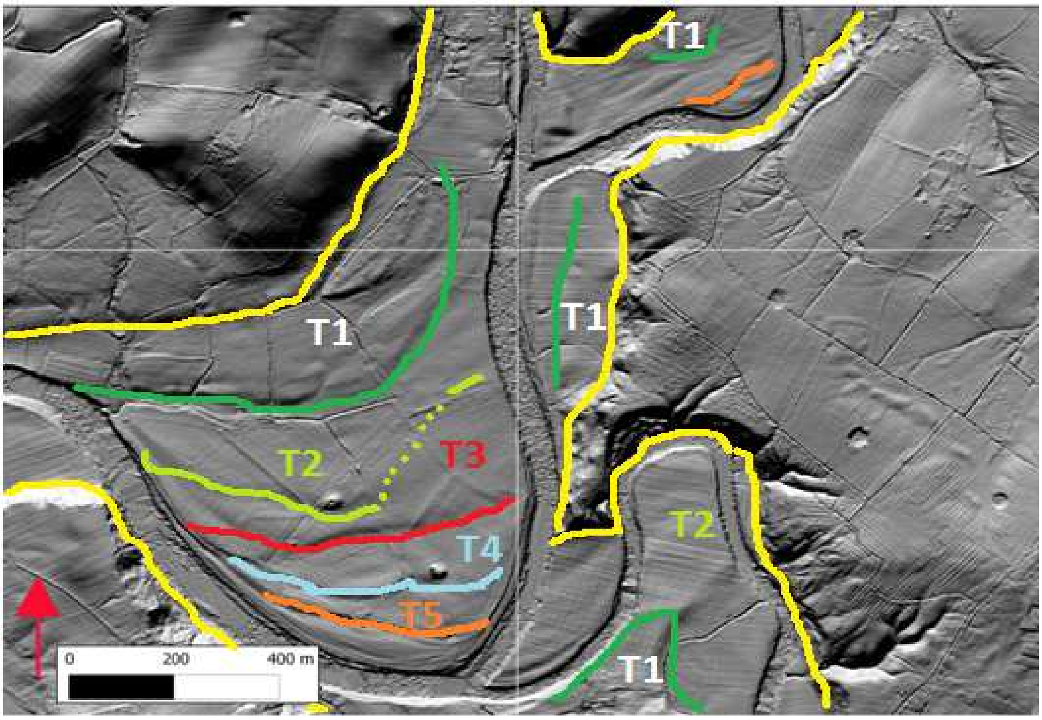

Figure 5.15 Suggested interpretation of the LiDAR showing the river terraces at Winckley Lowes

The River terraces are interpreted on figure above, T1 being the oldest terrace progressing to T5 being the youngest terrace, The mouth of the River Calder is difficult to interpret using LiDAR alone, being a much narrower inlet than the main Ribble flood-plain, further work would need to carried out to identify river terraces here. Coring would be a good technique, this would allow vertical samples to be compared at various sample points. It worth noting that the field boundary identified in figure 5.16 below, which is no longer visible to the naked eye, only appears to extend as far as the boundary limit of terrace 3 and 4 (*figure 5.15*), this could suggest that the feature was contemporary with mound A. The terrace limit between terraces 2 and 3 is less clearly defined, especially on the eastern edge. Mound B is situated on a much younger terrace than mound A suggesting that this mound was constructed at a later date.

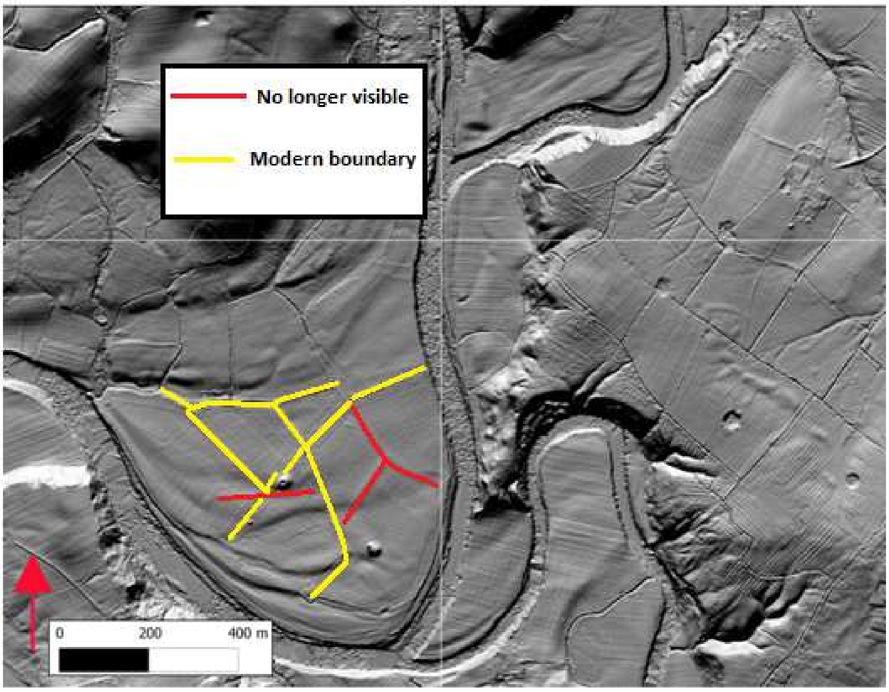

Figure 5.16 Field boundaries revealed on the LiDAR model

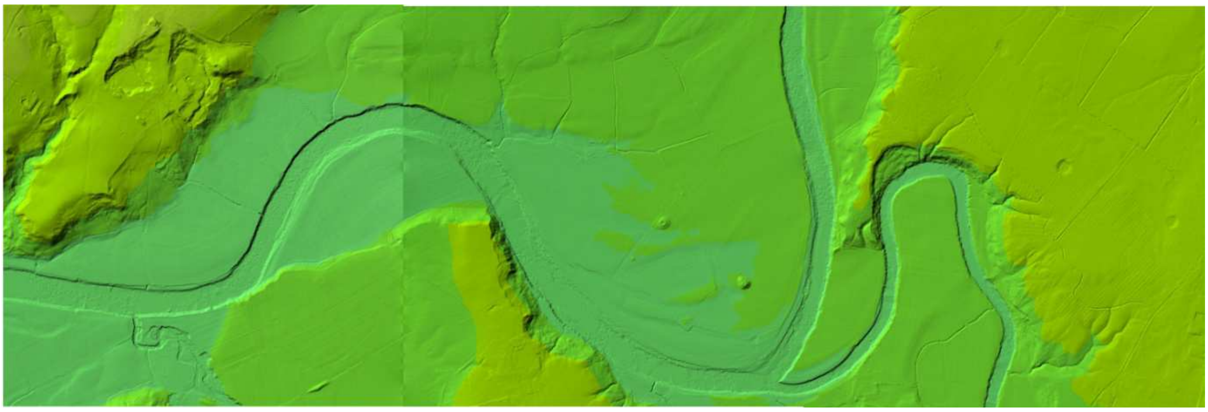

Figure 5.17 LiDAR imagery obtained in processed JPG format (Geomatics group, 2012-2013)

This LiDAR tile (*figure 5.17),* obtained in JPG format suggests that both mounds appear to be on the slightly elevated edge of the floodplains, overlooking the lower terraces, the lower lying land to the west of the mounds appears to contradict the terrace sequence as suggested earlier in figure 5.15. However this might be accounted for by the mouth of the River Calder, which appears to be in alignment with the lower terraces shown here, eroding the terrace and creating a truncated floodplain.

To enable an interpretation of the wider landscape, six LiDAR tiles have been processed and stitched together, this data has been processed to show a vertical exaggeration multiplied by a factor of 5 to enhance to contrast, the azimuth has been set to 350 degrees, and the altitude set to 45 degrees to enhance low relief changes of elevation. tiles SD6737, SD7037, SD7038, SD7038, SD7138 and SD7236 are illustrated in figure 5.18.The two extant mounds at Winckley Lowes are clearly visible, a third possible earthwork of similar circumference, but lower is also visible, this would appear to line up with the Winckley Lowes monuments and on a wider scale, the rest of the Calder Valley. Clay extraction pits can be seen on the higher ground overlooking the river.

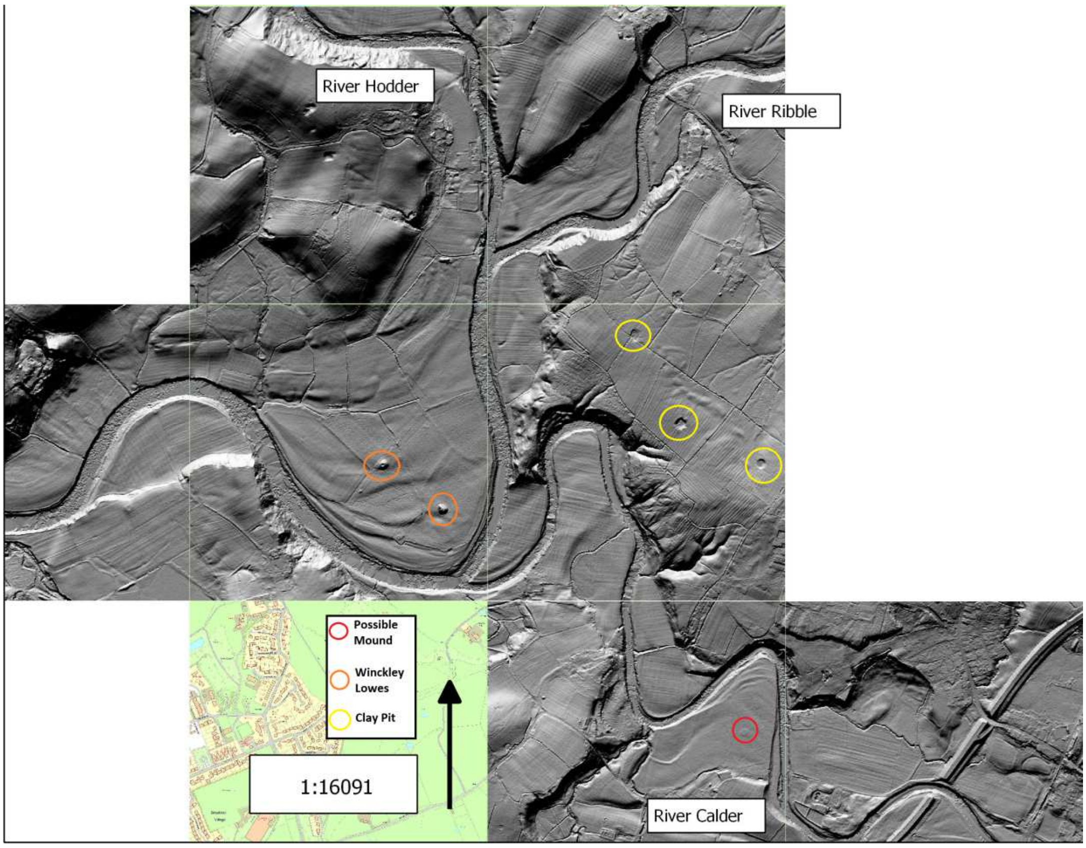

Figure 5.18 LiDAR coverage on a larger scale showing the two mounds at Winckley Lowes and a putative mound on the banks of the River Calder

5.2.2.3 Discussion

LiDAR is clearly a very useful tool for large scale non-invasive archaeological prospection on alluvial floodplains amongst other landscapes. River terraces are identifiable as are several other slight earthwork features such as the possible mound on the inside bend of the River Calder near the rivers mouth with the Ribble. Linear earthworks such as field boundaries and palaeochannels have also become evident including the field boundary or land demarcation earthwork which is no longer visible to the naked eye (*figure 5.16*). The topography of the mounds as modelled on the LiDAR suggests that both mounds are probably Bronze Age round barrows although Mound A has been misshapen, probably due to antiquarian investigation and secondary usage as a lime kiln.

5.2.3 Geophysical Survey

5.2.3.1 Introduction

A geophysical survey was carried out using a Bartington 601 fluxgate gradiometer. This survey was carried out in line with English Heritage guidelines which suggest that surveys are normally undertaken using gradiometers on a regular grid. English Heritage Guidelines recommend that a high resolution is advisable, the suggested minimum spatial resolution suggested is 0.25m along lines with a traverse spacing of 1m or less (0.25m × 1m) (Shmidt, 2007, 6).

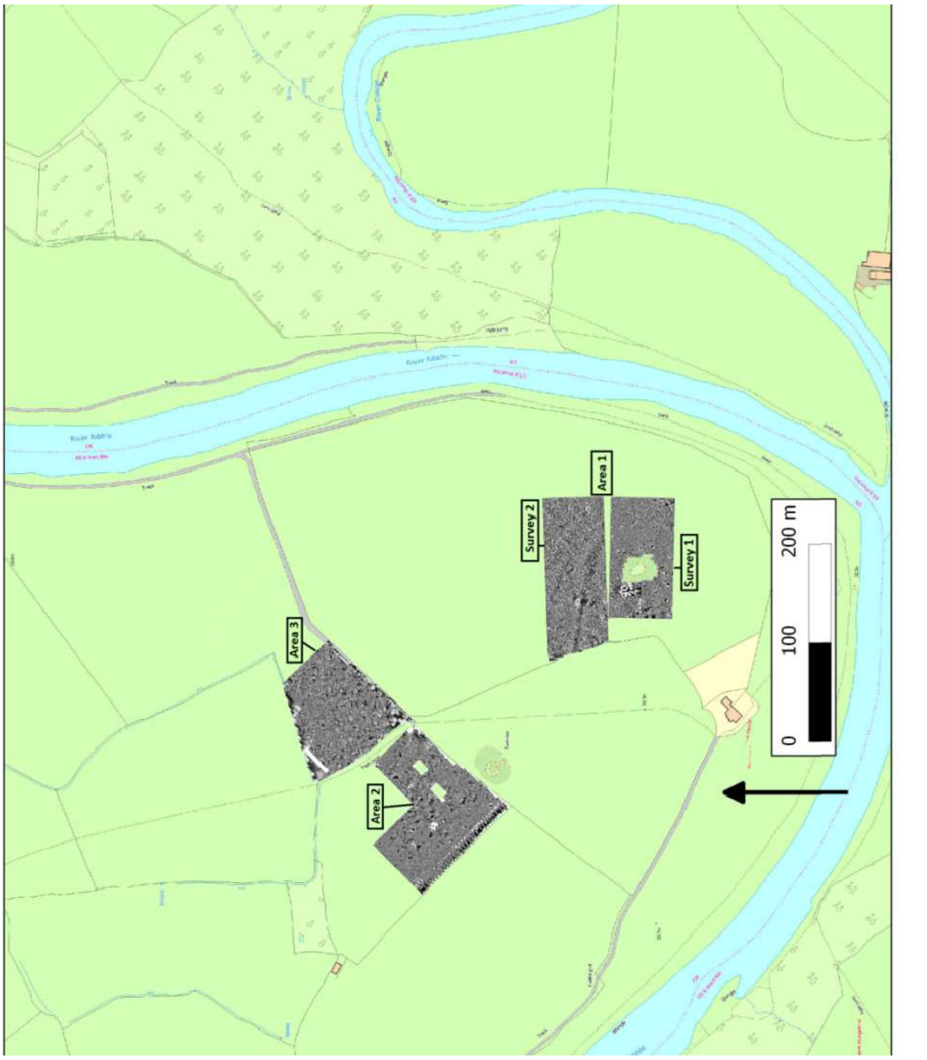

Figure 5.19 Composite showing gradiometer survey at Winkley Lowes

Three separate areas were surveyed on this site (*figure 5.19*), 18 grids were surveyed around Mound B (area 1), 16 grids to the north of mound A (area 2) and 18 grids on site 3 to the east of Mound A (area 3).

The purpose of carrying out a gradiometer survey on this location was as follows:

- To locate a ditch surrounding mound B
- To locate any remnant ditches, post holes, pits or areas of burning on areas 1,2 and 3.
- To locate and identify any geographical features such as river terraces and palaeochannels that might have been used by past inhabitants.
- To compare results from a ploughed area (sites 1 and 2) against an area used for pasture (site 3).

Area 1 was surveyed during March 2012, ground conditions were fair, the soil had been undisturbed since the harvest the previous year, approximately 5% of the survey area was thick waterlogged mud but on the whole, generally easy going and favourable survey conditions.

Area 2 was surveyed during March 2013, the ground had laid undisturbed since the harvest the previous October and was fairly well drained, the weather had been reasonably dry and surveying conditions were good. This site had originally been planned for survey during November 2012 but the volume of mud on this ploughed field at the time made this impossible.

Area 3 was surveyed during November 2012 following a fairly dry spell, the ground was fairly well drained on this field which was used for pasture in contrast to the adjoining ploughed field (site 2).

5.2.3.2 Results

5.2.3.2.1 Area 1

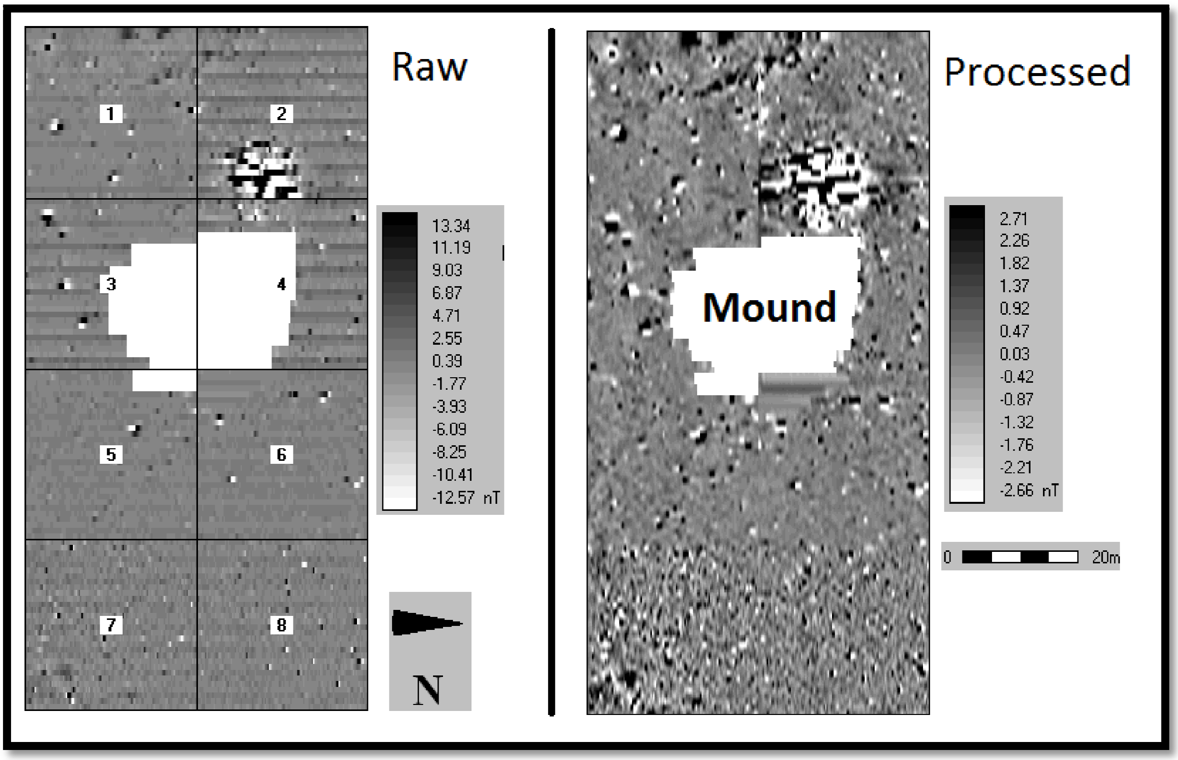

Figure 5.20 Raw and processed gradiometer survey, Area 1 survey 1

Area 1 was surveyed over a period of two days, each survey has been processed separately on two different composites due to the fact that they are not in true alignment. Figure 5.20 above illustrates the initial gradiometer survey, comprising of eight grids which actually included a section of the mound as part of the grid traverse (*figure 5.20*). This data has been clipped to -3nT to +3nT, this was found to produce the clearest graphics plot for this survey. An interpretation of these results is provided in figure 5.21 below. Grids 7 and 8 were surveyed by a different operator, this resulted in the tubes being considerably closer to the ground, this is why the graphics plot in these grids appear to be more mottled, at first glance this looks like bad data when in fact, the closer proximity to the ground is probably a truer representation of the alluvial deposit.

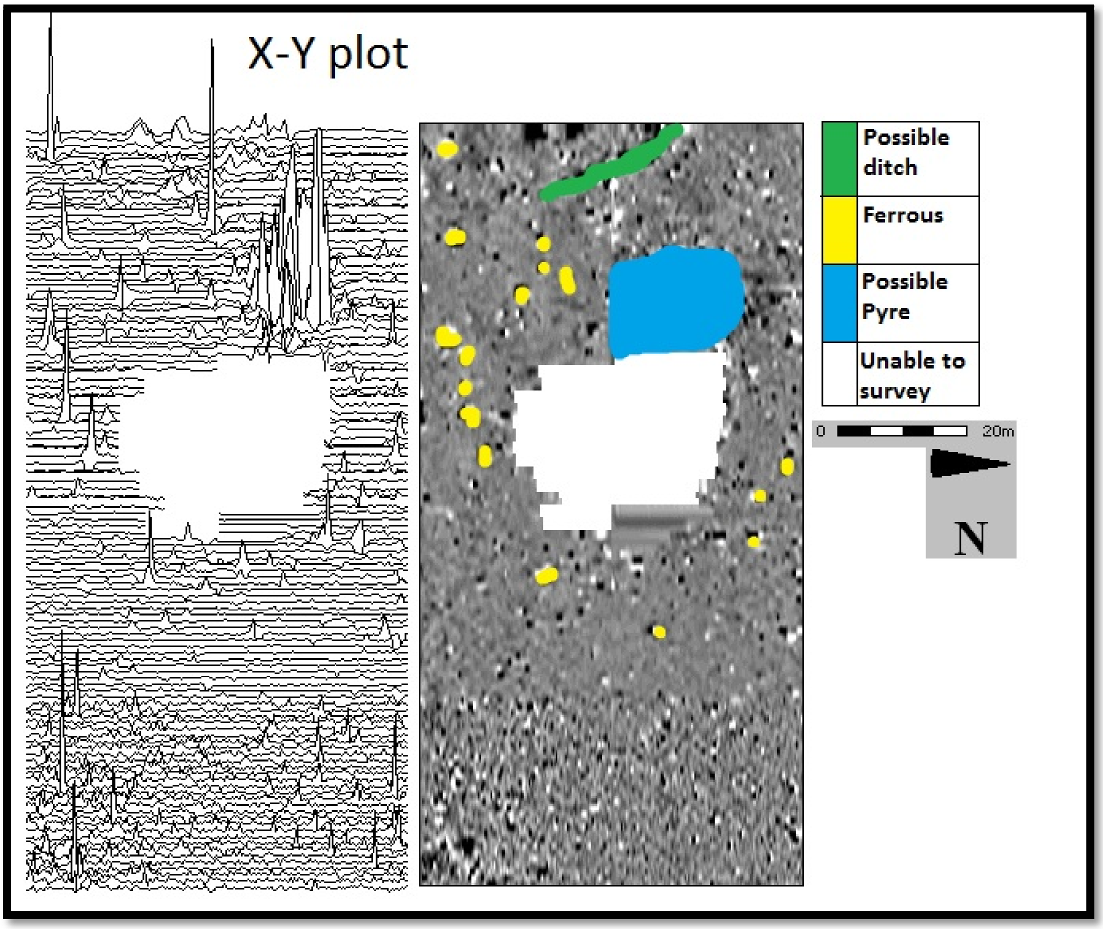

Figure 5.21 X- plot and interpretation of features identified within Area 1 survey 1

There appears to be a scatter of ferrous objects in the vicinity of the mound, the strongest of these dipolar responses have been highlighted in yellow and appear to be concentrated to the south of the mound. The green linear to the west of the mound probably represents a ditch and bank, this is typical of parallel negative and positively enhanced soils. The absence of a positive, magnetically enhanced curvilinear surrounding the mound suggests that this monument never had a contemporary ditch, however the area annotated as blue in figure 5.21 might represent a funery pyre where the polarity of the soils have been reset to north as an effect of high heat. To enable interpretation, the X-Y plot has been included (*figure 5.21), the* features annotated on figure 5.21 can clearly be seen on this plot which has been processed to a resolution of 0.2.

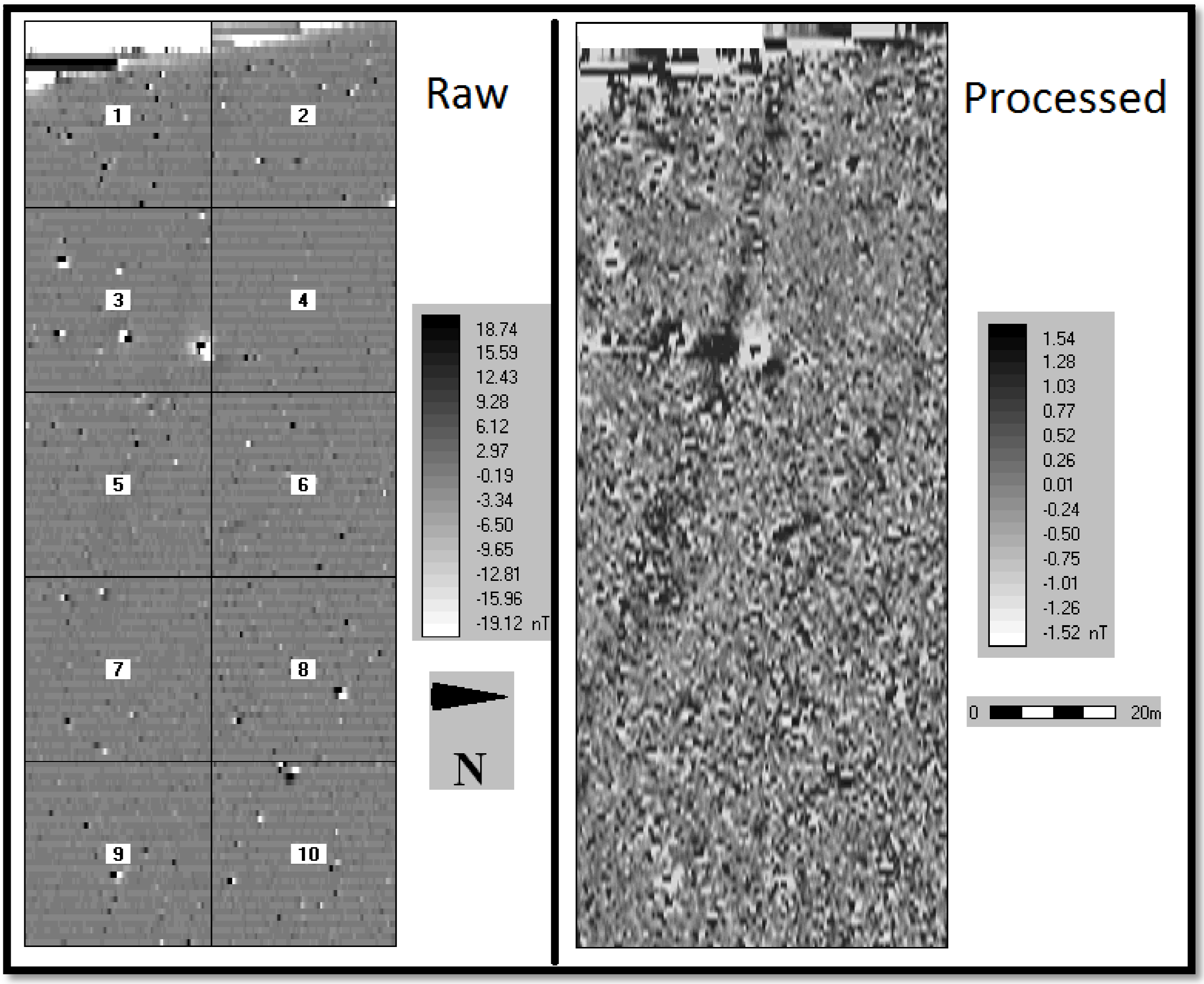

Figure 5.22 Raw and processed gradiometer survey, Area 1 survey 2

The data obtained from the second survey of area 1 is illustrated on the Raw and processed greyscale plot in figure 5.22 above, the large burnt area interpreted on the first survey (*figure 5.20*) resulted in that data to be clipped to 0 ± 3nT before any features could be observed, the data from this survey was considerably narrower in range enabling this data to be clipped at -1 to +1nT.

An interpretation of this survey is offered in figure 5.22 below. There appears to be several ditches, some of which have accompanying banks, the largest feature here is a possible large ditch or palaeochannel running from the western edge in an easterly direction before turning south between grids 7 and 9, there is no evidence to suggest that this feature continues into the area surveyed during the first half of the survey (*figure 5.21*). Although the large ditch or palaeochannel appears as a strong response on the greyscale plot, the X-Y plot suggests that it is fairly discrete suggesting that this is a shallow negative feature or a palaeochannel. Two possible pits laying either side of the linear appear to contain ferrous material.

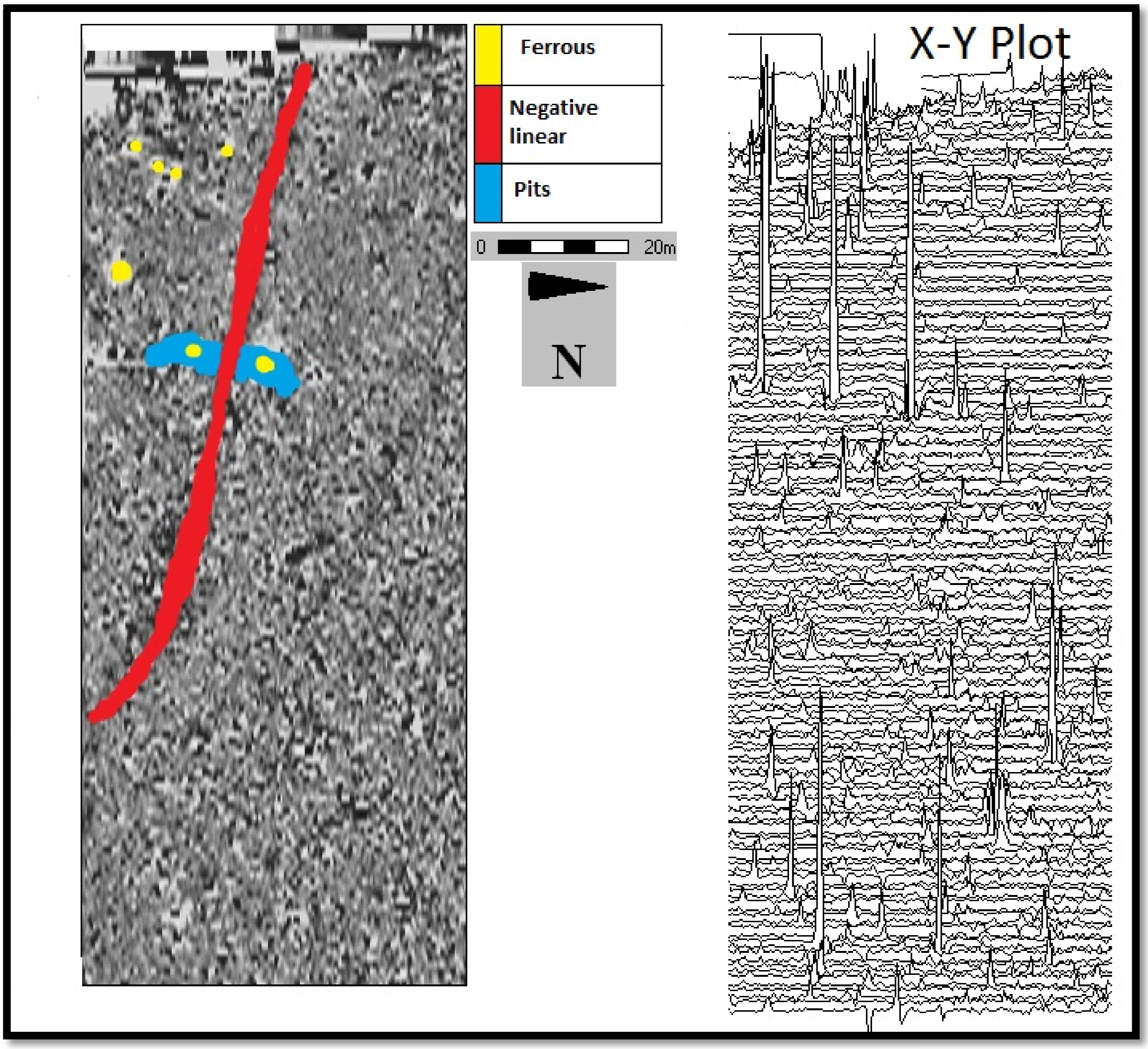

Figure 5.23 X-Y plot and interpretation on the features identified within the survey of Area 1 survey 2

5.2.3.2.2 Area 2

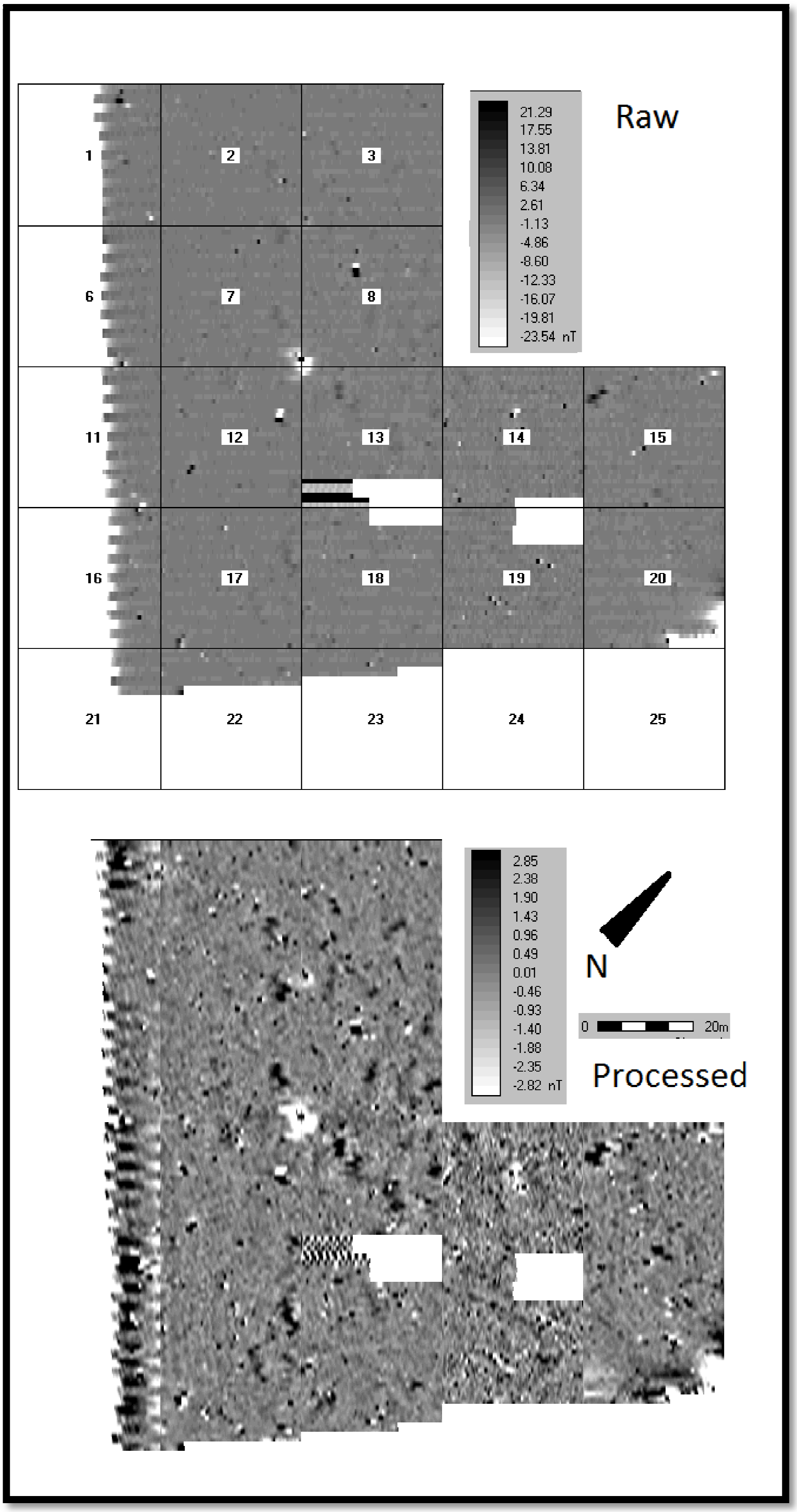

Figure 5.24 Raw and processed gradiometer survey from Area 2

The raw data and greyscale plot after processing is illustrated on figure 5.24 above, the data was clipped from -3 to +3nT.

An interpretation of this data is offered in figure 5.25 below, the X-Y plot is shown at a resolution of 0.2. This area was surveyed by three different people, grids 1-13, 16-18, 21-23, 15 and 20 were surveyed by people of similar heights whilst grids 14 and 19 were surveyed by a shorter person meaning the tubes were closer to the ground, this is likely to be why the data is these areas appears to be of greater contrast.

The interpretation (*figure 5.25*) shows that this area has a fairly high concentration of archaeological features, this area is very close to Mound A and therefore the concentration of archaeological features would arguably be denser than the surrounding areas. There is an alignment of five large postholes or pits through Grids 2,7,12 and 17 annotated as red marks on the plot, these postholes or pits are mirrored in Grids 3 and 8 by a further three features of similar size, it is feasible that there was some sort of rectangular structure here. Grid 19 contains circular ditch and bank features, these are possibly ring ditches which extends as a linear ditch through Grid 18.

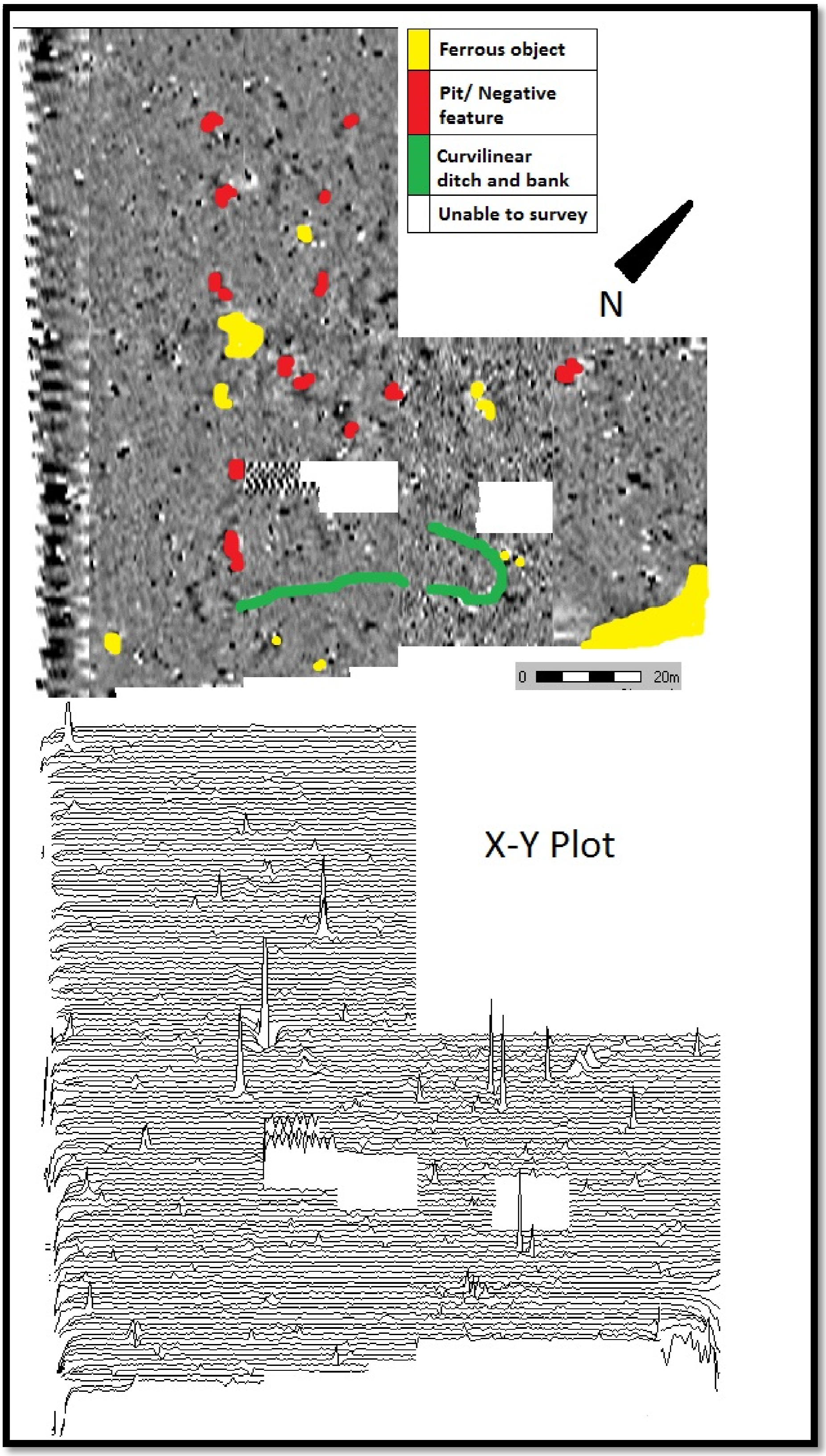

Figure 5.25 X-Y plot and interpretation of the features identified during the gradiometer survey of Area 2

5.2.3.2.3 Area 3

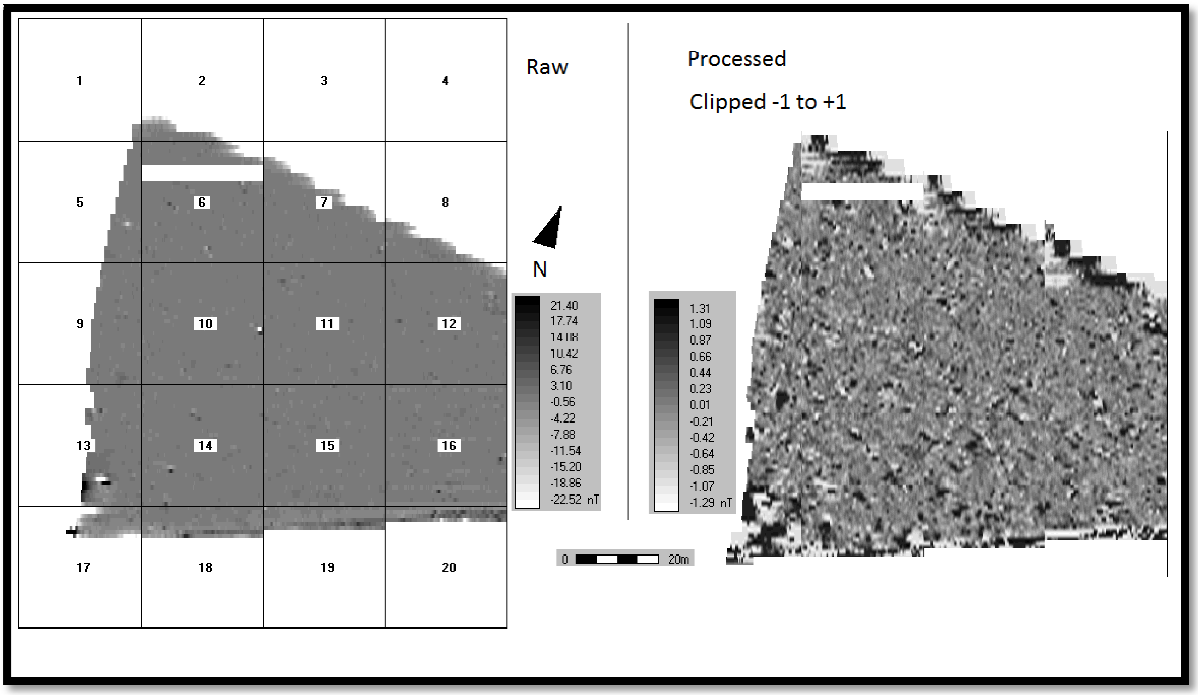

Figure 5.26 Raw and Processed data from the gradiometer survey of Area 3

The raw and processed greyscale graphics plots for area 3 are illustrated in figure 5.26 above, the processed data has been clipped to -1 to +1nT. An interpretation of this plot aided by an X-Y plot at 0.1 resolution is offered in figure 5.27 below. Area 3 was devoid of any responses that could be convincingly archaeological.

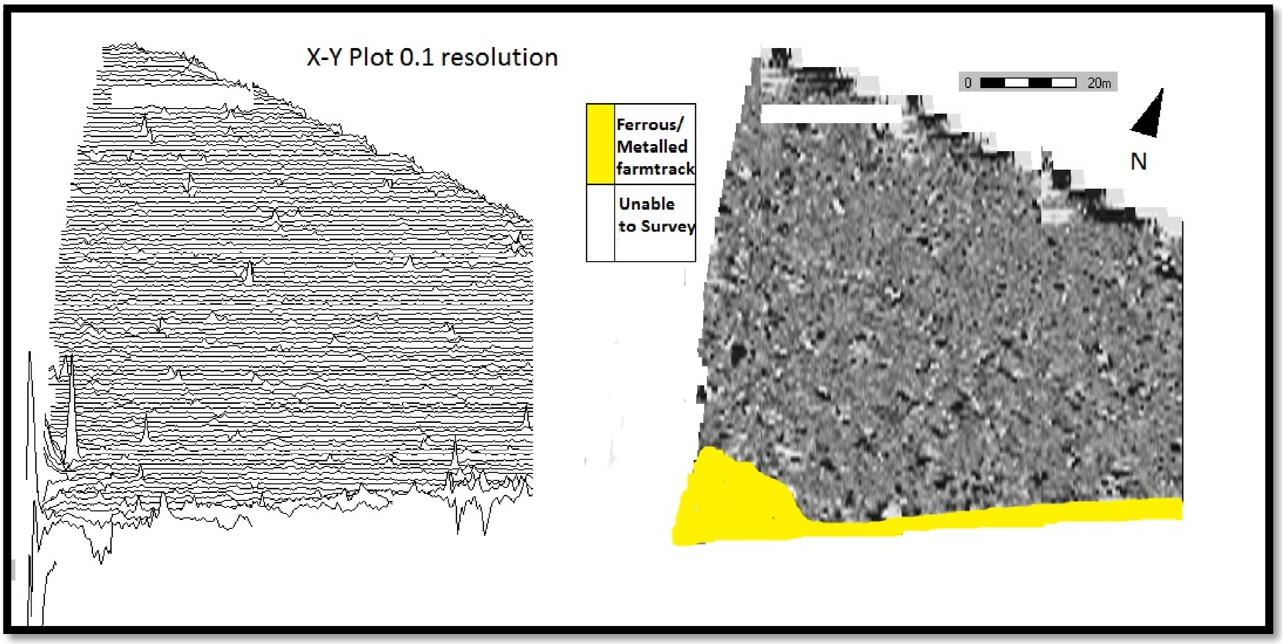

Figure 5.27 X-Y plot and interpretation of data obtained during gradiometer survey of Area 3

5.2.3.3 Discussion

Several features have become evident on Areas 1 and 2, these areas were surveyed by people of differing heights, the results of which suggest that alluvial soils are best surveyed with the gradiometer closer to the ground. A possible funery pyre is suggested as laying beneath Mound B in Area 1 with a linear earthwork or palaeochannel running west to east along the northern edge of the mound. The two pits containing ferrous material could potentially be Iron Age but more likely to be later, possibly contemporary with the Early Medieval battle. Area 2 yielded a particularly high number of possible features which is no surprise considering the close proximity to Mound A. The rectangular arrangement of six large postholes to the north of Mound A are likely to be the footprint of a structure.

5.3 Field-walking

5.3.1 Introduction

Figure 5.28 below represents the ploughed fields where field walking was possible, this entire area, measuring approximately 18 hectares was walked during May 2012 using a mixture of students and volunteers from the local area.

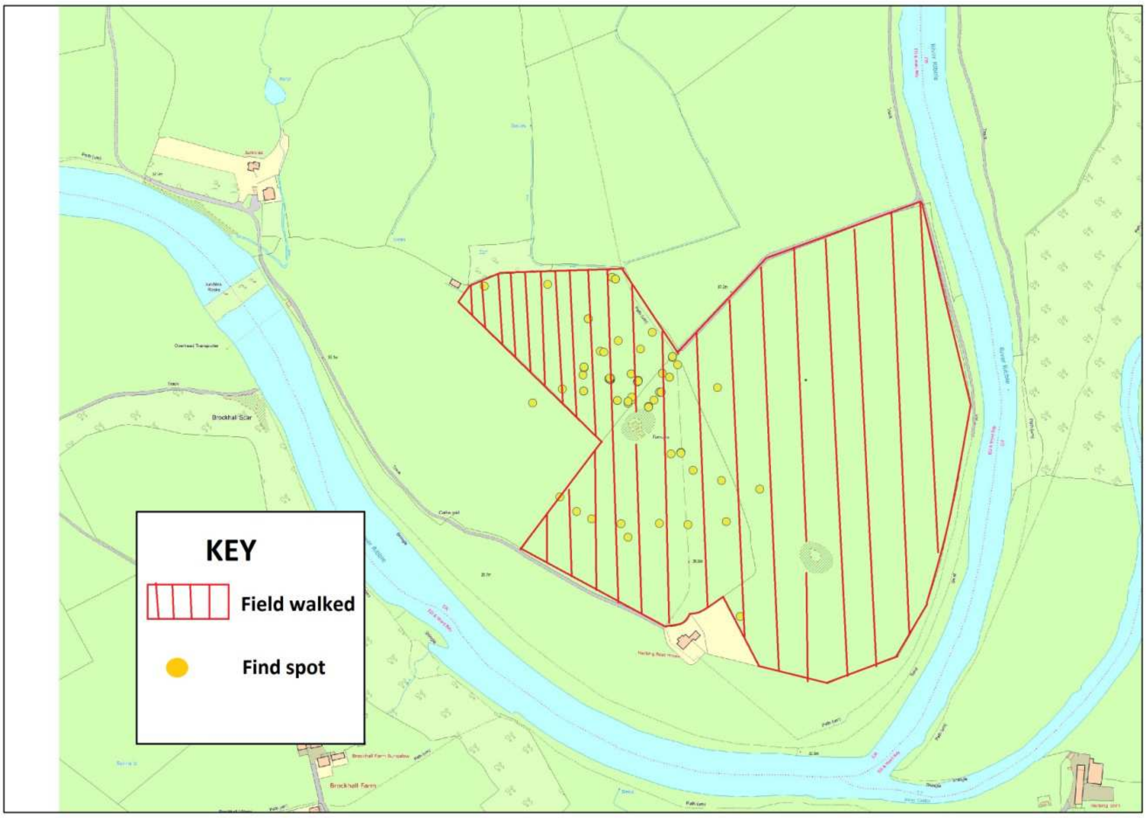

Figure 5.28 Area field-walked

The results from the field walking will be presented in this chapter using a series of distribution maps and pie charts. A total of 81 finds were recovered equating to 4.55 finds per hectare, which could be dated to prehistory, these have been split into broad typologies to analyse the proportions of flint and chert, the states of reduction and use of tool.

5.3.2 Results

The types of knapped flint are represented below in figures 5.29 and 5.30.

Type	Total
Debitage	62
Flake/Blade	15
Flake core	1
Core	4
Scraper	1

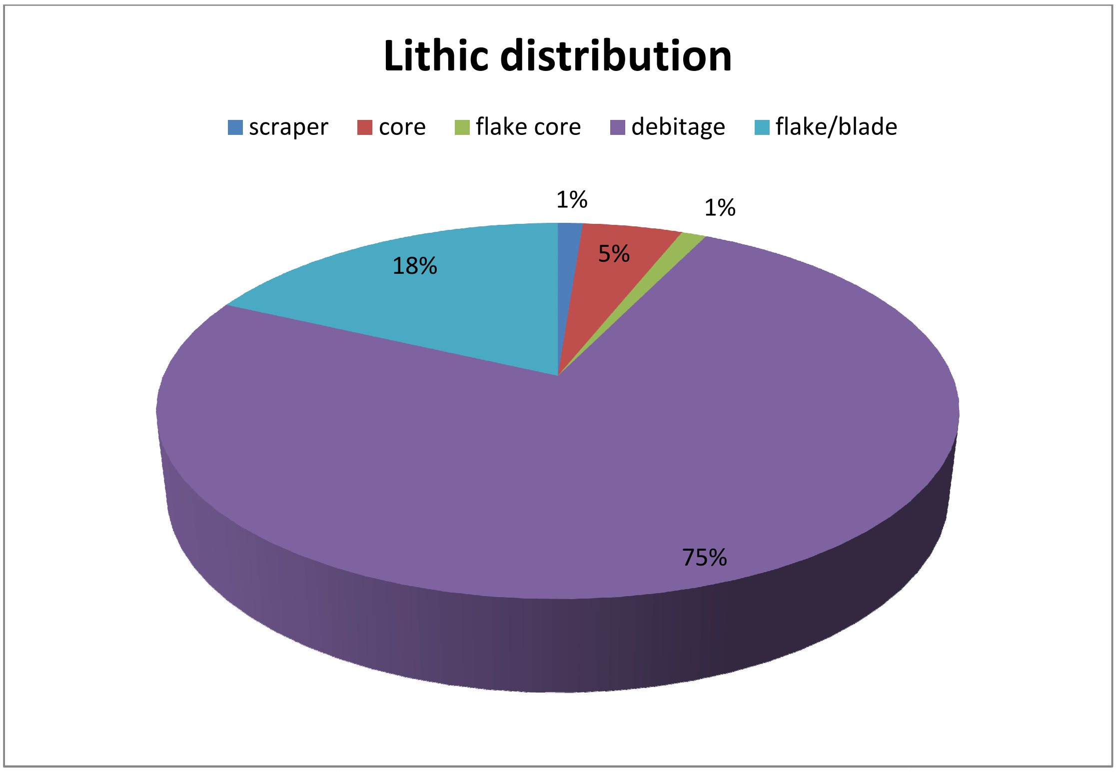

Figure 5.29 Pie chart illustrating the lithic distribution by type

Although not intended to be an exact science in terms lithic technology, a broad interpretation based on how the lithic item could serve a useful purpose or as a by-product resulting from the working of a stone tool is presented here. The pie chart (*figure 5.29*) demonstrates that three quarters of the assemblage was debitage whilst the remaining quarter comprised of tools or cores. A full list of lithics with metrics are presented in Appendix 1.

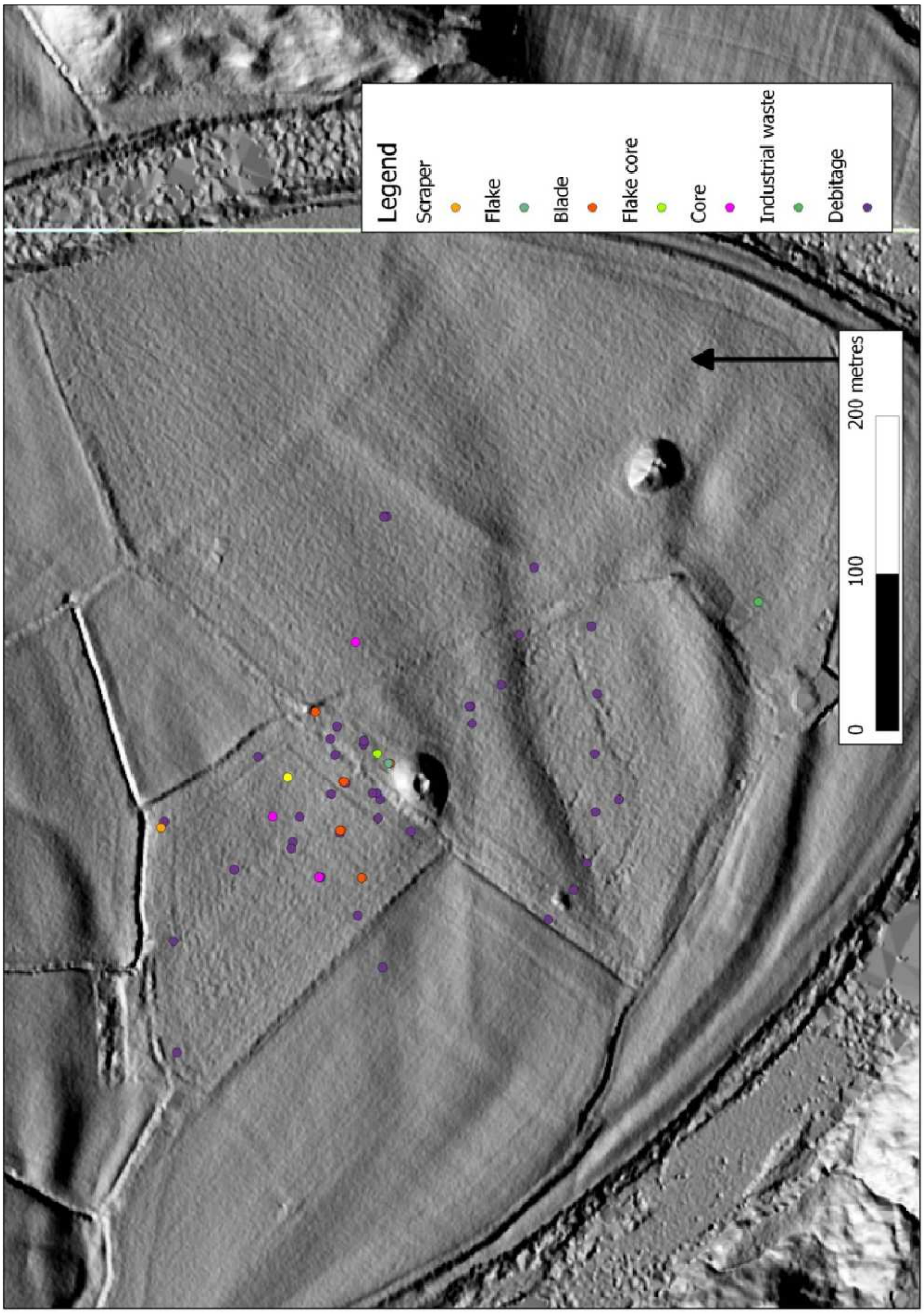

Figure 5.30 LiDAR map of Winckley Lowes showing distribution of Lithics by type

The distribution map figure 5.30 illustrates how the assemblage is concentrated around Mound A and primarily on river terrace T2. A single piece of industrial glass production debris was recovered from terrace T5 which had rounded edges, evidence of river transportation.

The reduction stage of the assemblage was divided up into primary, secondary and tertiary. The table and pie chart in figure 5.31 illustrate that 41% of the assemblage belonged to the secondary stage whilst the tertiary stage accounted for 48%. Primary reduction stage was represented by 7% with the remaining 4% hard to determine as consisting of poor quality chert.

Reduction Stage	Total
Primary	6
Secondary	33
Tertiary	39
Undeterminable	3

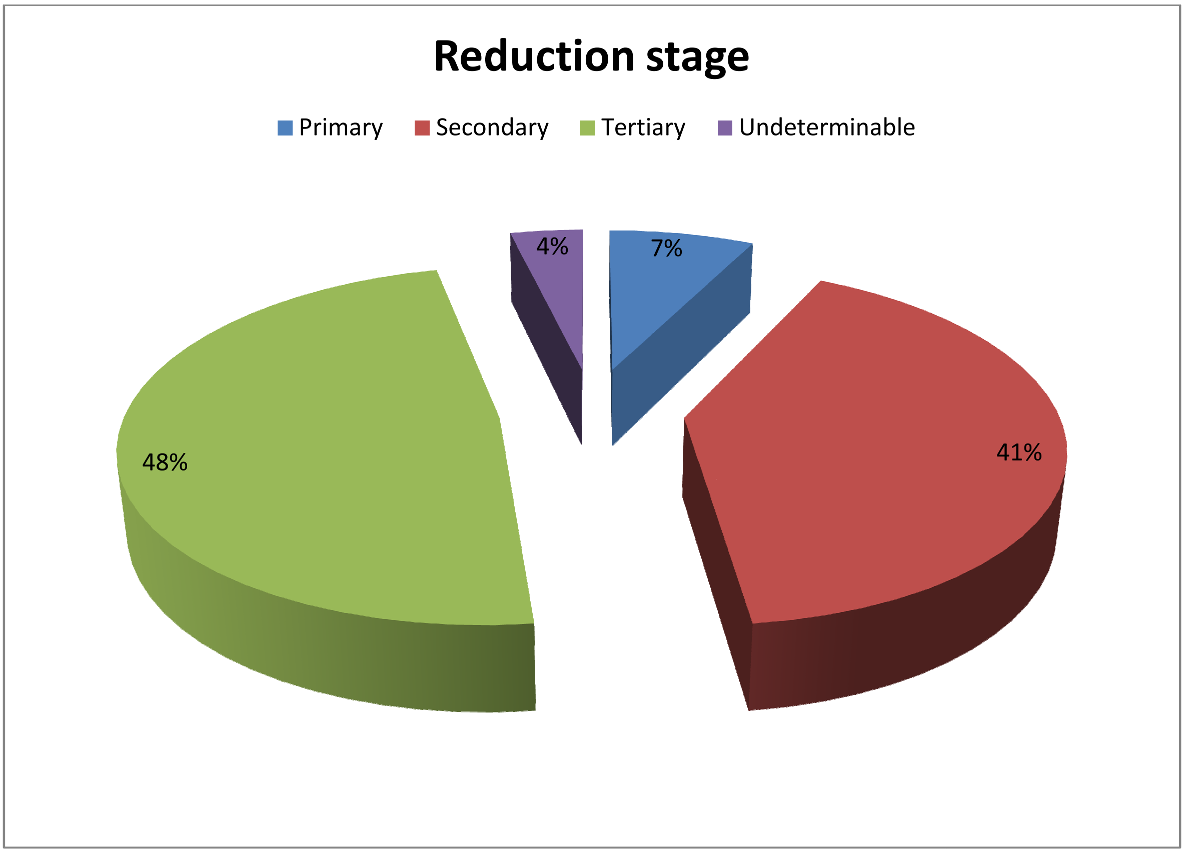

Figure 5.31 Pie chart illustrating the percentage of lithics at the reduction stage

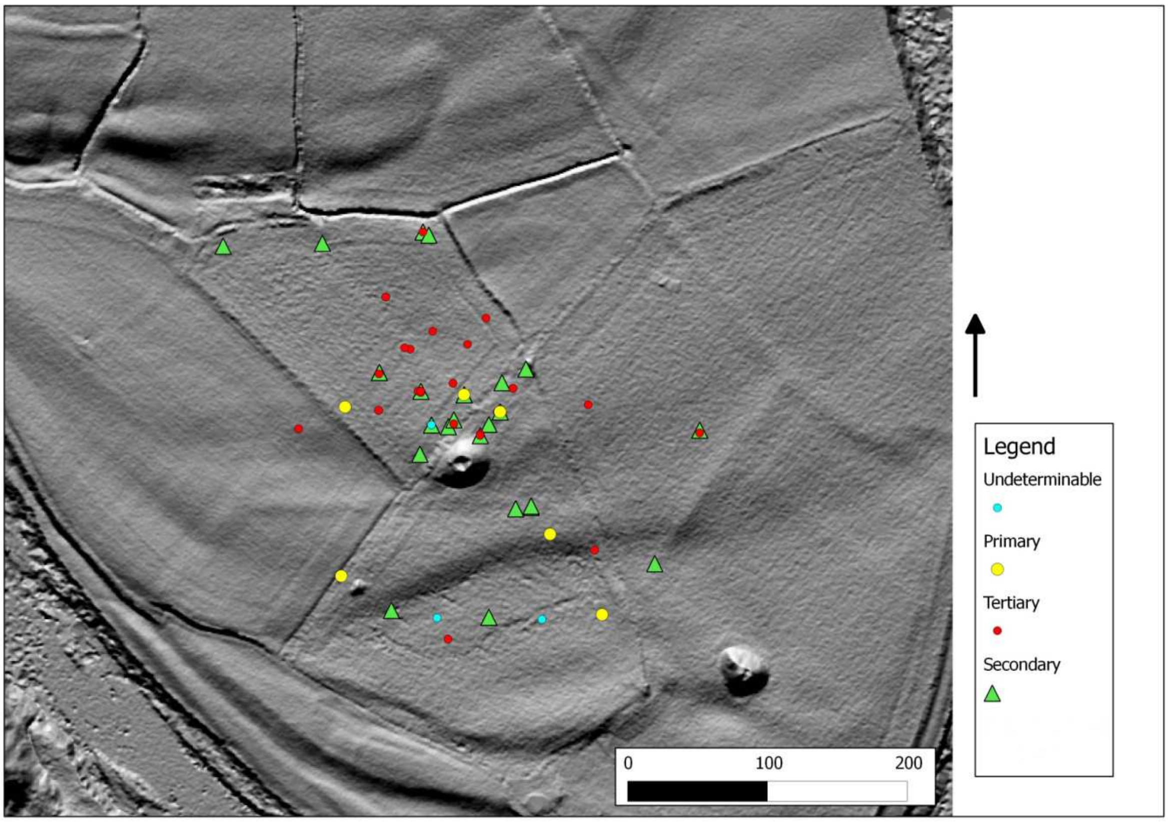

Figure 5.32 Distribution of lithics by reduction stage

The distribution of the assemblage (*figure 5.32*) by reduction stage is fairly evenly spread with the exception of the primary stage examples which were isolated a fairly linear spread on terrace T4 encroaching onto terrace T3.

Finally the distribution of chert and flint is illustrated. figures 5.33 and 5.34 below demonstrate that flint accounts for 57% of material whilst chert accounts for the other 43%.

Source Material	Total
Flint	47
Chert	34
Glass (industrial waste)	1

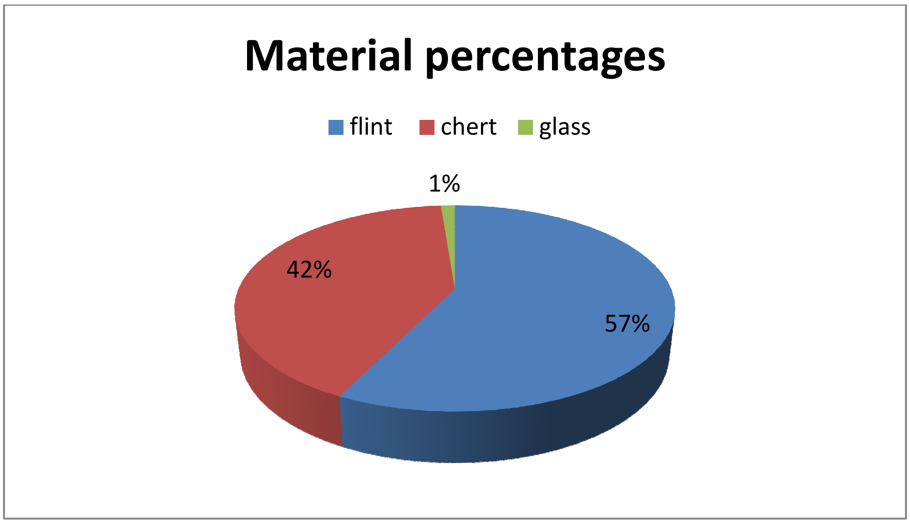

Figure 5.33 Pie chart illustrating the percentage of material recovered

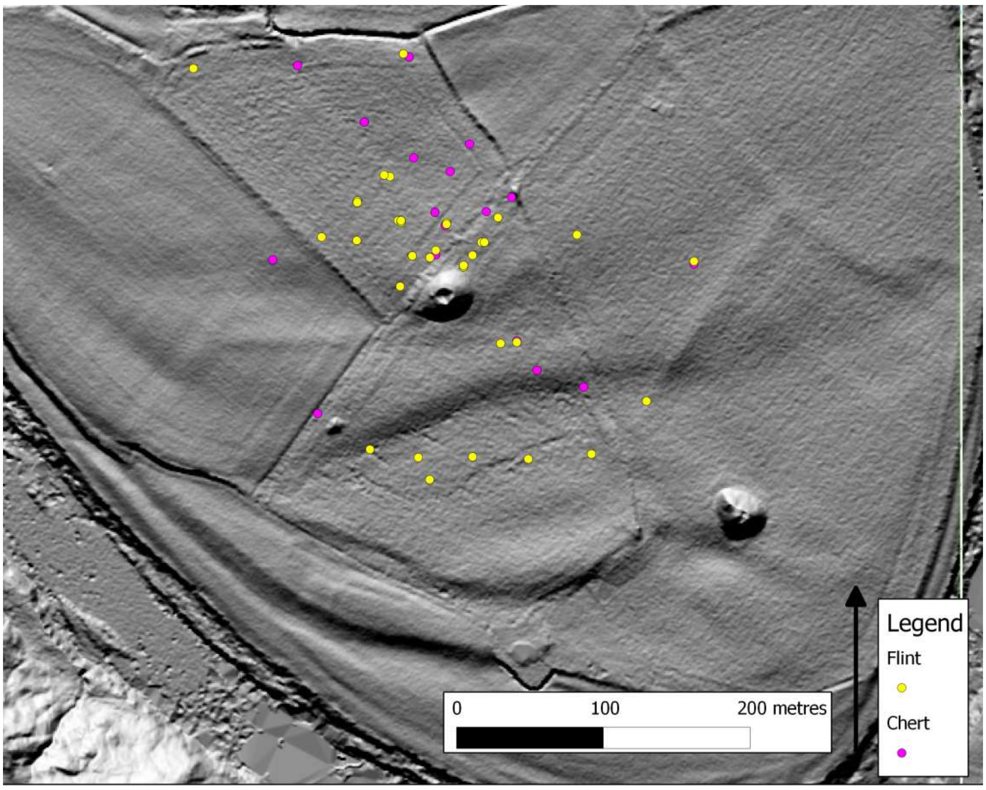

Figure 5.34 Distribution of chert and flint

The distribution of flint and chert is fairly evenly spread as illustrated on the distribution map above (*figure 5.34*).

5.3.3 The Finds

A Selection of the finds recovered during field-walking were photographed using a DSLR camera and are included in the following figures.

Figure number	Description	Material	Notes	Small find number
5.35	scraper	Dark cream flint	Blunt edge for hafting	7
5.36	blade	Mid cream flint	broken	13
5.37	blade	Dark till flint		22
5.38	core	Dark brown/grey flint		12
5.39	core	Light grey flint		1
5.40	core	Light grey mottled flint	Blade removal	19
5.41	Core flake	Light grey mottled flint		11
5.42	Blade	Light grey flint	Scuff mark flake prep	18
5.43	Utilised flake	Dark grey chert		47
5.44	Posed platform core	Dark reddish brown chert		50

Many of the lithics recovered were indicative of the Mesolithic, based on typology and size (Dickson, Parker and Jones pers comm)

Figure 5.35 Flint scraper

Figure 5.36 Flint blade

Figure 5.37 Flint Blade

Figure 5.38 Mesolithic Flint core

Figure 5.39 Mesolithic flint core

Figure 5.40 Mesolithic flint core

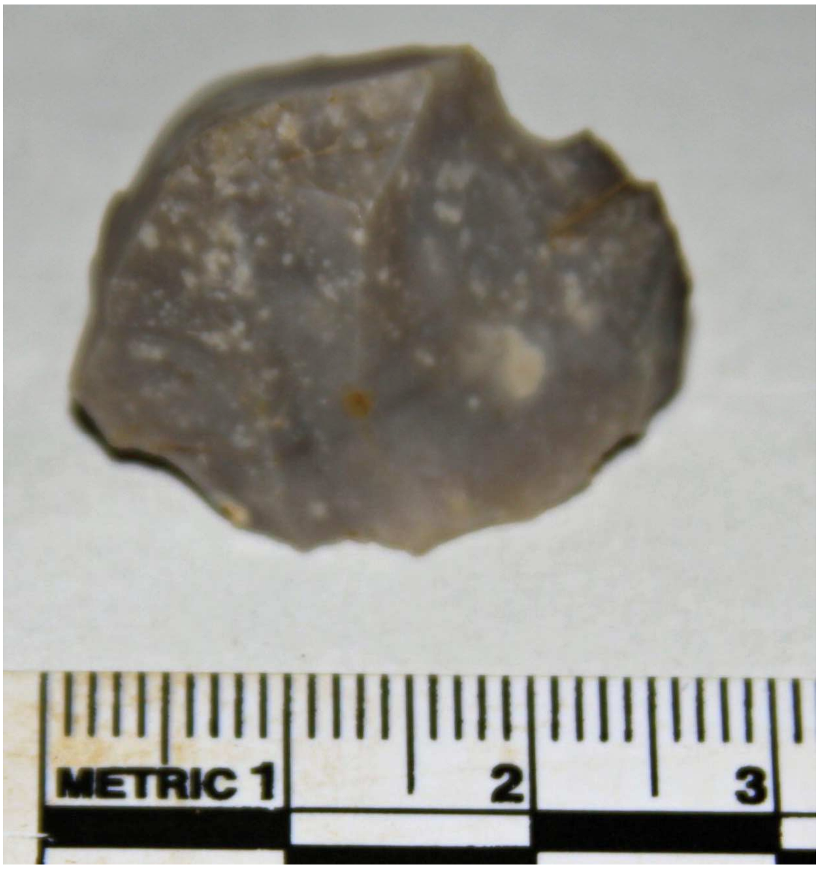

Figure 5.41 possible core

Figure 5.42 Mesolithic blade

Figure 5.43 Utilised flake

Figure 5.44 Posed platform core

5.3.4 Discussion

The concentration of lithics recovered equate to 4.55/hectare, however the lithics were recovered in clusters and were concentrated to the north of Mound A, a large proportion of the walked fields yielded no flint whatsoever. A single piece of chert recovered from a pasture field (*figures 5.28 and 5.34*), is a result of an anomalous coordinate. The close proximity of these clusters often appear as a single dot on the distribution charts because the handheld GPS was only accurate to approx 8 metres, therefore clusters were bagged together. There was clearly a lot of activity on terrace T2 north of Mound A. Chert was used extensively in the Mesolithic in the north of England (Hind, 1998), the high concentration of chert recovered along with the high density of tertiary and secondary lithics suggests that source material was not in abundance and there every piece was precious and constantly reused to reduce wastage. This is arguably typical of Mesolithic hunter-gatherer lifestyles. They were mobile nomadic people that would not want be immobilised by transporting huge amounts of source material around with them (Mithen, 2008). The presence of blades and prepared cores with platforms also suggest that the area was occupied during the Mesolithic The concentration on the higher river terrace T2 in comparison with the lower elevated terraces might suggest that this was the edge of the river during the Mesolithic when these flints were knapped. Conversely the dense concentration to the north of Mound A amidst features identified during the geophysical survey and the presence of high quality raw material amongst the high concentration of debitage is indicative of the Bronze Age. It is likely that the area was occupied periodically throughout Late Prehistory.

5.4 Topographic survey

A topographic survey of Mound A was undertaken during February 2012 prior to LiDAR data becoming available to micro-topographically create a model of the mound, this could then be used to ascertain the typology based on similar monument types. A Leica Builder 409 total station was used to map the mound and the resulting image is illustrated in figure 5.45 below

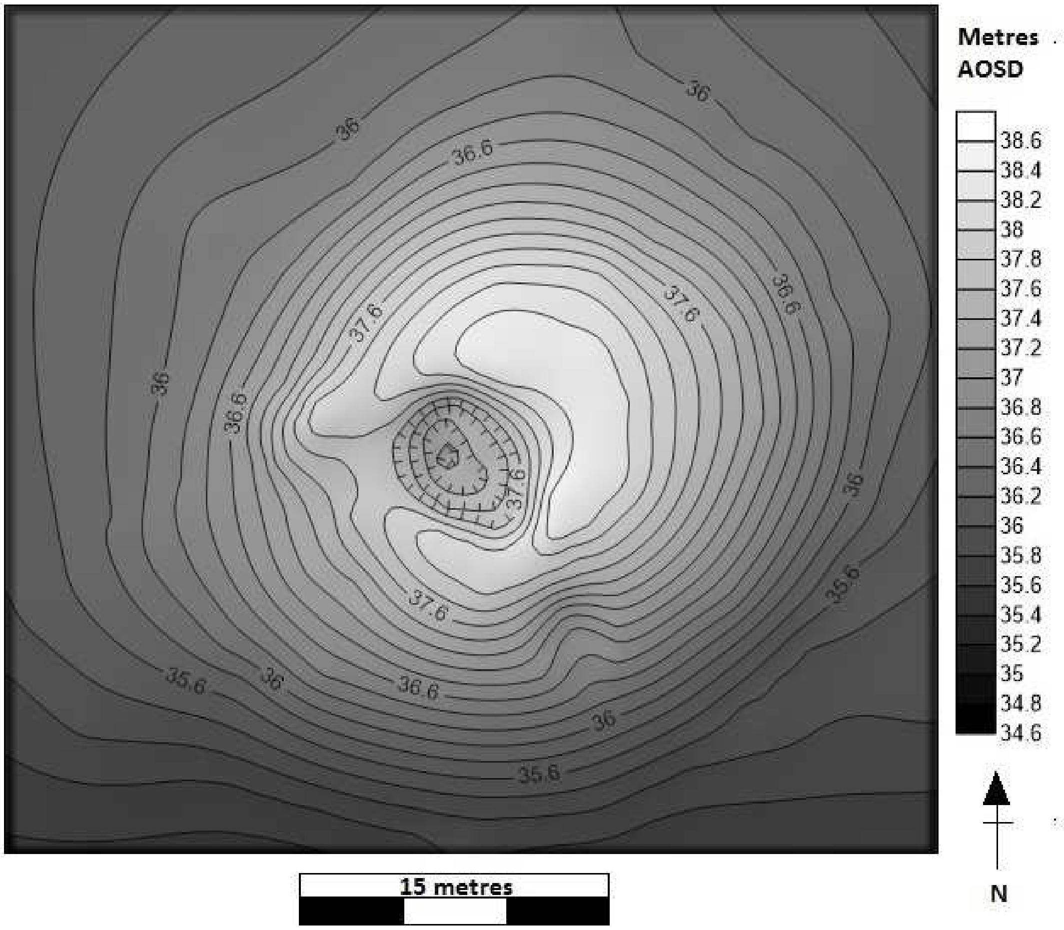

Figure 5.45 Topographic survey of Mound A viewed in plan from directly above

The mound is clearly steeper at the northern eastern end, aligned on a north east-south west axis which tapers off to the south western end. Both the LiDAR and this model illustrate the large depression in the centre. Initially this depression appeared to be the result of antiquarian excavations, however, Luck describes this depression as being visible when he arrived at the mound to excavate in the 1890's, Luck suggested that the crater was created when dug out for use as a lime kiln (1894, 34). This is possible considering his description and plans of his own excavation show no disturbance from previous unrecorded attempts to dig the barrow. An attempt was also made to model Mound B but was abandoned due to the dense vegetation preventing an accurate survey to be possible. This survey demonstrated that the mound is likely to be misshapen round barrow, the elongated south-western facing edge likely to be an accumulation of spoil excavated from the depression.

5.5 Discussion

This chapter has presented the results obtained from the Winckley Lowes site using four very different methodologies, LiDAR, gradiometer survey, field walking on the wide scale with a small scale topographic survey on a local scale. Each method has proved successful to a degree, however to fully understand the results, it is important to combine the results obtained and discuss how each method compliments the others.

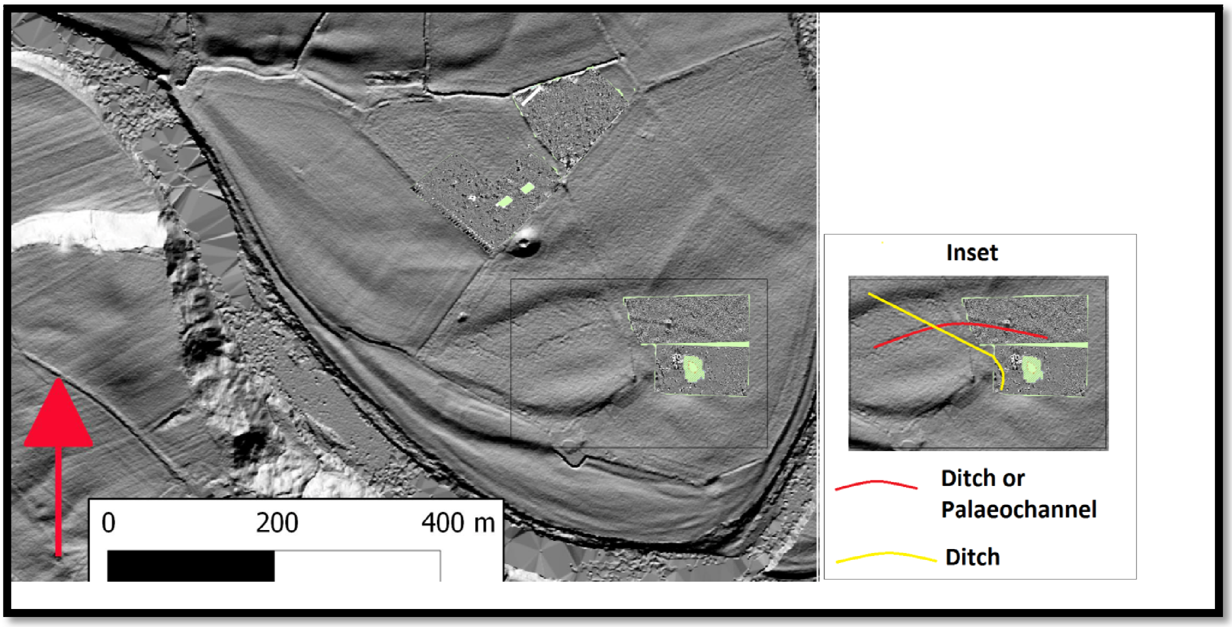

Figure 5.46 Gradiometer survey layered with LiDAR demonstrating how a combination of methods can aid interpretation of archaeological features

The LiDAR data has successfully revealed features which continue from anomalies on the geophysical survey such as the palaeochannel or ditch in Area 1 survey 2. The gradiometer survey on area 1 revealed a large ditch or palaeochannel, by combining the gradiometer survey results and the LiDAR tile, we can see that this feature continues as a curvilinear feature running from east to west, north of mound B (*figure 5.46*). A second linear ditch, possibly demarkating a boundary, can also be seen running from the south-west corner of Mound A across river terraces 3 and 4 , terminating in an arc, immediately east of Mound B.

LiDAR has also been successful in revealing river terraces which when integrated with the field walking results, provide evidence of the period of occupation for each terrace, the lack of lithic material recovered from the vicinity of Mound B and on terraces T4 and T5 suggest a much later date and consequently it could be reasonable to suggest that Mound B post dates mound A considerably, adding strength to the possibility that it was constructed to inter Chief Wada following his defeat to Eardwulf in 798AD

6 Conclusion

This paper sought to develop a balanced methodology for non-intrusive archaeological prospection on dynamic alluvial floodplains by using the confluence of the Rivers Ribble, Hodder and Calder and the potential ditches associated with the putative burial mounds contained within these floodplains as a case study.

The depth of alluvium on these floodplains is unknown, potentially the alluvium could be several metres deep. Therefore the arable fields within the study area were initially field-walked, the typology of the finds was then evaluated to assess possible periods of occupation which was not buried under thick alluvial deposit. The arable nature of part of the study area limited the timescale when field walking could be carried out. Crops were sown in May, providing a two week window when the landowner was agreeable. The results of this method were very encouraging, over 80 pieces of flint and chert were recovered, mainly from an area to the north of Mound A. The cores assembled from this river terrace could potentially date from the Mesolithic, it would be fair to suggest therefore that the depth of alluvium sealing the Mesolithic occupation horizon is not sufficient to completely seal and mask any archaeological features from later periods .The presence of these lithics provided enough evidence to suggest that a survey using a gradiometer would be the next method used.

Gradiometer surveying was carried around mound B (Area 1) prior to field-walking, several discrete putative features were identified. However this method was most successful in identifying a large palaeochannel or ditch. This feature was also identified on the LiDAR model, extending beyond the limit of gradiometer survey. A large sub-circular anomaly was recorded on the western edge of Mound B, this appeared to extend beyond the boundary of the mound, but also was evident underneath the mound. It is possible that there might be either a funerary pyre below this mound or there is a possibility that quantities of clay were fired here, pre-dating or contemporary with the mound. A further two surveys within proximity of mound A revealed further discrete earthworks, most notable of these being a series of large post holes or small pits interpreted as the footprint of a rectangular structure and a series of curvilinear banks and ditches. Gradiometer survey failed to reveal a ditch around Mound B. The survey in proximity to Mound A could not rule out a ditch, as the immediate area surrounding the mound was not incorporated into the survey area.

However, we know that not all mounds were surrounded by ditches (section 3.4), therefore cannot interpret the origin of Mound B based on gradiometer survey alone.

A scatter of ferrous material revealed during the gradiometer survey at Brockhall could be remains of the iron artefacts which were reported to have crumbed to dust on exposure to air (section 3.3), but there was very little evidence of archaeological features on this particular site.

LiDAR modelling proved very successful in locating river terraces and former field boundaries, particularly on terrace T3 where an old field boundary appeared to extend only as far as the extent of the terrace. A small mound at Brockhall was highlighted by the LiDAR model which also highlighted the extensive ploughing this floodplain has experienced and suggests that any former mound would have surely been completely destroyed .LiDAR also revealed a smaller putative earthwork on the banks of the River Calder

The topographic survey of mound A created a more detailed model than the LiDAR which further enhanced the structure shape. The result was very similar to the Keld Bank long mound on Ingleborough further up the Ribble Valley, both mounds were situated on the edges of terraces providing a further analogy with Keld Bank.

By abstracting the key conclusions from each method used, it would be fair to suggest that the floodplains were inhabited from the Mesolithic onwards. The three rivers joined here which would have provided a special meeting place for the inhabitants of all three valleys. This was celebrated by the construction of Mound A, probably during the Neolithic, to bury the dead on a site remembered since the Mesolithic. Mound B appears to be of later construction, as it is placed on the younger river terrace, however the possible funerary pyre beneath could well place this mound in the Bronze Age. It is feasible that one or more of the mounds was used to inter Chief Wada after his defeat. Although the precise dating of these mounds still remains unproven, this paper presents important evidence that this confluence of the three rivers saw occupation throughout late prehistory. This floodplain had seen very little investigation since the 19th century and there was no recorded field walking, gradiometer survey or LiDAR investigation here, this paper fills those gaps in the record on what is potentially a very important location and the only known multi barrow site on a riverine location in Lancashire.

This paper has demonstrated that, by combining different methodologies, it is possible to investigate alluvial floodplains successfully. The methods alone would have proved less conclusive than a combination. Field walking proved that there was occupation during the Mesolithic to the north of Mound A yet it is not until LiDAR data is used that we can see the correspondence of lithic distribution with an early river terrace. A combination of LiDAR and gradiometer survey revealed a large ditch or palaeochannel near Mound B, the lack of lithic evidence from field walking and later river terracing evident through LiDAR assists in the interpretation of Mound B as being significantly later in date than Mound A.

Much geo-archaeological prospection on alluvial floodplains/ river confluences has been concentrated in the Midlands and Southern England where low energy river systems with cohesive river banks predominate. This paper demonstrates that a methodological approach using multiple techniques can be successful in Northwest England on Medium energy river systems with non-cohesive river banks. The lithic assemblage recovered and archaeological features identified during the gradiometer survey demonstrates that riverine localities were being utilised for occupation in late prehistory in the area in the same way as demonstrated on the confluence of the Trent, Soar and Derwent in the Midlands, UK.

Hopefully in the future, this work can be followed up with a programme of test-pitting, to target potential anomalies identified on the geophysics surveys, but also to target a number of negative areas to build up a detailed environmental analysis of the area.

On the basis of this case study, geo-archaeological investigation of dynamic alluvial flood plains is most productive when different methodologies are combined. It is also clear that these methodologies should generally be applied in the following order to maximize information recovery and prevent large amounts of time and resources being devoted to unsuitable techniques in particular parts of the landscape.

Stage one of any study should be a desk based assessment of existing published and grey literature. Stage two is to use the methodologies identified in chapter 4 to analyse the available LiDAR data and identify both geomorphological and archaeological features. Once this is completed then field-walking of sample arable areas should be carried out as stage three. This should allow the potential date and depth of overburden to be evaluated for the river terraces identified during stage two. Stage four should be targeted fluxgate gradiometer survey. This will be guided by information from stages one and two as to the location of possible archaeological features and from stage three as to the potential depth of overburden. Following completion of these four stages then a potential fifth stage of gridded test pitting and coring could be used to add more resolution to the results from earlier stages.

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8 Appendices

8.1 Compendium of Finds

SF no.	Easting	Northing	Material	Type	Object/ debitage	Reduction stage	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Colour	Notes
1	0536452	5965075	flint	core	object	tertiary	8.10	19.26	17.43	22.89	light brown mottled	definate core, probably mesolithic.
2	0536387	5965069	flint	flake	debitage	tertiary	3.46	22.15	20.23	7.09	light brown mottled	possible flake off a core
3	0536387	5965069	flint	chunk	debitage	tertiary	5.40	29.68	14.44	8.48	mid brown	
4	0536532	5965056	chert	core trimming flake	debitage	tertiary	5.05	27.28	24.9	17.26	dark brown, glassy, mottled	core trimming flake
5	0536532	5965058	flint	chunk	debitage	secondary	6.47	29.49	19.85	9.03	dark brown	possible flake reduction off one edge
6	0536352	5965058	flint	flake	debitage	secondary	0.59	16.78	13.22	3.04	mid grey	possible retouch
7	0536332	5965197	flint	scraper	object	tertiary	3.55	33.62	16.69	5.12	mid brown, glassy	quality flint, blunt edge for hafting
8	05363401	5965109	flint	flake	debitage	secondary	2.07	31.02	16.60	4.20	dark grey, beach flint, mottled	
9	0536407	5965100	chert	blade	object	secondary	3.52	40.96	13.32	5.70	dark grey/brown	cortex on distall end, possible edge damage
10	0536305	5956140	chert	blade	object	secondary	4.53	37.58	18.12	6.18	mottled red/brown	poor quality, possible retouch
11	0536381	5965060	flint	core flake	object	secondary	6.99	24.18	19.21	16.28	mottled mid grey	looks like a chunk that has reduction edges
12	05363401	5965109	flint	core	object	secondary	13.75	34.90	24.68	16.90	dark grey/brown	mottled till flint, good quality
13	05363401	5965109	flint	blade	object	tertiary	3.18	39.88	15.00	4.42	mottled mid cream	broken, retouch
14	0536363	5965082	flint	blade	object	tertiary	0.33	17.0	7.31	2.31	dark grey	broken
15	0536363	5965081	flint	blade	object	secondary	3.01	39.9	14.26	5.39	light reddish cream	small piece of cortex on distal end
16	0536412	5965001	flint	flake	debitage	secondary	5.6	32.36	23.28	8.12	dark reddish cream	
17	0536412	5965002	chert	flake	debitage	secondary	2.26	29.91	13.96	16.86	dark brown/black	not great quality, poss removed from edge of nodule

SF no.	Easting	Northing	Material	Type	Object/ debitage	Reduction stage	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Colour	Notes
18	0536302	5965069	flint	blade	object	tertiary	0.55	29.95	6.10	3.11	mottled light grey	poss mesolith
19	0536302	5965096	flint	core	object	secondary	7.9	31.9	18.89	12.40	mottled light grey	same material as 18
20	0536302	5965095	flint	flake	debitage	tertiary	0.49	19.28	11.20	2.10	mid grey	slightly mottled, decent flint
21	0536302	5965096	chert	flake	debitage	secondary	4.11	32.98	17.88	6.65	dark brown	possible retouch but not significant
22	05363801	5965087	flint	blade	object	secondary	2.18	36.70	13.63	3.34	banded light/dark grey	
23	05363801	5965087	chert	chunk	debitage	secondary	3.86	29.02	15.46	7.68	dark brown	
24	0536340	5965059	flint	flake	debitage	tertiary	1.6	26.88	28.88	3.19	banded light/dark grey	possible slight edge retough
25	0536340	5965059	flint	chunk	debitage	secondary	3.12	23.09	15.09	9.91	mottled pinky red	
26	0536340	5965059	flint	flake	debitage	undeterminable	0.91	20.605	12.89	3.42	white cracked	burnt flint
27	0536375	5965052	flint	blade	object	tertiary	3.39	48.82	16.20	7.08	light grey	
28	0536375	5965053	flint	flake	object	tertiary	1.32	22.08	14.55	4.28	mid grey	possibly broken blade
29	0536324	5965113	flint	chunk	debitage	tertiary	3.06	18.70	15.82	7.89	mottled mid grey	
30	0536378	5965136	chert	flake	debitage	tertiary	1.76	26.60	14.50	4.28	dark reddish brown	
31	0536390	5965090	chert	chunk	debitage	secondary	9.87	29.70	29.56	10.63	dark reddish brown	
32	0536501	5964962	flint	chunk	debitage	secondary	6.65	36.51	25.02	9.89	mid grey	beach flint
33	0536458	5964971	chert	chunk	debitage	tertiary	1.35	23.31	9.86	5.91	dark reddish grey	
34	0536375	5965052	chert	flake	debitage	secondary	0.53	17.99	11.09	3.12	dark reddish brown	poor quality
35	0536375	5965052	chert	flake	debitage	tertiary	3.03	24.42	18.43	5.36	dark reddish brown	
36	0536383	5964922	flint	chunk	debitage	secondary	9.19	40.01	28.21	9.58	light greyish white	
37	0536277	5964950	chert	chunk	debitage	primary	3.73	24.55	21.80	8.38	dark reddish brown	80% cortex
38	0536481	5964819	glass	Ind waste	debitage	N/A	N/A	29.65	16.70	2.30	opaque turquise	industrial waste, glassmakin g
39	0536354	5964906	flint	flake	debitage	tertiary	0.56	18.89	10.31	3.52	light grey/white	broken
40	0536278	5965071	flint	chunk	debitage	primary	8.15	35.09	24.98	9.90	mid cream	
41	05362961	5964934	flint	chunk	debitage	secondary	8.55	40.12	22.42	7.32	light mottled	

SF no.	Easting	Northing	Material	Type	Object/ debitage	Reduction stage	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Colour	Notes
											white/grey	
42	0536313	5964926	flint	flake	debitage	secondary	1.95	23.61	18.82	3.42	light white/grey	
43	0536401	5965000	flint	chunk	debitage	secondary	9.18	37.51	24.89	13.99	light grey	
44	0536260	5965188	chert	flake	debitage	secondary	5.53	32.35	26.26	6.40	dark reddish brown	
45	0536332	5965197	chert	chunk	debitage	secondary	5.32	29.94	19.48	13.42	dark grey	poor quality
46	0536320	5965114	flint	flake	debitage	tertiary	2.93	32.04	20.24	4.70	banded light/dark grey	
47	0536365	5965117	chert	utilised flake	object	tertiary	2.44	13.01	7.52	6.40	dark grey	
48	0536245	5965055	chert	flake	debitage	tertiary	1.24	20.34	14.92	3.68	dark pinkish red	
49	0536189	5965185	flint	chunk	debitage	secondary	5.88	42.40	15.31	9.92	dark grey	
50	0536340	5965126	chert	core	object	tertiary	13.71	33.28	23.74	13.80	dark reddish brown	posed platform core
51	0536346	5964921	flint	chunk	debitage	undeterminable	14.06	36.33	32.26	8.78	dark cream, cracked	fire effected
52	0536421	5964921	flint	chunk	debitage	undeterminable	7.40	25.55	22.78	11.51	mid cream. Cracked	possibly fire effected
53	0536426	5964982	chert	chunk	debitage	primary	15.55	42.80	27.48	11.82	dark reddish brown	
54	0536464	5964925	flint	chunk	debitage	primary	1.13	16.55	13.63	4.98	mottled mid brownish grey	
55	0536356	5965060	chert	flake	debitage	tertiary	3.37	29.10	18.40	5.71	dark reddish brown	
56	0536356	5965060	chert	flake	debitage	tertiary	5.01	32.89	20.82	6.74	dark reddish brown	
57	0536356	5965063	flint	flake	debitage	secondary	1.07	21.55	13.90	4.78	dark grey	till flint
58	0536336	5965195	chert	chunk	debitage	secondary	4.98	39.28	15.20	10.48	mid reddish brown	
59	0536336	5965195	chert	chunk	debitage	secondary	20.28	49.28	39.29	16.31	dark reddish brown	
60	0536355	5965089	chert	flake	debitage	tertiary	0.24	13.28	7.86	2.24	dark reddish brown	
61	0536355	5965089	chert	flake	debitage	tertiary	3.47	29.98	18.20	5.77	dark reddish brown	
62	0536302	5965069	flint	chunk	debitage	tertiary	1.91	27.80	13.82	4.88	mid banded grey	
63	0536302	5965069	chert	chunk	debitage	tertiary	5.26	22.82	24.72	7.16	dark reddish brown	
64	0536389	5965069	flint	chunk	debitage	secondary	2.15	19.34	14.64	5.94	mottled mid grey	
65	0536389	5965069	flint	chunk	debitage	primary	0.88	14.12	10.16	6.38	dark grey	85% cortex
66	0536398	5965086	flint	chunk	debitage	tertiary	8.42	30.92	23.28	11.18	mottled mid grey	

SF no.	Easting	Northing	Material	Type	Object/ debitage	Reduction stage	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Colour	Notes
67	0536398	5965086	chert	blade	debitage	tertiary	1.9	33.10	10.34	5.24	dark reddish brown	
68	0536306	5965150	chert	flake	debitage	tertiary	2.66	25.98	22.48	7.54	dark grey	
69	0536306	5965150	chert	flake	debitage	tertiary	4.97	27.43	24.08	8.02	dark reddish brown	
70	0536306	5965150	chert	chunk	debitage	tertiary	2.91	25.86	15.22	6.52	dark reddish brown	
71	0536363	5965081	chert	flake	debitage	tertiary	0.9	15.68	14.15	3.78	dark reddish brown	
72	0536363	5965081	chert	chunk	debitage	secondary	0.89	17.12	10.98	6.34	mid reddish brown	
73	0536363	5965081	flint	chunk	debitage	primary	7.99	30.52	14.98	20.20	banded light mid grey	90% cortex
74	0536362	5965080	chert	flake	debitage	tertiary	3.83	25.82	18.30	8.26	dark reddish brown	possibly flake off a core but most likely debitage
75	0536363	5965081	chert	flake	debitage	secondary	11.16	37.12	27.02	9.92	dark reddish brown	hinge fracture
76	0536330	5965083	flint	flake	debitage	tertiary	1.21	26.53	22.68	3.18	mottled grey	
77	0536332	5965083	flint	blade	object	tertiary	1.11	20.82	11.98	2.92	mid pinkish red	broken blade, proximal end
78	0536332	5965082	flint	blade	object	tertiary	0.52	18.32	10.18	2.30	mid creamy brown	broken blade
79	0536332	5965038	flint	chunk	debitage	secondary	1.61	22.42	9.78	5.22	mid mottled grey	
80	0536332	5965083	chert	blade	object?	secondary	1.05	17.63	13.30	2.52	dark browny grey	
81	0536332	5965083	flint	blade	object	tertiary	0.41	22.66	8.10	1.51	mid bluish grey	complete blade
82	0536332	5965083	flint	flake	debitage	tertiary	0.22	12.68	12.12	1.32	mid mottled grey	

8.2 Section 42 application Winckley Lowes

34 Talbot Road

Penwortham

Preston

Lancashire

PR1 9QU

25 January 2012

Dear Mr Davidson

I wish to apply for a license under section 42 of the Ancient Monument and Archaeological areas act 1979.

The proposed research will be to carry out a programme of geophysical survey on the two extant barrows at Winckley Lowes on the river Ribble, Hodder and Calder confluence in Lancashire. The monument numbers which this application applies to are 23711 and 23712.

If a license is granted I intend to survey monument 23711 with a Bartington 601 gradiometer and follow that up with an RM15 resistivity meter. Monument 23712 will be surveyed with just the RM15.

Monument 23712 has quite substantial ground cover with a mixture of brambles and trees. Should permission be granted, may I be permitted to clear these low lying obstacles to allow more accurate recording? Only ground level branches and brambles would be removed, subsurface vegetation would not be disturbed whatsoever.

This survey work would be a vital component in my Msc work at the University of Central Lancashire which is an investigation into Bronze age funerary monuments and their riverine connections.

I can confirm that I have obtained permission from the relevant landowners and the tenant farmers in advance.

I successfully applied for a license under section 42 in 2010 to carry out similar investigations at Shap in Cumbria, the results of which have been presented to English Heritage.

Regards

Mike BirtlesBsc (hons)

Mike BirtlesBsc (hons)

8.3 Letter to Stoneyhurst Estates

34 Talbot Road

Penwortham

Preston

Lancashire

PR19QU

25 January 2012

Dear Sir/Madam

I write to seek permission to access land owned by the Stoneyhurst Estate.

I am undertaking aMsc research degree at the University of Central Lancashire, the area of which is of importance is the land farmed by Mr David Holden at Winckley Hall Farm. Should you be so kind as to grant permission, I will be using a small group of students to carry out the following work:

Field walking- five or six students will systematically walk in a parallel line across the freshly ploughed field identifying areas of prehistoric activity and cultural evidence of settlement contemporary to the Bronze Age burial mounds.

Geophysical survey- the scale of this depends on the results of field-walking, this will involve walking across the fields after the harvest using a Bartington 601 gradiometer, this detects changes in the earth's magnetic field resulting from anthropological activity in the past, again, I hope to detect signs of settlement activity contemporary with the mounds.

Coring – There is a potential problem that the alluvial deposits from the river terraces might be too deep to provide good results using the methods described above, I therefore intend on taking a minimal number of core samples to determine the depth beforehand. This involved a small diameter vertical screw auger that samples the deposits.

I have spoken to and obtained permission from Mr Holden and have applied to English Heritage for a license under section 42 of the Ancient Monuments and Archaeological areas act 1979. I will of course provide the estate with a copy of my results for your information.

I can assure you that none of these methods will have any physical impact on the land.

I look forward to hearing from you, if you have any further questions, please feel free to contact me on 01772 740142 or 07931793630

Regards

Mike BirtlesBsc (hons)

8.4 Section 42 Consent

ENGLISH HERITAGE
NORTH WEST OFFICE

Mr Mike Birtles
34 Talbot Road
Penwortham
PRESTON
Lancashire
PR1 9QU

Direct Dial: 0161 242 1453
Direct Fax: 0161 242 1401

Our ref: AA/100972/5

13 February 2012

Dear Mr Birtles

Ancient Monuments and Archaeological Areas Act 1979 (as amended) section 42 - licence to carry out a geophysical survey

BARROWS AT WINCKLEY LOWES, LITTLE MITTON, LANCASHIRE
Case No:SL00024488
Monument No. 23711

I refer to your application dated 25 January 2012, to carry out a geophysical survey at the above site.

English Heritage is empowered to grant licences for such activity and I can confirm that we are prepared to do so as set out below.

By virtue of powers contained in section 42 of the 1979 Ancient Monuments and Archaeological Areas Act (as amended by the National Heritage Act 1983) English Heritage hereby grants permission for geophysical survey of BARROWS AT WINCKLEY LOWES, for the areas shown on the map that accompanied your application (copy attached). This permission is subject to the following conditions.

1. The permission shall only be exercised by Mike Birtles and by no other person. It is not transferable to another individual.
2. The permission shall commence on 13 February 2012 and shall cease to have effect on 31 July 2012.
3. A full report summarising the results of the geophysical survey and their interpretation shall be sent in hard copy to Steve Boyle at the address below and electronic (pdf) format to jennie.stopford@english-heritage.org.uk, copied to Paul.Linford@english-heritage.org.uk no later than 3 months after the completion of the survey.
4. The enclosed questionnaire shall be completed and appended to the survey report. For convenience an electronic version of this questionnaire can be

POSITIVE ABOUT DISABLED PEOPLE

SUITES 3.3 AND 3.4 CANADA HOUSE 3 CHEPSTOW STREET MANCHESTER M1 5FW
Telephone 0161 242 1400 Facsimile 0161 242 1401
www.english-heritage.org.uk

ENGLISH HERITAGE
NORTH WEST OFFICE

Mr Mike Birtles
34 Talbot Road
Penwortham
PRESTON
Lancashire
PR1 9QU

Direct Dial: 0161 242 1453
Direct Fax: 0161 242 1401

Our ref: AA/100973/5

13 February 2012

Dear Mr Birtles

Ancient Monuments and Archaeological Areas Act 1979 (as amended) section 42 - licence to carry out a geophysical survey

BOWL BARROW 170M NORTH EAST OF HACKING BOAT HOUSE, LITTLE MITTON, LANCASHIRE
Case No:SL00024499
Monument No. 23712

I refer to your application dated 25 January 2012, to carry out a geophysical survey at the above site.

English Heritage is empowered to grant licences for such activity and I can confirm that we are prepared to do so as set out below.

By virtue of powers contained in section 42 of the 1979 Ancient Monuments and Archaeological Areas Act (as amended by the National Heritage Act 1983) English Heritage hereby grants permission for geophysical survey of BOWL BARROW 170M NORTH EAST OF HACKING BOAT HOUSE, for the areas shown on the map that accompanied your application (copy attached). This permission is subject to the following conditions.

1. The permission shall only be exercised by Mike Birtles and by no other person. It is not transferable to another individual.
2. The permission shall commence on 13 February 2012 and shall cease to have effect on 31 July 2012.
3. A full report summarising the results of the geophysical survey and their interpretation shall be sent in hard copy to Steve Boyle at the address below and electronic (pdf) format to jennie.stopford@english-heritage.org.uk, copied to Paul.Linford@english-heritage.org.uk no later than 3 months after the completion of the survey.

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Telephone 0161 242 1400 Facsimile 0161 242 1401
www.english-heritage.org.uk

English Heritage is subject to the Freedom of Information Act. 2000 (FOIA) and Environmental Information Regulations 2004 (EIR). All information held by the organisation will be accessible in response to an information request, unless one of the exemptions in the FOIA or EIR applies.

8.5 Stoneyhurst Estate Consent

Our Ref: MNL/LAD/STO/GEN/9
Your Ref:

CARTER JONAS

The Property People

Regent House
13-15 Albert Street
Harrogate HG1 1JX
T: 01423 523423
F: 01423 521373

Mr M Birtles
34 Talbot Road
PenworthAM
Preston
Lancs PR19 9QU

22 February 2012

Dear Mr Birtles

Stonyhurst Estate

Thank you for your letter of 25th January regarding the above. I confirm that as long as Mr Holden has no problem with you carrying out the works specified in your letter, then we are happy for you to go ahead. We would of course be grateful if you could send us any results.

Yours sincerely

Mark N Ludiman MSc MRICS
Senior Associate
For and on behalf of Carter Jonas LLP

E:mark.ludiman@carterjonas.co.uk
DD: 01423 707824

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